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HISTORY
OF THE
CORPS OF ROYAL ENGINEERS

VOLUME VI
GALLIPOLI, MACEDONIA, EGYPT AND PALESTINE
1914-18

CHATHAM
THE INSTITUTION OF ROYAL ENGINEERS
1952

**HISTORY OF THE
CORPS OF ROYAL ENGINEERS**

VOLUME V

**THE HOME FRONT, FRANCE, FLANDERS AND ITALY
IN THE FIRST WORLD WAR**

VOLUME VI

GALLIPOLI, MACEDONIA, EGYPT AND PALESTINE

VOLUME VII

**CAMPAIGNS IN MESOPOTAMIA AND EAST AFRICA, AND THE
INTER-WAR PERIOD, 1918 TO 1938**

Volumes V, VI and VII are published simultaneously.

FOREWORD

It is now thirty-eight years since the last volume (Vol. III) of *The History of the Corps of Royal Engineers* was published. The first two volumes were written by Major-General W. Porter and covered the period from early times till 1886. Colonel Sir Charles Watson then continued the story up till 1912 in Volume III. After an interval of time certain episodes of history can be seen in better perspective and it may be found that there are gaps that should be filled. It was to fill such gaps in the period covered by Volume III that Brigadier-General W. Baker Brown wrote Volume IV, which is now being published. These four volumes thus take us up to the eve of the first World War. As soon as official data became available after that war it was obviously our duty to continue the history, and this has been done, the events occurring during the period from 1914 until about 1939 being now recorded in Volumes V, VI and VII.

As explained in the Preface, these have not been the work of one man, as were Volumes I to IV, but many officers have helped with the writing and compilation. Their efforts have, however, been collected and co-ordinated by one Editor—Major-General H. L. Pritchard, who has also himself written a considerable part of the work. I feel that every member of the Corps should be most grateful to him for his labours, especially as he has continued unremittingly during the last few years although suffering from very seriously failing eyesight. He and his team have certainly produced a great work, and his personal example of devotion to duty must be an inspiration to us all.

Mention must also be made of the work done by Major-General Sir Eustace Tickell in preparing the typescript for printing and in correcting all the proofs, and by Colonel F. C. Molesworth in compiling the index.

It is always difficult to decide how long after the event history should be written. A regimental historian must certainly wait until the official histories, founded on allied and

enemy documents, have been published, but should not wait so long that the personal memories of those who took part in the events have faded. General Pritchard followed this happy mean, but could not complete his task before the second World War intervened. The result was that a considerable time elapsed before publication became possible. This in no way detracts from the value of his work as a history to be read by members of the Corps and others in years to come. It is, however, in some ways unfortunate that these volumes were not available for study before we once again embarked upon a war involving engineering of very great magnitude and diversity. I feel sure that we as a Corps could have profited more fully from the many lessons of 1914-18, had we been able to study them in time in the clearly marshalled form that is now available in these volumes.

As to their use for future generations who may have to repeat these things yet once again, there are many parallels between the two great wars, and lessons can still be learnt by comparing them in many of their details. It is only by studying how things have changed that one can make any sort of estimate as to their future trend. It is for this reason perhaps a pity that attention could not have been drawn in many places in this work to points of similarity or difference between the conditions of 1914-18 and those of a quarter of a century later. To have done so would have entailed much labour, and would, moreover, have still further delayed publication. This task is perhaps the duty of the author of later volumes.

To that ever dwindling body of sappers who took part in the events here recorded this history has a personal appeal; and to those who have since become, or are still to become, sappers this story of the deeds of their Corps in what was then the greatest war in history will certainly be of very great interest. It was a sapper war, and we entered it, through no fault of our own, both ill-prepared and under-manned, but, as these pages show, we achieved great things.

GUY C. WILLIAMS,

GENERAL,

CHIEF ROYAL ENGINEER.

1st January, 1951.

PREFACE

IN January, 1937, the Institution of Royal Engineers appointed an Editor to arrange for the continuation of the *History of the Corps of Royal Engineers* from the outbreak of the first World War on 4th August, 1914, to about the end of 1938, when preparations for the second World War were beginning.

The three volumes covering this period have been produced by team-work. The Editor advertised in the *R.E. Journal* for officers who would volunteer to write such portions of the history as they might select. He supplemented this advertisement by writing individually to many who had played prominent parts in certain events or in special types of work. The response to these appeals was most satisfactory, and as a result the history has been written by numerous authors. Some officers were good enough to act as sub-editors for a whole campaign or for definite portions of the history, finding the authors and compiling their work into a co-ordinated story. Others, invited by the Editor on account of the important part they had played in events, reviewed and commented upon the authors' and the Editor's productions. Amendments suggested by these commentators were usually accepted. The Editor asked some very senior officers to act as referees upon certain questions that he submitted to them. Several other officers undertook to search official historical records for information. The reader will notice variations in style, but there seems to be no necessity to apologize for this. The names of the 138 officers who have thus helped to produce Volumes V, VI and VII follow this preface in Volume V.

On 3rd September, 1939, the second World War broke out. By that date a considerable quantity of valuable information had been received by the Editor. Several officers had finished what they had undertaken to write, others had made good progress and hoped to complete shortly, while some had not succeeded in getting very far. The outbreak of war brought

the production of these volumes to a standstill because practically everyone concerned, including the Editor, became involved in war work. The writing of history had to give way to the making of it. Moreover, all official historical records were hustled into air-raid shelters, and became inaccessible.

In 1943, the Editor was able to recommence the work of editing and compiling those papers that he had received, and some other officers resumed the work that they had promised. In 1945, after the conclusion of the war with Germany, the official records began to be brought back to London or to record offices, but, like many other evacuees, they were not in the condition in which they had left five years before. Their hasty evacuation had upset the filing systems, and the tracing of particular documents had become difficult. Time was required to re-establish order. In 1945, when the Editor tried to regain touch with some officers whose promised work had not yet been received, he found that there had been casualties among intending contributors. It is often said with truth that history should not be written too soon after the events concerned, but difficulties certainly arise if the work is postponed too long.

The Editor and authors have been helped by officers who have conscientiously searched through many cubic yards of war diaries, but, with some notable exceptions, the war diaries of the commanders of most R.E. units were, to put it mildly, thoroughly disappointing and of little value to an historian.

The history of the Corps in India has been written by Lieut.-Colonel E. W. C. Sandes, D.S.O., M.C., in two volumes, entitled *The Military Engineer in India*. He has followed these up by another one, published by the Institution of R.E. in 1948, entitled *The Indian Sappers and Miners*. In relating those events in which Sappers and Miners from India have played a great part in many theatres of war alongside the British R.E., we have utilized information from Lieut.-Colonel Sandes's volumes to co-ordinate the accounts of the great work of both British and Indian engineers. There remains much history of engineer work in India between 1914 and 1939 for which space could not be allotted in the present volumes, nor, so far

as the Editor knows, has it been written elsewhere. It is to be hoped that this will be done in due course.

It was not until July, 1920, that the Royal Corps of Signals was created. Before that date signal units belonged to the Corps of Royal Engineers, and they expanded enormously during the war. The history of their work is being produced by the Royal Corps of Signals themselves and will not be found in the present volumes.

These volumes contain the history of World War I, written after that war and before World War II. In other words, there has been no attempt to compare the two wars, although editing was not completed until after the second.

We have attempted to write a history and not a technical treatise. We have, however, tried to explain the organization and systems of command and administration, and to bring out their merits or faults. We have also tried to show the effects of military operations on engineer work and vice versa.

A history of the Royal Engineers, who have carried out tasks of great diversity in war and peace in nearly every part of the British Empire and in many allied and enemy countries, cannot contain descriptions of every operation. Our object has been to emphasize the exceptional variety of the work demanded of the personnel and units of the Corps; and we hope we have succeeded in bringing out the complexity and the ubiquity of their activities. *Quo fas et gloria ducunt.*

THE EDITOR.

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R.E. IN THE GALLIPOLI CAMPAIGN, 1915

CHAPTER I

INCEPTION OF THE GALLIPOLI EXPEDITION

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FOREWORD BY THE EDITOR

It is not proposed to attempt a thorough examination of the very controversial questions concerning the strategical conception and inception of the Gallipoli campaign. It is likely that discussion upon them will continue indefinitely. There is not space available for a conscientious investigation of the subject, nor would a reader expect to find it here, and to deal with it superficially would be a mistake. Historians, responsible statesmen and fighting leaders of every belligerent and some neutral countries in the war of 1914-18 have produced histories, biographies and memoirs which contain a mass of information which may be studied by any serious investigator of these difficult strategical problems.

It would be quite easy to prove that before about 25th February, 1915, a secretly planned and executed combined naval and military operation, using a comparatively small land force, could have landed unopposed on the Gallipoli peninsula, and occupied it with negligible casualties. There were certainly glittering strategical prizes to be secured by the exploitation of such an easy initial success if large armies had been available in Egypt to carry out that exploitation in great depth, but to say that these strategical prizes could have been secured by the Allies with the available forces of 1915, and that the war would thus have been shortened, is pure speculation. It is doubtful indeed whether a conscientious search of the mass of information now available, would produce evidence to support such a speculative conclusion. On the contrary, the evidence might well prove that in 1915 the Allies did not possess sufficient resources for two major co-ordinated offensives in the East and the West. Lord Kitchener told the Cabinet in November, 1914, that: "We shall not be ready for anything big for some time."

Investigation of the evidence might perhaps justify the statement that another two years were to elapse before the British, French and Russian armies were at sufficient strength to permit of two such major co-ordinated offensives. About the same time, November, 1914, Lord Kitchener gave the Cabinet his opinion that 150,000 men would be necessary for a combined military and naval operation with Constantinople as its objective; Lord Fisher, First Sea Lord, thought the land force should be 200,000.*

Here are some of the facts which should cause us to hesitate before giving any opinion on the subject without a conscientious investigation of all the information available. The British Cabinet appointed a Royal Commission in 1917 to investigate the cause of the failure of the Gallipoli campaign, but the mass of information which we now have at our disposal was not available to that Commission, and their conclusions should therefore be treated with reserve. In the winter of 1914/15, the Russian High Command found themselves in an extremely dangerous position, since their stock of munitions was obviously about to disappear, and their armament was depleted. This was made plain to all the world when in April, 1915, the German victory at Gorlice-Tarnow was exploited to a depth of several hundred miles, the Russians being driven back to beyond Brest-Litovsk. In 1915, both the French and British Governments, especially the latter, had quite inadequate stocks of munitions and artillery. The French army did not reach the peak of its strength until the summer of 1916; the British army not until the spring of 1917. The Russian army was not re-munitioned and rearmed on a satisfactory scale until the summer of 1917, but by that time its morale was undermined by a succession of disastrous defeats and by internal troubles which were about to develop into revolution.

The foregoing gives some explanation of the great delay in arriving at a decision to undertake the Gallipoli campaign, a decision that was followed by an attempt to make up for this delay by over hasty improvisation and very little, if any, staff preparation. Moreover, we now (in 1947) have at our disposal all the experience of the wonderful and numerous triphibious operations in the Mediterranean, Atlantic and Pacific during the war of 1939-45. Just as those, who conceived and executed those operations so skilfully, had at their

* In 1915 the Air Forces of all the belligerents were too undeveloped and weak to affect strategical decisions concerning the Gallipoli campaign.

disposal the information about the errors committed in the conception and starting of the Gallipoli campaign, so we now have at our disposal the following recent information.

Wavell's brilliant capture of Tobruk and Benghazi, with a diminutive force in 1941, could not be followed by the capture of Tripoli and Tunis, and he could not even hold Benghazi for the lack of further reserves and resources. We also know that although we were able to land, unopposed, 60,000 men and reinforce the Greeks by extending their right along the River Aliakmon in 1941, that did not enable us to convince the Turks that it was safe to become our ally, and it did not lead to the salvation of Greece and Yugoslavia. The excellent planning and staff preparation during several months for the successful landing of Anglo-American Forces at Algiers could not be followed by a rapid occupation of Tunis for lack of reserves and suitable land communications on which to move them. It was not until the Eighth Army arrived in Tunisia (south) and the First British Army and American Force had been built up and provided with suitable communications behind them, that the unique and overwhelming victory at Tunis could be won. The success of the Allied landings in Sicily and the hard-fought conquest of that island were mainly due to the organization of well equipped bases at Malta and Tunis, close to Sicily, whereas Mudros was almost useless for a long time to the army in Gallipoli. The unopposed landing on the toe of Italy, supplemented by a stoutly resisted landing on the beaches of Anzio, did not give us Rome until many more months of hard fighting. The capture of Rome did not open the way to the centre of Europe or the conquest of the Balkans because reserves and resources were required elsewhere. The capitulation of the Italian army supplied us with an ally who was completely exhausted and unable to give any serious help for a long time. The capture of the islands of Cos and Leros, without the possibility of maintaining adequate air and naval forces at suitably equipped bases in the vicinity and reserves for exploitation, again did not convince Turkey that it would be safe to become our ally. Without intricate planning and equipment and large armies close at hand in England, the successful landing on the beaches in Normandy on "D" Day, 1944, would have led to ultimate defeat, just as the lack of a properly equipped base at Mudros, and the absence of a reserve army in Egypt in 1915, led to frustration on the edges of the Gallipoli peninsula.

Perhaps enough has now been said to impose caution on the

writer and reader, before claiming a vast harvest of strategical fruits from an initial success that might perhaps have been obtained early in 1915 by small land forces effecting a surprise in conjunction with the navy on the Gallipoli peninsula. We propose therefore to introduce our story of the work of the R.E. in the Gallipoli campaign 1915 by noting only the facts concerning the continuous effects on the military operations and therefore on the work of the R.E., of the initial delay in arriving at a Cabinet decision to start a campaign, and the lack of time after that decision, for proper staff preparation for such a difficult amphibious operation so far from a good base at Alexandria and without a suitably prepared advanced base at Mudros.

PRELIMINARY DELIBERATIONS AND THE NAVAL BOMBARDMENT

In November, 1914, when our country was fighting for its existence and for that of France on the continent of Europe and had been brought to a standstill, the Grand Duke Nicholas, C.-in-C. of the Russian army, being hard pressed in the Caucasus, called upon us to make a diversion to draw some Turkish troops away from his front. Our statesmen and their technical advisers, therefore, reviewed the whole strategical situation of the war, including the possibility of forcing an entry through the Dardanelles. The Gallipoli peninsula was finally chosen for the operation, although the forcing of the straits had always been rejected as a possible combined operation on the few occasions when it had been considered previously. A proposal to attack our common enemy on an entirely new front aroused deep opposition from that part of the nation and of the army and navy which maintained that an enemy should always be met where he is strongest. It was urged as well that we were endangering the result of the war by dividing our strength. At long last, the Cabinet, rejecting these views, came to a decision on 28th January, 1915, to act against Turkey in the Levant. They ordered an attempt to be made to force the Dardanelles by ships alone. The actual words were "to capture the Gallipoli peninsula." This enterprise was a costly failure. It had been preceded by an earlier naval demonstration, and so greatly were the Turks alarmed by these operations that a coastline, which in February, 1915, was almost entirely unprepared for defence and garrisoned by inert

and badly armed troops, was by April converted into an impregnable fortress.

When the navy found itself stopped by an enemy minefield on 18th March, at a cost of several battleships, our Government directed a great military expedition to the Dardanelles, an expedition for which no adequate staff preparation had been made. To the scene of operations were sent out, on the afternoon of the day following their appointment, the Commander-in-Chief and his Chief Staff Officer, together with a hastily collected General Staff, but without representatives of the A or Q branches. Sir Ian Hamilton, as C.-in-C., and Major-General Braithwaite, his C.G.S., had been given a task for which they had been allowed no time to choose or consult their staff, general and technical, or to appreciate the military and naval position. This vanguard of generals was quickly followed by their army and its vast equipment, hastily and indiscriminately loaded without regard to any orderly plan for disembarking on a hostile coast and going into action without delay. The ships which had been hastily collected for this great force were compelled to return to Alexandria for three weeks to be unloaded and reloaded on sound military lines. Meanwhile, every foe from Berlin to Constantinople took note, and made the necessary preparations for a stout defence of the Dardanelles.

To the aid of this effort came our navy with its unequalled strength and age-long efficiency. To our aid came also the Dominions of Australia and New Zealand. France, as our ally, produced a *Corps Expéditionnaire d'Orient* of 18,000 men to help us in the fight. On 25th April, 1915, the battle was joined on the beaches of the Gallipoli peninsula—Helles and Anzac.

Confronting the British Commander-in-Chief on that day was a German general of first-rate ability—Liman von Sanders,* together with Mustapha Kemal, a soldier and leader of the kind which is given to a nation not twice in a century.

Such in bare outline were the events leading up to the Gallipoli campaign, but we must consider in somewhat greater detail certain outstanding episodes before the military operations began. The facts are gathered chiefly from the *Official History of the Military*

* Before 1914 General Liman von Sanders had been placed at the disposal of the Turkish Government to reorganize their army. When Turkey entered the war they sent him to take command of the Turkish forces on the Gallipoli peninsula. He was assisted in this task by a few German officers.

Operations in Gallipoli, Volume I, to which the reader is referred.

On 27th November, 1914, as we have seen, our Government was informed that the Grand Duke Nicholas, who found himself in difficulties in the Caucasus, asked for a British demonstration against Turkey. On 19th January, Mr. Churchill (then First Lord of the Admiralty) informed the Grand Duke that the Government had determined to force the Dardanelles. In the interval a paper had been circulated to the War Council, prepared by Lieut.-Colonel Hankey, Secretary of the Council, by direction of the Prime Minister. That paper contained the argument for a Gallipoli campaign. After calling attention to the deadlock on the Western front, Colonel Hankey suggested that Germany could be struck at most easily through her allies, and particularly through Turkey. In a few months Britain would be able to supply three army corps for an attack on Turkey, and if Greece and Bulgaria could be induced to co-operate, it should be possible to capture Constantinople. The advantages accruing from such an operation would be numerous. In addition to gaining the adherence of the Balkan states and destroying Turkey's armed resistance, communications with the Black Sea would be reopened. The *Official History* further points out that "the forcing of the Dardanelles might lead to a revolution in Constantinople and an appeal for a separate peace. Bulgaria, Greece and Rumania, perhaps even Italy, might be attracted to the banners of the Entente. The Central Powers would in that case be enclosed by an iron ring. The way would be open for an advance up the Danube. Russia could receive her much needed war material."

What were the prospects of success? "Up to 25th February," says the Turkish Official account, "it would have been possible to effect a landing successfully at any point on the peninsula, and the capture of the straits by land troops would have been comparatively easy." Even though the Turks, under German direction, had had six months to make good the defences and minefields of the straits, yet, in the opinion of the German Admiral von Usedom,* who knew better than anyone the strength and weakness of the fortress and the capacity of its defenders, the enterprise was still capable of accomplishment if the British Government would face the loss of ships. "The English," wrote Liman, "allowed us four good weeks

* Admiral von Usedom had been lent by Germany to the Turkish Government before 1914 to reorganize their navy and to advise them upon the coast defences of the Dardanelles and the Bosphorus.

of respite for all this work of preparation before their great disembarkation . . . This respite just sufficed for the most indispensable measures to be taken."

DISPATCH OF A LAND FORCE TO MUDROS

On the 16th February, the War Council, following the opinion of the Admiralty, determined that the army must be brought in to try their hand if the navy failed to force the Dardanelles. They decided accordingly that :

1. The 29th Division was to be dispatched to Mudros at the earliest possible date. It was hoped that it would be able to sail in nine or ten days.
2. Arrangements were to be made for a force to be dispatched from Egypt if required.
3. All these forces were to be available in case of necessity to support the naval attack on the Dardanelles.
4. Horse boats were to be taken out with the 29th Division, and the Admiralty were to collect small craft, tugs and lighters in the Levant.

But it was not until the 10th March that Lord Kitchener, the Secretary of State for War, felt that the situation in France was sufficiently satisfactory to allow him to release the 29th Division for operations against Turkey. It should here be mentioned that the Dardanelles Commission later gave as their opinion that this three weeks' delay in the dispatch of the 29th Division was the cause of the loss of the favourable moment for action, as seems clear also from the above quoted enemy opinions.* On the other hand, the weather would not have allowed a safe disembarkation of troops on the beaches before 25th April.

There had been a naval bombardment of the forts at the entrance to the Dardanelles from 19th to 26th February, and on the latter date a naval party had landed without opposition at Sedd-el-Bahr, the fort on the European side of the entrance to the straits, and had demolished the guns. Two months later on the same spot the 29th Division lost 3,000 men at the landing.

Incredible as it may seem, it was not until 11th March that the

* The reader is, however, referred to the Editor's foreword concerning the conclusions of the Dardanelles Commission.

General Staff was informed that any large *military* operations in the Dardanelles were contemplated. On 12th March, Sir Ian Hamilton learned that he was to command the expedition, and next day, with his Chief of Staff and a few General Staff officers, he left England. For over a fortnight he had no "A" or "Q" staff officers with him, nor any engineer officer. Events were to prove that his arrival at the Dardanelles was not an hour too soon, but the separation of his staff caused by this hurried departure was a misfortune from which the force never quite recovered.

To Mudros on the island of Lemnos went Sir Ian Hamilton, followed by his first troop-transports, but he saw at once that Mudros was for the time impossible as a base. It had no water supply, no piers or jetties and an unsheltered harbour. Although Mudros was only seven hours from Gallipoli, it was evident that Alexandria, even though it was fifty hours from the beaches, must at the start be the main base. So back to Alexandria went the military transports, while Sir Ian, from H.M.S. *Phaeton*, witnessed the failure of the fleet on 18th March to force the straits.

TRANSPORTS RELOADED AT ALEXANDRIA

At Alexandria, chaos in the loading of the transports had to be reduced to order. "Even the available quay space of the Egyptian ports was barely sufficient to cope with the vast amount of unloading and reloading that had to be undertaken. In the hurry of embarkation in England the contents of the transports had been even more intermixed than was at first realized, and there was no alternative to completely unloading every ship. One of the infantry battalions of the 29th Division, for instance, had been embarked in four different vessels. Units had been separated from their first line transport, wagons from their horses; guns had been loaded in one vessel, their ammunition in a second and, in some cases, the necessary fuses in a third. For a whole week, the ammunition of the 29th Division's ammunition column could not be traced at all. A similar confusion existed in the supply ships, each of which had to be almost completely unloaded and its cargo re-sorted on the quays. These vessels were then reloaded in such a way that each of the various categories of supplies on board would be easily accessible."*

All this time the Levant was alive with Turkish spies. Constantinople knew exactly what was going on, but it is curious to read that

* *Official History—Military Operations, Gallipoli*, Vol. I, p. 116.

while delay was thus dogging our footsteps, the enemy had given up all for lost. Liman von Sanders and the American Ambassador at Constantinople, and also the latter's special agent at his embassy, have placed on record that the fall of the outer forts in February caused consternation in Turkey. Everyone in Constantinople believed that the success of the allied fleets was inevitable. The Germans were apprehensive that a revolution would follow the fleet's arrival at the Golden Horn and that Turkey would sign a separate peace.

The naval attempt to force the straits on 18th March disastrously failed, owing to an unlocated minefield. Three battleships were sunk and three badly damaged. Clearly Gallipoli was now an affair principally for the army. On 27th March, Mr. Churchill telegraphed to Admiral de Robeck, Commander of the British Fleet, that though he had hoped the result might be achieved without the army being involved, he now saw that a combined operation was essential.

During the five weeks which elapsed between the naval attack and the military landings the Turkish scheme of defence was improved out of all recognition, and on 25th April, Sir Ian Hamilton's Mediterranean Expeditionary Force began the task of overcoming it.

CHAPTER II

THE LANDINGS AT HELLES AND ANZAC

Engineer preparations for the advanced base and the landings—
Engineer operations at the Helles landing—Engineer operations
at the Anzac landing—Results of the landings at Helles and
Anzac—Survey.

ENGINEER PREPARATIONS FOR THE ADVANCED BASE AND THE LANDINGS

We may now consider the R.E. problems as they presented themselves to the senior engineer officer with the expedition—Brigadier-General A. W. Roper. When he was appointed, Engineers-in-Chief were unknown and he was called "Technical Adviser to the Commander-in-Chief," a vague if high sounding title which carried with it insufficient authority and no executive power whatever.

Sir Ian Hamilton took with him no engineer officer when he went out to Mudros, nor was any technical officer present with him at the time of the naval action of 18th March. General Roper, in fact, knew practically nothing of strategic plans, of engineer requirements or of material available before he reached Alexandria. Before he left London, he had persuaded the Adjutant-General of the Royal Marines to wire to Malta to send timber to the Levant for his possible needs, especially for piers, but, although General Roper was given to understand that the timber would be available, the Director of Works on the peninsula (Brigadier-General G. S. McD. Elliott) never received it. In point of fact, General Roper was told by the C.G.S. that it was expected that the Turks would retire as soon as we landed and that therefore nothing very elaborate would be required. It is also interesting to note that on 25th July a wire was received from the War Office to say that piers were an Admiralty responsibility.

When he reached Mudros prior to the landings, General Roper was told that it was not intended to use Mudros any further, and that it was no use bothering about the water supply there. He was also informed on 5th April that nothing elaborate in the way

of piers on the island would be required. As an illustration of the haphazard manner in which the expedition had been fitted out by the War Office, it may be mentioned that the whole staff of the "Technical Adviser" consisted of one clerk.*

When he arrived at Alexandria, General Roper had a conference with the Chief Engineer of the Australian and New Zealand Army Corps (Brigadier-General A. J. de Lotbinière), the C.R.E., 29th Division (Licut.-Colonel Hingston) and the A.D.W., Alexandria (Licut.-Colonel L. H. Close). General de Lotbinière said that he was arranging for several 60-ft. barrel piers, both for Anzac and for Helles. These were to be carried on the transports. There were also six 100-ton lighters, as well as 250 ft. run of trestle bridging for each place. He had also ordered 10,000 4-gallon kerosene oil tins to be filled in Alexandria with water and carried in these lighters, and in addition, another 10,000 tins in 5,000 packing cases for the 29th Division. The iron lighters were fitted with gangways, anchors and piles for holding them in place, and they contained galvanized iron tanks, pumps, hose, etc. Unfortunately the lighters proved to be untowable in rough weather, the navy cut them adrift and only one of them reached Anzac beach. Some iron tanks were, however, landed, but they were often damaged by shrapnel and splinters and were difficult to repair. Other water receptacles, such as skins, were collected throughout Egypt and taken to the front, and the troops *en voyage* were instructed to save all empty biscuit tins and other containers capable of holding water.

It was found at Mudros that the reloading at Alexandria left much to be desired from an R.E. point of view, and that many essential stores had been left in Egypt. The unloading facilities at Mudros were totally inadequate throughout the campaign. The shortage of sea transport will be discussed in the next chapter.

The British *Official History*† points out that the only engineers sent out with the Expeditionary Force were the field companies of the divisions. At this early period of the war, the usual lines of communication units for engineer work had not yet been raised and trained, and such as existed were in great demand in France. Piers, water supply and roads were the main demands on the engineer troops on the peninsula (in spite of the statement that piers were

* The same staff, in fact, that had been allotted to the "Engineer Adviser" to the C.-in-C., B.E.F., the previous August, and of course immediately found to be ludicrously inadequate. See Volume V.

† Vol. I, p. 119.

an Admiralty service), and until army troops companies began to arrive *months* later, it was the front line work that had to suffer.

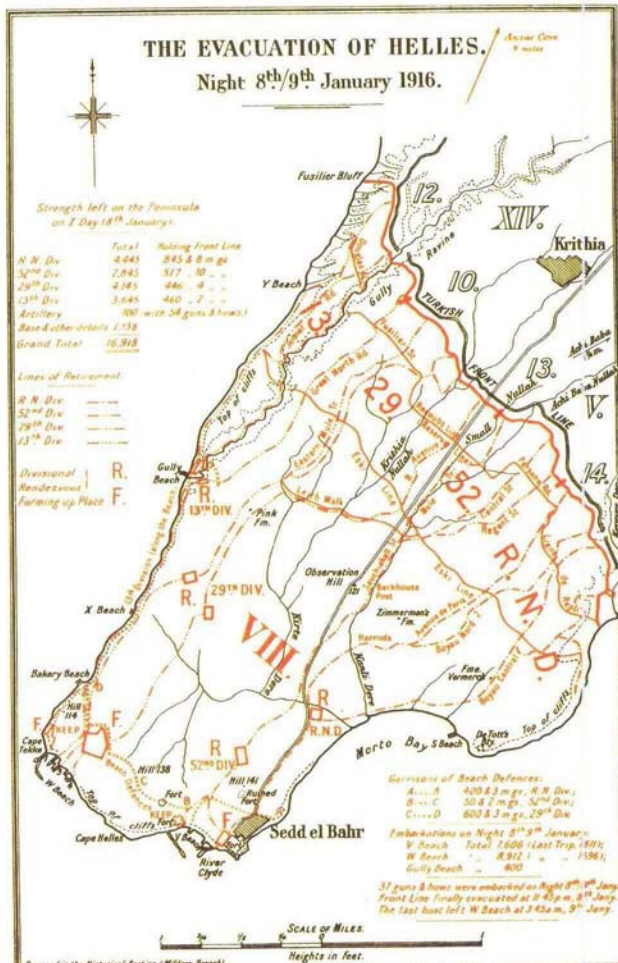
No attempt will be made here to describe the landings. This has been fully done in the British *Official History*, and in the monumental *Australian History* and in that of the New Zealand Engineers. An account of the work of the Royal Engineers with their comrades from the Dominions is the purpose of the present work. At Helles the landings were made by the 29th Division and by some units of the Royal Naval Division. At Anzac the 1st Australian Division effected the actual landing before sunrise, and later in the morning the Australian and New Zealand Division began to get ashore.

ENGINEER OPERATIONS AT THE HELLES LANDING

(See Sketch 1, facing this page, which shows the final positions held at the time of the evacuation eight months later.)

Our *Official History* makes very little mention of engineer activity at Helles on 25th April. The battles on those beaches were too fiercely contested for much sapper work to be done, even on water supply. In the initial landing of the covering force one section of the 1/2nd London Field Company on the right reached S beach, the 1/1st West Riding Field Company disembarked from the *River Clyde* at the deadly V beach and the C.R.E., with his small staff and the rest of the London Company, at W beach, to be followed by the 2/2nd Lowland Company who were with the main body.

At W beach, the R.E., under fire, tackled the very formidable Turkish wire entanglements and made a causeway for guns up the declivity above the beach. This was of immediate use. When night fell, the beach was lit by flares, and the sappers began to assemble into rafts the barrel piers from Alexandria. These piers lasted for weeks in spite of rough weather. A light trestle bridge was also started and two roads were begun. Tube wells could not be sunk on the beach but a well was dug and lined, and water tanks and horse troughs erected by the Lowland Field Company. Water from a lighter helped to fill them. A spring under the cliff was found and cleared. News was received that the front line was retreating and might be broken, so the West Riding Company was sent forward and extended in support of the infantry. The G.O.C. sent the Adjutant (Captain Macaulay, R.E.) to see if he could place wire in front of our line, while the C.R.E. reconnoitred a second line of defence. Casualties were severe.



ENGINEER OPERATIONS AT THE ANZAC LANDING

(See Map 1, Suvla and Anzac, in end pocket.)

As regards the Anzac landing north of Gaba Tepe, the *Official History* records* that "No story of the Anzac landing would be complete that did not mention the three field companies of the Australian Engineers," under their C.R.E., Lieut.-Colonel G. C. E. Elliott, R.E. (1st Australian Division), and Lieut.-Colonel G. R. Pridham, R.E., C.R.E. (N.Z. Division).† "Some of the 1st Field Company, landing with the advanced echelon, for the moment forgot their allotted role. They dashed forward with the leading infantry to the top of Plugge's Plateau (at the north-east end of MacLagan's Ridge) and it was some little time before they could be re-assembled on the beach. Later in the morning, the engineers were divided into three parties, one to make roads, another to search for water, and the third to construct piers for landing stores. Paths to the top of Plugge's Plateau, and a track for 18-pounder guns to the top of Queensland Point were constructed during the day; and communications up Shrapnel Gully were greatly improved. A water-tank boat, provided with eleven galvanized tanks and pumps was towed ashore, and early in the evening there was enough water available to supply the whole force. Kerosene tins were used to take water to the troops. On the right flank, a certain amount of water was found in Shrapnel Gully. Pumps and troughs were erected, and a fair amount of water was available late in the afternoon. On the left flank no water could be found in the first instance, but water tins were landed and sent to the troops in the line. A barrel pier had arrived by noon and pontoon equipment a little later; and despite the continuous shrapnel fire from Gaba Tepe, an excellent landing stage was erected in Anzac Cove. This pier proved invaluable for evacuating the wounded and 1,500 men were embarked from it before midnight on the 25th/26th April."

The *Official Australian History* records that "A few hours after the first man landed, two special parties of the 2nd Field Company of Engineers, under Captain T. R. Williams and Lieutenant W. H. Dawkins, began to search the gullies for water. By nightfall they had two tube wells sunk at the mouth of Shrapnel Gully. Next day,

* Vol. I, p. 195.

† At the landing on 27th April the second composite A. & N.Z. Division had only the 1st Field Company. A field troop (N.Z.) landed on 13th May, the 2nd N.Z. Company on 3rd June, and the 3rd N.Z. Company landed later.

Dawkins, a Duntroon boy, moved to Dawkins Point—the seaward end of McCay's Hill—and by the second evening he had sunk twenty shallow wells, which gave 20,000 gallons daily of good soakage water."

At 6 p.m., the 1st Field Company of the New Zealand Engineers (Commander, Captain A. G. McNeill, R.E.) landed at Anzac. It was transferred to large cutters which were run aground on the beach. Men leaped into the water, and after landing picks, shovels and other gear, the field company was lined up in the shelter of a cliff. They were at once put to digging support trenches, gun emplacements and machine gun posts on Plugge's Plateau. Next day many were needed for front line duty as riflemen, and Corporal Saunders, N.Z. Engineers, won the D.C.M. The company had engineer charge of Quinn's Post of immortal memory, which was some twenty yards from the enemy line at the head of Monash Gully and had to be constructed from shallow rifle pits into a firing line, from which saps were pushed forward into a new trench on the crest by joining the sap-heads. This method of gaining a line further forward was often made use of at Anzac throughout the succeeding months. Bomb-proof shelters and barricades had to be constructed, a dangerous business with the enemy within bombing range. Mention should be made of the work done at Anzac by 1st Field Company of the R. Naval Division (Major Morgan, R.M.), which landed a few days later. These engineers distinguished themselves on their first time under fire by constructing the main road from the beach to the reserve position on MacLagan's Ridge under constant shell fire.

RESULTS OF THE LANDINGS AT HELLES AND ANZAC

Reviewing the general results of the landings, although both at Helles and Anzac the troops got ashore and held on, it could not be denied that the day had been more favourable to the Turks than to ourselves. Indeed, at midnight 25/26th April, Sir Ian Hamilton was aroused from sleep to decide what was to be the reply to a grave message from Sir William Birdwood, Commander of the A. & N.Z. Corps, representing the state of affairs as so serious as perhaps to make immediate re-embarkation advisable. Sir Ian, after consulting the navy, replied that re-embarkation would be most difficult and dangerous. "Dig yourselves in and stick it out," he said.

This the Anzacs did bravely, but until August the only Turkish

territory they held was a crescent of rough hillside, one and a half miles long and 1,000 yards from the coast at its greatest depth. The ridge and valleys were mostly, though not entirely out of view of the enemy, but the strip of beach was under enemy observation and was enfiladed every day by their batteries with deadly results. High traverses of biscuit boxes, etc., were soon erected perpendicular to the sea line, under which shelter could be taken, but right up to the evacuation the first shell that arrived was nearly always followed by the call "Stretcher bearer."

At Helles, on the other hand, elbow room beyond the beaches was very soon obtained. The difficulty here was not that of holding the ground that had been seized, but of making any further advance.

SURVEY

The only map of Gallipoli available for use during the attack was a one-inch compilation made by the Geographical Section. From the nature of the case it was not reliable, and its inaccuracies caused many difficulties.

Early in 1915, a field survey section was got ready for the expedition, but was not eventually taken. As a consequence, operations and particularly artillery co-operation were hampered by the lack of any reliable survey. Fortunately, a moderately good and fairly recent map was found upon a captured Turkish officer. This was promptly reproduced by the Survey of Egypt and distributed. Arrangements were then made with this very efficient department to send Mr. Meldrum, with the rank of Captain, to undertake original surveys.

Later a maps and printing section (corresponding to the 1915 organization on the Western front) was sent to the Dardanelles, under the command of Lieutenant A. G. Ogilvie (later Professor of Geography at Edinburgh University). This section was, however, independent of the survey section under Captain Meldrum. It is probably true to say that in no other theatre of war were overlapping and lack of touch in survey matters so marked.

CHAPTER III

THE ADVANCED BASE AT MUDROS

Delay in developing Mudros—Higher engineer organization—Shortage of stores and plant—Shortage of skilled labour—Use of Mudros as an advanced base—Piers at Mudros—Water supply and hutting—The island of Imbros.

DELAY IN DEVELOPING MUDROS*

THE situation therefore at the beginning of May was that we had obtained a footing on the peninsula, and at the time it seemed quite possible that further advances could be made which would lead to the hoped-for capture of Constantinople. No one could have foretold that eight months later we should still find ourselves with the problem of maintaining large numbers of troops on the small and exposed Gallipoli beaches.

Under these circumstances there seemed to be no necessity to build up a large organization at Mudros. The island had been used for launching the attack but it was intended to maintain the force by direct shipments from Alexandria until Constantinople was in our hands. The shipments were to be made in ocean-going vessels whose cargoes were to be discharged by lighters on to temporary piers at Helles and Anzac. These piers would only be in use during the summer when the Mediterranean is almost always calm.

We have seen that Brigadier-General A. W. Roper, before even leaving England, had made arrangements to send materials for the construction of piers at Mudros, but he was definitely informed in May that there was still no intention of developing the island as an advanced base. Admittedly the Admiralty had originally intended to form a naval base at Mudros to support the naval attack on the straits. When, however, the operation became primarily a military one this policy was not pursued, and it was a long time before it was realized that without proper facilities on the island no successful advances would be possible on the main land.

During May large ships continued to anchor off the beaches and to be discharged by lighter, but at the end of the month the battleships *Triumph* and *Majestic* were torpedoed by German submarines near the peninsula. This led to an important decision which entirely

*Mudros is a village on the shores of a large bay on the south of the island of Lemnos, but during the campaign the word was used indiscriminately for the bay and the island itself.

changed the situation, though its serious effect does not appear to have been realized at the time. It was decided that no ocean-going ship should proceed beyond Lemnos, where cargoes would be transferred to smaller vessels in its harbour, Mudros Bay, which was protected against submarines. In other words the complete tonnage of maintenance stores and supplies was to be handled at least twice in a harbour quite inadequately developed for the purpose. It was perhaps not foreseen how extremely difficult, if not impossible, this procedure would become, and ships were sent from England and Alexandria to Mudros without previously ensuring that they could be dealt with there.

Congestion and delays began to occur, but the hope that the use of Mudros would soon be unnecessary still affected policy, and no serious effort was made to improve the facilities in the harbour. The result was that by July, congestion became very serious. Ships often took six or eight weeks to discharge, many had to sail in the submarine-infested Mediterranean for one or two months before they could enter the harbour, and furthermore even when cargoes had been unloaded the items required by the troops could not be sorted out so as to be reloaded for transshipment in smaller vessels. It was not until July that the very serious situation occurring at the advanced base compelled the adoption of a longer term policy, and from that date onwards determined and successful efforts were made to develop the island.

It is interesting to consider whether in fact useful work could have been accomplished before July even supposing that policy had allowed it. The engineers were suffering under at least three major difficulties—they entirely lacked a suitable and adequately staffed organization at the top, they were extremely short of stores and plant, and thirdly, they had quite insufficient skilled labour. Let us deal with these three separately.

HIGHER ENGINEER ORGANIZATION

In Volume V of this history, we have seen that no provision had been made for an Engineer-in-Chief or Chief Engineers in France at the beginning of the war. The same situation occurred at Gallipoli. Brigadier-General Roper was merely an "Engineer Adviser" and his staff consisted of one clerk. There was admittedly a Chief Engineer, Brigadier-General A. C. Joly de Lotbinière, appointed to

the Anzac Corps, but not at first to the force at Helles. There was a Director of Works, Brigadier-General A. S. McD. Elliott, responsible for the advanced base, with a D.D.W. at Mudros and an A.D.W. at Imbros, but owing to the policy not to develop these places his staff was far too small to plan and supervise any large works. The Director of Works exercised general supervision over an A.D.W. at Alexandria, but this officer, Lieut.-Colonel L. H. Close, also served the Chief Engineer of the forces in Egypt. In course of time Colonel Close built up in Egypt a large and efficient base park and workshop organization, which is dealt with in later chapters, but there is no doubt that the service of two masters made his position difficult.

SHORTAGE OF STORES AND PLANT

The operation had been planned, as we have seen, in very great haste and there had been little time to lay in, even in Egypt, stocks of engineer stores adequate to maintain a force of the size very soon to be employed on the peninsula. The main difficulty, however, was not a shortage of stores in the base depot at Alexandria, but rather the movement of them even to Mudros and, still more so, to the beaches. The congestion at Mudros was such that only ships containing items vitally essential to the operations could be handled, and we read of many instances where cargoes of engineer stores were either delayed in unloading or even returned to Egypt. Thus a situation arose where the very materials which were required to increase the unloading facilities were those which did not arrive. This was further accentuated by the fact that many of the engineer stores were particularly difficult to handle with the crude means available at Mudros and on the beaches. The result of these difficulties was that Gallipoli suffered more acutely from shortage of engineer materials than any other campaign and, in fact, availability of stores always set a limit upon what could or could not be done. Since such small tonnages could be allotted to the engineers on the peninsula, it was all the more important to have an organization capable of meeting sudden and particular demands. This is where Mudros failed, because there were no facilities ashore for building up, and sorting out adequate reserves from which to meet these sudden calls.

SHORTAGE OF SKILLED LABOUR

We must remember that this was just the time when the failure of our allies in France to carry out their promised work on the

L. of C. was producing heavy demands for technical units for the Western front—units of a type not planned for and not easy to raise or equip. All that could be spared at first for the Gallipoli campaign was the 13th Base Park Company—a most unsuitable unit for the purpose but one that did valuable work. It was followed by the 1/3rd (Lancashire) Workshops Company. By August four army troops and one railway company had arrived, but from April till July there was most definitely an acute shortage of skilled labour. This shortage not only affected pier construction but also all the other work required at the advanced base—water supply, roads and all the buildings for hospitals, stores, rest camps, headquarters, etc., at both Mudros and Imbros and of course on the peninsula itself.

Unskilled labour was of course obtained from Egypt, Malta and Greece in proper proportion to the very limited amount of skilled labour. Egyptian unskilled labour is capable of a phenomenal output, equalled only by that of the Chinese, and the Egyptian labour at Imbros maintained its reputation, but at Mudros, it did not prove so satisfactory. When working on the unloading of ships in the harbour, which was by no means smooth for small vessels, the Egyptian labour was often sea-sick, homesick and really sick. Of course, neither Egyptian nor other civil labour could be blamed for lacking enthusiasm for work on the actual beaches, although some were willing volunteers.

USE OF MUDROS AS AN ADVANCED BASE

To sum up, it would appear that, from the moment it was decided not to send big ships to the peninsula, it should have been quite clear that a long time was bound to elapse before cargoes could be double-handled at Mudros. It was probably the decision to work this quite undeveloped harbour at a rate far beyond its capacity, which led to the great difficulties that arose. Not only were the necessary piers and wharves non-existent but shore facilities—roads, light railways, buildings, water supply etc.—were totally inadequate and could not be provided without long delay. Moreover the one method by which cargoes might have been handled more quickly—adequate tugs and lighters—were also lacking.

Under these circumstances it is tempting to be wise after the event and to suggest that a far better solution would have been to have loaded the small ships, destined for the beaches, at Alexandria and to have sent them direct, while Mudros was used for handling

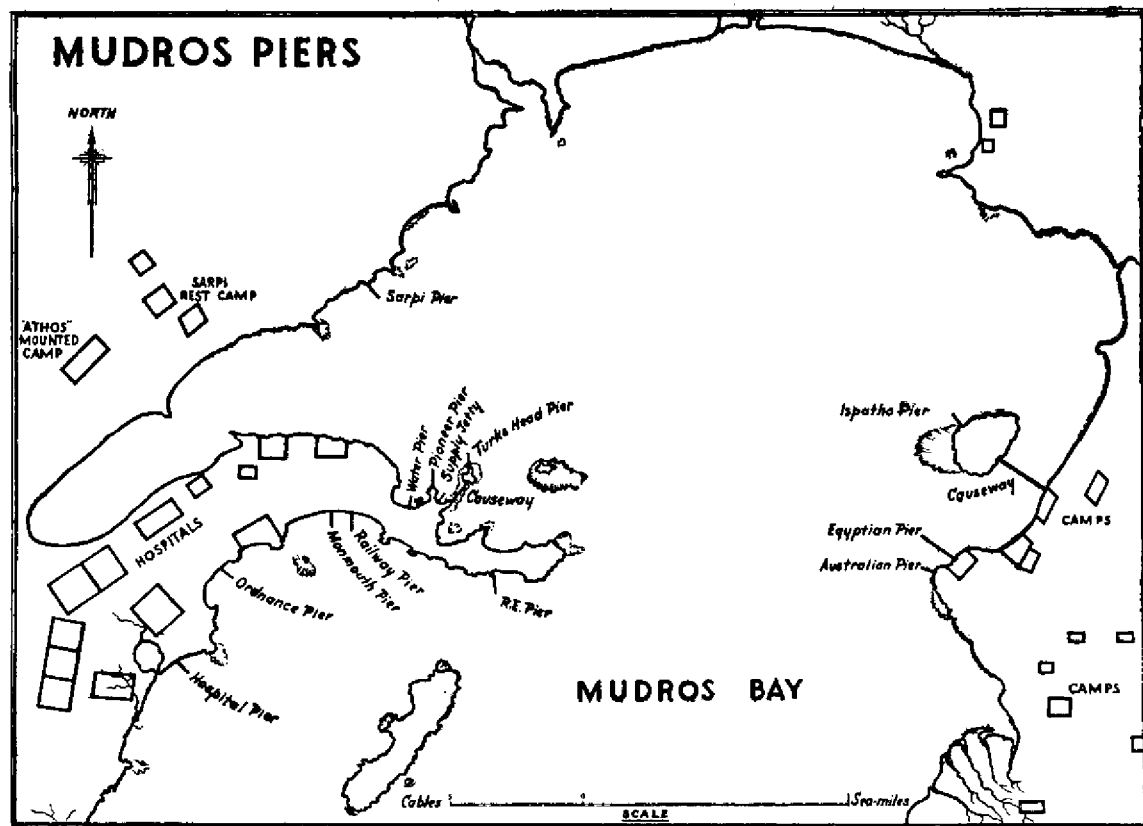
only the tonnage that could be dealt with without congestion. This view was definitely arrived at by General de Lothinière in November in a report sent to the President of the Mediterranean Transport Commission. There may of course have been a great shortage of these small 1,500-ton vessels—a shortage which was felt acutely during World War II—and this being so it might not have been possible to use them on the trip from Alexandria which took fifty hours as against the seven hours from Mudros to Gallipoli.

It was the opinion of Major-General Sir Godfrey Williams, who was appointed Engineer-in-Chief in September, when he subsequently wrote his reflections on the campaign that "The chief R.E. oversight was the failure to foresee in good time the necessity for deep-water piers and wharves at Mudros. The lack of them meant great loss of time and waste of shipping, because stores from sea-going ships had to be transferred to barges before landing. Had work been started at once there was ample time to make piers to which ships could lie alongside before, say, the end of June."

Experience in World War II, however, tended to show that deep berths for full sized ships with adequate cargo handling space can seldom be built as quickly as this. It might have been that narrow piers with adequate depth of water at the pier-head could have been constructed during April, May and June; it is, however, very doubtful whether such piers would have dealt with the tonnages involved until far more work had been done to provide sufficient area of pier-head to receive the cargo and some means of clearing it rapidly. Experience in World War II would indicate that a better solution in this tideless harbour might have been the provision of an ample frontage of shallow-depth berths with a generous area of cargo handling space behind them. Given these conditions and also plenty of tugs and lighters (or better still self-propelled shallow craft), the discharge of the large ships would have been no slower than by direct working on to narrow piers. This is certainly true for calm weather, and the winter storms would probably have equally affected the working of deep-water berths in the unprotected harbour.

Some successful attempts were made to give greater storm protection by the sinking of ships and the filling of them by dredgers. It was found that these operations were far from easy and they were started too late in the season. Here again the feeling that Mudros would not be required except temporarily probably influenced policy. The result was that as soon as rough weather occurred all operations were seriously affected.

Sketch 2



REPRODUCED BY PERMISSION OF THE ADMIRALTY

PIERS AT MUDROS

(See Sketch 2, facing this page)

Having discussed the reasons why work was not started earlier, we will deal with what was in fact accomplished. Work began in a small way in July and was continued at increasing speed for the rest of the year. By the end of December the following piers had been built and were in use :—

Australia Pier, 7 ft. of water, Mudros East, built in March.

Egyptian Pier, 6 ft., Mudros East, built in August and September.

Pioneer Pier, 12 ft., begun in July and lengthened in September.

Ordnance Pier, 8 ft., built in August and September.

Railway Pier, 7 ft., built in September.

Hospital Pier, 7 ft., lengthened and reinforced in September.

Sarpi Pier, 8 ft., just finished, delayed by rough weather.

The following were still under construction, the last two not being shown on the sketch :—

Turk's Head Pier, 22 ft., almost complete with causeway.

Monmouth Pier, 8 ft., required further widening and strengthening.

Supply Jetty, 15 ft., almost complete, delayed by rough weather.

R.E. Pier, 25 ft., required much additional work owing to slipping of the sunken ship forming the pier-head.

Ispatho Pier, 6 ft., at Mudros East, required two more months' work to lengthen by 240 ft. to give 9 ft. of water.

Kondia Pier, 23 ft., frontage of 60 ft. with 20-ft. depth completed, but remaining 440 ft. of frontage required two more months' work.

Alessandrini Pier, 35 ft., required four months' work to complete.

WATER SUPPLY AND HUTTING

At Mudros, Imbros and on the peninsula, the initial supply of water was brought by the navy from the Nile and either pumped to tanks or reservoirs on shore or carried in containers. This system, of course, involved much sea transport, and could furnish only a limited supply. It was therefore the business of the R.E. to develop local sources, from which water could be distributed by pumps and pipes to water-points at which the troops could collect it under staff arrangements. In July the wells so far constructed at Mudros

could not yet meet the demand, and arrangements for transporting water to the shore were overstrained, i.e., the lighters, tugs and picket boats were insufficient, but more were expected by August. Some of the water brought by the navy in lighters was being pumped ashore through a 3-in. main. The navy were erecting a condensing plant on the west side, estimated to deliver 50,000 gallons a day, to be pumped to a reservoir on the hill, and distributed by pipe. Sixty wells had been sunk and were being fitted with pumps.

On 19th October, the condensing plant was in operation and producing about 33,000 gallons a day, and wells were giving a good supply at Mudros West. From then onwards the water supply ashore was sufficient to meet all demands, and when the evacuation occurred in December it was possible to meet the sudden call for water for 100,000 men.

In August, 1915, the D.W. made arrangements to collect for Mudros, Imbros, Anzac, Helles and Suvla, a supply of timber and corrugated iron sheets for issue to Chief Engineers for erection by them. In September, he had received and was erecting at Mudros, portable sectional huts, ordered in June, July and August, and also some excellent hospital huts were being erected by contract. The following hospitals were under construction and approaching completion:—One general hospital of 1,040 beds, two stationary hospitals of 624 beds each and one infectious hospital. Hutting, therefore, continued steadily for L. of C. services, until stopped by the decision to evacuate. Generating plant was installed and provided electric light for all huts.

By the end of December five miles of road had been completed, and twenty-three miles were under construction. A railway was constructed by the 117th Railway Company, connecting piers, camps and hospitals, but it came too late to be of use. Under Captain E. W. Gill and Lieutenant H. E. Glover of the 13th Base Park Company, workshops were established at Mudros with commendable rapidity after the arrival of the unit, and produced a number of the many items required, including many trench stores.

THE ISLAND OF IMBROS

Imbros was the site of G.H.Q. from 21st May until the evacuation. It was also the centre for distributing water to Helles and Anzac. It offered a rest-camp for troops from the peninsula on the rare occasions when the more war-weary of them could be spared for a

week or so. It possessed a small advanced workshop for the beaches, run by the 1/3rd Lancashire Works Company. Further, it provided stone from its quarries for roads, principally at Helles.

The chief trouble at Imbros was that its harbour Kephalos, was a mere bay facing north. Even a light northerly breeze made landing almost impossible. The navy sank two small stone-filled steamers, under the lee of which two piers were built which served their purpose in calm weather; but the November storms wrecked everything—piers and block ships and all small craft. A large ship was then sunk as a breakwater, and it stood fast.

A 6,000-ton ship, the *Mercédès*, was anchored close off shore. She was refilled from the *Sunic*, which travelled between Mudros and Imbros, as well as from vessels arriving from Alexandria. She pumped water through a 3-in. floating main into large steel reservoirs on the pier. From these reservoirs, water carts were filled for local supply. Wells were also dug on the island giving 30,000 gallons a day. Early in September, Major Pitcairn developed very quickly a good supply from a stream 250 ft. above, and delivered through three miles of 6, 5, and 4-in. iron pipes over very rough country. This gave more than 50,000 gallons a day and might have been developed to ten times as much had we held on. To supply Anzac and Helles a small vessel holding 200 tons of water took its supply from the *Mercédès*, ran the fifteen miles to Anzac and anchored a mile off the coast. Until August (when motor water-vessels were obtained), water lighters were towed out from the beach to the small vessel, filled from her, and discharged by hand into tanks ashore. The evacuation of Suvla and Anzac brought to Imbros some 12,000 troops and taxed the island's water supply, but the demand was satisfactorily met.

There was ample good stone and the Lancashire Works Company erected a stone crusher supplying road-metal for the beaches. A disinfectant and a bathing establishment were built for the troops arriving from the front. Captain M. R. Kennedy, Director of Public Works in the Sudan, was in charge of much of the work on Imbros. He had at his disposal an Egyptian works battalion, which was largely engaged on piers, breakwater, and water supply. They worked excellently. At Imbros, as at Mudros, huts were provided for semi-permanent services, such as A.S.C. bakeries, etc., under the A.D.W., Lieut.-Colonel Galbraith.

CHAPTER IV

HELLES DURING MAY, JUNE AND JULY

Operations, May to July—R.E. work on the beaches—Water supply and roads—R.E. work on the defences—R.E. in the offensives.

(See Sketch 1, facing page 12)

OPERATIONS, MAY TO JULY

AFTER the landing at the end of April, every effort was made to give greater depth to the beach heads and to push the Helles front forward in the general direction of the Achi Baba Ridge. The operations are described in the *Official History* as the first and second battles of Krithia. They terminated on the 8th May, and the *Official History* records that at that time "The allied line in the Helles zone extended from the Aegean coast a few hundred yards short of Y beach to a point on the Dardanelles south-west of the mouth of Kereves Dere. Measured in a straight line the total length of front was about two and three-quarter miles, of which roughly two-thirds were held by the British and the remainder by the French. The trench lines were not yet continuous and though in places they were within a few hundred yards of Turkish advanced posts, for the most part a gap of nearly half a mile separated the opposing forces."*

The Commander-in-Chief was by no means willing to accept such a stalemate situation and was determined that on the Helles front he would mount an offensive with a view to capturing the Ridge of Achi Baba. Of course reinforcements were necessary before such an offensive could be launched, and on 15th May, they began to land. By 2nd June, the line, starting at the coast of the Dardanelles, was held on the right by the French Corps which had been transferred from the Asiatic shore, where it had made a diversionary landing at Kum Kali at the end of April. On its left the line was continued by the Royal Naval Division, the 42nd Division and finally the 29th Division to the Aegean Sea.

"The battle of 4th June, officially named the Third Battle of Krithia, was the first to be fought on the peninsula under conditions

* *Official History*, Vol. II, Chap. III, p. 28.

of definite trench warfare. All along the front from shore to shore the opposing forces faced each other with continuous lines of trenches, protected in some places with wire. Here and there, in parts of the Turkish position, were strong-points, capable of all-round defence."*

On the 4th June, the attack was made, after a strong artillery preparation by guns from shore batteries and ships, by three British divisions and an Indian brigade, and simultaneously by two French divisions on their right. The centre British division—the 42nd, made a considerable advance, but owing to the other formations on right and left being unable to advance so far, some of the ground had to be given up. "By nightfall, the day's fighting had only resulted in a gain of between 250 and 500 yards on a front of about a mile. This meagre result had cost the VIII Corps 4,500 officers and men out of a total of some 16,000 actually engaged. The French losses in their fruitless morning attack amounted to 2,000."† The assault had been carried out with incredible gallantry and bloody losses, but had obviously failed.

"The Turks carried out a series of ineffective counter-attacks throughout 5th June, and on the morning of the 6th, more reinforcements having reached them, they launched a determined attack on the new British line. On the 42nd Division front the attack succeeded in some places in gaining ground, and on the front of the 88th Brigade, the whole of the awkward salient in Hız was recaptured. Confused fighting continued for some hours at the junction of the two branches of Kirte Dere; but a strong British line was finally constructed in this neighbourhood, and a second attack in the afternoon was repulsed without difficulty."‡

Several minor enterprises were carried out in June and the first week in July to improve our position preparatory to another serious assault, of which the *Official History* reports:—"The objective for the allied attack on the 12th July was the enemy's front system of trenches from the north-western bank of Kanli Dere on the left, to the Rognon defences on the right. The frontage of attack was roughly a mile of which 1,000 yards were allotted to the 52nd Division and about 700 yards to the French . . . The two days' fighting of 12th–13th July cost the Allied force very heavy casualties. But the Turkish infantry, though this was not appreciated in the British lines at the time, had again been soundly beaten and their

* *Official History*, Vol. II, Chap. IV, p. 42.

† *Ibid.*, p. 53.

‡ *Ibid.*, p. 54.

casualties, as now admitted by Turkish official reports, had exceeded 9,000."*

By 16th July, the British and the French had fought themselves to a standstill. There had been the usual gallantry with bloody losses. The fighting was very confused and though some ground had been gained, no decisive alteration in the general situation on the Helles front was made.

In July, all the troops ashore on the Helles front were formed into the VIII Corps under the command of Lieut.-General Sir Aylmer Hunter Weston (late R.E.), who had up till then been commanding the 29th Division. The R.E. units in the corps were :—

VIII Corps (Chief Engineer, Brigadier-General J. A. Gibbon) :—

29th Division	C.R.E., Lieut.-Colonel G. B. Hingston, mortally wounded on 6th June and succeeded by Lieut.-Colonel A. W. Savage, with 2nd London, 1st West Riding and 2nd Lowland Field Companies.
Royal Naval Division	C.R.E., Lieut.-Colonel A. B. Carey, with 1st, 2nd and 3rd Field Companies.
42nd Division	C.R.E., Lieut.-Colonel S. L. Tennant, with 1st and 2nd East Lancashire, later called 427th and 428th, Field Companies.
52nd (Lowland) Division	C.R.E., Lieut.-Colonel G. B. Motherwell, with 2/1st and 2/2nd Lowland Field Companies.
Corps Troops	13th Base Park Company, 254th Tunneling Company.

R.E. WORK ON THE BEACHES

(See Sketch 3, facing p. 34)

As a result of the disorganization of the Lines of Communication between Alexandria and Gallipoli, the supply of engineer stores, material and plant to the units on the peninsula was totally inadequate. The R.E. were expected to do feats of engineering without the necessary resources for the purpose, and were driven to every

* *Official History*, Vol. II, Chap. VII, pp. 100 and 111.

kind of improvisation. It would be difficult to say whether we or our comrades of the artillery had the more bitter grievance at Gallipoli. The gunners were sometimes reduced to two rounds per day per gun.*

Work on the building of piers and their repair after stormy weather went on continuously, and the results on W beach by the time of the evacuation in January, 1916, are shown on Sketch 5, facing p. 90. It should be realized, however, that it was a long time before anything approaching this fairly satisfactory layout had been achieved. It will be seen that pier No. 1 was prolonged by a break-water composed of sunken ships filled with sand by a dredger supplied by the Director of Works. Pier No. 1, in conjunction with No. 3, thus formed a small harbour, inside which pier No. 2 ran out for about 250 feet. Further south was another sheltered area, though far smaller, formed by the L-shaped No. 4 pier.

We have already mentioned the original trestle and barrel piers, erected under fire immediately after the landing on W beach. This type was continued for a few days, but by 1st May a pile and trestle jetty had been completed. The next stage was to replace the barrel raft piers by piled trestles, and, during July, to build a stone break-water and pier running out to a depth of 17 ft. of water, and also a small T-shaped pier running out to 8 ft. By the end of July, all piers then under construction were of a stronger type.

Dugouts were constructed for the shelter of personnel permanently employed on supervising beach work. A certain amount of protection from shell splinters was also given by the dumps of stores and supplies. Causeways and decauville were laid across the beaches and also laterally, four and a half miles of decauville being used eventually at Helles. The 13th Base Park Company, which landed on 15th May, carried out much of the foregoing work, and were also in charge of unloading, receipt and issue of all R.E. stores, chiefly timber, which came from Mudros or Alexandria. The unloading of boats also fell to them.

When, as we have seen, this company was transferred to Imbros,

* Of course their comrades in France were in the same condition. It was not until the battle of Loos in September, 1915, that the gunners really began to get sufficient ammunition for an offensive, and the handicap of no pre-war preparation for munitions on an adequate scale began to be removed. At Gallipoli the shortage of munitions of all kinds was further aggravated by the strangulation of the lines of communication beyond Alexandria.

and later to Mudros, they left a small detachment at Helles to continue responsibility for receipt and issue of stores.

WATER SUPPLY AND ROADS

Water Supply. We have explained the system of transport of water from Imbros to Helles, where it was either pumped ashore or landed in containers. It was, of course, the business of the R.E. to develop all sources of water they could find on shore, so as to make this laborious and uneconomical transport by sea unnecessary. At the landing, and in the early period after it, wells were sunk inland where water was reasonably plentiful, and at the beach where a large number of troops lived, a very good spring was found on 26th April under the cliff at W beach and provided some 80,000 gallons a day. A Norton tube well on the beach was found to be useless. Water was piped where possible to avoid fouling by animals. Fuel for boiling water was never available.

By 28th April a large number of small existing wells were being used in the 29th Division's forward sector. The advantage of a large number of supplies of water became clear, but necessitated a correspondingly large number of small pumps. It was a counsel of perfection when stores were so scarce. Some Norton tube wells were also in use. By the end of May, Helles was almost independent of water brought by sea, and rain in May and June kept the wells filled. The water ration was from a half to one gallon per day.

The 1st West Riding Field Company, superintended the construction by 500 infantry of an artillery road to the front, about four miles inland. The area in our possession was comparatively small and therefore road work was limited, but mule tracks had to be made over rough country, and three were cut down the side of the cliff. By the end of May there were miles of rough road to be maintained.

R.E. WORK ON THE DEFENCES

Prior to August, 1914, the infantry of the regular army had had very little training in trench warfare, and the Territorial and New Armies were perhaps even less trained before they entered into battle. R.E. units in peace time had, however, specialized on this work. In every theatre, therefore, during the opening months of a campaign, the R.E. were required to give much elementary training and assistance to infantry units, and to undertake, with their

limited numbers, work such as wiring, digging, revetment and drainage, which should have been, and later was, undertaken by the larger numbers in infantry units. The *Official History* even observes that R.E. energy was wasted in those early days by employing sappers for carrying forward material for consolidating captured trenches.*

The British soldier is notorious in history for his aversion to digging. He will cheerfully stand in a very shallow trench behind a parapet obviously not bullet-proof, and consider himself very hardly used if told to deepen the trench and thicken the parapet. Casualties and experience soon, however, taught them the construction details in trench warfare, when once shown how to do it, and up to the end of July the R.E. were much engaged in helping the infantry to acquire this necessary knowledge and experience. Commanders and staffs in all theatres of war at first had little knowledge of how best to make use of their engineer units, so that they were often needlessly frittered away. In the Helles area, however, R.E. units were legitimately employed on consolidating important keypoints in trench systems captured by the infantry. For instance, on 27th April, the 1st West Riding Field Company fortified Hill 14 which had been captured at night. Later on we read of redoubts being constructed by R.E. units within eighty yards of the Turkish trenches.

From August, 1914, up to September, 1915, the war factories had produced no satisfactory hand bombs, and the excellent Mills bomb, later produced in its millions, was not available during the first year of the war. Consequently, as early as the first battle of Ypres in France in October, 1914, field companies were required to improvise bombs from empty jam tins, filled with ammonal and with very primitive and dangerous fuses. This also occurred in Gallipoli, and a paltry output of about 250 per day in the Helles area was reached with difficulty. Had the Mills bomb been at our disposal in large quantities there can be little doubt that we could have bombed the Turks out of all their defences. Periscopes were another trench store produced in considerable quantities.

Of course, splinter-proof, and sometimes 6-in. shell-proof, shelters for many purposes, were the special task of the R.E. Much wiring in no-man's-land was also done by them, and some months elapsed before the infantry entirely relieved them of this task.

As soon as further progress on the surface of the ground became

* *Official History*, Vol. II, p. 43, footnote.

a major operation, only to be carried out after long artillery preparation, we became involved during the intervening static periods in a considerable programme of mining, as was happening in France and had happened in many previous wars. Preparation began about the middle of May, but there was a great shortage of trained men and of mining tools. On the front of the 29th Division, offensive mining began on 10th June, and this kind of warfare soon began to predominate. At first shallow galleries were run out and small charges were blown. This was followed by organized defensive mining, and in July, the 254th Tunnelling Company, R.E., was formed, mainly by transfer of miners from other units, and allotted to the VIII Corps. The Turks were now mining also, but were soon put on the defensive. Both at Helles and at Anzac, mining was under the direct orders of the General Staff, a system criticized by the D.F.W. at the War Office in his notes on the campaign. In France, on the other hand, the staff dealt only with the strategic and tactical policy of mining, but left the execution of the work entirely in the hands of the R.E.

R.E. IN THE OFFENSIVES

This may be illustrated by giving some idea of how the R.E. were employed in the third battle of Krithia, from 4th to 6th June, 1915. For the attack field companies were allotted to brigade commanders. It was not until later in the war that it became the accepted practice for a C.R.E., like any other commander, to retain a reserve under his own hand for use when the situation had become clearer. Moreover, in the 42nd Division the engineers accompanied the infantry in the assault, converted to our use captured Turkish trenches, joined in the bombing and, when the fighting became closer, suffered considerable casualties. Helping to convert captured trenches and building barricades was, of course, their proper task, but in later battles it was the accepted practice that engineers should not actually accompany the first assault waves. Officer patrols, usually including the O.C. of a company, each with an N.C.O. and a few orderlies, would follow up very close behind to make an appreciation of the best use to be made of their men, who would be moved up later. Only when a definite R.E. task was required that could be specified beforehand, would the requisite R.E. detachments accompany, or if necessary precede, the first assault wave.

On 4th June, R.E. also constructed bridges over trenches to carry guns. On 6th June, Lieut.-Colonel G. B. Hingston, C.R.E., 29th Division was unfortunately mortally wounded, and was later succeeded by Lieut.-Colonel A. W. Savage.

It was impossible between April and August to withdraw any R.E. for rest, but later in the year a few units were able to have a short period on the island of Imbros. In this respect the Gallipoli sappers were even worse off than those in France.

CHAPTER V

ANZAC DURING MAY, JUNE AND JULY

Operations, May to July—Composition of the Anzac Corps—The terrain of Anzac—Piers on the beaches—Water supply—Engineer work in the front line.

(See Map I in pocket at end)

OPERATIONS, MAY TO JULY

THE *Official History* states that "at Anzac the months of June and July were relatively uneventful. Their principal incidents were trench-digging, tunnelling and mining, a succession of brushes with the enemy wherever the opposing lines were in close touch, and demonstrations to assist the VIII Corps on the dates of the Helles battles . . . General Birdwood was to make no serious attempt to break out of his position and the enemy was to be taught to believe that the main British effort would continue to come from the south."*

The Turks on their part, had no intention of launching an attack, and except for one ill-starred attempt on the 29th June, the enemy adopted an attitude of passive defence. On the other hand, along the Anzac front, mining and countermining was on a considerably larger scale than at Helles, and was continuous from the end of May.

"It was part of the G.H.Q. plan for the third battle of Krithia, fought on 4th June, that General Birdwood's troops should make a feint attack on the morning of the battle to prevent the enemy from detaching any portion of his northern garrison to reinforce the southern zone."† Owing to the necessity for secrecy, information was not given to the Corps Commander sufficiently early to enable him to mount a serious demonstration. Only minor operations in various parts of the line could be arranged for that purpose. In order to co-operate with the attack on the 12th July on the Helles front, another demonstration was staged in the Anzac area with rifle and machine gun fire.

"Towards the end of July, though the secret of the coming

* *Official History*, Vol. II, p. 113.

† *Ibid.*, p. 118.

operations was still jealously guarded, the preparations for accommodating large numbers of reinforcements made it clear to all at Anzac that great events were at hand. Instantaneously the spirits of the troops revived and the daily number of sick grew steadily smaller."*

COMPOSITION OF THE ANZAC CORPS

The Corps consisted of the 1st Australian Division with three Australian field companies and the 2nd Australian and New Zealand (composite) Division with at first one, and later two, field companies, and a field troop. The N.Z. Field Troop landed on 13th May and took over engineer work west of the Nek. The 2nd N.Z. Field Company landed on 3rd June and started work in Monash Gully. The Australians were reinforced on about 23rd May by dismounted brigades of Light Horse. The Chief Engineer of the Anzac Corps was Brigadier-General A. C. Joly de Lotbinière, succeeded at the beginning of August by Brigadier-General Godfrey Williams. The C.R.E., 2nd Division was Lieut.-Colonel G. C. E. Elliott.

THE TERRAIN OF ANZAC

Fourteen miles north of Cape Helles the Australian and New Zealand Army Corps landed on 25th April, and after fierce fighting occupied an entrenched line, at the most some 400 feet above sea level, and dominated by heights rising at one point to 971 ft. Here less than a hundred yards away, and at one point (Quinn's Post), only fifteen, the Turks were equally strongly entrenched. These heights formed the backbone of the narrow peninsula and could we have taken them the straits and the Turkish army would have been at our mercy.

The front line was at most five furlongs from the sea. The narrow beach was under enemy observation from Gaba Tepe two miles to the south and was, in fact, searched in enfilade many times a day by a 4.2-in. battery known as "Beachy Bill," sited in an olive grove two miles to the south-east. Hardly for a moment, day or night, did the rifle fire cease, the enemy bullets passing overhead to the sea like a never-ending cricket match in which the batsmen were always scoring boundaries. The corps and divisional headquarters were dug into the narrow gullies in the steep hillsides and were thus protected. Valleys, partly under enemy observation, led up to the

* *Ibid.*, p. 123.

trenches, and along them had to be carried every day, chiefly by trains of donkeys but also by men, all the water (in sacklike panniers), rations, ammunition and other supplies for the front line. The trenches themselves, fire, support and communication, became very soon, at the hands of these big men from Australia and New Zealand, the deepest and most efficient of any theatre of war, the fire trenches averaging eight feet deep. In this work they were much helped by the easy and stable type of soil.

PIERS ON THE BEACHES

(See Sketch 3, facing this page)

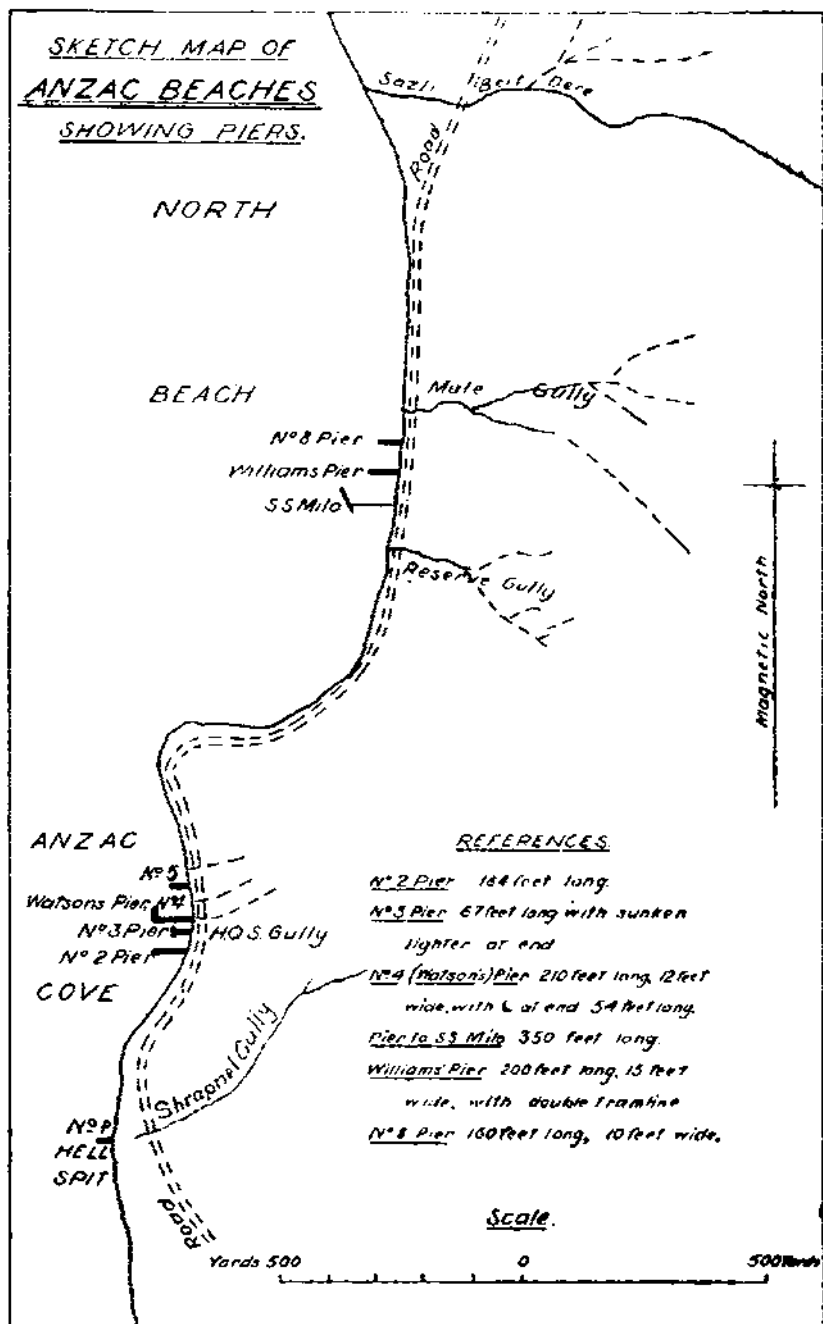
Eight piers were constructed on the beaches in the Anzac area. Working from south to north, No. 1 was at Hell Spit opposite Shrapnel Gully, and Nos. 2, 3, 4 and 5 in Anzac Cove, No. 4 being called Watson's Pier. North Beach was not included in the Anzac area until after the August offensive, so that we will refer to the three piers there in a later chapter.

As we have already seen, the Australian Engineers began to build piers immediately they landed. The first, named after Colonel Watson, an Australian signal officer was 210 ft. long and had nineteen bays supported on piles, with a depth of water at the end of twelve to thirteen feet.* It was under enemy artillery observation from Gaba Tepe, and it and its neighbour were probably the most heavily shelled piers in the history of the war. Except for Quinn's Post, there was no more dangerous spot in the Anzac area. The men working on them, whether for unloading or repair, could, after the first shell burst, take cover under high traverses of biscuit boxes erected along the centre of the piers.

On 1st June, a second and rather stronger pier on piles, No. 5, north of Watson's was begun and was completed in three weeks. For the pile driving an 8-in. unexploded Turkish shell was emptied and used as a drop hammer. Work proceeded continuously until all the five piers shown on the map had been completed. By the end of July great use was being made of them, and they were available

* The first nine bays were trestles, the remainder 20 to 24-ft. piles, 10 by 10 in., with steel shoes. Bracing, decking and other timbers were of 12 by 3 in. Outer piles were slightly battered, the centre piles vertical. Fastenings were made from $\frac{1}{2}$ to $\frac{3}{4}$ in. round and square bar iron. The pile driver was 20 ft. high. When the trestles were destroyed by storm, they were replaced by piles.

PIERS AT ANZAC



Sketch 3

for disembarking the strong reinforcements which the Anzac Corps received during late July and early August, and the large consignments of munitions and stores required for the big offensive described in the next chapter. No. 2 pier was 184 ft. long, No. 3, 67 ft. long with a sunken lighter at the end, while Watson's was provided with an L end 54 ft. long.

The piers stood up well till the storms in October and November almost broke them up. Among their worst enemies were the heavily laden lighters that were moored to them, and loosened all timbers whenever the sea was not dead calm. Occasionally lighters broke adrift in bad weather and charged about like buffaloes.

On the beach at Anzac (as dangerous a spot as the front line) were other engineer activities. The R.E. dump was at Hell Spit, in full view of Gaba Tepe (which made the drawing of stores rather unpopular), but after the advance in August, it was transferred to North Beach. A mule shelter was dug and a bomb-proof casualty clearing station on the beach.

There was a great deal of rough road or track work to be supervised both for guns and infantry. A road for guns up Monash Gully was made by 3rd May.

WATER SUPPLY

We have seen that water was brought by sea from Imbros, but, as at Helles, it was the business of the engineers to supplement and ultimately to replace this by supplies developed and distributed on shore. The following is an extract from a letter dated 24th July, 1915, from the Chief Engineer, Anzac Corps (Brigadier-General A. C. Joly de Lotbinière) to the D.F.W. :—

" We have a small vessel, 6,000 tons, holding 200 tons of water, which takes its supply from the *Mercédès* at Imbros, runs the fifteen miles from Imbros to Anzac, and anchors about a mile off the coast. Up to the present, water lighters have been towed out to this vessel, filled from her, returned to the pier and discharged by hand into tanks on shore. From these tanks, water has to be carried by mules and by hand to the troops in the fighting line. As the beach is very narrow, the congestion caused by this means of distributing water was excessive. In order to get rid of this congestion and to relieve the troops from the heavy fatigue of carrying water, I decided to place tanks in the valleys behind the firing line, connect these tanks with 3-in. pipes from the pier, and pump water direct by

steam from the pier into the tanks. I also ordered tanks for 75,000 gallons over and above the daily needs, to form a reserve in the event of our water vessel being sunk by submarine . . . The wells at Anzac for some time supplied the whole of the right flank with water, but since the dry weather set in, they are giving us less and less. Our present yield from wells is not more than 12,000 to 14,000 gallons, and our supply from lighters runs to about 18,000 gallons a day. The daily ration of water at Anzac is one gallon per head for cooking and drinking. No fresh water whatever is used for washing, and recently we have had to warn the troops against boiling their rations as this entails using a large amount of water. The supply I have just described is our permanent arrangement for the garrison of Anzac."

The wells, so rapidly developed by the Australian Engineers immediately they landed, were at first close to the sea and, though just drinkable, the water was brackish and unpleasant. It was not long before the earlier wells began to dry up and others had to be dug higher up the valley where they lasted an even shorter time. The following quotation from the *Australian History** shows how small was the ration of water for the trenches :—

"The garrison of Quinn's during this time was receiving only one-third of a gallon daily per head. At Pope's the allowance was a full water bottle (one quart). The troops in Monash Valley were approximately 4,000 strong, and at the end of May, they had been supplied with 1,800 to 2,000 gallons nightly from the beach in addition to the well water. By the end of June, when the supply from the beach to Monash Valley was stopped, the engineers had eleven wells supplying that valley and the neighbouring sectors, their depth averaging twenty-eight feet (some shafts were over fifty feet), one of them giving 750 gallons during the day, while another filled several hundred kerosene tins in a morning."

Once or twice only were these wells replenished by heavy rainfall. So early as 1st May water was dammed in Shrapnel Valley and thence piped under heavy fire to Dawkins Point, where there were two large watering places. These pipes were constantly broken by heavy transport at night. Other water was dammed and then pumped into troughs or barrels.

It became necessary, as summer drew on, to depend less and less

* Vol. II, p. 347, footnote.

on wells and more and more on a piped supply from a central reservoir, with a capacity of 49,000 gallons, on Plugge's Plateau north-west of MacLagan's ridge, and not far from the beach. Two steam pumps were erected on shore by the 2nd Australian Field Company under Captain Williams. This officer had been in charge of all water supply since the landing. They also drew water from lighters and pumped it into the reservoir. The stability of this large reservoir caused the Chief Engineer (who was struggling against a severe attack of illness) some anxiety, owing to the fact that part of the foundation was on "made" ground. This was well rammed and timbered, however, and no movement took place.

The piped system suffered from frequent trouble through breaks caused by shell fire, which were easily repaired, and also through airlocks which were a distracting source of annoyance, as they were difficult to locate, and mention must be made of an alarming situation that arose on Anzac beach at the very time when two new divisions were about to land. The trouble was twofold—pumps and water-boats. The water-ship *S.S. Moorgate* from Imbros was "lost" just when she was particularly needed to bring water for building up the reserve; and the steam pumps on the beach (two very old Worthingtons obtained from Egypt) broke down again and again for many hours at a time on these critical days. It had been decided, as we have seen, to build up at least one day's reserve of water at Anzac. The 49,000-gallon steel tank was connected up by a section of the 1st New Zealand Field Company and man-handled by 110 men to a site on Plugge's Plateau by the 24th July, and filling began on the 29th. The internal stays had been left behind and had had to be replaced with windlassed wire. Subsidiary tanks were placed along pipe lines branching north and south from the main tank, which was to be filled by the steam pump on the beach from the water motor-lighters, which, in turn, drew from the water-ship.

The 134th A.T. Company, R.E. (Captain C. J. W. Vasey, R.E.), landed at Anzac in July, and took charge of the pumps, tanks and pipes. The branch pipes had just been laid, and the 134th Company had laid two rising mains, separated by twenty yards to avoid both being wrecked by one shell. Airlocks on the branches were plentiful owing to the hasty laying, and one took more than a day to put right. The chief trouble, however, was the boiler, whose injector would not work, and gave only a small head of steam. These old pumps gave the Corps Commander more anxiety than anything

else, until replaced several weeks later by a much better one obtained from the navy. Spare fittings were very scarce and had to be improvised.

Everyone at Anzac at that time knew the so-called "Greek" boat, obtained from Alexandria and manned by Maltese. Her function was to fetch water from the water-ship, lie at the pier and pump it ashore. The pier was distinctly unhealthy and it is not surprising that on one occasion, when the boat's military guard was by chance away, and the 4.2-in. battery "Beachy Bill" was doing its worst, the Greek boat loosed her moorings and fled for safety to the hospital ship, whence she had to be brought back "under arrest" by an armed pinnace! In revenge, she proceeded to burst her canvas pipe, which also received a charge of shrapnel, so she was able to withdraw to Imbros for repairs, much to the delight of her crew. Some weeks later a shell exploded in her engine room and she became a wreck. It may be added that one of the "Beetles" (flat-bottomed bullet-proof lighters, with engines capable of giving five knots, brought from England for the Suvla landing), fitted with pumps and tanks, met all these water needs a few weeks later.

The most critical days for water supply followed. On 29th July, when pumping to the reserves began, the pump broke down and the water to the troops had to be carried by fatigue parties amounting to thousands of men. The pump then worked very intermittently, and on 1st August, a serious situation became critical, for no water lighter arrived. Sir William Birdwood had to telegraph G.H.Q. that without water lighters, not only would he have to stop the new brigades from disembarking, but he would even have to begin sending troops away. The errant lighter was found just in time, but pumping was often interrupted by shell fire. The *Australian Official History** says, "Though the water supply continued to be the main anxiety of the 'Q' Branch, nevertheless, only once did the shortage seriously affect the operations." (i.e., at the beginning of August.)

ENGINEER WORK IN THE FRONT LINE

Trench warfare at Anzac was immensely interesting to the sapper. A vast tunnelling system soon developed and was the main occupation of the troops for the whole campaign. Anzac provided a classic ground for developing the art of sapping and mining, as the conditions were very suitable, the opposing lines were close,

* Vol. II, p. 450.

the soil was easy to work, and yet needed no timber except at the openings; the men were physically splendid and artillery fire was not (till late November), sufficiently heavy to make it necessary for the galleries to be deep. Indeed, the Anzac engineers developed an original technique whereby they ran their tunnels forward about two feet below the surface and joined the heads of the tunnels by T-ing out right and left. On a given day, they took off "the lid" and thus obtained a fire position perhaps with complete surprise, and only half as far from the Turks. The method proved dangerous when, later in the year, the Turks were provided with heavy artillery, and many men were buried in the shallow tunnels.

That was the theory and in part the practice, but time was needed. The Turks were by no means idle, and this surface tunnelling was rarely completed as planned. On 19th July part of an underground trench, originally intended as a fire trench, was opened, but was used as an obstacle or trap, the recesses being filled with barbed wire and the roof above them scraped so thin that an enemy would fall through and be killed by sentries below. In another part of the line a high entanglement was put in the trench the night it was "unlidded." By the end of May, tunnelling and mining, both defensive and offensive, took up the greater part of the energies of everyone, including the General Staff who, for want of any scope for normal tactical developments above ground, naturally (if perhaps unsoundly) took a leading part in developing these schemes.

The first record of tunnelling was at Quinn's Post, where the 1st Australian and the A. & N.Z. Divisions met at the head of Monash Gully. This post was but a few yards in front of a very steep hillside, and if the enemy could blow it up they could take our whole position in enfilade. Accordingly, the New Zealand Engineers on about 9th May drove in from the slope in rear three listening tunnels twelve or fifteen feet deep. Mr. C. E. W. Bean, Historian of the *Official History of Australia in the War*, significantly says* that "in the long run more was effected at Quinn's by entrenching than by all the bloody local assaults undertaken from that post." Sorties seem to have effected little or nothing. Retaliation by bombing followed any activity and the New Zealand sappers were hard put to it to provide material for overhead cover. Only small charges could be used in mines at Quinn's, otherwise the whole position would have been dangerously shaken.

* Vol. II, *The Story of Anzac*, p. 126.

Enemy mining was first heard on 17th May by an old Australian ganger. His officers were sceptical about it but he was right. The Turks blew their mine on the 23rd before the Australians could sufficiently advance their counter-mine. It was on 29th May that the Turks made their great coup and blew up half of Quinn's Post, and seized its ruins, whence they were able to throw and roll bombs on to the Australian supports below. After the most desperate struggle since the landing, involving the death of Major Quinn himself and many others, the defenders, however, regained their famous post. Had this fight ended differently, the whole Anzac position would have become untenable. Two days later, two New Zealand Engineers crawled out from Quinn's in face of continuous rifle fire and bombs. They carried 12 lb. of gun-cotton and electric and time firing apparatus, and fastened the charge to a timber blockhouse in a mine crater twenty feet from our trench, and fired it. The blockhouse and its garrison were entirely demolished, but here, as so often, it was easier to deny a site to the enemy than to occupy it ourselves.

Much has been said about Quinn's Post, as it was the deadliest spot on the peninsula. The corner known as "The Race Course" was the worst in Quinn's, and was for a time abandoned owing to a Turkish bombing, but the 2nd N.Z. Field Company recovered it. It was not unusual for two or three mines a day to be fired there, but all along the front from Quinn's southward, to where the line turned back to the coast, the situation was somewhat similar. Driving tunnels forward, listening, laying, tamping and blowing mines were the normal work of the front line. Twelve to twenty tunnels in the 1st Australian Divisional front were generally in progress simultaneously. Raids above ground were almost unknown. The results of mines were usually craters but they rarely helped either side to take ground. The size of charges increased to 100 lb. and even more.

Wiring was difficult with the lines so close together. The 2nd Australian Field Company found the best method was to coil wire into 12-ft. lengths and to throw them out over the parapet, making an effective entanglement among brushwood. The New Zealand Engineers favoured *chevaux de frise* ("Knife rests").

Machine-gun positions, artillery gun-pits and communications had to be executed or supervised by the R.E. Parts of Monash Gully leading up to the fire trenches on the heights came under enemy view and had to be traversed or blinded with sacking on wire. Crossings over the communication trenches were made for guns.

A very important part of the engineer work in the early days on the peninsula was bomb making, as no ready-made bombs had been sent out from home. The output of jam-tin bombs, with no more than two or three men at the work, reached 200 a day. The manufacture of periscopes and periscopic rifles was also begun early in May, the former at 3,000 a day. The glass for them was obtained by the Chief Engineer mainly from the mirrors of sea transports. The periscopic rifle, devised by Lance-Corporal Beech, Australian Engineers, was found very accurate up to 200 or 300 yards, and, largely with its help, the Australian snipers dominated the Turks throughout the campaign.

To illustrate the disastrous effects of disease (mostly of a dysentery kind) on the strength of units, it may be mentioned that on 30th June, the working strengths of the three Australian Field Companies were 33, 9 and 25 respectively!

CHAPTER VI

THE COMBINED OFFENSIVE AND THE LANDING AT SUVLA

Decision to reinforce Gallipoli—Inexperienced divisions—Disposal of reinforcements on arrival—Plan for the co-ordinated offensive—Holding attacks at Helles—The Anzac offensive on 6th and 7th August—Fighting at Anzac on 8th and 9th August.

(See Map 1 in pocket at end)

DECISION TO REINFORCE GALLIPOLI

By 6th June a stalemate condition had been reached, which could only be broken by strong reinforcements—an appreciation of the situation that was confirmed by the operations ending on 13th July. The questions arose, first, could such reinforcements be supplied, and second, how and where should they be used? An entirely new strategic conception appeared to be necessary, and became the subject of a study by the Commander-in-Chief and his staff, in consultation with the Admiral and his staff, and by the War Office, Admiralty and Cabinet at home. The reader is referred to the *Official History** for a full explanation of the various courses that were considered and how the final decision was reached on 5th July to send five divisions to Sir Ian Hamilton. Of these, the 53rd and 54th were Territorial and the 10th, 11th and 13th were New Army divisions.

INEXPERIENCED DIVISIONS

It must be remembered that the rapid expansion of the British Army to a total of seventy divisions had produced many problems, in particular that of the provision of officers and N.C.Os. to train and command in battle, and provide headquarter staffs. The result was that all commanders, from corps to company, all N.C.Os. from Sergeant-Major to Lance-Corporal and all staff officers were holding posts in which they had had no battle experience. Moreover only a very small proportion of the officers and N.C.Os., and practically none of the privates, had yet taken any part in fighting in the current war.

* Vol. II, pp. 56-63.

It was found in Gallipoli and also in France that all such rapidly created and trained formations required some preliminary initiation into war conditions before they could be expected to be really battle-worthy. There was never any lack of gallantry, but there was a lack of battle and administrative experience and of staff work, which prevented them from operating in strange circumstances in a proper state of health and efficiency. They had to learn how and when to sleep; how and when to feed or obtain water. It was this "know how" that was missing. The 10th, 11th and 13th Divisions were absolutely the first New Army divisions to enter battle, and had less than a year's experience of army life. In the following month, in France, the inexperienced 15th, 23rd and 24th Divisions entered the Battle of Loos, and it was this lack of "know how," that caused the 23rd and 24th Divisions to be exhausted before they even came under fire. These facts must be remembered when studying the landing at Suvla Bay and the subsequent operations.

DISPOSAL OF REINFORCEMENTS ON ARRIVAL

Six battalions of the 10th Division were sent to Mitylene harbour and the rest of the 10th Division to Mudros. The 33rd Brigade of the 11th Division were temporarily disembarked at Helles, where they did obtain some preliminary battle experience. The rest of the 11th Division troop-ships were distributed between Mudros and Imbros. The 13th Division, the 19th Indian Brigade and a New Zealand Brigade were put ashore on successive nights in the Anzac area and hidden among the ravines. The dismounted Australian Light Horse Brigade was also landed in the Anzac area and put into the front line. All units on the peninsula, both British and Australian, received strong drafts to bring them up to strength.

We must also note the arrival at Imbros in late July of a very efficient and well equipped specialist unit, known as the Royal Australian Naval Bridging Train (R.A.N.B.T.), recruited from stevedores and dockers in Sydney. This unit arrived in its own vessels, loaded with excellent bridging and pier-building equipment and started practice at once in unloading. Its very useful activities during operations will be described later.

The diary of the C.R.E., 11th Division states that they had been given fifty pontoons, eight trestles and thirty-eight barrel piers, all with superstructure, and that they had persistently asked the navy at Imbros to practise towing pontoons, but this was not done.

PLAN FOR THE CO-ORDINATED OFFENSIVE

On the afternoon of 6th August, holding attacks were to begin on the Helles front and to continue next day in order to pin down the Turkish reserves and to prevent them from reinforcing either the Anzac or Suvla areas.

The Anzac Corps, now reinforced to a strength of about three divisions, was not only to carry out an offensive from its existing front to capture Gun Ridge, but was also to break out on the night of 6th/7th August from its northern boundary to surprise and wipe out the Turkish troops manning the defences on the coastal route. Two assaulting columns were then to march that same night through the gap as far as Chailak Dere and Argyll Dere, respectively, up which they were to climb to assembly points on the hills. At dawn, the two columns were to attack Chunuk Bair and Hill 971. This enveloping attack against the northern prolongation of the watershed ridge would thus coincide with the attack made from the main Anzac front. With the whole watershed ridge in our hands, further exploitation might cut the communications of the Turks on the peninsula, and would thus facilitate an advance on the Helles front. Moreover, this attack on the left would greatly assist the advance of the right of the IX Corps, which on the night of the 6th/7th August was to make a surprise landing in Suvla Bay, to effect a junction with the left of the Anzac Corps on the watershed ridge and complete the destruction of the Turkish army.

Success on either the Anzac or the Suvla front alone, would probably cause a complete defeat of the enemy, but, together and co-ordinated, the result should be overwhelming.

Such then was the scheme for this great offensive. For a description of its execution, and for an explanation of the unfortunate causes of its failure, the reader is referred to the *Official History*, but it is necessary here to give a very condensed outline of the operations in order to describe the framework in which the engineers had to carry out their part.

HOLDING ATTACKS AT HELLES

The VIII Corps was only required to make holding attacks on the 6th and 7th August, to pin down the Turks and to prevent them from moving reinforcements to the Anzac and Suvla fronts.

The *Official History** states that "The initial attack was to be a small operation to flatten out the Turkish salient where Krithia Nullah joined Kirte Dere. This entailed the capture of a network of trenches and strong-points on a frontage of approximately a mile."

The attack was made by the 125th and 127th Brigades of the 42nd Division, on the right, and by the 88th Brigade of the 29th Division on the left. "Within a few seconds of the opening of the British bombardment it was answered by heavy and sustained fire from the enemy's batteries." "The strength of the Turkish defensive organization had been gravely miscalculated, and a few minutes after zero hour the 88th Brigade had been shattered." The casualties of this brigade amounted to nearly 2,000 out of the 3,000 engaged. It was long before this grave situation was realized at Divisional Headquarters, but it was appreciated in time to prevent the night operations which had been contemplated and now found to be impracticable.

The 42nd Division attacked next morning on a front of 800 yards, again with disappointing results. "In less than twenty-four hours, in a limited attack on a front of one mile, three brigades of the VIII Corps had lost nearly 3,500 of the 4,000 officers and men which an earlier calculation had laid down as the maximum that the whole corps could afford to lose in a series of operations to help the main offensive."† It should also be noted that Liman von Sanders had in fact moved his reserves on the Helles front to reinforce his front at Anzac. "Orders were issued that the Helles garrison was to undertake no more offensive operations till the march of events in the north had automatically weakened the Turkish southern line."‡

THE ANZAC OFFENSIVE ON 6TH AND 7TH AUGUST

It is necessary to form a general mental picture of the ground over which the commanders and staffs of the Anzac Corps were required to manœuvre three divisions, mostly at night, in order to deliver their co-ordinated attack.

From the beaches the ground rose very steeply to a height of about 1,000 feet, and the rocky scrub-covered hills were intersected by intricate and often precipitous boulder-strewn ravines. In the whole of the manœuvre area there were no tracks, except those made

* *Official History*, Vol. II. pp. 168, 171 and 172.

† *Ibid.*, p. 176.

‡ *Ibid.*, p. 177.

by goats or the feet of Turkish soldiers, tracks that were rocky, steep and meaningless. It was country suitable for mountaineers in daylight, but far too difficult for the manœuvring and co-ordination of long columns of men and mules during the short hours of darkness.

The two columns organized to carry out the operation on the northern flank each had a covering force to clear the way for the main body. These right and left covering forces contained the N.Z. Field Troop and half the 72nd Field Company R.E., while the 1st and 2nd N.Z. Field Companies and the remainder of the 72nd Company were with the main bodies.

Soon after dark on 6th August the leading troops started from the left of the Anzac front, and after fierce fighting they captured the enemy defences on the coastal road, thus clearing the way to the assembly positions. The main columns were, however, many hours late in reaching these positions and failed to capture either Chunuk Bair or H. 971.

Although the failure of the assaulting columns was known at Anzac Headquarters, it was considered that a renewed advance would be facilitated by adhering to the orders for the attacks at dawn on the main front, although it was realized that this would be a desperate venture. The dash and outstanding gallantry displayed in these attacks by the Australian Light Horse Brigade and other units is brilliantly described in the *Official History*, but is painful reading, as the losses were terrific.* The attacks on Chunuk Bair and H. 971 had not yet even materialized although there were at that time no Turks to oppose them. At 10.30 a.m. on 7th August the attack was made on Chunuk Bair, but the enemy had by then manned his positions and the assault was defeated with heavy losses.

FIGHTING AT ANZAC ON 8TH AND 9TH AUGUST

It was not until dawn on 8th August that two companies of the Wellington Battalion, N.Z. Brigade reached the much coveted ridge of Chunuk Bair, with small parties of the 7th Gloucestershire Regiment on their left, and of the 8th Welch on their right.

Those who thus reached the ridge now looked down upon the Dardanelles and obtained a fine view in rear of the Turkish positions, but daylight also revealed Turkish troops strongly entrenched on

* 650 out of 1,250 of this gallant brigade were killed or wounded, mostly killed.

their right. All day long the holders of Chunuk Bair, only hastily entrenched in rocky ground, suffered very severe casualties from Turkish cross fire, while defeating frequent counter-attacks. At night on 8th August, the few survivors were relieved by parties of the Otago Battalion and Wellington Mounted Rifles.

At 5.15 a.m. on 9th August, the 1/6th Gurkhas and a detachment of 6th South Lanes, made an isolated attack upon the summit of Hill Q. After a stiff bayonet fight, the ridge was captured but unfortunately could not be held.

The *Official History* explains the desperate efforts made by commanders, staffs and units to assemble and deliver a co-ordinated attack on the whole stretch of the watershed ridge, a length of just under three miles, but the historian is compelled to comment—“ It is now clear that by midday on 9th August, the Anzac offensive had failed. Officers and men alike had given of their best. But the New Zealand and Australian units were physically unfit at that time for any prolonged strain. The New Army troops though well trained, were lacking in necessary experience, and the steep and confusing hillsides, the unaccustomed heat and the torture of thirst, had combined to form a greater obstacle than the opposition of the enemy.”*

* *Official History*, Vol. II, p. 222.

CHAPTER VII

LANDING OF THE IX CORPS AT SUVLA

Turkish defensive dispositions—Plan for the landing—Landing of 11th Division on 6th August—Landing of 10th Division on 7th August—Race for the hills at dawn on 9th August—Events on 9th August.

(See Map I in pocket at end)

TURKISH DEFENSIVE DISPOSITIONS

BEFORE describing the British landing at Suvla we will consider the arrangements made by the enemy to defend that piece of coast. The garrison, known as the "Anafarta Detachment," under a Bavarian officer named Major Willmer, held a front of about thirteen miles—from Azmak Dere to Ejelmer Bay. It consisted of four (reduced on 6th August to three) battalions, one pioneer company and one squadron of cavalry, with no machine-guns or barbed wire. Their artillery consisted of two field batteries and a few antiquated and mountain guns—a total of nineteen pieces.

Major Willmer did not expect a landing at Ejelmer Bay and concentrated on preventing troops once ashore at Suvla from gaining the Anafarta ridge before he could be reinforced from Bulair, which would take at least thirty-six hours. He put three battalions in the forward area with a few mountain guns, and his fourth battalion and the two batteries in a chain of posts from Baka Baba to W. Hills, astride the Suvla-Anafarta Sagir track. Strong-points, each for about three companies, were constructed on the Kiretch Tepe ridge and Hill 10, with a third on Chocolate and Green Hills. These were well camouflaged and protected by trip-wires (not barbed) and a few mines. The forward troops were instructed to avoid being cut off, and to withdraw if necessary to the main position.

We must remember that this information was not known to the attacking troops or to their commanders.

PLAN FOR THE LANDING

The plan for the landing of the IX Corps, under Lieut.-General Sir Frederick Stopford, was for the 11th Division to land in the

Suvla area on the night of 6th/7th August, and to be followed by the 10th Division next day, no artillery, vehicles, animals or heavy stores being put ashore till after the 10th Division dismounted troops. The original intention had been to ensure the capture of Chocolate and W. Hills by dawn and to press on quickly to Biyuk Anafarta, but these objectives and their timings were not very clearly laid down in the orders.

The shipping programme was complicated, as troops had to be moved from Mudros, Imbros and Mitylene (and even some from Helles) and landed with great secrecy at Anzac, to be followed by the assault landing of the two divisions at Suvla. The inadequacy of the facilities at Mudros was severely felt but was overcome in part by the provision of many more small cargo ships and craft. All went well, however, until the divisions reached the assembly area off Suvla, the 11th by dark on 6th August and the 10th by dawn next morning.

The ships were to be protected by an anti-submarine net across the bay, and it was expected that the troops landed during the night would have cleared the hills sufficiently by daybreak to give immunity from the Turkish guns.

From right to left, the beaches were lettered C and B, between Azmak Dere and Nibrunesi Point, and A in Suvla Bay, the last named being used contrary to naval advice. The 32nd and 33rd Brigades were to land at B and, if necessary, C beaches, followed later that night by the 34th Brigade on A beach, which was to become from then onwards the main landing place, and was to have piers constructed by the R.A.N.B.T. and the R.E. and arrangements made for the reception of water.

LANDING OF 11TH DIVISION ON 6TH AUGUST

"It was just after 9.30 p.m. when, in pitch darkness, the destroyers and lighters carrying the 32nd and 33rd Brigades and 11th Division Headquarters to B beach swung into line abreast and felt their way to shore."* Their landing was unopposed, but soon after 10 p.m. a red flare had shot up from the direction of Lala Baba showing that the enemy knew what was afoot. Before 11 p.m. the 32nd Brigade had taken Lala Baba, but with severe casualties.

It was 9.30 p.m. when the 34th Brigade entered Suvla Bay in its three destroyers towing lighters to attempt a landing on A beach

* *Official History*, Vol. II, p. 235.

—a landing that was to be completely disorganized and delayed by the reefs and shoals encountered in the bay and by Turkish artillery and rifle fire. Lighters grounded sometimes as much as 1,000 yards from land, and the troops waded ashore, but not at the points they had expected. The confusion was intense, but the units did eventually manage to sort themselves out, many hours too late, however, to carry out efficiently their intended roles.

One of the first battalions to overcome the difficulties of the landing was the 11th Manchesters, who were directed towards Kiretch Tepe ridge. Throughout the night, in face of ever-increasing resistance, they continued to advance towards the strong-point on the summit but at dawn were halted by fire about 800 yards to the west of it.

At 9 a.m. on 7th August the situation was as follows. On the left the Manchesters were here held up on Kiretch Tepe, from the lower slopes of which various units connected up with the 32nd Brigade on Hill 10 and Lala Baba, both in our possession. The 33rd Brigade had advanced from B beach but was waiting for orders to go on. The 34th Brigade had some fairly complete units in reserve, but there was a large and disorganized mass of men near A beach. No artillery, vehicles or animals had yet been landed. The three field companies were ashore, one working on A beach, but the others being held in reserve.

Meanwhile three Turkish battalions had left Bulair at 5.30 a.m. on their long march to reinforce Major Willmer, to be followed during the morning by two Turkish divisions.

LANDING OF 10TH DIVISION ON 7TH AUGUST

When the ships carrying the 10th Division arrived at daybreak on 7th August the leading units were diverted from A beach, and disembarked on B beach, where they came under the 11th Division. Later in the morning, however, it was found possible to land north of Suvla Bay, and this is where 10th Division Headquarters, three battalions and the field companies were put ashore. The division was thus split up and also in confusion.

The impracticability of A beach had completely disorganized the naval programme, as many lighters and other craft scheduled for subsequent use had been lost or seriously delayed. Moreover, trouble was being experienced at Mudros with the loading of guns and wagons, and it was now obviously impossible to land the corps and

divisional artilleries and more than a few of the stores during 7th August. The programme for the landing of sea-borne water was also seriously in arrears.

Units of the IX Corps, from companies upwards, and even Corps Headquarters itself, were extraordinarily lax in the rendering of situation reports. The Commander of the 11th Division was particularly badly served in this way, with the result that a series of orders and counter-orders was issued, and disorder resulted. Although adequate signal arrangements with Imbros existed, it was not till noon that G.H.Q. learnt the situation at 7.30 a.m., and although this message was somewhat disturbing they were virtually in ignorance throughout the 7th of the chaos at Suvla. They were, of course, fully occupied with the reports from Helles and Anzac. The IX Corps Commander was still in his headquarter ship, and was finding difficulty in taking control of his troops on shore.

During the day the confusion became more serious and the non-arrival of the water-ships made matters worse. As the day became hotter the confused mass of men became completely exhausted and mad with thirst.

The Commander and Staff of the 11th Division failed to clear up the situation in time to make a co-ordinated attack during daylight but an assault on Chocolate and Green Hills was launched at about 7 p.m. and they were in our hands by midnight. No plans had been made, however, for the capture of the important W. Hills or Tekke Tepe ridge.

The disappointing results of the first day's fighting are summed up in the *Official History** in these words:—"It will be seen therefore, that throughout the first twenty-four hours at Suvla, the only progress made by the IX Corps had been the capture of the Turkish outposts on the two horns of the bay, and the two strong-points on Hill 10 and the Chocolate Hills. On the Kiretch Tepe ridge the line had not been advanced beyond the position reached by the 11th Manchesters, and here the enemy's strong-point had not been definitely located. All the encircling hills which it had been hoped to reach by dawn on the 7th were still in Turkish possession; and twenty-four of the thirty-six hours which the Turks probably needed to bring their reserves from Bulair had already slipped away. More than half of General Stopford's force of twenty-two battalions had not yet been seriously engaged with the enemy. Nevertheless, the losses of the IX Corps in their first twenty-four hours ashore had

* Vol. II, p. 261.

amounted to roughly 100 officers and 1,600 men, or rather more than the total strength of the Turks arrayed against them."

RACE FOR THE HILLS AT DAWN ON 9TH AUGUST

Various events during the 8th August caused the British Commanders to refrain from launching an attack with all the infantry of the 11th and 10th Divisions against the three battalions and nineteen guns of Willmer's Detachment. Willmer had withdrawn to his main position, with the exception of the three companies still in the Kiretch Tepe strong-point, and consequently all the other hills dominating the Suvla plain were unoccupied.

It was not until 3.30 a.m. on the 9th August that three battalions of the 32nd Brigade were assembling to advance towards Tekke Tepe ridge. At that moment the leading wave of three Turkish battalions reached the summit of the ridge towards which the British were advancing, but from which they were still two miles away. The Turkish reinforcements from Bulair had won the race to Tekke Tepe ridge to which the Commander of the IX British Corps had referred as being "vital to the security of the Suvla Bay." When the Turkish Divisions left Bulair, thirty-five miles away, the 10th and 11th British Divisions were within two to four miles of these vital hills, manned by only three Turkish battalions and nineteen guns—hills which were to give victory in the Gallipoli campaign not to the British troops, but to the Turks.

EVENTS ON 9TH AUGUST

At 3.30 a.m. on 9th August the 32nd Brigade was assembling to advance and seize the Tekke Tepe ridge. Lieut.-Colonel Moore, and his 6th East Yorkshire Pioneer Battalion, were with this brigade. He, fully appreciating the importance of time, did not wait for the whole of his battalion, but advanced at 3.30 a.m. with one company. Major F. W. Brunner, R.E., also appreciating the urgency, took two sections of his 67th Field Company and advanced alongside the Pioneers. It was when dawn was breaking on the 9th August that this tiny advanced guard, climbing up the western slope of Tekke Tepe ridge, ran straight into the leading Turkish battalions coming down the slope to attack the British. Lieut.-Colonel Moore and Major Brunner, greatly outnumbered as they were, attempted to make a fighting retreat with their small units which incurred

many casualties, including Colonel Moore and Major Brunner killed. Only a remnant rejoined the 6th East Yorkshire Pioneer Battalion, which was leading the advance of the 32nd Brigade, but also had to retreat. It was now daylight, and the Turkish infantry were well supported by their artillery, but there was no artillery for the 32nd Brigade, who had no choice but to take up a defensive position further back on the Suvla plain.

Meanwhile the 33rd Brigade had started to move towards W. Hills, but found that the Turks now occupied Scimitar Hill, fighting for which continued all day and ended disappointingly.

During the morning of 9th August the 53rd (Welsh) Division was landed, but became split up in reinforcing various parts of the line.

An attack by the 131st Brigade to try to take Kiretch Tepe was no more successful than the others.

Conditions had by now become chaotic. The infantry was without artillery support, the supply of ammunition, rations and particularly of water had broken down; there was no transport and the men were exhausted, dispirited and mad with thirst.

An attack was however arranged to be carried out by the 53rd Division assisted by the 11th Division on 10th August. It was a complete failure and it was decided to spend 11th August in reorganization.

The Suvla landing had completely failed to achieve its object and even at Anzac the 10th August saw the loss of the hard-won position on Chunuk Bair. The total British casualties on the three fronts amounted to 25,000.

CHAPTER VIII

R.E. IN THE OPERATIONS OF 6TH TO 10TH AUGUST

R.E. in the attacks at Helles—R.E. in the Anzac operations—R.E. in the fighting at Suvla—Piers at Suvla—Water supply at Suvla—Development of local water supplies.

R.E. IN THE ATTACKS AT HELLES

IN the preparations for the holding attacks at Helles the R.E. were employed upon the usual front line tasks required before any offensive launched in trench warfare. Such preparations have been fully described in other chapters dealing with fighting in France and elsewhere, and need not be repeated here.

The assaults launched by the 29th Division on 6th August and by the 42nd Division next day resulted in but small gains, and it was only on these short lengths of front that the engineers were required to help with consolidation and with new communications across no-man's-land.

R.E. IN THE ANZAC OPERATIONS

From 6th August onwards, the 71st Field Company were employed in mining at Russell's top, for which they were highly commended by the divisional commander.

Major A. J. Wolff with two sections of the 72nd Field Company which, as we have seen, were with the left covering force, helped to dig rifle pits at the front and subsequently worked on communications from the beach to the front line at the head of Chailak Dere, where we were struggling for the heights on Chunuk Bair. There was only one route from front to rear, and the half company worked hard to make it safe for troops, stretcher bearers and pack mules. The other two sections of the 72nd Company were in the thick of the fighting from 7th to 10th August.

On the 10th, Lieutenant Bradstreet, R.E., was sent forward by the Brigade Commander to rally infantry parties which had just lost their officers, and had been driven back from "The Farm." He succeeded in this, though wounded, and was recommended for

special promotion, but was killed while wiring in front of the line on 7th December.

On 8th August, the C.R.E., 13th Division, Lieut.-Colonel G. D. Close was wounded and was succeeded by Major A. J. Wolff.

The 1st and 2nd New Zealand Field Companies were with the right and left attacking columns. Their work was finding water and clearing tracks, and they were also used as infantry. The New Zealand Field Troop with the right covering force worked on front line defences at old No. 3 Post, then at the Apex, and later in August, on Rhododendron Spur. The 1st New Zealand Field Company moved up on 7th August to Chailak Dere at the foot of Chunuk Bair to consolidate new ground taken.

The New Zealand Engineers did very useful work on an engine for the pump of the old Turkish well at No. 2 Post, which successfully supplied two divisions. When the overworked engine broke down, the sappers filed up new bearings out of abandoned service pumps, broke off the burnt cylinder rings and replaced them with new rings made from a Turkish 4.5-in. shell, using only a hack saw.

For the columns on the left, water was at first supplied from a lighter on the beach, but on 8th August an excellent well was found in the newly gained ground, and a petrol pump was at once sent to serve it. New wells also were dug, the first being ready by dawn on 11th August.

The R.E. kept a pier under repair on North Beach for evacuating the wounded.

R.E. IN THE FIGHTING AT SUVLA

The R.E. units and their dates of landing at Suvla were :—

IX Corps, Chief Engineer Brigadier-General A. C. Painter, who was evacuated by hospital ship on the 9th and succeeded by Brigadier-General E. H. Bland.

11th Division, 6th August	C.R.E., Lieut.-Colonel E. H. Bland, succeeded on 9th August by Lieut.-Colonel F. A. K. White with 67th, 68th and 86th Field Companies.
10th Division, 7th August	C.R.E., Lieut.-Colonel F. K. Fair, with 65th, 66th and 85th Field Companies.
53rd (Welsh) Division, 9th/11th August	C.R.E., Lieut.-Colonel T. C. Skinner, with 1st Welsh, 2/1st and 2/2nd Cheshire Field Companies.

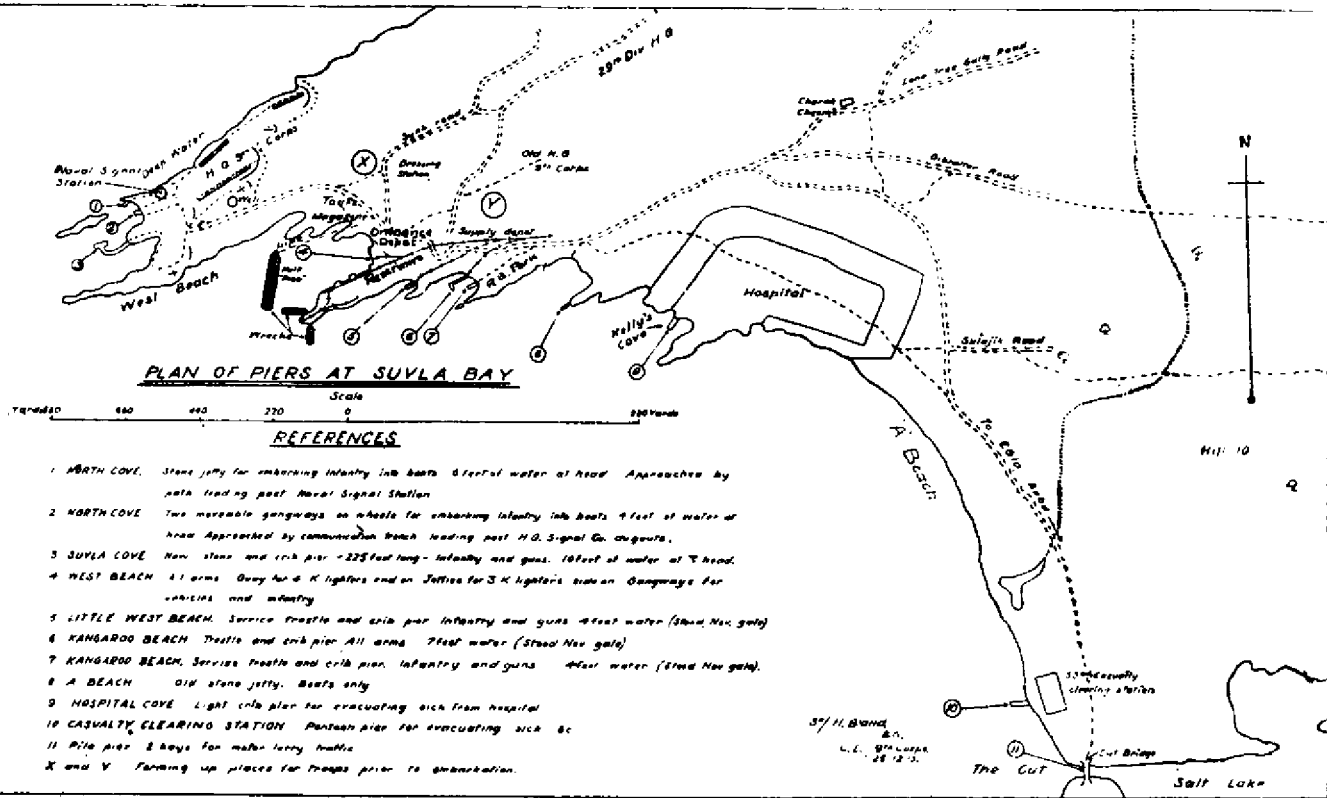
The field companies of the 11th Division at the landing and during the next few days were intended to work with their brigades, but as the brigades failed to advance, the companies at first remained near the beach. The 10th Divisional R.E. began to land at Suvla Bay at dawn on the 7th. The 66th Company with the 30th Brigade pushed forward that day up the Kiretch Tepe ridge on the left. The 65th Company marched next morning to strengthen the position gained on the Karakol Dagh. Improvised stretchers were used to carry R.E. Stores. For the next four days, the companies helped to strengthen the position, which extended from the sea, north of Kiretch Tepe, to south of Chocolate Hill. They improved tracks and the inadequate water supply, built sangars under close hostile rifle fire, and were frequently employed as infantry. The 85th Company dug a well on 8th August below the ridge to the south of Kiretch Tepe, and on the 9th, the 85th and 66th Companies formed part of a general reserve to an attack on the left, and were used to hold parts of the ground so gained. The 65th Company built shelters for Corps Headquarters and constructed a support line. On the 11th Lieutenant Waller and two sappers directed an infantry bombing party on Jephson's Post, which was captured. This post was approximately the high water mark of our attack on the Kiretch Tepe ridge.

No account of the landings at Suvla gives a true picture if it omits reference to the prevalence among these young troops of dysentery. To be thrown into battle for the first time on an unknown desert shore was a fierce enough ordeal for the vanguard of Kitchener's New Army. Yet these men were called upon to march, fight and work under a blazing sun on a pint of water a day and often in the clutches of a weakening disease. These were officers and men of whom our Corps may well be proud.

PIERS AT SUVLA

(See Sketch 4, on opposite page)

Eleven piers were ultimately constructed on the Suvla coast. Of these Nos. 1, 2 and 3 were sited on the open sea beaches outside and just to the north of Suvla Bay. Nos. 4 to 9 formed a group inside the bay on its northern and rather more sheltered shore. No. 10 was on the original A beach, just north of the Cut. The eleventh, called South Pier, was two miles to the south and just inside the



southern end of Suvla Bay. Only two of these piers, Nos. 5 and 6, were constructed during the first three days of the landing.

Brigadier-General A. C. Painter, Chief Engineer, IX Corps, was fully aware that he must give first priority to the construction of piers and to the delivery by lighters of sea-borne water at or near the piers. The actual site of the piers was to be chosen in consultation between the C.E. and the Principal Military Landing Officer. The main landing place for the corps was planned to be at A beach, inside Suvla Bay, and accordingly it was there that the C.E. disembarked on the morning of the 7th August. The 68th Field Company (Major F. A. K. White), of 11th Division, was ordered to report to him for work on piers and water supply, and the R.A.N.B.T. for work on piers.

It was a long time before there was any communication between the C.E. and Corps Headquarters, and consequently, throughout 7th August, he was not informed that at 6 a.m. it had been decided to abandon A beach, and to substitute for it a new beach north of Suvla Bay. The 68th Company kept their rendezvous with the C.E., but the R.A.N.B.T. was landed at the north of the bay and out of touch with him.

By 9th August two piers were in working order at the north of Suvla Bay, one of steel lighters with barrel-pier gangways and the other of pontoons. Their construction, much delayed by the change in site, had been largely the work of the very efficient R.A.N.B.T., who later built most of the other Suvla piers.

WATER SUPPLY AT SUVLA

There is no doubt that the failure of the XI Corps to gain their objectives on the Suvla hills was due in no small part to the exhaustion of the troops by acute thirst owing to the failure of the initial water supply. It is, therefore, most distressing to have to record that we now know that in those very hills there was abundant water for the thirsty attackers, had they been able to reach it. If, in fact, the operation had gone according to plan the water shortage would not have been at all serious in spite of the failure of the initial supplies to arrive as had been arranged.

As the result of experience gained at Heliès and Anzac, it was decided that the same principles for the distribution of water should be followed. Initial supplies of sea-borne water were to be

either pumped from lighters or carried ashore in containers, and then distributed, under staff arrangements, by pack mules or carrying parties. On landing, the engineers would search for and develop sources on shore and would install pumps. All engineer stores for this water-supply development were to have high priority in the landing programme.

The Director of Works, Brigadier-General Joly de Lotbinière, obtained four wooden lighters and handed them over to the navy at Imbros. Each contained 62 tons of water, and was equipped with a pump, about 150 feet of hose and a wooden tank, with taps for water-bottle filling, to be landed and filled from the lighter. On board each lighter was a party of four sappers from the 68th Company. Sealed petrol tins and other containers were also to be landed and sent up to the troops on mules under staff arrangements. Small additional quantities of drinking water were to be carried on naval small-craft and in the "beetles" that landed the troops. The troops were expected to be dependent on this sea-borne water for the first two critical days and chiefly upon the 56,000 gallons contained in the four big lighters. Provided it could be distributed, this was enough for forty-eight hours, the supplies in containers being additional.

Two of the lighters arrived at Suvla at 5.30 a.m. on the 7th, in tow of S.S. *Krini*, and at 9 a.m. she was ordered by the Rear-Admiral to proceed to the beach, slip the lighters and let them run under their own way, one to A beach (old) and one to A beach (new). These two beaches were inside Suvla Bay, and were the ones originally selected to be the main landing places, an arrangement that had been cancelled by the Admiral-in-Command about three hours earlier. The third lighter did not leave Imbros till 9th August, and arrived that afternoon at the same place as the first. The fourth grounded at Imbros and never left harbour.

The first lighter hit a sand-bank some way out at the north of A beach, but by trestle-building the hose was got ashore and water delivered that evening. The second lighter came floating in under Lala Baba at 11 a.m. Sapper Harris, of the 68th Company, swam out and brought her in on a line, but her shore tank was missing. Troops in the neighbourhood got out of hand, seized the lighter and started to pump into bottles direct, some even cutting the hose with their knives. Consequently, the first lighter delivered no water till the evening, the second was damaged by thirsty troops, the third did not arrive till two days later and the fourth never started.

Moreover, no mules for carrying containers were put ashore the first day.

The Chief Engineer and the 68th Company, hourly expecting the arrival of the vitally important third and fourth lighters, remained on A beach for the whole of the 7th, thus wasting many crucial hours.

S.S. *Krini*, having slipped her two lighters, steamed to B beach, drawing in so close that hoses could be passed ashore, and from her 200-ton tank she pumped a considerable quantity of water, which was mainly used for ambulance units.

DEVELOPMENT OF LOCAL WATER SUPPLIES

It would at first seem that considerable delays occurred in the development of wells and other sources of water on shore. We must remember, however, that until at least 10th August the field companies had no tools or stores other than those that the men had carried ashore. There was a store-ship specially loaded with engineer material, including pumps and water-supply plant, but she had to wait her turn in the landing programme and in the confusion received no priority. It must also be remembered that the good, but never adequate, supplies eventually available at Helles and Anzac were not produced in the first few days, but required long periods of prospecting and development.

With the exception of the 68th Company, employed as we have seen on A beach, all field companies during 7th and 8th August were with their brigades, who held them in reserve in constant anticipation of an advance into the hills. The 66th Company was in fact used to support and assist the attack on Kireitch Tepe ridge, and the 67th, with a pioneer company, led the advance up Tekke Tepe on the evening of the 8th.

From the available evidence it would seem that in the 10th Division the 85th Company dug a well below Kireitch Tepe, and two wells were found and used at North Beach. The three field companies from 9th to 12th August were used for improving "the very inadequate water supply," but they were also strengthening the position on the divisional front, improving tracks, and on the 9th, with a pioneer battalion, were "constructing shelters for Corps Headquarters and a reserve line of trenches near Ghazi Baba."*

In the 11th Division, throughout 7th and 8th August, two of the

* *Official History*, Vol. II, p. 285.

three field companies were held in reserve for the various attempted advances, but in this division the water shortage was far less acute, the troubles being mainly due to the non-arrival of the mules and containers. The G.O.C. 33rd Brigade has stated that he did not think that his brigade were hindered by lack of water, and in the *Official History* we read that "near Lala Baba there were several wells, and at B and C beaches there was from the first an abundance of sea-borne water. Owing to the delay in landing mules and water receptacles, it was only possible to send small quantities of this water to troops in the front line; but the discovery of a good well north of Chocolate Hill relieved the situation in that neighbourhood on the night of 7th August."* The abundance of water on these beaches was doubtless in part due to *Krini* and her 200-ton tank, but the supplies were constantly augmented by the small quantities carried by all the craft landing on these good beaches.

* *Official History*, Vol. II. p. 263.

CHAPTER IX

GALLIPOLI FROM MID-AUGUST TO LATE SEPTEMBER

Situation in mid-August—The combined attack on 23rd August—Reinforcements for Gallipoli or France?—R.E. work at Suvla from mid-August to late September—R.E. work at Helles late August and September—R.E. work at Anzac late August and September—Preparations for winter hutting.

SITUATION IN MID-AUGUST

ON 10th August the issue of the Gallipoli campaign had been settled, but the British would not admit it and the Turks could not yet be sure of it, so both sides set to work for further tests of battle. The Turks were well satisfied with the dominating positions on which they had forestalled the British, from Battleship Hill through Hill 971, the Anafarta Spur and Tekke Tepe ridge to the Kiretch Tepe ridge on their right. They forthwith set to work with industry and skill to fortify these positions in order to render them impregnable, and few work with more industry and skill on fortifications than the Turkish army, especially when directed by Germans.

The British C.-in-C. was at that moment determined to break the stalemate conditions on all three fronts by mounting further offensives. The VIII Corps at Helles, however, never again made any considerable attempt to attack. But the IX Corps at Suvla with the Anzac Corps did launch one prolonged offensive on 21st August.

Confusion continued to prevail in the IX Corps, and prevented any serious operation between 11th and 15th August. On the other hand, we now know that General Liman von Sanders was caused great anxiety by the advance of the 10th Division on the Kiretch Tepe ridge, because the Turkish situation on his right flank was so weak that there was nothing to prevent an advance of the British (if they had possessed an organized and well provided force) from capturing at Ak Bashi, a few miles north of Kilia, the main ammunition dump for the whole of the Turkish force.

On the evening of 15th August, General Stopford was relieved of the command of the IX Corps by the temporary appointment of

Major-General de Lisle, from the 10th Division, and during the next week several other divisional and brigade commanders in the IX Corps were changed. General de Lisle was informed that by 18th August he would receive 5,000 rifles, made up by dismounted men of the 2nd Mounted Division, due to arrive from Egypt, and that he would also receive two brigades of the 29th Division.

By 17th August, the C.-in-C. and his Chief of Staff had made a thorough appreciation of the whole situation on the peninsula fronts, created by the failure of the British offensive between 6th and 10th August, with the 25,000 casualties incurred. After also reviewing the enemy situation, he sent a cable to the War Office informing them that no successful operation could be expected unless he received 45,000 reinforcements and 50,000 in new formations, a total of 95,000 men. This cable caused considerable sensation in the War Office and in the Cabinet, and, as we shall see, it was many weeks before their discussions were concluded and a decision reached as to a further policy.

THE COMBINED ATTACK ON 23RD AUGUST

Meanwhile, the C.-in-C. at Imbros and General de Lisle were hammering out a scheme for a further offensive to be carried out on 21st August by the IX Corps and the left of the Anzac Corps in co-operation. The IX Corps objective was to be a north and south line astride the southern end of the Anafarta Spur, including Scimitar Hill. General Birdwood's left flank was to co-operate with one brigade by capturing Hill 60 and a position to the north of it, to connect with the new right flank of the IX Corps.

If success were obtained, the result would be that the junction between the two corps, both of whom would have advanced a considerable distance from the coast, would be secure, whereas the existing line ran close to the sea and was weakly held across the valley of the Azmak Dere. The operations would give a safe lateral communication along the coast, while the advance up the Anafarta Spur and Scimitar Hill, would add considerably to the security of the coastal plain below them. Prior to the commencement of this operation, General de Lisle was reinforced by 2,000 of the dismounted men of the 2nd Mounted, and by the whole of the 29th Division from Helles.

The attack was to be made by the 29th Division on the left and the 11th on the right, while the 10th Division was to follow through

and exploit success. The 54th Division was in Corps reserve, and the 53rd held their existing line to protect the left flank. The Anzac Corps were to employ an Australian brigade and the 29th Indian Brigade.

Operations started on the afternoon of 23rd August. The advance of the 29th Division was stopped half-way up Scimitar Hill, where a line was held and organized. The advance of the 11th Division was driven back to Kazlar Chair and no communication was established between the IX and the Anzac Corps. The situation on the Anzac front had been little better. Very heavy casualties had been suffered and all that had been gained was the wells, and a precarious foothold on the slopes of Hill 60. After midnight, the complete failure of the day was realized at IX Corps Headquarters. Their losses had been 5,300 killed, wounded and missing out of 14,300 engaged.

As the junction between the two corps was still weak and the coastal route between them insecure, General Birdwood deemed it essential to arrange a further assault on Hill 60. He estimated that 1,500 fit men would suffice, but such was the state of the Anzac Corps that it was found necessary to draw upon nine different units, comprising Australians, New Zealanders and the Connaught Rangers.

The attack was launched on the afternoon of 27th August, and after two days of the most desperate fighting experienced in the whole campaign, daylight on the 29th revealed the capture of all the defined objectives; but to the great disappointment of all engaged in this terrific onslaught, the captured trenches did not encircle the hill, "the actual summit, shutting out all view of the northern slopes and seamed by deep entrenchments, was still in the hands of the enemy."* The left flank of the corps was now, however, secure, but this bitter fighting on Hill 60 was the last straw, and at the end of August the Anzac Corps was incapable of further effort.

REINFORCEMENTS FOR GALLIPOLI OR FRANCE ?

The failure of the British offensive on Gallipoli in August, 1915, brought the first World War to a crisis. The inability of the western allies to support and nourish major offensives in both France and the Dardanelles, was now coming to light for all the world to see. The

* *Official History*, Vol. II, p. 361.

British defeat on the peninsula, coupled with the long and disastrous withdrawal of the Russians after their overwhelming defeat at Gorlice-Tarnow in April, were signals to neutrals to align themselves accordingly, and on 6th September Bulgaria signed a convention with Germany and Austria, outlining the parts which each would play in the invasion of Serbia. Protracted discussions between the British and French Governments begun in July, were continued throughout September to decide whether their main effort should be concentrated in France or in Gallipoli, and, if the latter, how it should be conducted and what reinforcements were required.

Meanwhile the C.-in-C. in Gallipoli continued to stress the deplorable condition of his army and the strategic consequences of the recent loss of 40,000 men, in battle and through sickness. He also pressed for a reply to his request of 17th August, for 95,000 reinforcements, and definitely informed Lord Kitchener that without them he would have to contemplate evacuating the Suvla area and remaining on the defensive.

All these discussions were brought to a definite conclusion when, on 27th September, Bulgaria mobilized against Serbia and Greece, who immediately asked for reinforcements from France and Britain totalling 150,000 men. France and Britain agreed to supply them, and Lord Kitchener telegraphed to Sir Ian Hamilton that two British divisions and probably a French division must be withdrawn from his force and embarked for Salonika. Although at the time it was not admitted, this decision was the doom of the Gallipoli campaign and foreshadowed the evacuation of the peninsula.

R.E. WORK AT SUVLA FROM MID-AUGUST TO LATE SEPTEMBER

In preparation for the attack on 21st August, the engineers of the IX Corps were fully employed in helping the infantry to consolidate or improve the defensive positions occupied on the morning of the 11th, and in the preparatory work always required before a major offensive. From their dominating hills the Turks had such good observation of our defences and back areas that the difficulty of constructing satisfactory protection was very much increased.

In the 10th Division, Major A. ff. Garrett, commanding the 65th Company, had been severely wounded on 14th August, and Captain Scovell had taken over. He was killed on the night of the 15th/16th, when the Turks counter-attacked an outlying post held by his company. On the same night, Lieutenant Jameson was killed, Lieutenant

Patterson, M.C., severely wounded, and the company lost sixty men of the hundred engaged.

Captain Satterthwaite was wounded while the 66th Company was helping to strengthen, under heavy shrapnel fire, an advanced position in the hills. They were employed on defences until 19th August, when they returned to Suvla Bay to be attached to the 2nd Mounted Division, which had arrived from Egypt dismounted and without R.E. On 21st August, they and the 85th Company took part in the attack by the IX Corps on Scimitar and W. Hills but no R.E. work of interest was carried out. The 10th Division embarked for Salonika on 30th September.

The 53rd (Welsh) Divisional Engineers after landing at Suvla on 9th-11th August were employed on normal field company tasks. The 2/1st Cheshire Field Company built shelters for Corps Headquarters and put the only building in the Suvla area into a state of defence.

After the first very critical days, water supply presented little difficulty as everywhere in the plain of Suvla it could be found from five to fifteen feet below the surface, but the flow was always small. The 67th Company produced only 1,500 gallons a day after three weeks' work.

There were some sixty small watering places for the front line, but the water was not good. Wells had from time to time to be deepened, and were kept covered and protected. Unserviceable pontoons sunk in the ground were used as storage tanks. Water was usually found in strata overlying clay or impervious shale. On one occasion a mine shaft being sunk in the front line turned into an excellent well, giving 3,000 gallons per day. It will thus be understood why mine warfare did not play such a leading part at Suvla as it had at Anzac.

The eleven piers in the Suvla area were all in various stages of completion or utility by the end of September. The Chief Engineer records that "the piers and so-called wharves were necessarily of a flimsy nature—partly pontoons and trestles, and mostly filled up with boulders." He goes on to say that "practically no cement was available from start to finish, and what there was had to be used to grout the stone piers and quays. The greater part of all piers was simple boulder work (around trestles etc.). Boulders were plentiful and the Egyptian Labour Corps fetched them and widened the base of piers by throwing them in. In some cases, there were two bays of Weldon trestles on a pier-head. The casualty embarking

pier was composed almost entirely of pontoons. Railway rails were found particularly useful in the places where they could be driven by improvised pile-drivers, as they were less liable to storm damage, owing to the smaller resistance offered to the waves."

R.E. WORK AT ANZAC, LATE AUGUST AND SEPTEMBER

On 19th August two sections of the 72nd Field Company took over part of the front line at the Apex from the New Zealand Engineers. No technical work was done in the battle of Hill 60, nor did engineer units take part. We turn to ordinary sapper work as recorded in the war diaries from August onwards.

Water supplies were further improved, and new wells were developed at North Beach, which had been gained during the August attack. Two of these yielded 10,000 gallons a day and were equipped with water pumps, tankage, etc.

North Beach gradually superseded Anzac Cove for the reception of stores and sea-borne water. Four piers had been in use for a long time in Anzac Cove and one at Hell Spit, but in August the construction of three new piers was started at North Beach, and work continued throughout August and September.

Before the attack on 23rd August the 71st and 88th Companies of the 13th Division were engaged on piers in shallow water at North Beach for evacuating the wounded. On 30th August, the division and its engineers were transferred to Suvla.

R.E. work on the beach showed ceaseless activity under Brigadier-General W. B. Lesslie, whose ubiquitous energy Anzac knew so well. He had replaced Brigadier-General Godfrey Williams as C.E., Anzac Corps, in September, when the latter was appointed Engineer-in-Chief, M.E.F. On 8th September, it was decided to concrete the piers, beginning with Watson's. On 15th September, the 37th Fortress Company, R.E., arrived and began this work and also the underpinning of the main reservoir with wooden girders.

The protection of piers at the various beaches began to cause the Director of Works some anxiety at the end of August, and in early September he made arrangements for sinking two ships to protect the new pier at Lala Baba. On 11th September he decided to sink a third. He had already sunk one at Malo Bay, Helles, two at Lancashire Landing, two at Imbros and one to form a pier at Mudros. He could get no labour to fill these ships with sand or ballast but by the 29th September he had obtained a big dredger

from the Suez Canal Company. The work of this dredger at Helles and later at Suvla, where she was eventually lost in a storm is described in Chapter XI.

R.E. WORK AT HELLES LATE AUGUST AND SEPTEMBER

R.E. work in the line in the late summer and autumn did not differ greatly from that in earlier months. On 17th August, Brigadier-General J. A. Gibbon was appointed C.E., VIII Corps, and took charge of all engineer work at the Helles base, hitherto carried out by the Director of Works. The 1/3rd Lancashire Works Company was removed to Imbros, and the 126th Company alone remained, with about 200 casual labour which was constantly changed and suffered much from sickness; 1,200 Greeks arrived at the end of October, but were not entirely satisfactory.

In September, the 136th Monmouth Army Troops Company built two reservoirs on the cliff above W beach, each to hold three days' supply, and a Worthington pump was installed at the pier for filling them with water brought by sea.

For the piers at Helles see sketches 1 and 5 facing pages 12 and 90. The Helles piers were considerably damaged by rough weather, and pile-drivers, made from parts of sunken ships, were used in an attempt to secure the boulders with raking wooden piles driven at the sides. Later, a supply of rails became available and they were driven vertically into the sea bed. In order to complete the harbour and provide accommodation for barges, it became necessary that No. 1 pier, which in August was only half-way to No. 1 hulk, should be extended right up to it. This was done with wooden piles and large stones, and was completed early in October. A photograph taken six years later shows the piers and wharves more or less intact.

PREPARATIONS FOR WINTER HUTTING

In August estimates were made and orders placed for material to provide winter shelter for the troops. For Anzac alone this amounted to 5,000 tons. The Director of Works ordered from home, 5,000 tons of corrugated iron, 1,000 tons of timber, 10,000 stoves, nails, trench-pumps, etc., to supplement what could be bought in Egypt.

The D.F.W. at the War Office wrote later:—"The subject of hutting in the three areas in the Gallipoli peninsula was considered in August. It was intended to collect as great a quantity of material

in the shape of timber and corrugated steel as possible and leave to the C.Es. of the various army corps the duty of providing the shelters or huts required, the labour being found partly by the field companies, partly by the base companies of the R.E. Doubtless if the weather had been calm and if the shipping problem had presented no difficulties, this arrangement would have worked all right, but mainly owing to the lack of transport there was the greatest shortage of materials for hutting and much suffering was thereby caused to the troops. Accessory buildings for ten camps for 10,000 men were ordered, but those for eight camps only were sent out. The buildings were the same type as hospital huts so that they could have been used for hospitals if necessary."

CHAPTER X

AUTUMN IN GALLIPOLI

Changed situation in October, 1915—Discussions upon the future of the campaign—The November blizzard.

CHANGED SITUATION IN OCTOBER, 1915

To those at home and at Imbros responsible for directing operations on the Gallipoli peninsula, it was obvious at the beginning of October that the imminent invasion of Serbia by the Central Powers and Bulgaria, if it succeeded (as it did within a few weeks), would give the enemy the use of the trunk railway from Vienna through Belgrade and Sofia to Constantinople. This railway would, of course, be used for sending guns of all calibres, plentiful ammunition and also German specialists to the Turks. With the dominating positions they held in the peninsula and with the increased range and weight of heavy artillery, they would be able to bombard all the beaches, piers and back areas of Helles and Suvla, and of course the front line trenches. To counter such bombardment it would be desirable to reinforce the British artillery with similar types of guns and ammunition, but at least nine months must elapse before British industry would be able to supply adequate armaments and ammunition for even one theatre of war, and certainly not two. Moreover, there was as yet no hope of helping the Russians in their far more serious need for munitions. The engineers on the peninsula would be required to provide strong protection against bombardment, not only in the trenches, but also in the back areas, and would be employed continuously in repairing bombarded piers.

It was also known that during the autumn and winter we should have another powerful enemy—the weather. The seasonal gales would frequently interrupt the service of small vessels from Mudros and, more frequently, interrupt the open lighters and boats plying between these ships and the beaches. High seas were sure to beat against the twenty-four piers on the open beaches, and these would need constant and heavy repairs. Although it was not until November that it was realized that wintry blizzards many degrees below freezing point would cause the troops to suffer very heavy

casualties, and even death, from exposure, yet even in August the engineers, as we have seen, were ordering materials for winter shelter in the trenches and the back areas.

It was clear that a very large tonnage of engineer stores would be required for protection of the troops against both shells and weather, and for the maintenance of the piers, and this in addition to the normal requirements for the defences and water supply. It has been shown that even in fine summer weather, and in spite of the rapid improvements which by the end of September had taken place in the development of piers, quays and water supply at Mudros and Imbros, the sea transport between Alexandria and the peninsula was totally inadequate for keeping the engineers supplied with materials for the work demanded of them. When the gales further reduced supplies, how could they be expected to carry out the foregoing additional tasks?

It was therefore obvious at the beginning of October that a kaleidoscopic change had taken place in the military situation on the peninsula, as these menacing problems crowded in rapid succession upon those responsible at home and at Imbros.

DISCUSSIONS UPON THE FUTURE OF THE CAMPAIGN

The weather opened its offensive with gales on the 8th, 9th, 27th and 31st October. They did considerable damage to the piers at Suvla, Anzac and Helles, seriously interrupted shipping services and wrecked or damaged many lighters and small craft, with the result that there was a very grave drop in the supply of all war-like types of store.

Throughout the month, the situation at Gallipoli, the critical events in the Balkans and the failure of the Loos offensive in France, produced many difficult strategical problems for consideration by British and French Governments and their advisers. There was much discussion upon the different courses. The British authorities lacked reliable information to enable them to decide whether to renew the offensive or to leave Gallipoli, and on 11th October, Lord Kitchener telegraphed to Sir Ian Hamilton asking for an estimate of probable losses if the peninsula were evacuated.

As the result of the findings of the Dardanelles Committee, Lord Kitchener cabled to Sir Ian Hamilton, on 14th October, that the Government had decided to make a change in command and to send Sir Charles Monro to take over; but as there would be some

delay in his arrival, General Birdwood would act as C.-in-C., M.E.F., during the interval.

Meanwhile, from the forward battle positions of the IX Corps at Suvla, a defensive system was gradually evolved, similar to those at Helles and Anzac. The force was, however, steadily dwindling from sickness and normal casualties. On 10th October, the establishment of troops on or *en route* to the peninsula was 200,540, but their strength was only 114,087. "It was obvious indeed that the Expeditionary Force lacked the numbers, organization and physical fitness essential to the success of any considerable offensive operation."*

On 28th October, Sir Charles Monro with his Chief of Staff, Major-General A. L. Lynden-Bell, arrived at Imbros. He had in his possession the most definite instructions from Lord Kitchener upon the points on which he was to report, when looking at the situation from an entirely military point of view. Events in the Mediterranean did not however wait for the wavering allied Governments to come to a decision. On the contrary, the Central Powers and Turkey, and also the weather, caused events to take place which had very important bearings on the situation.

"During the first fortnight of November, there had been an unpleasant succession of strong south-westerly winds; and even a moderate sea, with the wind in the south-west, would ruin the undertaking . . . The IX Corps reported unusually heavy and accurate shell fire on supply depot near C beach; South Pier badly damaged by the storm; work on A beach stopped by heavy seas; no landing possible at present."†

By 15th November the British and French Divisions which had pushed up from Salonika to gain touch with the retreating Serb had failed to defeat the Bulgars interposed between them, and were obliged to fall back into Greece, whose attitude was uncertain and even menacing.

On 9th November, Lord Kitchener began a week's tour of the positions on Gallipoli, and then sailed to Salonika and thence on to Athens.

On 17th November "A violent southerly gale had done so much damage to the piers at Lancashire Landing that the VIII Corps was obliged to use the French Piers at V beach for its normal daily requirements. Another gale on the 20th had done further extensive

* *Official History*, Vol. II, p. 392.

† *Ibid.*, p. 417.

damage, and at Anzac and Helles alike, the belief was gaining ground that evacuation could not be undertaken without almost prohibitive risk."*

On 22nd November, Lord Kitchener cabled home his long expected report, in which he stated that "as German assistance for the Turks on the peninsula was now practically available, and as, in this case, the British positions could not be maintained, evacuation seemed inevitable. He recommended that the evacuation of Suvla and Anzac should be proceeded with but that Helles should be retained." On 23rd November, Lord Kitchener confirmed General Monro in command of all the British Forces in the Mediterranean outside Egypt, with General Birdwood in command at Gallipoli to carry out the evacuation. He sailed for England next day.

Sir Charles Monro ordered the preliminary withdrawal of stores to be hurried on, and informed General Birdwood that the conduct of the operation would be left entirely to him.

The War Committee, on receipt of the foregoing recommendations, recommended the Cabinet to evacuate the whole of the peninsula, and a meeting of the Cabinet was held on 24th November at which, however, no decision was reached and further delay was to follow.

THE NOVEMBER BLIZZARD

Meanwhile, in Gallipoli, on 26th November, General Davies, the Commander at Helles, reported that evacuation was impossible until all the piers damaged by the gales were repaired. But on that very day "a fierce south-westerly gale began, veered next day to the north and lasted for three days." Many of the small craft from Anzac had been sent to Imbros for shelter, but the central ship of the breakwater there was smashed to pieces and all the small craft were wrecked. At Suvla, with its protection from northerly winds, there was little damage, but "At Anzac and Helles, the shore was strewn with wreckage, and the loss of small craft was so great that it was now more certain than ever that, even in a spell of fine weather, the evacuation of all three beaches at once was no longer a possibility . . . A violent thunderstorm on the evening of the 26th was followed by a torrential downpour which lasted for twenty-four hours and soaked the men to the skin. An icy hurricane then began to blow from the north; the rain turned first to a blinding blizzard and then to heavy snow; and the snow was followed by two nights

* *Official History*, Vol. II, p. 420.

of exceptionally bitter frost . . . At Anzac, thanks to caves and underground galleries, a large number of the men were able to shelter from the storm. At Helles, too, where the trenches were mostly in sloping ground, they suffered little from flooding, and the troops bore the strain remarkably well. The IX Corps at Suvla was far less fortunate in its positions. The troops on Kiretch Tepe Sirt were exposed to the unbroken fury of the storm, while those in the low-lying tracts had all their trenches flooded. The dry water-courses in the plain became rushing torrents and on the southern flank, where the front line defence across Azmak Dere consisted of a barricade, a wall of mud and water several feet high came rushing down the nullah and drowned Turks and even pack ponies were washed into the British lines.**

In many places the troops had to take refuge from the weather either on their parapets or in the sodden ground behind. Fortunately, the Turks were in no better position. For some hours the troops on both sides stood out in the open; the weather had produced an artificial armistice. The Official Historian states: "The severe cold following the floods proved an unbearable strain to men whose health had already been undermined by the hardships of the summer campaign. Hundreds were dying from exposure . . . all over the plain streams of utterly exhausted men were struggling back to the beach, many collapsing on the roadside and freezing to death where they fell."† Shelter could not be found for all the sick. While the storm lasted, it was equally impossible to evacuate the sick from the peninsula or to get help from outside.

On 30th November, the wind abated, and for the next three weeks there was an almost unbroken period of perfect autumn weather. During the blizzard, at Suvla alone, there were 5,000 cases of frost-bite, and over 200 men had been drowned or frozen to death. Added to this, the Turkish bombardment of the trenches daily increased in intensity. About 7th December, it was reported that Suvla piers had been washed away almost weekly, the roads were nearly impassable owing to the recent heavy rains and there was not nearly enough cover for the troops already there.

On 7th December, the Cabinet at last definitely decided to evacuate Suvla and Anzac, but to remain at Helles. This decision was telegraphed to Monro with orders that it was to be acted upon without delay.

* *Official History*, Vol. II, p. 432.

† *Ibid.*, p. 433.

CHAPTER XI

THE EVACUATION OF SUVLA AND ANZAC

The scheme for evacuation—Engineer tasks from October to December—R.E. work at Suvla from October to December—The blizzard at Suvla—Work at Suvla for the evacuation—General remarks upon piers at Gallipoli—R.E. work at Anzac from October to December—R.E. tasks at Anzac during the evacuation.

THE SCHEME FOR EVACUATION

By 8th December, good progress had been made with the re-embarkation of stores, and a number of guns had been sent away. The total garrison of Anzac and Suvla had been reduced to 83,000 men.

Normality in the appearance on shore and at sea was the essential principle of the scheme for hoodwinking the Turks and not arousing any suspicion that withdrawal was in progress. If it was successful there was a reasonable chance that the Turks could be kept in ignorance of the fact that evacuation had started till after the last man had left the shore. Thus, at Anzac, reserves and supports would be withdrawn first, and the final stage would be the withdrawal of the remaining troops in one bound from the front line to their boats. At Suvla, the final scheme was similar to that for Anzac, but slightly modified because the defences were constructed to protect what were called Reserve Areas, near the beaches.

The number of embarking points was to be increased, by using trestle piers assembled beforehand and hidden until the last moment. Various devices were prepared for the automatic firing of rifles and bombs after the troops had left. It was decided to explode a large mine on Russell's Top to cover the final withdrawal on the last night from this dangerous locality which, if occupied by the Turks, would give them command of North Beach piers, at a range of 500 yards, but no other mines were to be fired to arouse or alarm the Turks.

The scheme was ready in every detail before the definite instructions to evacuate Suvla and Anzac were received on 7th December. On the 8th, therefore, General Birdwood, now C.-in-C. of all troops on the peninsula, ordered the intermediate stages to be put in motion.

On 9th December, the existing garrisons were : at Anzac, 36,000 men, 97 guns ; at Suvla, 41,000 men, 91 guns. These garrisons were to be reduced during the intermediate period to 20,000 in each area. These final garrisons, with the minimum of guns, animals, vehicles and stores, were to be withdrawn during the last two nights. It was estimated that it would require ten days to reduce the existing garrison to the final figure.

In fixing the date of the intermediate stage, the ruling factor was the date by which the breakwater at Imbros could be repaired, because shelter there for small craft was essential during strong north winds. The Admiral therefore arranged that a collier would be sunk on the morning of the 18th December to fill the hole in the breakwater, and orders were issued that the intermediate stage must be completed on the morning of that date, the final stage taking place on the nights of 18th and 19th December.

The intermediate stage, favoured by ideal weather, proceeded without a hitch, and without disturbing the normal appearance of the scene. Day after day the Turks remained inactive and day after day the sea remained a flat calm. By the morning of the 18th, all that was left ashore was 40,000 men, fifty guns, a few animals and vehicles, and a greatly reduced quantity of supplies and stores. "At Suvla, thanks to the deep water jetties and piers, with tram lines running down to them which, under the immediate supervision of Lieut.-Colonel R. V. Jellicoe, R.E., had been constructed in the rocky inlets on the northern shore of the bay, the salving of heavy stores had been a far easier task than at Anzac, where the open beach had prevented the development of any such facilities. At Suvla, too, it had been possible to keep three large store ships continuously in the bay for loading animals and stores, whereas at Anzac, owing to the reported presence of submarines, and to the fact that it was unusual for large ships to lie at that anchorage, this could not be done."* Vast heaps of valuable stores were ruthlessly but unavoidably prepared for burning on the final night.

Both at Suvla and at Anzac, the programme for the first night was completed without a hitch. The weather was ideal. The garrison left during 19th December succeeded in simulating normal activity. That day an Austrian battery damaged South Pier, but it was repaired within a few hours, and during the night the withdrawal was carried out with the same clock-like precision as before.

At Anzac, the whole garrison at Russell's Top, the last post to

* *Official History*, Vol. II, p. 453.

be abandoned, was cleared by 3.24 a.m., and Lieutenant J. P. Caddy, R.E., was ordered to fire the mine. At 4.10 a.m. the evacuation of Anzac was complete. "At Suvla, the final night's programme was carried out with the same orderliness as at Anzac and with the same amazing success. Here, too, the Turks remained in ignorance of the retirement till after daybreak."* The last act at Suvla, was the firing of the Supply Depot.

"The total numbers withdrawn from Anzac and Suvla amounted to 83,048 officers and men, 186 guns, nearly 2,000 vehicles and 4,695 horses and mules. At Suvla, not a single casualty was suffered on the final night, and not a wagon, gun, horse, mule or donkey was left ashore. At Anzac, the total casualties amounted to one man wounded early in the evening, and one hit in the arm by a spent bullet when his lighter was leaving the beach. Nine guns and howitzers—all of which were previously destroyed, were abandoned by the Anzac Corps, but all save one were worn out and practically useless. Twenty mules and fifty donkeys which were needed till the last moment were left ashore at Anzac, and the stack of supplies which was set on fire and partially destroyed consisted of 200,000 rations. Practically all the gun ammunition at Anzac was saved, and all the small arm ammunition except 5 million rounds. This, as no sea transport was available to take it away, was thrown into the sea . . . From the moment the evacuation was ordered, the sea remained as smooth as a village pond. Sixteen hours after the last boat left the shore a fierce gale sprang up which, twenty-four hours earlier, must surely have led to disaster."†

ENGINEER TASKS FROM OCTOBER TO DECEMBER

The work of engineers in war is governed, like that of other arms, by the main decisions of the High Command, and is also affected by the reactions of their enemies, among whom it was known in the Mediterranean that the autumn and winter weather must be included. It may therefore be profitable to examine the dates of the main decisions taken during the latter period of 1915 and the actions of our enemies, including the weather.

Up to the end of August, the British M.E.F. had been consistently on the offensive, with pauses at intervals, during which defensive

* *Official History*, Vol. II, p. 458.

† *Ibid.*, pp. 459 and 460.

work was carried out, but always with a view to the resumption of the offensive at the earliest possible date.

At the end of August, the C.-in-C. fully realized that he no longer possessed resources for the continuation of the offensive, and he therefore applied for very strong reinforcements. This request was followed by long discussions by the allied Governments. During this period of discussion, the C.-in-C. was compelled to remain on the defensive and that role was imposed on the work of the R.E., who also had to continue the upkeep and improvement of water supply, roads, tracks and decauville.

Now considering the actions of the enemy, it has been explained why a great increase occurred in the volume and weight of bombardment by the Turks. This at once involved the provision of better protection for the troops. It had been foreseen by the engineers, even in August, that shelter would be essential to give protection from the rigours of wintry weather, but the necessity for these was brought home to everyone by the terrible blizzard of 26th-28th November.

By far the most obvious and the most important, arduous and difficult work was the construction, repair and maintenance of the piers. It was fully realized that autumn and winter gales would produce the need for a constant battle with the sea.

Finally, when the decision was at last taken to evacuate Suvla and Anzac, special tasks of various kinds were allotted to the engineers in the scheme so carefully and successfully worked out. Notable among these was the construction of additional temporary and emergency piers, and the efficient maintenance of the existing ones.

In considering the work demanded of the engineers, one must constantly keep in mind the incapacity of the sea transport to deliver to the peninsula the engineer stores, plant and tools which were essential for such a large programme. A notable example of the difficulties under which work had to be done was the torpedoing of *Orange Prince* in mid-November, entirely loaded with engineer stores, among which were 3,000 tons of hutting material which, if it could have been delivered successfully two months earlier, would have been erected before the blizzard burst upon the troops. We have described the difficulties in transferring stores from large ships to smaller vessels at Mudros and Imbros, difficulties which seriously reduced the capacity of the L. of C. After the beginning of July, when the engineers were first permitted to start seriously

on this work, great improvements were made at Mudros and Imbros by providing piers, quays and accommodation on shore, but at the same time, demands were constantly growing so that even in December the advanced base still constituted a bottleneck in the sea route.

R.E. WORK AT SUVLA FROM OCTOBER TO DECEMBER

Defences. The Suvla terrain presented its own special difficulties. On and near the Kiretch Tepe ridge and on Chocolate Hill, the soil was so rocky that blasting was always necessary, but south of Chocolate Hill, the ground was low and waterlogged and in the autumn required an immense amount of drainage. It was here that the effects of the blizzard were particularly felt.

The whole area was carefully mapped. It was all visible to the enemy and miles of communication trenches had to be dug. Scattered trenches were also required at intervals to give protection to parties who might be caught by shell fire while moving in the open. Much work was done on fire trenches but owing to lack of cement, joists, rails and timber, no real protection against heavy bombardment was ever practicable. Considerable areas of land mines were laid in no-man's-land. Wiring in front of trenches was greatly thickened, but it was some time before the infantry could do this unaided.

Drainage in the late autumn required long collector drains, very carefully levelled and excavated. Infantry working parties for this work, when available, frequently arrived completely exhausted on account of sickness. When the fire trenches were lowered to give protection against heavy shelling, drainage difficulties were greatly increased and pumping from sumps had to be resorted to.

Brushwood mats for roofs and floors of dug-outs were made in considerable quantities. Bricks of sorts were made for fireplaces. Superintendence of infantry, either in their own trenches or on working parties, absorbed a large proportion of the diminished R.E. personnel.

In September, the 5th Anglesey Army Troops Company arrived at Suvla and their diary shows a typical variety of work:—construction and maintenance of decauville; excavating and blasting for sunken reservoir; construction of landing stages; covering reservoir made with unserviceable pontoons; repairing tanks damaged by shrapnel; repairing roadways and making signboards; laying pipes to water storage tanks; making splinter-proof shelters for water tanks, and other water supply work; constructing

splinter-proof dug-outs; erecting a shelter for a disinfector; repairing tools; erecting a temporary footbridge.

The 2/1 Welsh Field Company were throughout largely employed on construction and upkeep of IX Corps Headquarters.

After Lord Kitchener on 22nd November had recommended evacuation, defences began to be constructed by the R.E. of the 13th Division for what were known as Reserve Areas near the beaches. The 85th Field Company constructed on 14th and 15th December a "keep" for the rear guard during the final stage. It consisted of four groups of fully-wired fire positions, echeloned back from IX Corps Headquarters to the cliff south of Suvla Cove.

THE BLIZZARD AT SUVLA

The unprecedented floods which accompanied the blizzard at the end of November, not only completely flooded, but washed away many trenches and of course did enormous damage, especially to the entire draining system. Lieut.-Colonel E. N. Mozley, C.R.E., 2nd Mounted Division, records that his sappers had to wrestle with the repairs to the damage done by the five-foot wall of water and mud that swept down the Azmak Dere, and the engineers of the 29th and other divisions were busy building bridges on the communications routes.

The following are further extracts from the diary of the C.R.E., 2nd Mounted Division:—

"At 7 a.m. on 27th November Coningham came in painting the situation in lurid colours. Out at 8.45 with the G.S.O. Met the brigadiers. Wading all morning deep in water. Dreadful stories of sudden floods.

November 28th.—A blizzard. Bad reports from brigades. Men dying of cold and men falling sick rapidly. Went out with the General and met the brigadiers. Worse reports—South Western Brigade and Scottish Horse going rapidly to pieces and many dead men. We can do scarcely anything. Kits and tools lost in great quantities. The 410th Field Company (2nd Division) records 'infantry passing through their camp from the front, greatly exhausted, the majority having abandoned their arms and equipment.' Wind rose rapidly in afternoon . . . and in the evening it turned colder than ever . . .

November 29th.—Wind still high and in the same quarter. Went

out alone to trenches. Drying up but miserably cold. Our tool carts firmly embedded in frozen mud. Men more cheery.

November 30th.—With General round lines, a beautiful calm day which has come in time to save many men. Lots of cases of frostbite and came across some dead men on our way out."

WORK AT SUVLA FOR THE EVACUATION

Important tasks were wiring and the laying of mines in no-man's-land and between our front line and the reserve areas; 3,000 mines were laid, using up all surplus explosives. Lines of flour were put down by the R.E. on the last two nights to guide the retiring troops. The sappers, whose duty it was to close the gaps on the final night, were the last to embark. Three R.E. officers were left behind to set on fire at 4.0 a.m. two huge dumps of supplies on the beach. They blazed long and fiercely. Paraffin-soaked dumps further inland were automatically fired at the same time by means of candles burning an inch an hour.

The following is an extract from a letter that appeared in *The Times* in December, 1915:—

"It got nervously exciting towards the end, for no one would have believed that the weather would hold out. Days passed in which one could lie about on grass or sand as in a warm English summer afternoon, almost forgetting that a short three weeks before men had died of exposure in the same place, and that thousands of feet and toes had been lost in the blizzard's aftermath. The last two days, and still more the last of all, were thrilling. Had the enemy known and attacked they would certainly have pushed Anzac and probably us into the sea. They looked on, occasionally shelled us and did nothing. The work of the sappers was to impede their advance in case they did find out and go for us. The officers and men went out at night between our parapets and those of the enemy, which were only a few yards apart, putting up wire and laying down land mines—jumpy work, especially as the last few days the waning moon made it a close business whether we could finish the job or not. Had we delayed one night longer we could not have gone out at night to make the mines efficient."

Much work was done on roads leading from divisional areas to the embarkation beaches. The 53rd Divisional Engineers were mainly employed during October and November on road work and bridging.

They built a piled bridge across The Cut for heavy traffic and guns and a road across soft sand on sleepers, at 3-ft. centres, with the spaces filled with gravel. It needed continual maintenance, but a similar road made by the 2/1st Cheshire Field Company with sleepers at 2-ft. centres, and the spaces filled with stone, proved satisfactory. They also helped to construct the tramway from South Pier to C beach, which involved in some places cuttings 10 ft. deep. Sleepers were very scarce, and brushwood had sometimes to be used. Tramways ran across the beaches on to many of the piers.

The following information about the work done on the piers at Suvla during October, November and December has been supplied by Brigadier-General Bland, C.E., IX Corps. See Sketch 4, facing p. 56.

The constant damage to piers was one of the main factors that led to the decision to evacuate, as the navy could not guarantee to maintain the landing of supplies during the winter storms since the whole coast was a lee shore. Prior to the evacuation, a number of additional embarking places were built, mostly boulder-filled crib piers, and these answered the purpose owing to the fine weather on the critical nights. These cribs were towed out into position partly filled with boulders and were then filled to the brim and connected. The only purely timber pier was South Pier, built by the 133rd Company, R.E., in October. The company averaged from seventy to forty strong and were helped by 130 men of the R.A.N.B.T. and by fifty Welsh pioneers. The pier was 260 ft. long with a 40-ft. T-head, with 13-ft. spans and a 12-ft. roadway, on trestles. It reached to ten feet of water at low tide. (Tide in the Aegean Sea is only a foot or two.) The November storms damaged it very badly. It was then rebuilt in constantly rough water, with twelve crib piers, and finished by the 16th December, just in time for the evacuation. A chance shot from a 5.9-in. gun tore a hole in it the day before the evacuation, but there was just enough material to patch it up. In 1919 not a trace of these piers was to be seen. Mention should be made of the suction dredger, employed for stabilizing sunken vessels by filling them with sea sand or shingle. The Director of Works obtained it from the Suez Canal Company after the Suvla landing, and it did excellent work on the sunken hulks at Helles in October. It was then moved to Suvla, where it filled three or four ships before being lost in one of the storms. It could handle 4,000 cubic yards in twenty four hours, and in that time could sink a vessel.

Another large pier was No. 3, just north of Suvla Point, built by the 86th Field Company (Captain R. E. B. Pratt) with a company of 6th East Yorkshire Pioneers. It was begun on 27th November and was ready for use in emergency by 12th December, when 100 ft. of stone filling 8 ft. wide on top and 4 ft. above high water was completed, reaching to $4\frac{1}{2}$ ft. of water at the head. It was finished by the R.A.N.B.T., as the 86th Company was needed prior to the evacuation for defence work. Four large pyramidal cribs 15 ft. by 10 ft. at base, 8 ft. by 6 ft. at the top, and each containing 40 to 50 tons of boulders, were placed and connected by 25-ft. spans. Cribs were 10 ft. to 15 ft. high, and reached to 10 ft. of water at low tide. Two large cribs formed a T-head. Intermediate crib trestles were placed between cribs to strengthen the pier. All was completed by 15th December. Well over 1,000 tons of rock were blasted out of the adjoining cliffs and used in this pier. The rock filling was tied together with decauville rails, with cement grouting at the sides of the stonework and at the abutments. The pier was heavily and continuously used during the evacuation and gave no trouble.

On Kangaroo beach, the R.A.N.B.T. built a trestle crib pier in October 150 ft. long with 30-ft. T-head. There were 7 ft. of water at the end. A second pier of six service trestles was built near by. At Little West beach a pier of eight service trestles with crib head was built by the R.A.N.B.T. for infantry evacuation. At North Cove the 86th Company built a shore jetty in 8 ft. of water. The general shortage of material was lamentable.

GENERAL REMARKS UPON PIERS AT GALLIPOLI

The lessons learnt from the attempts to build sea-worthy piers and breakwaters under the conditions that existed on the peninsula were summarized as follows in January, 1916, by Major-General Sir Godfrey Williams, Engineer-in-Chief, M.E.F.:—"Our experience goes to show that as regards wave action, the best form of pier is an entirely open one of piles, well driven and braced, with the decking well raised (at least five-and-a-half feet) above sea level, and with deck planks spaced 2 in. apart so as to reduce the pressure on the underside from the waves. Such a pier at Anzac has remained practically undamaged. It is true that the site is slightly sheltered and that latterly it has received some protection from a sunken

ship, but it has survived buffetings from heavy seas. The disadvantages are that it affords little shelter for boats or lighters alongside, and that it is liable to damage from loose or badly handled craft driving against it. Moreover, there is a tendency to leave lighters, full or empty, tied up to the piers when the sea gets up, and the alternate pull and jolt on the piling from these heavy craft gradually loosens the piles. For breakwaters and solid piers, where there is any considerable sea, no stones that can be got out or handled are of any use unless confined by piles and sheeting or by some sort of grillage. Of course, a solid pier of large concrete blocks or something like a Vibrocel construction would have been best both for piers and breakwaters, but I am convinced we could never have got the plant and cement to the beaches in time, unless we had begun a good deal earlier than August. The ships sunk by the navy as breakwaters, have generally been too small and weak, and we have not been able to fill them properly."

In this connection Major-General Sir George Scott Moncrieff, D.F.W. at the War Office wrote, subsequent to the conclusion of the Gallipoli campaign :—"Some criticism has been made on the policy of using sunken ships to form piers or breakwaters, and it has even been asked why, from the first, piers of concrete were not constructed. The reason why sunken ships were used is that time was of extreme importance and that the use of such ships was the only means whereby large and heavy masses could be presented rapidly to the violence of the waves. A concrete deep-water pier would have taken years to build in such a site, and any form of trestle work would have been wrecked in heavy storms, as in fact it was in the cases where it was used."

R.E. WORK AT ANZAC FROM OCTOBER TO DECEMBER

It was on 11th October that, for the first time, water was delivered at Anzac from a lighter at its moorings 200 yards out. A little later, water storage was increased. On 24th October, four tanks each of 1,000 gallons, were erected at the pumping station at Anzac Cove. Five 220-gallon cylindrical tanks were then issued to the divisions. In November, canvas tanks were erected in the valleys, and 2-in. pipe-lines up the valleys to these tanks were pushed forward as far as material allowed. Wells continued to give a good supply. On 9th October, a 54th Division well was yielding 24,900 gallons daily and other wells, including satisfactory wells on North

beach, 18,000 gallons. All were covered and fenced. On 29th October, pipe connections were made to pump water from lighters at the *Milo* to the tanks on Anzac beach and thence to the Plugge's Plateau reservoir.

October saw the start of two further enterprises, neither of which, however, was successful. One was a plant for condensing 22,000 gallons of sea water a day. This plant included four large vertical boilers, and was to be erected on a site close under the cliff south of Anzac Cove. Excavation began on 9th October, and gradually the heavy material was brought from Mudros, and piece by piece the ambitious edifice was erected with a gantry. Unfortunately work was not unnoticed by enemy observers, perhaps those on Gaba Tepe point, two miles to the south, although the cliff had been cut back to conceal the plant. On 24th November, when all was practically ready, heavy and directed artillery fire smashed two of the boilers. It was clear that nothing short of a roof of concrete and heavy rails would make the plant safe, and the Engineer-in-Chief ordered it to be dismantled.

The second enterprise was a deep-well boring plant sent out with expert American personnel. It was hoped by this means to tap water-bearing strata which would be independent of the seasonal drying up of surface water. Two American expert well-borers arrived on 20th October with a drilling rig. Next day one of them was wounded and evacuated. The other left. The derricks were, however, erected in Monash Gully, but came into the view of the enemy, who promptly shelled them. They were therefore erected on another site, but the necessary tools did not arrive until 22nd November, and drilling was resumed. When the bore was 12 ft. down, orders were received that the plant was to be removed (in view of the fact that a decision to evacuate had by then been reached.)

On 28th October, the blizzard rendered all work on the beach impossible and no sea-borne water could be received. There were only three days of half-rations ashore, and a very critical water situation arose. Many pipes ashore were frozen, involving many bursts.

Roads had been cut along the sides of the valleys to be clear of the expected winter torrents. The tramway, which had been laid from Anzac Cove to North Beach to serve the piers there, was brought inland some yards, to a higher level, to be clear of the waves. By 16th October, the tramway had been laid to a point

1,000 ft. north of Mule Gully, and the formation was completed as far as No. 2 Outpost. By 6th November it had reached Indian Brigade Headquarters further north. In November, a high level road along Anzac Beach and Ari Burnu Point was begun, involving bridges over the gullies. The intention was to have a road above winter storm level and to leave the actual beach to mule carts. This road was proceeding fast when evacuation was ordered.

The danger from shell fire and the general severity of life at Anzac was found to be too severe a trial for Greeks, Egyptians and Maltese, and they had gradually to be sent away.

Hutting for the winter began in October, but made little headway owing to the shortage of materials. Terraces were dug under cover of the steep hillsides, for living and hospital huts, stables for the mules and for ammunition. Winter cookhouses, ration stores and an operating theatre were built.

Piers, Beach Work and Storms. On 15th October, the piling of a 45-ft. L. end to Watson's Pier was completed. A bay was added to Williams' Pier at North Beach and the piles at No. 8 Pier were driven. The concreting of Watson's Pier proved difficult owing to the unsteadiness of the sheeting in rough water. It was therefore decided to use concrete blocks instead, and to extend the pier. This the 37th Company, R.E. carried out, using bolts and nuts instead of spikes for the timber work. The Chief Engineer decided on 29th October to concrete only the heads of Williams' and Watson's Piers, as small craft would not shelter at them in rough weather.

During the first of the storms on 8th and 9th October, a loaded lighter tied to No. 2 Pier broke adrift, tore away 30 ft. of the pier and went ashore. An empty horse boat on the south side of Watson's Pier charged the shore end, passed straight through and carried away 40 ft. of trestle work and the two 3-in. main suction pipes leading to the steam pump on shore. This temporarily cut Anzac off from its water ships.

The storm, however, did little harm to the piers on North Beach. They were repaired in two or three days, but it was quite clear what the future held in store. On 26th October the navy sank the steamship *Milo* as a protection to the North Beach piers. She was a great success until the very end, and although during the storm of 15th and 16th November she broke her back, she did not shift.

Very heavy seas occurred on 27th and 31st October. The piers were not badly damaged, but much small shipping was lost. Again, on 11th November, all small craft had to go to Imbros for safety

and the transference of the North Beach tramway to a position further ashore was begun. On 15th November, a combination of gales and gunfire destroyed the decking of Watson's Pier, and two days later the outer half of No. 2 Pier (next to Watson's) was washed away. Williams' Pier was left almost intact, but only the piles of No. 8 Pier, next to it, remained. The whole beach was then awash. It was decided not to re-erect No. 2 Pier.

The battle of the piers was, in its way, as gallant an affair as that of the tunnels and trenches on the hills above, and just as subject to continuous shell fire.

Dug-outs on a deeper scale were begun in late October when Bulgaria joined the enemy. They were untimbered as no material was to be had, but fortunately the clay soil was very stable, and when the Australian Historical Mission visited Anzac in 1919 the deep galleries were found to be still in existence.

The front line work was almost entirely underground. As no further attack on a large scale was likely, the mining and counter-mining became less menacing. In October, the Turks showed some activity in advancing their galleries and the Australian miners dug defensive ones. Tunnels ran at different levels, and on 17th October, a Turkish gallery destroyed one above it and was in its turn destroyed by one of ours below. An "envelope" gallery protecting our front line had been constructed during the fighting in early August. From it a few short low-level tunnels, and from the trenches above several high-level galleries, were led forward. The working party for the whole consisted of fifteen Australian sappers, twenty-six miners from the infantry and fifty-six carriers. A Turkish gallery was broken into at several points. Much bombing followed and there were many adventures when our workings met those of the enemy, but there little ground was gained.

On 29th October, Lieut.-Colonel G. C. Elliott, C.R.E., 2nd Australian Division, Major S. F. Newcombe, R.E., two Australian Engineer officers and seventeen men, were poisoned by carbon monoxide from an ammonal charge, and the Australian officers died. In mid-November various charges of from 200 to 500 pounds of ammonal were used, causing much havoc to the Turks. They were usually fired when the enemy were believed to be from two to six feet from our workings. Mining activities always suffered considerably from shortage of materials. The workings were all surveyed at 30 ft. to 1 in.

In late autumn drainage of trenches became very important.

During the blizzard the troops at Anzac, being on high ground in deep trenches and dug-outs, did not suffer to the same extent as those at Suyla and Helles, but conditions at the end of November were exceedingly unpleasant and work on the front line became impossible.

R.E. TASKS AT ANZAC DURING THE EVACUATION

Beginning on 11th December, extra entanglements together with contact mines were placed in front of the beach defences on the right flank, and the wiring of the fire line was everywhere increased. Mines were not placed in the gullies as it was thought they would hamper troops moving back to the beaches. Mills bombs just reached the peninsula in time to be used with trip wires during the evacuation. In the fire trenches, in order to deceive the enemy, periscopes continued to be shown, fires were kept going, and a semblance of trench digging was kept up by men who shovelled loose earth on to the parapet, but let it fall back into the trench. An Australian Corporal of Infantry invented a reliable automatic method for firing rifles in the front line after the last man had left.

It was feared that on the last night the enemy, whose trenches were so near to our own, might hear the sound of boots moving on the trench bottom; blankets were therefore laid, soft earth was sprinkled and the last parties wore socks or sandbags over their boots.

Small trestle footbridges for use on the flanks, five at the mouth of Azmak Dere and two at Anzac Cove, were placed after dark on the night of evacuation.

Lieutenant Kirkaldy, R.E., who had erected the condenser plant, often under fire, demolished it, as it could not be removed. Nearly all the elaborate pumping plant was destroyed. The divisional engineers destroyed ten pieces of artillery on the last night.

The most dramatic moment in the Anzac evacuation was the firing of the enormous mines. There were three of these, one at Arnall's, 50 ft. below ground, charged with 2 tons of ammonal, and two, 30 ft. below ground charged with $\frac{1}{2}$ ton each, at Russell's Top. They were fired at 3.30 a.m. by Lieutenant Caddy, of the 2nd Australian Division. There followed a tremendous but fruitless rifle fire from the enemy. The mines completely destroyed the enemy's front line above them, killed seventy men, formed two large craters and, of course, led to the enemy's discovery of the evacuation—too late.

CHAPTER XII

LAST DAYS AT HELLES

R.E. work in the autumn—Plans for the final evacuation—The evacuation—The R.E. at Helles during the evacuation—Conclusion.

(See Sketch 1, facing p. 12)

R.E. WORK IN THE AUTUMN

DURING the autumn the strengths of units at Helles fell away badly owing to casualties, disease and lack of reinforcements, e.g., in October the 428th Field Company of the 42nd Division were down to thirty-one sappers. The strain on the R.E. is indicated by the fact that the 413th Field Company were withdrawn to rest in December for the first time since they had landed.

The R.E. work in the line in late summer and autumn did not differ greatly from that in the earlier months. When the 1/2nd West Lancashire Field Company joined the 42nd Division on 13th October they were employed on front line work. In December deep dug-outs were built in anticipation of heavier bombardment.

Tunnelling continued all through these months more or less uneventfully. Miners from the infantry were collected to assist the R.E., and this they did to great purpose, some of their mines being 100 ft. below those of the Turks. The miners were later collected into a unit called the VIII Corps Mining Company, under the direction of Major H. W. Lane, and were subsequently formed into the 254th Tunnelling Company, R.E.

A large magazine (500 ft. by 20 ft., and 9 ft. high) was begun in November, near Lancashire Landing, as shelling of the beach had become serious. It was excavated by Greek labour.

Roads were badly held up in October for want of material, and stone had to be brought from Imbros, the first load arriving on 5th November. At the end of that month the Imbros quarry was delivering 100 cubic yards daily. Another quarry was opened in mid-December. The diary of the Monmouth Company records the quarrying of stone locally for roads being built by them. A steam tractor was used on the beach to haul in timber from sunken barges.

One-and-a-half miles inland, there was by now ample water in wells, and arrangements were made to pipe it down to the beach

at Lancashire Landing to save the cost, labour and daily risk of landing Nile water. Unfortunately, piping gave out when the line had been laid half way, and, as the C.E., VIII Corps points out, "a far greater weight of water from Alexandria was used every day than the whole weight of the pipes required to connect up and complete the scheme." It was not until 18th November that enough pipes were received to finish the line, and after this no more water was brought by sea. The pipe-line proved invaluable during the evacuation, in spite of damage by shell fire. A well was sunk by the 136th Monmouth Army Troops Company at Gully Beach.

In the autumn the construction of winter shelters became pressing, including those for headquarters of brigades, battalions and companies, and, of course, for dressing stations. The roofs were made of corrugated iron with a covering of three inches of earth, but the shortage of material was extreme. In October the 427th Field Company of the 42nd Division constructed winter quarters for the reserve brigade in Gully Ravine. These were sunk 3 ft. into the ground, timbered and sandbagged. Baths and disinfectors were started in late October. A stationary hospital was completed by the Monmouth Company. In mid-November the rains began and their violence ruined much of the R.E. work. The great blizzard of November, which was so disastrous at Suvla, was far less severe at Helles, though the temperature fell to 14° F.

The principal work of the Royal Engineers was the erection, strengthening and maintenance of the piers. (See Sketch 5, facing p. 90.) It was a ceaseless fight against shell fire and the storms beating from the south on an unprotected shore. Ultimately, when rails and expanded metal became available, the following type of pier and breakwater was evolved with the assistance of Lieutenant E. Mathews, R.E., an ex-military Foreman of Works, who, alone amongst the staff, had had considerable experience in coastal work.

The piers were twelve to eighteen feet wide, according to their position, and consisted of an outer framework of steel rails driven vertically into the sea bed at intervals of from fifteen to eighteen inches, these lines of piles being secured by U-bolts to horizontal rails at sea level, and tied together by transverse rails every 6 ft. The structure was lined with expanded metal and filled with stone to four feet above water-level. Up to six feet depth of water, rails of 25 lb. per yard were sufficient, but heavy rails were used for greater depths than this. The system greatly reduced the amount of stone filling, moreover, large stones were only necessary on the

outsides and the core could be filled with smaller stones well compacted. No. 3 Pier, which was made in this way, was 12 ft. wide and 320 ft. long. It was completed in about two months, and was still more or less intact in 1922. No. 4 Pier and various wharves were completed by October.

After three days of gales in mid-November, half of No. 1 Pier was badly damaged and No. 2 Pier completely destroyed. The urgency and importance of repairing and strengthening the piers was then fully realized, and permission was given to employ all necessary labour, including artificers from the infantry. A field company, R.E. was allotted to the work, under Lieut.-Colonel A. B. Carey, R.E., C.R.E. Naval Division, and a total of 600 men were now employed as against a maximum of 200 before the storms.

Work on the beaches was always carried out under long range shell fire. At first this was not serious, but in November the Turks placed powerful 6-in. guns on the Asiatic shore and enfiladed Helles beach accurately. The casualties amounted to an average of eighty-four per day.

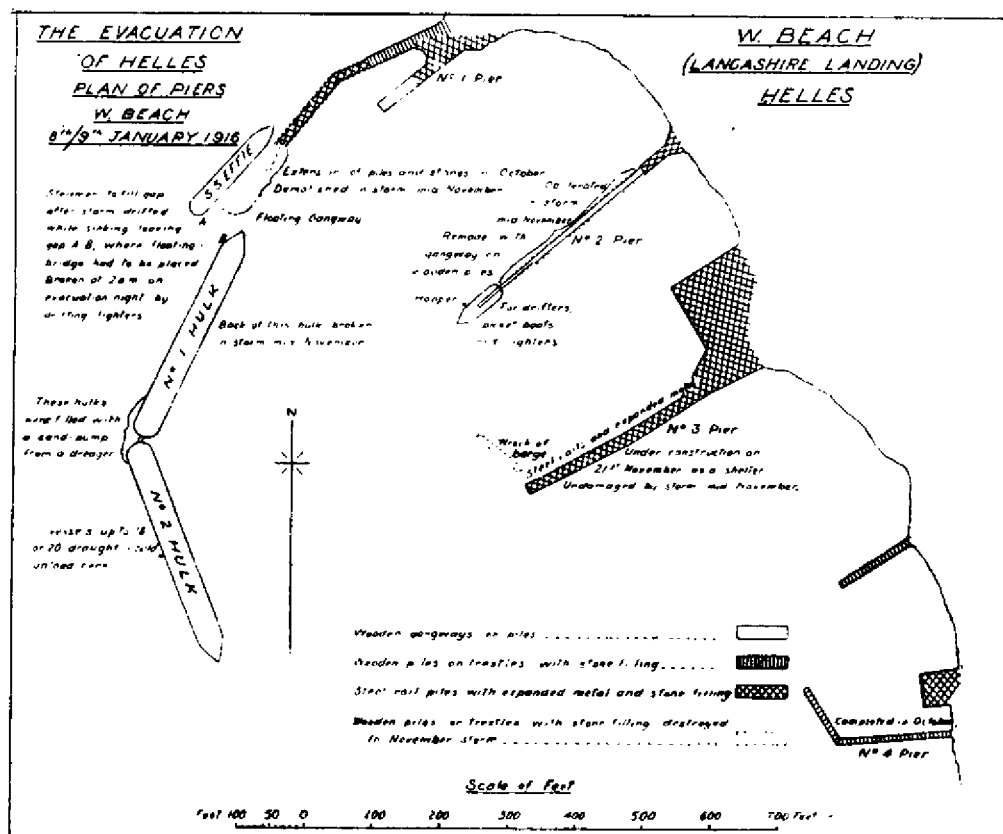
PLANS FOR THE FINAL EVACUATION

(See Sketch 1, facing p. 12)

On 21st December Anzac and Suvla had been evacuated, but "Helles was to be held for the present." On 24th December Sir William Robertson, new Chief of Imperial General Staff, telegraphed to the C.-in-C. M.E.F. "Make all preparations for immediate evacuation of Helles without, however, prejudicing a contrary policy of remaining there." On 28th December he telegraphed "The Government have decided that the Cape Helles position may now be evacuated. The withdrawal should be carried out as soon as practicable, but at your complete discretion."

It was clear that the only way to deceive the Turks a second time would be to complete the final stage of evacuation in a single night. Forward trenches must be held in strength to the end and the final garrison must withdraw in one bound from the front line to the boats. Redoubled care would be required to preserve normality in the appearance of the scene on shore and at sea. There would have to be great activity up to the last moment in patrolling, bombing and mining to retain our ascendancy in no-man's-land and prevent Turkish patrols from gaining information.

Arrangements were made for the Royal Naval Division to take over the French line at the mouth of Kereves Dere and the VIII



Corps front would then be held from right to left by the Royal Naval Division, the 52nd, 29th and 13th Divisions (less one brigade). It was decided that the intermediate stage was to be completed by 8th January, and that, weather permitting, final evacuation would take place on the night of the 8th/9th. "Thanks to the hard work of the Royal Engineers and the labour parties working under them, very good progress had been made in the repair of the piers on W beach, and from Christmas Day onwards the evacuation of animals and material not likely to be wanted in the winter—even if the position were retained—was pressed steadily forward."*

On 5th January the weather became so unfavourable that it was clear that all plans must be governed by the number of men who could be evacuated during the final night. At a joint Military and Naval Conference it was decided that, subject to the R.E. carrying out certain improvements to the breakwaters at V beach and additions at Helles, the navy could embark 17,000 men in one night, and that figure was fixed as the final garrison.†

We now know from Liman von Sanders' memoirs, that he had instructed his troops on the Helles front to be exceedingly vigilant in order to detect any signs of a British withdrawal, and that he was preparing to bring all the guns and the best divisions from the abandoned Suvla and Anzac fronts in order to mount an overwhelming bombardment and offensive against Helles at the earliest possible moment.

By the morning of 7th January, the Turks had not discovered that more than half the garrison had been withdrawn from the peninsula, but at midday, following a period of profound quiet, a violent bombardment was opened on the front of the 13th Division on Gully Spur. It continued until 4 p.m. and was the heaviest ever experienced on the peninsula. At that hour the enemy's officers could be seen trying to urge their men to assault, their trenches were bristling with bayonets, but our reduced artillery, with great assistance from the naval guns, delivered such an accurate and strong bombardment that the Turkish soldiers could not be induced to leave the trenches except at a few points, where they were quickly dealt with by rifle fire. At 5 p.m. the bombardment ceased, and the enemy made no further attempt to test the strength of

* *Official History*, Vol. II, p. 466.

† From 25th December, 1915, all work on piers and quays and breakwaters was under the orders of Lieut.-Colonel A. B. Carey, C.R.E. Naval Division.

the British line. He remained convinced that there were no thoughts of immediate evacuation.

THE EVACUATION

Favoured by a quiet night, 2,300 men, nine guns and nearly a thousand animals were embarked on the night of 7th/8th January, and the garrison now stood at just under 17,000, ready for the final withdrawal.

Success now depended on the weather, and in the morning the Admiral de Robeck ordered the final stage to begin on the night of 8th/9th January.

Almost the whole force was to embark at the piers of W and V beaches. Parties of engineers were to stay to the end in case of damage to the piers. The enemy and his guns were unusually quiet, but at about 7 p.m. the breeze began to freshen. "At nine o'clock the wind was blowing at 35 miles an hour and its force was steadily increasing. Angry seas were pounding the frail piers. Two heavy lighters, breaking adrift, crashed into the flimsy floating bridge on which so much depended, and the engineer party, under Lieutenant G. M. C. Taylor, working in black darkness with the waves dashing over them, were hard put to it to make the necessary repairs . . . In spite of these difficulties, however, and thanks to the seamanship, courage and resource of the naval personnel, both afloat and ashore, the second echelon of troops was embarked well up to time and all the thirty-seven guns to be evacuated were safely got away. The superb handling of the troop carriers, and the consummate skill which enabled the destroyers to be brought alongside the awkward hulks at W and V in pitch darkness and half a gale of wind, were worthy of the highest traditions of the Royal Navy, and won the admiration of all troops who benefited by them."*

By 3.30 a.m. the sea was running so high that further embarkation at W and V beaches would soon be impossible, but by 3.45 a.m. the last picket boat left the shore and the evacuation was complete. The main magazine at Helles blew up with a thunderous roar.

For the second time within three weeks the German High Command and the Turks had been hoodwinked and the evacuation of Helles with a rough sea was just as successful as those of Suvla and Anzac in a calm, not a single life having been lost.

* *Official History*, Vol. II, p. 476.

THE R.E. AT HELLES DURING THE EVACUATION

The R.E. were employed with the infantry to construct defences to cover the beaches. All communication trenches not to be used on the final night were blocked and those to be used were carefully marked.

The C.R.E., 29th Division (Lieut.-Colonel A. J. Wolff), records that the defensive and automatic mine arrangements were very similar to those which his divisional engineers had made and used at Suvla.

Major Cracroft-Amcotts, O.C. 72nd Field Company of the 13th Division, describes the doings of his company from 1st to 8th January as consisting of "work on communications, improving the main route down Gully Ravine; erecting bridges across the Gully streams; constructing redoubts; strong points and entanglements; all both by day and night." On 7th and 8th January this company prepared bonfires and mines with automatic time-firing arrangements. The 52nd Divisional Engineers mention placing automatic Very pistols and rifle devices, setting trip wires for bombs, and much destruction of material. The engineers of the Royal Naval Division at and after midnight connected up mines and closed barricades and entanglements, as the last parties passed through to the beaches. The last act was the firing of six large mines.

"At V beach a new pier was made to take two 'K' lighters, and a connection was made to the sunken French battleship for direct embarkation on to destroyers. The making of a number of small temporary piers in Bakery Gully and on X beach was practised at night. These were of four-legged trestles in six feet of water, and could be reconstructed in one and a half hours in calm water; in rough, they were useless."

At W beach No. 1 Pier had been repaired with rail piles and stone filling to within about a hundred feet of No. 1 Hulk. The gap was bridged with twenty-eight floating spans, made out of water tanks, metal drums and wooden casks of different sizes, extemporised by the 3rd Field Company Royal Naval Division. At a rehearsal on the 7th January it had been found that 1,000 men could pass over the bridge in an hour. On the night of embarkation the bridge was used by 2,000 troops until, at 2 a.m. in the rising storm, two heavy lighters crashed into it and, as previously stated, the party under Lieutenant G. M. C. Taylor had great difficulty in making the necessary repairs. It was later entirely broken up by two more

lighters. The company had also constructed long platforms on each side of a sunken collier from which the troops could go straight on board destroyers.

No. 2 Pier, which had been completely demolished to some hundred feet from the shore, was remade with a gangway on wooden piles. The hopper at the end of the pier was filled with stones to prevent its moving. No. 3 Pier had been completed to 300 feet from the shore, with steel rails and expanded metal, and was not damaged by the storm.

From piers 1, 2 and 3 on W beach, over 9,000 men were embarked safely on the night of 8th/9th January."

CONCLUSION

The brilliance of the planning, organization and administration, and the steadiness and discipline of the troops, resulting in this almost miraculous withdrawal from positions on the peninsula, in many places but a few yards from the enemy, aroused such world-wide astonishment and admiration that for an appreciable time it diverted attention from the fact that the British and French had suffered a major defeat.

"Yet, though the campaign failed in its main object—the capture of the Turkish capital—it was not an unredeemed failure, and the work on the peninsula in 1915 contributed largely to the eventual winning of the war. It was in great part due to the attack on the straits that the Germans cancelled their heavy offensive in the west which they had planned for the spring of 1915, that Italy entered the war, that Greece remained neutral, and that Bulgaria held aloof till the result of the campaign seemed clear. The threat to Constantinople protected the Suez Canal and relieved the Russians from Turkish pressure in the Caucasus. Finally, it was the heavy fighting in Gallipoli that destroyed the flower of the Turkish army and prepared the way for Lord Allenby's victory in Palestine."*

We must always remember, moreover, that the lessons learnt during the landing and subsequent fighting at Gallipoli taught us many lessons concerning the conduct of combined operations—lessons which have proved invaluable on many subsequent occasions, particularly during World War II.

The engineers who had done so much with so few resources were soon to have opportunities to show what they could accomplish under conditions of less heartbreaking difficulty.

* *Official History*, Vol. II, p. 486.

**ROYAL ENGINEERS IN THE BALKAN
CAMPAIGN, 1915-18**

CHAPTER XIII

THE LANDING AND ADVANCE INTO SERBIA

Introduction—Allied landing at Salonika—Work in Salonika harbour—Allied advance up the Vardar—Withdrawal to Salonika—The British Adriatic Mission—Railway work during the operations.

(See Map 2)

INTRODUCTION

THE allied Balkan campaign of 1915-18 was conceived in haste in the autumn of 1915 in fundamental disagreement between the British and French Governments, and even more so between their military advisers. There was also disagreement in the Greek Government upon whether they should be neutral or belligerent, and if the latter then on which side. In response to an urgent invitation from M. Venizelos, the Greek Prime Minister, the British 10th Division and the French 156th Division were embarked in the last week of September, 1915, at Mudros. The Greek King Constantine, however, disavowed his Prime Minister's invitation and dismissed him.

As the allied troop-ships approached Salonika their commanders were thus in doubt whether their landing would be opposed or welcomed, or whether they would be ordered to return. They were, in fact, neither opposed nor welcomed nor ordered to return. The Greeks adopted an aloof attitude of frigid neutrality, which might at any moment turn into hostility. Being neutral they placed no hindrance in Salonika upon the movements of the Bulgarian Consul and even of Bulgarian officers, who noted down particulars of every allied unit as it disembarked.

Not till late in 1917 was the Greek Government united in a declaration of belligerency on the side of the allies. Their unity was even then by no means shared by all ranks of the army or by all the population, but it sufficed to ensure valuable co-operation in the victorious campaign of 1918. The fundamental disagreement upon Balkan strategy persisted, however, between the French and British General Staffs until a fortnight before the opening of the final successful offensive. As to the two governments, the French

never wavered in their policy of treating the Balkan theatre as important and deserving of strong backing, but the British blew hot and cold. They usually supported the opinion of their General Staff that collaboration should be rigidly restricted to the defence of a perimeter round the harbour of Salonika, and that adequate equipment and transport should not be issued to their army to enable it to co-operate in an offensive. They were no doubt much influenced by the fact that they had to provide most of the shipping for a sea route of 3,000 miles passing through the submarine infested Mediterranean.

This fundamental disagreement upon policy at the top could not fail to exercise a baleful and restrictive influence upon the efforts of all British commanders and administrators down to the lowest level. Whereas operations and their supply questions should be studied and planned at least six months ahead, the British army in the Balkans was usually operating under the belief that they might at any moment be withdrawn to the defended perimeter or even be ordered to evacuate the theatre. We emphasize this vacillating policy and its effect upon both planning and supply, because engineer work is particularly dependent on foresight and the regular provision of materials, plant and labour.

The difference between the British and French policy is seen from the names given to their respective forces. The British, wishing to restrict their army to the defence of the port, called it "The Salonika Army," but the French named theirs "*L'Armée d'Orient*." Our Salonika army fought Germans, Bulgars and Turks, and played its part in influencing Greece and Rumania to join the allies. They compelled Bulgaria to sue for an armistice, and liberated Serbia, Yugoslavia and Rumania. The subsequent advance threatened Constantinople, and put the coping stone on Allenby's victory in Palestine and Syria, bringing about the armistice with Turkey. The Editor therefore feels that he is entitled to head these chapters of Corps history "The Royal Engineers in the Balkan Campaign, 1915-18," and he would ask the reader to try to realize the restrictions under which they worked.

ALLIED LANDING AT SALONIKA

(Map 2)

On 6th October, 1915, the Germans and Austrians opened their offensive and invaded Serbia from the north. By the 8th, they had

crossed the Danube and on the 9th entered Belgrade. Their advance up the Morava valley in spite of brave resistance by the Serbs proceeded irresistibly. While the Germans advanced southward the Bulgars were to attack from the east, and in particular they were to penetrate into the Vardar valley at Veles (Koprulu) and Skolpje (Uskub), thus blocking the escape route of the Serbians through this defile into Greece. King Constantine of Greece was determined to keep his country neutral with an inclination to benevolence towards the Central Powers, so he declined to take any action to delay the Bulgarian attack, and, as we have seen, dismissed his Prime Minister for inviting Anglo-French forces to land at Salonika. On 14th October the Bulgars, without declaring war, advanced into Serbia, and by the 24th had reached Veles in the Vardar valley.

After heated Anglo-French discussions orders were issued in late September for the British 10th Division and the French 156th Division at Gallipoli (both very worn out by their trying campaign) to embark for Salonika, and for other British and French divisions to sail from France. General Sarrail was appointed to command the French *Armée d'Orient*, and Lieut.-General Sir Bryan Mahon the British Salonika Army, with instructions to help the French to defend Salonika and its harbour. General Sarrail's intention, however, was to dash with such force as he could collect up the Vardar valley to help the retreating Serbs and to hold off the Bulgar attack on their flank.

The enemy had seized the initiative and the allies soon found themselves hustling and bustling without any previously prepared plans—a situation which the British army in its long history has learnt to accept.

The embarkations at Mudros and Marseilles were hasty improvisations; the disembarkation at Salonika was chaotic. There had been no time for planning, transport was woefully short and the Greek railway officials obstructive. Many of the men were still in khaki-drill uniform and shorts, some without overcoats. The units were separated from their transport, which arrived some time later and when it did was quite unsuitable for the roadless country. The force had only 350 lorries.

The 10th Division had disembarked by 17th October and was followed by the 22nd Division in November, the 28th in December, the 27th in January and the 7th Mounted Brigade (with a field troop) in February.

It was under the foregoing conditions that the Royal Engineers

had to start improvements to Salonika harbour and to help the Salonika army to fortify a wide perimeter. Major-General S. R. Rice arrived at Salonika to take up the appointment of Chief Engineer, and Colonel A. R. Reynolds accompanied Army Headquarters from Mudros, as Assistant Director of Works.

WORK IN SALONIKA HARBOUR

Although the fine natural anchorage at the head of the Gulf of Salonika will accommodate a number of large vessels, the enclosed harbour contained, in 1915, only three full-depth berths—a number far too small for the allied needs. Much work was necessary to provide the piers and other facilities required for unloading the tonnage required to maintain a force, which eventually grew to thirty-one allied divisions.

At the start unloading was by lighters and local boats plying to the limited quay space, but pier construction was started at once and proceeded continuously. For some distance from the shore the water was shallow and the bottom was of mud forty to sixty feet deep. The town of Salonika and the surrounding country at first provided hardly any useful materials except stone, and all stores had to be imported, a few from Greece, but nearly everything from elsewhere. The resources of the country were, however, steadily developed and Mediterranean skilled labour and contractors, mostly Greek, were soon attracted by the money to be earned. The Director of Works at Headquarters, Mediterranean Expeditionary Force (M.E.F.) was initially responsible for the supply of engineer stores, and began by dispatching what he could from Mudros, but, as was explained in the chapters on the Gallipoli campaign, Mudros was hardly a reliable source.

We will here temporarily leave the engineers at the Salonika base "scrounging" and improvising in order to help to unload the troops, their baggage, vehicles, food and ammunition, and to transport them inland to camps and depots at first completely non-existent.

ALLIED ADVANCE UP THE VARDAR

Having landed at Salonika on 12th October, General Sarrail at once dispatched the vanguard of a French force that was to cross the Greek frontier and to advance up the Vardar valley to make a

junction with the main Serbian army, held up just north of Skolpje by the Bulgar incursion from the east—an incursion that by 24th October had completely cut the route to Salonika. General Mahon was at first forbidden to send British troops beyond the perimeter required for the defence of Salonika, but by the 22nd October he had received permission to comply with General Sarrail's urgent request for British reinforcements in Serbia.

On 22nd October the 10th Division dispatched the 30th Brigade group, containing the 66th Field Company less two sections, to Dojran Station, and on 31st October began to take over the right of the French line, which was some sixty miles long and ran north-west from Lake Dojran across the mountains, thence along the river Vardar nearly as far as Veles (Koprulu).

At Krivolak, about forty miles from Dojran, the French held a strong bridgehead, which had to be served by two flying ferries. One of these was constructed by a combined detachment drawn from the 65th, 66th and 85th Field Companies with all the divisional bridging equipment—six pontoons and six trestles. At this point the Vardar flowed at four or five miles per hour, with turbulent eddies and was 130 yds. wide and 8 ft. deep at the banks. The work was difficult but the ferry was working by 9th November. The detachment then withdrew, leaving Lieutenant J. Evans-Gill with twenty-six sappers (and only twenty-one horses) as a party to operate and maintain it.

On 10th November the remainder of the 10th Division arrived at the front and took over about twenty miles of the line running north-west from Lake Dojran to the pass at Kostorino. They were much hampered by their four-wheeled wagons and lack of pack transport.

On 22nd November General Sarrail heard that the main Serbian army had failed to break through the Bulgars at Skolpje and were thus condemned to retreat over the high Albanian mountains to the Adriatic. He therefore ordered preparations for a withdrawal, but he was in no hurry to go, hoping to retain on his front (as he did) Bulgarian forces which would otherwise harass the retreating Serbs.

On 26th November snow began to fall. This was the beginning of the terrible blizzard which blew for several days, and in Gallipoli caused several thousand British casualties from exposure.* The

* This blizzard (the dreaded "Vardar wind") was repeated at about the same date in 1916, 1917 and 1918, but we were then better prepared for it.

ill-clad British troops of the 10th Division suffered severely. Twenty-three officers and 1,663 men had to be evacuated to Salonika with frost-bite or in a state of collapse. The 22nd Division who had just disembarked at Salonika sent forward their 65th Brigade to reinforce the front and the first battalion reached Dojran on the night of 6th December.

WITHDRAWAL TO SALONIKA

On the morning of 6th December, the Bulgars attacked the 10th Division forcing them to retire, and a further withdrawal occurred on the 8th after heavy fighting. Next day the French on our left were attacked, and began withdrawing down the road to Dojran behind us, and it fell to the 65th Field Company to carry out demolitions of culverts in their rear to delay the enemy. The defile at Dedeli, a most important sector of the British line, held by two battalions and the divisional cyclists, was placed under the command of Lieut.-Colonel F. K. Fair, the C.R.E.

On the evening of 11th December the enemy again acted boldly and a general retreat began across the frontier. The British and French units on the right became inextricably mixed and were lucky to reach Dojran Station (just inside Greek territory) without more casualties. The Bulgars did not cross the frontier, and the British returned to Salonika, some by train from Dojran and Kilinder, but the majority by road.

Meanwhile, Lieutenant Evans-Gill and his small party had had great difficulty in dismantling under shell fire his bridging equipment and moving it to the railway station (also under shell fire), where a passive Greek railway staff were very slow in providing trucks. The blizzard wind and 27 degrees of frost made working conditions terrible. On 6th December the party and their bridging equipment arrived by train at Strumica Station, where, with the assistance of a French working party, they constructed another flying ferry. This was dismantled on the 8th, and some of the equipment was loaded, with French assistance, into railway trucks. The French undertook to float the pontoons down the Vardar, and the remainder (except one wagon abandoned for lack of horses) and all Lieutenant Evans-Gill's party proceeded by march route, arriving at Salonika on 12th December. For this fine performance Lieutenant Evans-Gill was thanked personally by General Sarrail. Little had he known, when he packed his equipment at Krivolak, that he and

his pontoons were leaving a point on the Vardar destined to become the vital strategic objective of a battle involving nearly thirty allied divisions—a place whose recapture by Yugoslav cavalry nearly three years later was to be an important factor in ending the war.

THE BRITISH ADRIATIC MISSION

As soon as it became obvious that the Serbians would have to retreat over the mountains through Albania, the War Office sent out the "British Adriatic Mission" to help the Serbian army to reach the eastern shore of the Adriatic and embark there for passage to Corfu and later to Salonika. The first officers of this mission reached Scutari on 24th November. "A party of Royal Engineers under Lieut.-Colonel A. C. Macdonald was dispatched a little later for the construction and repairs of roads . . . The British Engineers did very valuable service in improving the ferries across the streams between Medua and Durazzo—service in default of which the Serbians would never have escaped."*

RAILWAY WORK DURING THE OPERATIONS

On 1st October Brigadier-General A. B. Hamilton and a few officers from Mudros had landed at Salonika to find out what preparations could be made for the disembarkation of a British force. The party included Colonel M. E. Sowerby, R.E., from the Sudan Government Railways, the Director of Railways designate. Their reception by the Greek authorities was so frigid and obstructive, not to say hostile, that Brigadier-General Hamilton communicated with the British Embassy at Athens, where the news of his party's arrival was as unwelcome as it had been in Salonika. He was told that they should go to ground until the situation became clearer.

On 2nd October the Greek Government took control of all the three railways in Macedonia hitherto owned and worked by private companies, but it was not until 5th October, the day when the first British troops landed, that Major Sowerby was able to get into touch with the Greek railway officials, who were still however passively obstructive. Shortly afterwards Lieut.-Colonel F. D. Hammond, R.E., arrived with a small group of officers and other ranks as a nucleus of a Railway Transport Establishment unit.

* *Official History, Military Operations, Macedonia*, Vol. I, p. 36.

Their mission, under Colonel Sowerby, was to get into touch with the civilian and military railway staff and to inform them of the transport requirements of the British force.

On the Macedonian railways locomotives and rolling stock were scarce and in bad repair, telegraph and telephone communication not properly organized and railway administration inefficient. Civilian trains impeded military traffic, and in fact the daily mail-train to Drama, loaded with spies, took precedence over all others. There were no roads to the front and the allied troops depended on the two railways—to Dojran Station and up the Vardar valley. These were single lines with passing places sometimes separated by as much as twenty-six miles. The Vardar valley line was Austrian owned and still had an Austrian staff working with the Greek military railway authorities.

Under these circumstances the confusion that prevailed during the foregoing operations can well be imagined. The British railway staff did however manage to cajole the Greeks into providing the absolute minimum of our requirements. One or two military trains ran daily but never to time; the telegraph line between Salonika and Dojran was jammed with messages, of which very few arrived; and enough transport was never available to serve the stations either at the base or at railhead.

CHAPTER XIV

THE DEFENCE AND CONSTRUCTION OF SALONIKA BASE

The perimeter defences—Deployment of the garrison—Work on the defences—Work at Stavros—Salonika docks—Salonika Base—Water supply—Engineer organization—Base and L. of C. units—Railways during the spring of 1916.

THE PERIMETER DEFENCES

(Map 2)

WHEN the force dispatched to the rescue of the Serbs had been compelled to fall back on Salonika, it found the base not yet organized or equipped. The situation, in fact, could hardly have been more confused. Disembarkation was in progress of five more allied divisions all trying to disentangle their units and equipment, so thoroughly mixed as the result of hurried loading in unsuitable ships. There was every reason to expect that the enemy would exploit and continue his successful advance in order to capture Salonika before its defences could be constructed and its garrison deployed. Although he did in fact halt on the frontier, his so far victorious army offered a very serious threat which made the defence of the base a matter of urgency. This defence was exactly the purpose for which the British Government had agreed to supply their troops.

The situation, *vis-à-vis*, the Greek Government was still obscure, and the local commander of the Greek troops would not permit the allies to fortify Salonika or even to make a reconnaissance for the work. It was obvious that Greek neutrality might change to hostility at any moment. Energetic diplomacy at Athens and General Sarrail's determination caused him to order reconnaissances to begin on 10th December, only two days before the allies were driven over the Greek frontier less than forty miles away. Work was started on 16th December in a dense fog, four days *after* the enemy had reached the frontier, but when the fog cleared two days later much of the work had to be re-sited.

Obviously the most urgent part of the defences was the sector across the two railway routes down the Vardar valley and across the railway and road which connect Salonika with Monastir to the

west. This important sector was allotted to the French, who now had three divisions. Their line ran up the Vardar for some twenty miles, then turning eastward joined with the British at Dautli, twelve miles north of Salonika. The British line ran thence through Aivatli to Lake Langaza. The tired 10th Division and 17th French Colonial Division from Gallipoli were allotted to the mountainous plateau east of Salonika, thus completing the perimeter.

The British line produced a problem of the type that occurs so frequently when siting defensive positions. North-east of Dautli there was an isolated group of hills the main peak of which was only 5,500 yards from our line which it overlooked and dominated. It was, moreover, within long gun range of the shipping in Salonika harbour. Should this feature be occupied as an advanced position? General Mahon rejected it as untenable, but General Sarraill was in favour of holding it and his view was shared by General de Castenau, who was sent out in December by General Joffre to inspect the defences of Salonika. In the end no serious work was ever done on this controversial and rocky mountain, and when the matter again became important two years later General Sarraill's successor supported the British view.

The front east of Lake Langaza also provoked some discussion. There is a natural line running due east from the lake, first seven miles of valley, mostly swamp, then Lake Beshik and finally the steep-sided Rendina gorge to the sea. This line required no more troops than the perimeter line east of Salonika and protected the whole of the Calcidice peninsula, but was almost inaccessible and afforded no defence in depth; moreover the lakes were by no means impassable and were not easy to defend. An alternative would be to hold the mountain range north of the above lake-gorge line, but this would require more troops and longer communications.

As soon as the 10th Division had rested and been reinforced, it was decided that they should move out to the lake-gorge line. The 30th Brigade group marched on 20th December to the gap between Lakes Langaza and Beshik, while the 29th Brigade group were taken by sea to Stavros to entrench and hold the gorge. The track from Salonika to the 30th Brigade passed through wild and rocky country and it required a long time and much labour to make it really serviceable. The 29th Brigade on the other hand could only be supplied by sea with no proper landing facilities at Stavros, where a pier had to be built as is described later. Naval launches were taken on pontoon wagons to patrol the lakes.

DEPLOYMENT OF THE GARRISON

In mid-January the 10th Division was relieved by the 27th and the line was then held, from right to left, as under :—

XVI Corps, Lieut.-General G. F. Milne,

Chief Engineer, Brigadier-General H. L. Pritchard.

27th Division C.R.E., Lieut.-Colonel G. Walker, with 17th and 1st and 2nd Wessex, later named 500th and 501st, Field Companies.*

10th Division,
in reserve C.R.E., Lieut.-Colonel F. K. Fair, succeeded in February by Lieut.-Colonel E. M. S. Charles, with 65th, 66th and 85th Field Companies.

Corps Troops.—143rd Army Troops Company.†

XII Corps, Lieut.-General Sir H. F. Maitland Wilson,

B.G., G.S., Brigadier-General F. G. Fuller, late R.E., Chief Engineer, Brigadier-General G. Godby, succeeded in January by Brigadier-General F. K. Fair.

26th Division C.R.E., Lieut.-Colonel C. G. W. Hunter, with 107th, 108th, and 131st Field Companies.

28th Division‡ C.R.E., Lieut.-Colonel E. S. Sandys, with 38th, 2/1st Northumbrian and 1/7th Hants, later named 449th and 506th, Field Companies.*

22nd Division C.R.E., Lieut.-Colonel D. M. F. Hoystead, with 99th, 100th and 127th Field Companies.

7th Mounted Brigade,‡ 6th Field Troop, O.C., Captain F. E. Fowle.

finding outposts

Corps Troops.—140th Army Troops Company.†

* The new numbers were adopted in 1917, but the units are referred to by their Territorial names throughout the following chapters.

† In November, 1916, a second company was posted—the 286th Army Troops Company to the XVI Corps and the 287th to XII Corps.

‡ The 7th Mounted Brigade and the 28th Division were transferred to the XVI Corps in July, 1916, on the advance to the frontier, their places being filled in November and December by the 8th Mounted Brigade and the 60th (London) Division, respectively.

WORK ON THE DEFENCES

On 16th January General Mahon was placed under operational command of General Sarrail, C.-in-C. Allied Armies, but administratively he remained under C.-in-C., M.E.F. Thus the Deputy Director of Works was responsible to the Director of Works, M.E.F., at Mudros, for the Salonika base and L. of C., and neither he nor the Chief Engineer could indent direct on the War Office for stores or plant, but had to demand from the Director of Works, M.E.F., and later from the Levant Base, Alexandria, which was formed early in 1916.

Throughout the winter, work was continued daily on the defences under trying conditions. Many of the trenches were in rock, necessitating slow and laborious blasting, while others were in low-lying ground with all its drainage troubles. Moreover, the troops had to live in tents on the bare hillsides in weather that alternated between bitter cold and heavy rain. Very useful work, however, was done by all arms, the gunners and infantry taking great interest in their defences, while the sappers built trench shelters, headquarters, machine-gun emplacements, etc., and supervised work on communications and obstacles.

As the evacuation of Gallipoli was proceeding, large quantities of engineer stores were dispatched from Mudros and Alexandria, and the War Office also made direct shipments of wire and sandbags. "By 12th January, 1916, the C.R.E. of the 26th Division, Lieut.-Colonel C. G. W. Hunter, calculated that his division had put out 245 miles of wire, and that he would require ten times that amount if three lines of defence were to be prepared and the redoubts wired all round in accordance with the original plan. This was, however, never carried out. The supply of engineering stores for the entrenched camp is a remarkable feat to the credit of British administration, because at the same time far greater quantities were being sent to Egypt, where the fortification of the Suez Canal on a grand scale was being undertaken."*

There is little doubt that the enemy should have been able to capture Salonika in December while our troops were still disorganized by disembarkation, lacked piers, transport and roads, and before they had had time to construct adequate defences. By the end of

* *Official History*, Vol. I, p. 91.

January the enemy's opportunity had passed—Salonika by then was strongly defended. The *Official History* refers to it as "the entrenched camp," but to the troops, who had put up those thousands of miles of barbed wire, it was always "the bird-cage."

WORK AT STAVROS

On the relief of the 10th by the 27th Division in the long sector forming the right of the British front, the 17th Field Company, under Major T. Gracey, disembarked at Stavros with the 80th Brigade, and by 13th February, 1916, were helping to defend the sector between Lake Beshik and the sea. The line ran for five miles through difficult country along the north side of the Rendina gorge.

Their tasks, typical of engineer work that winter, involved the improvement and maintenance of the lateral road running through the gorge, the building of a decauville line parallel to it and the opening up of tracks over the hills to the trenches. For this work local labour was recruited. Several small bridges were required. Much work was of course done in assisting the infantry to construct defences, and a reinforced concrete platform was made for a 6-in. gun. Water supply was carried up to the trenches. Reconnaissances, involving very adventurous rides, were made in the wild country in front, as far as the Struma valley, in order to correct the very inaccurate Austrian map. The most interesting work, however, was probably the construction of a pier at Stavros, for the garrison was entirely dependent upon maintenance by sea.

The pier had been begun by Lieutenant J. H. Waller before the arrival of the rest of the 17th Company, and it took two-and-a-half months to complete. It was of ingenious design involving the minimum use of imported material. Cribs made of locally felled timber were floated into position and sunk by being filled with "sausages" made of boulders held together by a net of barbed wire. The deck had a reinforced concrete framework, to which was secured torpedo netting in order to hold the ballast surface. Fender piles were driven outside. The pier was 50 ft. long, 25 ft. wide and reached to 22 ft. depth of water. There was, of course, very little rise and fall of tide. The pier was used by "K" lighters throughout the war and stood up well to winter gales.*

* A full account, with photographs, appeared in the *R.E. Journal* of April, 1922.

SALONIKA DOCKS

Our story left the engineers at Salonika doing what they could to help the army to disembark and to move to base depots and camps or further out for work on the defences. Improvisation soon developed into the organized planning of a suitable base for an allied force destined to increase considerably. The British provided most of the shipping and accepted a major share in the work of developing the base. The base area at first consisted of the flat ground between the sea-shore and the foot of the surrounding chain of hills, but was later gradually extended till it had a radius of some eight miles. An L. of C. area outside the base afterwards extended to within about twelve miles of the new front line.

The first and most urgent demands were for piers to expedite the unloading of the ships and for railways, decauville and roads to clear the very restricted quays. Although the lack of quay-space created great delay at the start, on a long term view it was fortunate, in that it prevented a recurrence of the mistake made at the French ports, where the misappropriation of the dock area and transit sheds as permanent depots caused great delay to shipping and was found extremely difficult to correct. In Salonika there was no alternative to the construction of depots outside the town with good communication between them and the docks, and once that had been accomplished, the period of congestion and delayed shipping was over.

On 8th November work was started on a new timber pier on piles driven deep into the mud, and about the same time repairs were undertaken to an existing coal pier that was in a state of collapse. These repairs were finished at the end of February, a temporary pontoon pier being provided meanwhile.

Eventually six piers were built for British use :—

- (i) Marsh Pier, west of the town, 1,169 ft. long, 43 ft. wide, water 7 ft., with a Y-shaped pier-head 269 ft. and four lines of decauville.
- (ii) Gravesend Pier, also west of the town, 1,021 ft. long, 9 ft. wide, water 7 ft., with a 286-ft. pier-head and decauville track.
- (iii) Malta Pier, 278 ft. long, 16 ft. wide, with 7 ft. of water.
- (iv) New Pier, 590 ft. long, 22 ft. wide, with 15 ft. of water. Completed early in March, 1916.
- (v) Hay Pier, 33 ft. wide.
- (vi) Karaburun Pier.

In spite of the length of these piers, the depth of water was only enough for lighters or very small vessels, but by the end of 1916 British ships were landing about 40,000 tons per week for the British army and about the same amount for the allies. A tug and a small motor vessel from Mudros were at the disposal of the A.D.W. for landing R.E. stores.

SALONIKA BASE

A new railway line was laid from the docks to a new marshalling yard at Dudular, about four miles out along the Monastir road. This relieved the civil line of all docks traffic. In the marshalling yard trucks were sorted for consignment to the various base depots. The railway was also extended southwards through the town to Mikra where a raised and healthy site with cool sea breezes was used as a hospital area.

There were eventually twenty-five general hospitals (four completely hutted) each with about 2,200 beds, and on the L. of C., seven stationary hospitals each with 600 beds. There were also eleven convalescent camps. These all involved the provision of roads, water supply, and huts for wards, operating theatres, kitchens, messes, staff quarters, lavatories, stores and other accessories, electrically lighted throughout. Hutting was provided in the tented hospitals for all purposes except for the wards and quarters. In corps areas there were the usual casualty clearing stations and field ambulances, but as conditions remained semi-static for nearly three years, these were gradually placed upon a semi-permanent basis involving considerable work. Some of the general hospitals were moved to hill sites every summer, a very necessary operation in this malarial country, but one that increased the demands upon the sappers.

The ordnance depot was at first in tents, but these were gradually replaced by hutting, mostly prefabricated in Alexandria. By May, 1916, twenty-one large sheds had been shipped. They had a span of 40 ft. and a total area of about 21,000 square feet. Large buildings were also provided for A.S.C. motor transport and ordnance workshops. Other depots established in the base area were the supply depot, a big ammunition depot with high earth banks between the huts, a remount depot with dry standings and shelters for the animals, a veterinary hospital, a medical stores depot, base camps for troops and, of course, the R.E. base park and workshops. All

these depots and camps required access by rail and, or, road and decauville. The traffic very soon played havoc with existing roads, especially the Seres road running north-east from the town. Transport for road-making was very short indeed.

The foregoing gives a picture of what was ultimately accomplished at the base, but the early progress was distressingly slow, owing to the disorganized unloading of the ships, the absence of sufficient piers in the harbour and communications from it to the depots, the lack of transport and road-making plant, and above all the intense shortage of R.E. units and local *skilled* labour. "If the early period was one of breathless hand-to-mouth improvisation, there was afterwards well-controlled smooth-working efficiency . . . The whole machinery was in chaos until the end of January, 1916, by which time a railway had been laid between the docks and the depot, and even then months elapsed before all was running smoothly."* It would probably be true to say that not till the end of 1916 was the base area properly developed and working well, and not till the middle of 1917 was the L. of C. really efficient.

WATER SUPPLY

In one respect it was fortunate that the allied landing took place in winter, for during the dry season the water supply of Salonika was too small for even the civil population. As it was, the enormous increase in consumption immediately over-taxed the five springs upon which the town depended. Repairs were, therefore, started upon a disused and damaged Roman aqueduct—an open channel, stone-lined and beautifully graded—running from Eurentik, four miles east of Salonika, but it was not until June, and at the cost of great quantities of cement, that this aqueduct was delivering about half a million gallons per day to the base area. At first, surface wells were dug and provided with small pumps and pipe-lines, and a limited supply was also obtained from the town system. The solution, however, to the very big water problem was not found until artesian sources were tapped by six to ten-inch boreholes sunk to depths of from 200 to 700 feet. Deep-well pumps and storage were installed and pipe-lines were laid to camps and depots.

The well-boring and the installation of the pumps was done by a British firm—Messrs. Beeby Thompson & Co.—who, in January,

* *Official History*, Vol. I, p. 272.

arrived from Gallipoli where they had been doing valuable work. Under the general direction of the Chief Engineer, they sank at least forty borcholes (twenty-eight for the British and twelve for the French) within nine miles of Salonika, giving a total yield in the British area of about half a million gallons per day. These deep wells were supplemented by 1½ or 2-in. tube wells driven to a depth of about twenty-five feet in the dry beds of streams and on the shores of lakes. Several of these, coupled up to a Merryweather pump, would yield up to 1,000 gallons per hour. Having finished this work in the base area, Mr. Beeby Thompson dispatched some well-boring crews to the L. of C. and corps areas. He also equipped lorries with crews and tube-well plant, with which on suitable sites hundreds, or even thousands, of gallons per hour were produced within a few hours of arrival. These lorries were a great help in corps areas and during the final victorious advance.

ENGINEER ORGANIZATION

We have seen that Colonel A. R. Reynolds arrived at Salonika in October as Assistant Director of Works, receiving general instructions and supervision from the Director of Works (M.E.F.) at Mudros, and later Cairo. This was probably the best arrangement during the period of improvisation in this hastily conceived theatre of war, but obviously could not last long. The first change came in May, 1916, when the A.D.W. became a D.D.W., responsible, not to D.W. (M.E.F.), but to C.E. Salonika army. The next step did not occur till 1917, when the Army Commander at Salonika was made a Commander-in-Chief dealing on all matters direct with the War Office. As a result, the Chief Engineer, Salonika army, became an Engineer-in-Chief and his D.D.W. a Director of Works.

We start therefore with Colonel Reynolds as A.D.W., but in March, 1916, when the Chief Engineer, Brigadier-General S. R. Rice, became Engineer-in-Chief in France, Colonel Reynolds succeeded him, and Colonel J. P. Blakeway became D.D.W., and in 1917 Director of Works. In May, 1916, when Brigadier-General Reynolds vacated his appointment, he was succeeded by Brigadier-General H. A. Livingstone who could not, however, take it up till August, as he had not yet recovered from a wound in France, so Brigadier-General H. L. Pritchard acted as Chief Engineer, Salonika army, in the interval. In 1917, when Brigadier-General Livingstone

became Engineer-in-Chief he was given the rank of Major-General.

Brigadier-General Blakeway had under him an A.D.W., Base, Lieut.-Colonel A. G. T. Cusins (later Lieut.-Colonel H. N. Hooper) and an A.D.W., L. of C., Lieut.-Colonel G. S. Pitcairn (later Lieut.-Colonel G. B. O. Taylor).

BASE AND L. OF C. UNITS

The dates of arrival of non-divisional R.E. units were :—

Base Units

137th Army Troops Company	November, 1915
37th Army Troops Company	January, 1916
139th Army Troops Company	February, 1916
33rd Base Park Company	November, 1915
4th Advanced Park Company	November, 1915
28th Fortress Company (detachment)	January, 1917
117th Railway Company	February, 1916

L. of C. Units

420th (West Lancs) Field Company	November, 1916
138th Army Troops Company	January, 1917
95th Labour Company R.E.	December, 1916
96th Labour Company R.E.	December, 1916
Mining Company	

Corps Units

143rd Army Troops Company (XVI)	November, 1915
140th Army Troops Company (XII)	January, 1916
286th Army Troops Company (XVI)	November, 1916
287th Army Troops Company (XII)	November, 1916

There were thus only five army troops companies in Macedonia for the first year of the campaign, when most of the construction had to be done. Then, when the possibility arose of an advance to the Danube to co-operate with Rumania, four more companies arrived, but too late had the advance been successful, and even too late to prevent a very serious situation arising on the existing communications during the winter of 1916/17. The establishment of foremen of works, engineer clerks, etc., was pathetically small, the first draft of two foremen and five clerks not arriving till March, 1916.

The 33rd Base Park Company was at first sent with a very much

reduced establishment, and being unable to cope with its task, it had to be reinforced by the undesirable system of posting small parties from each army troops company until it was eventually made up to full strength. Major A. G. T. Cusins, who commanded the unit until he was appointed A.D.W., Base, wisely planned the base park for its inevitable expansion into a large depot, with an extensive timber-yard, numerous store-sheds and well equipped electrical, metal working and joinery shops. A decauville line ran from the "New Pier" in the harbour to the centre of the park. Later in 1916, a part of the park was set aside for an E.-in-C's. reserve of stores for use in case of an advance. This reserve, mainly of bridging materials, proved to be of great value during the operations in 1918. In 1917 both the Base and Advanced Parks were served by standard-gauge railway with ample unloading sidings.

RAILWAYS DURING THE SPRING OF 1916

The Macedonian railways remained under Greek control until June, and it required great tact on the part of our small Railway Transport Establishment to secure even a restricted railway service, but as the allied forces grew, and especially when the French began to advance up the Vardar valley, the Greek railway administration gradually became somewhat more helpful. Moreover, the efforts of our own modest resources in railway units soon began to bear fruit, and improvements appeared in both railway lay-out and operation at the base. Our Railway Transport Establishment (R.T.E.), now called the Movement Control staff, was slowly increased to twenty-five officers and 154 other ranks, who could not only then carry out liaison duties but also supply certain operating personnel.

In the first week of February, the 117th Railway Construction Company arrived from Mudros. This unit, supplemented by local labour, enabled the Director of Railways to start the construction of sidings in the base depots, and to insert some additional passing places on the two single-line railways running north.

Early in the year the French blew up the railway bridge over the Struma at Demir Hisar, thus cutting the line from Constantinople to Dojran.

The Greek railway administration eventually agreed to construct a station at which British troops could entrain at Salonika in the event of a move northward, but the general attitude of their Government, well indicated by the exorbitant prices charged for

allied railway traffic, made it quite obvious that, if we were to advance, the existing organization would break down at once.

On the return of our troops to Salonika in December, 1915, there had appeared to be no likelihood of any call for the development of railways behind an advance; Colonel Sowerby had therefore handed over to Lieut.-Colonel F. D. Hammond, and returned to Egypt where he was destined to do valuable railway work during the Palestine campaign.

CHAPTER XV

THE ADVANCE TO THE FRONTIER, SUMMER, 1916

The British advance to the Struma valley—R.E. work in the forward area—The climate and malaria—The enemy defensive position—Communications in the British area—Organization for road building—Railways—Survey.

THE BRITISH ADVANCE TO THE STRUMA VALLEY

(Map 2)

WE now know that by March, 1916, General von Falkenhayn had given up all idea of attacking Salonika. The allies were, of course, ignorant of his decision, but it was clear that withdrawals were being made from the German Eleventh Army in Macedonia, so that by the end of May only one German division remained. At the same time, the Serbian army of 120,000 men who had escaped to Corfu had there been rearmed and equipped for mountain warfare by the French, organized in six divisions and transported to Salonika, making a total there of fifteen allied divisions.

From February onwards, General Sarrail, supported by General Joffre, was pressing for an advance to the Greek frontier to get into close contact with the enemy. The British C.I.G.S. tried to adhere to a purely defensive policy, but one concession after another was wrung from him by the French General Staff, and on 24th February, he telegraphed to General Mahon that, although no operations on a large scale were contemplated, a portion of the British forces would be given transport suitable for offensive action. On 16th March, General Sarrail began to move French troops forward, and on the 24th General Mahon was authorized to advance up to, but not over, the Greek frontier. Two brigades of the XII Corps were accordingly moved to near Sarigol on the railway to Dojran, by which time all four French divisions were forward. On 25th April, General Joffre again pressed our C.I.G.S. to hasten the equipment of the British Salonika Army for mountain warfare, but on 17th

May the British Government were still opposed to any offensive operations, asserting that "strategically the right course was to bring the whole of the troops away."

As a result of the telegram from the C.I.G.S. on 24th February, demands for pack transport and limbered G.S. wagons were submitted on establishments and scales already prepared. Chief Engineers of corps had made their proposals for the requirements of divisional engineer units, and all field companies began to make tool-racks and boxes for carrying their equipment on pack saddles, and to train drivers and sappers to handle loaded mules. It was not until 11th July, 1916, that the War Office finally approved a pack transport establishment for the Salonika army and authorized the reorganization of units accordingly. Ten thousand mules were required in addition to those with mountain batteries. It was not until the autumn that the authorized establishment was completed and the British became the best equipped force in Macedonia. On this new establishment there were no wheeled vehicles with field companies, and the horsed pontoon and trestle wagons were withdrawn and parked at the base to be sent forward when required. As, however, stationary warfare prevailed until September, 1918, units were much handicapped by not having their bridging vehicles for hauling long timber and other material along tracks where lorries could not go.

On 9th May, 1916, General Mahon, having been appointed to command the force operating against the Senussi in the Egyptian western desert, handed over command of the Salonika army to Lieut.-General Sir George F. Milne, and Lieut.-General Sir Charles J. Briggs assumed command of the XVI Corps.

On 27th May a Germano-Bulgar force marched through the Rupel Pass into the Struma valley, occupied Fort Rupel, and advanced without Greek opposition to positions ten miles south of the frontier. General Milne soon found himself in a dilemma. His instructions from home required him to avoid "extensive operations," but the enemy were advancing and the French looked to him to help in stopping them on a long front in the Struma valley, fifty miles away and inaccessible except by a narrow and ill-made road. Only a portion of his infantry and engineer units were yet equipped with pack animals, and his wheeled transport barely sufficed for the communications supplying the defences of Salonika. Under prevailing conditions his army was almost immobile. His engineers had been given the minimum of personnel, equipment

and material to develop the Salonika base and its defences, and policy had precluded preparations for a large scale road-making programme in hilly country beyond the perimeter.

On 9th May it was agreed that the boundary between the French and British forces should run south-west from Lake Butkovo, but this division was not destined to last long. The boundary between the two British corps was to be the Salonika-Seres road. The defence of the Struma devolved on the British from the evening of 9th June, 1916. By 27th June preliminary dispositions had been made, but only three brigades were in the Struma valley. On the left the 85th and 84th Brigades of the 28th Division were holding the river from Orlyak bridge to Lake Butkovo, with the 83rd Brigade in reserve, working with urgency to open up a track for wheels through the hills from Lahana on the Seres road to a point in the Struma valley near the existing Kopriva bridge. The 10th Division had the 29th Brigade on the Struma from the north-west edge of Lake Tahinos to Orlyak bridge, with the 30th Brigade working on the main road. The 31st Brigade and the rest of the army were unable to move from the Salonika defences owing to lack of transport to maintain them further forward. The neutral Greeks were still holding the mouth of the Struma.

By 3rd August the 22nd and 26th Divisions of the XII Corps had moved up to hold a front from Kilindir on the Dojran railway to north of Lake Arjan. On their left were the French 122nd Division, and on their right were two French divisions, in touch with the left of British 28th Division, now transferred to XVI Corps. The 28th Division held a front of thirty-two miles, as far as Ahinos on Lake Tahinos, the north-western half of which was practically dry. The 7th Mounted Brigade patrolled down to the mouth of the Struma, where the 80th Brigade of the 27th Division had replaced the Greeks. The 10th Division, much reduced by malaria, had been withdrawn to ten miles north of Salonika. Some French regiments were in front of the 28th Division, east of the Struma.

As a result of the operations in August to help to persuade Rumania to enter the war, the British army relieved all the French troops east of the Vardar, and was then responsible for the whole front from the mouth of the Struma up to Lake Butkovo, and thence to Lake Dojran and to the Vardar a few miles south of Gevgeli. For the next two years they were destined to hold this front of ninety miles, and to occupy the, then, almost roadless triangle of mountains and malarial swamps contained between it and Salonika.

R.E. WORK IN THE FORWARD AREA

During June, July and August, while these various changes in the allied dispositions had been taking place, the engineers of the forward divisions had been far from idle. Their main task was of course the making of roads through the mountainous country. These involved heavy blasting on the precipitous hillsides and the construction, with the bare minimum of timber and cement, of large numbers of bridges and culverts across the dry nullahs that turned to mountain torrents after every fall of rain. All units employed very large numbers of civilians—men, women and children.

As an example of the work of this period, we will again quote from the experiences of the 17th Field Company on the right of the line. The company moved forward in July with the 80th Brigade to the mouth of the Struma, evacuated by Greek troops. Here, at Neohori, the river has cut a narrow gorge through the mountains—a gorge that has been a battle-field in every Macedonian war for centuries. It was essential to hold a bridgehead on the far side to protect the gorge which provided the only lateral communication. The Greeks had destroyed the bridges over the river, but as all our heavy artillery remained on the western hills, a 750-ft. pontoon bridge, on a site concealed from the enemy, was sufficient to maintain the bridgehead garrison. This was destined to remain in continuous use for nine months until replaced by a semi-permanent bridge to carry 60-pounder guns. It was always called "Hall's Bridge," after Captain G. F. Hall of the 17th Company.

As all communications to the troops, O.P.s. and headquarters on the slopes of the hills south-west of the Struma were under view and within range of enemy artillery, it was essential to have a concealed approach from the sea coast, suitable for limbered-wagons and 30-cwt. lorries. This road was reconnoitred and laid out by the company officers and constructed mainly by the hard-working 26th Middlesex Pioneer Battalion. At the same time the light railway was extended from Stavros to Tasli, where it connected with the road.

In helping the infantry to construct a veritable fortress in this important area and the artillery to make gun emplacements, and in building hangars for the R.F.C. and winter shelters for all arms with water supply for the garrison, the company was more than fully occupied until well into 1917.

THE CLIMATE AND MALARIA

Having described the circumstances under which the British army advanced from Salonika in 1916, it will be convenient here to say a few words about the conditions under which they were to live and operate until their next and victorious advance in 1918.

During the very hot summers, from April till the end of August, they met a foe more fierce than any Bulgar and at whose hands they suffered far greater casualties. This was the anopheles mosquito, active everywhere but particularly so in the swampy valleys, the Struma valley itself being probably the worst malarial district in Europe, and its malaria the most malignant. In May, 1916, when the 10th and 28th Divisions entered the valley, they found that the Bulgar had withdrawn some distance from the river, leaving the mosquito to do its work, which it did with dreadful efficiency. For instance the 65th Company, after marching thirty-seven miles in thirty-eight hours without one man falling out, found themselves in the intensely hot Lake Tahinos area, and in spite of spending much time and labour on all possible anti-malarial measures the men began to go down like nine-pins, and the whole division had soon to be withdrawn. One battalion of the 28th Division, when they left the plain, could just find enough officers and men to drive out their transport wagons. The 38th Company of this division, although in a very bad area, were lucky in their camp site, a knoll about fifteen feet above the plain, and only lost about one-third of their strength. That the mosquito continued to be a most potent military factor throughout the campaign may be judged from the fact that by the date of the armistice the battle casualties had amounted to only one-seventh of those from malaria.*

During September the intense summer heat abated and malaria casualties began to fall, but the dry weather gave place to heavy rain in October, and the end of November was always marked by the arrival of the "Vardar wind." It blew at gale force with many degrees of frost and left the country under snow, to be followed, except on the hill-tops, by deep mud. The blizzards were usually repeated several times and the mud remained to produce acute discomfort, if not complete immobility, until March.

In spite of the climate, its effects on health and the rarity of

* *Official History*, Vol. II, p. 351, gives the total battle casualties as 23,762 and admissions to hospital from malaria as 162,517, of which 787 died.

leave to England, the Salonika army can claim that its morale throughout was very high, a fact that struck senior officers* of all nations when they visited the theatre.

THE ENEMY DEFENSIVE POSITION

The line taken up by the Bulgars in front of the British sector was immensely strong and, whether viewed from in front or studied in detail after the war, disclosed not one weak point. The main enemy defences ran along a line of steep and almost trackless mountains rising like a wall in places to more than 4,000 feet above the plain. This barrier was broken very occasionally by narrow and easily defended passes—the historic gateways of Macedonia. On our right the hills descended steeply to the sea leaving but a sandy track along the shore. Next came the Angista valley leading to Drama, its entrance protected by the broad and swampy Tahinos Lake. Through this valley passed the railway from Dojran to Constantinople, now cut by the French demolition of the bridge at the north end of the Struma valley. Running north-east from the towns of Seres and Demir Hisar were mountain tracks through the tangled hills.

Then came the famous Rupel Pass, by which the Struma enters the broad Seres plain curving through the malarial swamps east of Lake Butkovo. Through the Rupel a road led to the valley of the Strumica, the main lateral route behind much of the Bulgar position, and thence northward to Sofia. The pass itself presented an almost impregnable gateway. To the west runs the Belasica Planina range, unclimbable for forty miles except by a few precipitous tracks. At its western end is the Kosturino Pass, through which the 10th Division had been attacked in 1915. This was little more than a track and its entrance was protected by Lake Dojran and the very difficult country to the west of the lake. Finally there was the Vardar valley, in places almost a gorge with high mountains on either side. Through this valley ran the strategic railway from Salonika to Nish, where it joined the vitally important line connecting Constantinople with central Europe. During the next two years, of course, the Bulgars considerably improved their communications,

* One of these appreciative visitors was Lieut.-General Sir Henry Lawson (late R.E.), who had been G.O.C.-in-C., Northern Command, and was visiting all theatres as head of a commission appointed to study economy in man-power.

producing six or seven roads fit for wagons across the hills into the Struma plain and the Dojran position. They also laid a light railway into the Rupel Pass and along the Strumica valley, connected to their standard-gauge system at Radomir, twenty miles south-west of Sofia.

COMMUNICATIONS IN THE BRITISH AREA

The British divisions deployed in front of this forbidding barrier were connected with their base by the slenderest of communications. On the right there was the sea route to Stavros, and thence along the coast—soon to be provided, as we have seen, with a decauville line connecting with the new road into the rear of our position. The only other route to the Struma valley was the Salonika-Seres road, with but 12 ft. of metal and no foundation. The Dojran front had no road access whatever, but there were the two single-line railways—the J.S.C. (Junction-Salonika-Constantinople) to Dojran Station, where it came under shell-fire, and the main line up the Vardar. These were connected by the lateral line from Kilinder, south of Dojran, to Karasuli on the Vardar, a line that could only be used at night. It is important to note that the third railway from Salonika, running west to Monastir and used by the French on our left, had been connected by the Greeks early in 1916, at Plati, twenty-five miles from Salonika, with the line running north from Athens to Larisa. Salonika was thus joined by rail to southern Greece.

Between the Seres road and the railways to the Dojran front there was no vestige of a lateral track suitable for wheeled traffic.

Such was the problem confronting an army equipped and intended to hold a static line within a few miles of their base; but during the course of the next two years they had entirely changed the picture. In assessing their achievements it is now hard to remember how different and how much more difficult was the road-making problem of those days. Except for steam-rollers (not diesel) and a few unreliable stone-crushers there was no mechanical plant, and even air-compressors and pneumatic drills were very rare. The use of tar or bitumen was in its infancy, and the standard 3-ton lorry had narrow solid tyres. It is true that we had a small number of 30-cwt. pneumatic-tyred lorries, but never sufficient to save the main roads from the devastating effects of the 3-tonners. Nothing short of 18-in. thick of hand-packed soiling and two 4½-in. layers of well rolled metal could be trusted to last for more than a few weeks.

By 1918 the following radial and lateral routes had been made, *vide* Map 2.

Routes to the Struma :—

A standard-gauge railway from Salamanli, on the Dojran line, to Guvezne, on the Seres road, and thence to near Langaza (20 miles).

A light railway and a road fit for limbered wagons from near Langaza to Stavros and thence to the mouth of the Struma (52 miles).

A road for limbers from east of Lake Langaza to Lake Tahinos (30 miles).

The complete reconstruction of the Seres road to take heavy lorries as far as the Struma (45 miles).

A road for light lorries from Lahana, on the Seres road, to Kopriva, on the Struma. This was also connected by decauville to the Seres road at Likovan (total 32 miles).

Routes to the Dojran front :—

A lorry road from Salonika to Kukush, near Sarigol on the Dojran railway, thence north to Snevche (43 miles).

A light railway from Sarigol to Karamamudli, two miles north of Snevche (43 miles).

A route north from Snevche to Poroi Station between the Struma plain and Dojran. This included a ropeway, $1\frac{1}{2}$ miles long, with a rise of 640 ft. and capacity 70 tons per 8-hour day (9 miles).

A light railway from Yanesht Station on the Dojran railway, to connect with the lateral line west of Kilinder (10 miles).

A lorry road from Salonika up the Vardar to Karasuli, made by the French (30 miles), and continued by the British to near Dojran (20 miles).

Lateral routes :—

A road for limbers along the Struma from its mouth to Kopriva (42 miles).

Limber roads parallel to this (24 miles).

A light railway from Gudeli, at the north-west end of Lake Tahinos, to Kopriva (16 miles).

A limber road from Lahana to Kukush (23 miles).

A limber road connecting the Lahana-Kopriva road, at Paprat, to Snevche (26 miles).

A limber road from Guvezne, on the Seres road, to Kukush (18 miles).

Lorry and limber roads from Salonika to east of Lake Langaza (total 45 miles).

ORGANIZATION FOR ROAD BUILDING

The supervision of the road-making programme was provided by the personnel of both field and army troops companies, the latter being responsible for most of the lorry roads and some of the light railways.

The unskilled labour was found from infantry battalions, pioneer battalions (of which there was one per division), prisoners of war and civilians. The pioneer battalions were good workers but were liable to be taken away at short notice for combatant duties, moreover very close liaison was necessary between the C.R.E. and the battalion commander, who might be the senior.

The administration and payment of the very large numbers of civilians employed caused at first considerable trouble. The system adopted by most units was for each man, woman or child to be given at the end of the day's work a piece of paper showing the day's earnings, and signed perhaps merely by the sapper in charge of the gang. These "pay slips" were honoured by the unit on the next pay day, or even by the base paymaster, having passed through the hands of Jewish discount firms in Salonika. The "pay slips" had to be backed by rolls giving the often unpronounceable names and the earnings of the workmen. This very loose system was replaced in the summer of 1916 by the creation of a Directorate of Civil Labour, responsible for recruitment, administration and pay of all civilians and for their allotment, under staff direction, to the services requiring them.

RAILWAYS

In June, 1916, General Sarraill took over the administration and working of the Macedonian railways, and appointed a joint Anglo-French administration for the purpose, Lieut.-Colonel F. D. Hammond being the senior British representative. The immediate objectives were:—

- (i) To take over the existing technical personnel, who included Frenchmen, Belgians, Brazilians, Greeks, Macedonians and even Austrians, and presented a serious language problem.

- (ii) To supplement this technical personnel by the employment of British and French railway staffs and units.
- (iii) To increase the rolling stock and number of locomotives, and to improve the water supply.
- (iv) To repair the permanent way, at the same time increasing the number of passing stations, and sidings at the base and rail-heads.
- (v) To expand the movement control staff (R.T.E.).
- (vi) To make plans for new construction of both standard-gauge and light railways between Salonika and the front.

The British operated the Dojran railway and Karasuli lateral, and the French the Vardar and Monastir lines, but co-operation was very close and there was always much mutual help in times of stress.

As soon as the advance to the frontier occurred there was great difficulty in meeting the ever-growing demands, and in July both British and French made urgent requests for additional personnel, rolling stock and equipment. On 8th September the 19th Railway Operating Company arrived, with an establishment of 282 all ranks, and capable in theory of working a hundred miles of single line. This unit was extremely useful, but unfortunately its first camp, though convenient for railway operations, turned out to be deadly for malaria and the casualties were very heavy. Two more railway construction companies also arrived at about the same time to reinforce the 117th Company. In October the 32nd Railway Operating Company was formed from railway personnel serving in other units, and the following spring, as the results of transfers, this company became responsible for workshops while the 19th Company carried out operation.

The Macedonian theatre always had a low priority in the allotment of railway equipment. During 1916, thirty-five locomotives were received, of which eleven were nearly thirty years old and only suitable for shunting, while twenty-two, originally ordered by the Serbian Government, arrived completely dismantled and required much skill and patience to assemble. It was not until 1918 that a further twenty-two were received. With regard to wagons, 300 came in 1916, 1,100 in 1917 (of which 600 were without spring buffers and could only be used in the base) and 600 in 1918, of which 300 had been ordered by the Greek State Railways. Ambulance trains were converted from the local very verminous passenger coaches. Railway

stores, almost non-existent when we took over, were ordered every six months from England. A stores depot was provided in 1917, but not till the end of the year did an experienced railway storekeeper arrive. The R.E. Army Signals provided all the telegraph and telephone services required.

During 1916 and 1917 many improvements and additions were made to the railway system for port clearance and distribution to base depots, many new depot sidings being provided and a line laid to Lembed, five miles from Salonika on the Seres road. New stations were provided at Marsh Pier and Gravesend Pier, west of Salonika, and a line was run through the town to serve the piers on the east. A new station—the "Chantier Anglais"—was built for the assembly of trains for dispatch to railheads. New sidings were added at the railheads—Kilinder, Karasuli, Yanesh and Sarigol, and the distance between passing stations reduced to 5 miles. The new line from Salamanli, on the Dojran line, to Guvezne, on the Seres road, and thence to near Langaza was completed in 1917 and not only served the light railway to the mouth of the Struma, but reduced the length of the lorry haul on the Seres road.

The results of this work were gratifying for, whereas in 1915 there had often been great difficulty in running one train a day to the Dojran front, the service was gradually increased to a regular fifteen trains a day. During some months in 1918 the railways carried nearly 130,000 tons (about half of which was ex-port and the remainder ex-depots and miscellaneous traffic), 100,000 personnel and 1,000 animals, plus 9,000 sick and wounded in ambulance trains.

In June, 1918, the twelve battalions withdrawn from the theatre travelled by rail to Bralo and thence, via Itea, on the Gulf of Corinth, and Taranto to serve on the Western front. This so-called "Mediterranean L. of C." has been described in Volume V of this History. The section from Plati (west of Salonika) to Bralo contained some gradients of nearly 2 per cent, greatly reducing its capacity. It was worked by the Greeks, but the 35-mile road link from Bralo to Itea, including the rest-camps, was built by the French and British and the pier at Itea by the British.

In 1916 Lieut.-Colonel F. D. Hammond became Director of Railways, with Lieut.-Colonels G. Rhodes as A.D. Railways and L. H. Kirkness as A.D. Transportation. In October, 1917, Hammond left in order to serve on a Mesopotamian Transportation Commission, and Rhodes became Director of Railways.

SURVEY

When the army landed at Salonika it was supplied with copies of the Austrian General Staff map of Macedonia, and very soon discovered that it was far from accurate—in fact, it could not be called a map, but did give a somewhat sketchy impression of the country. For planning roads or defensive positions or for artillery purposes it was useless.

The Maps and Printing Section compiled a map of the Salonika defences based on work by Captain Meldrum, a French survey section and other sources, but on the advance to the frontier, the call for better maps, flash-spotting and sound ranging, and the lack of reliable triangulation became so acute that the formation of a survey company was inevitable. Lieut.-Colonel H. Wood arrived in December from commanding the 1st Field Survey Company in France, and began a systematic survey, using all available survey personnel—later to become the 8th Field Survey Company. In one respect he was fortunate, in that no usable triangulation existed and he was compelled to make a new one, thus escaping the troubles and "adjustments" inherent in the use of the existing minor triangulations of the Western front. He measured a 6,000-metre base with new azimuths and latitudes, pushed on with field work and started topographical mapping at the beginning of 1917. The British area was planetabled and the ground in front photographed from the air and mapped from a framework of intersected points.

In the winter of 1917/18 Major R. H. Phillimore arrived from France and Lieutenants H. B. Symons and B. T. Wyatt from India with detachments of Indian topographers and draughtsmen. Officers were sent to France to be trained in sound ranging, and later two sound ranging sections and an observation group arrived.

During 1917 the situation gradually improved, but it was not until January, 1918, that reliable and finished maps began to appear. "The later British work was at least equal in accuracy to the French; in clarity it was distinctly superior, and some of the sheets were really handsome examples of the draughtsman's art."* During the campaign a large number and variety of maps were issued, and 1,500 square miles of triangulation, 2,200 of good topography and air-photo compilation of 100 miles of front were completed. During the final advance the Indian planetablers displayed their well-known ability in rapid exploratory surveying.

* *Official History*, Vol. II, p. 21.

A junction was made with the German surveys behind the enemy line and the company presently found itself in Constantinople collating a mass of German and Turkish work.

There can be no doubt that, had a complete survey unit been sent to Salonika in 1915, reliable maps and accurate data for the artillery would have been available a year earlier. As in Gallipoli and other theatres it was disheartening for survey officers to know that in works units fairly close at hand there were enough trained map-makers to have entirely altered the situation.

CHAPTER XVI

OPERATIONS DURING AUTUMN, 1916

Rumania joins the Allies—Holding operations—Capture of the Karajaks and Yenikoi—The capture of Bairakli Juma—Attacks against Virhanli and Turnbitza Farms—Operations by the XII Corps during the autumn of 1916—The capture of Monastir—Arrival of the 60th Division.

RUMANIA JOINS THE ALLIES

ON 27th August, 1916, Rumania declared war on the Central Powers but not upon Bulgaria. She absolutely refused to accept the allied plan for her to remain on the defensive against Austria and Hungary and to attack southwards, sweeping down upon the rear of the Bulgarian army, almost all deployed along their southern frontier. A junction would thus have been made with the British, French and Serbs, who might then have been able to advance in co-operation with the Rumanians perhaps as far as the Danube. It has been argued that, had these ambitious operations been embarked upon, the allied transportation establishments would have been strained, perhaps even to breaking point, with the possibility that the forces based on Salonika would have shared the fate of Rumania, who suffered within a few months one of the most crushing defeats in history. This is merely conjecture and General Sarrail was not called upon to co-operate in any way with the Rumanian army, who in fact promptly invaded Transylvania with their backs to Salonika. Under the military convention with Rumania he was, however, required to start an offensive on 20th August, in order to prevent the withdrawal of Bulgar forces against our new ally.

Operations in fact began before that date, for, when on 5th August the Bulgars crossed the frontier south of Monastir, he promptly replied with a limited attack south-west of Dojran. The British co-operated on the left, with the result that Horseshoe Hill* was captured and consolidated by a battalion of the 22nd

* See Sketch 6, facing p. 160. Horseshoe Hill, south-west of Doljeli, was the southern end of the "P" Ridge, later to become so famous.

Division, accompanied by two sections of the 131st Field Company with wiring materials.

Doubtless the Central Powers had obtained information about the plans agreed between the Allies and Rumania, and decided to attack before the 20th August. In any case, on the 17th the Bulgarian First Army made a swift advance along the Monastir-Salonika railway against the Serbs, and on the 18th their Second Army poured through the Rupel Pass, the Greeks again retiring before them. They drove back a French detachment and patrols of the 7th Mounted Brigade who were east of the Struma, and advanced down the left bank till they reached the bridgehead of the 27th Division at the mouth of the river. At the same time they occupied the ports of Kavalla and Dedeagatch to the east, the Greek garrisons being evacuated by sea. The Bulgar offensive on both flanks caused General Sarrail to change his plans, and on the 20th he decided to stand on the defensive on the British front and to attack with French and Serbs further west. It was then that the whole of the front from the sea to the Vardar was handed over to General Milne, as we have already recorded.

General Briggs, commanding the XVI Corps, determined on an active defence. On 20th August a party of six officers and seventy-seven other ranks of the Surrey Yeomanry and the 17th Field Company under the command of Captain G. F. Hall, R.E., moved out from the Neohori bridgehead, and early next morning blew up the railway bridge beyond Angista Station and also another bridge on the railway to Constantinople, with the loss of one officer and one sapper wounded. Another demolition party, again under Captain Hall, left Neohori on the 23rd, with an escort of about 200 yeomanry and cyclists and supported by a battalion and a section of guns. Having burnt three road bridges over the Angista river they attempted to destroy the bridge at Vulchista. The enemy, however, were in too great strength, and the force had to withdraw, but first burnt another bridge instead.

HOLDING OPERATIONS

"Now began a long period of British pressure upon the enemy, on both the Dojran and Struma fronts, effected by operations ranging from quite small raids or mere feints to attacks made by a whole division and with the object of holding the ground won."*

* *Official History*, Vol. I, p. 162.

In operations in the Struma valley, crossings of the river were nearly always required. In the autumn there were certainly places where it was fordable, but there was always a danger of a sudden rise in level of several feet. The river bed was sandy and during floods was constantly on the move and the banks liable to scour. Under these conditions the service trestle of those days was unreliable and all the Struma bridges required specially made timber trestles, reinforced with piles as soon as possible. They were then usually replaced by bridges for 3-ton lorries on piles driven at least sixteen feet. The maintenance of the bridges before the piles had been driven always caused anxiety, but thanks to considerable skill and labour no serious failure ever occurred.

During the first of these operations—a large scale raid on 10th September—no artillery or transport crossed the river so that nothing was required but footbridges and rafts. The XVI Corps attacked on a wide front astride the Seres road, with the 27th Division co-operating from the Neohori bridgehead supported by fire from naval guns. The 7th Field Troop operated rafts made from their canvas boats near Gudeli. The 10th Division used sixteen rafts and also a footbridge 333 ft. long, while the troops of the 28th Division, west of the Seres road, forded the river but used a few rafts for the wounded. The villages of Karajakoi Bala and Zir and Nevolyen were captured and considerable casualties inflicted on the enemy before our troops were withdrawn in the evening (see Map 3).

THE CAPTURE OF THE KARAJAKOIS AND YENIKOI

(Map 3)

The next attack, on 30th September, again made with the object of holding the enemy while the French and Serbs carried out their large scale operations on the Monastir front, was more ambitious. The two villages of Karajakoi and also Yenikoi were to be taken and held, while demonstrations were made on the right flank as far as Neohori. The many river crossings, co-ordinated by the Chief Engineer, XVI Corps, and carried out under the direction of the C.R.E., 10th Division, were complicated by a rise in the river of more than three feet during the operations. The crossings were as follows :—

At Fitoki on the right a French detachment forded the river, but on their return had to be ferried across with great difficulty

by the 85th Company on very hastily made rafts, for which timely action the officer commanding, Major A. G. Turner, was awarded a Croix de Guerre. On the next seven miles of the river eleven ferries were used, the one ford was staked and roped and the existing bridge at Komaryan was redecked. Near the site of the future Wessex Bridge, south of Karajakoi, the 85th Company built a trestle bridge, 430 ft. long for guns. This took three rather anxious days' work in the rising river. Between here and Orlyak Bridge there were two footbridges (290 and 400 ft.), one ferry and a lightly piled artillery bridge (360 ft.), made in two days by the 65th Company, and a third footbridge made by the 28th Division.

The main attack was made at dawn on 30th September, the troops having crossed at night. By the evening the two Karajakois were in our hands, and wiring was immediately started along the new perimeter by the two Wessex Companies of the 27th Division and the 65th and 66th Companies of the 10th Division, who already had had a hard day's bridging. The first Bulgar counter-attack developed just as the wiring was being finished, but it was beaten off, and further attacks the next day and night never passed the wire. On 3rd October Yenikoi was taken, sappers with carrying parties following closely behind the attack. A strong counter-attack was made in the afternoon, offering an extraordinary spectacle to the observation posts and battle-headquarters on the hills above Orlyak. It was almost annihilated by our artillery, but the sappers of the 65th Company took their full share in the infantry defence. The 28th Division had meanwhile made a small advance from Orlyak Bridge and the front of the complete bridgehead was consolidated. The enemy had suffered very heavily and withdrew for some distance. Further cautious advances were therefore made and deep reconnaissances carried out by the cavalry and armoured cars. During one of these night advances much surprise and hard words were produced by several wagons of the 65th Company, full of men and material, who charged forward through the leading troops and disappeared into the night in order to repair a bridge for the armoured cars.

THE CAPTURE OF BAIRAKLI JUMA

The next attack was made on 31st October by the 28th Division with the object of capturing Bairakli Juma on the left of the Struma front, and then linking up with the Yenikoi bridgehead, thus giving the impression of a further intended advance on a wide

front. Bridging material had been collected in good time, and a new bridge for wheels known as Artillery Bridge was built by the Northumbrian Company about two miles upstream of the existing Kopriva Bridge. Further to the left were two pack bridges, one built by the Hants. Company and one, near the junction of the Butkovo river, by the 38th Company. This was 250 ft. long in 12-ft. bays at a site chosen for tactical reasons. The river again rose several feet, producing strong eddies at the sharp bend in the river, and the launching of trestles became difficult, but the bridge was in use by 26th October. The Hants. Company's bridge gave trouble from scour on the 30th, but was reopened next day. Deployment on the far bank was carried out successfully. The very wet weather had impeded bridging, but helped the attack, the garrison being taken by surprise and Bairakli Juma captured on the 31st. The remainder of the line was advanced producing a bridgehead 15 miles wide—from the Karajakois to the Butkova-Struma junction. Detachments from the field companies had followed up closely with carrying parties to wire in and help to consolidate the new positions.

ATTACKS AGAINST VIRHANLI AND TUMBITZA FARMS

At dawn on 17th November began a period of far less successful operations south-east of Seres. The intention was to advance the whole line on the Struma plain but to hold permanently only certain positions on the Virhanli stream which runs from Seres to Lake Tahinos. The advance on the left was carried out with ease, but Tumbitza Farm, one of the main objectives on the right, proved to be strongly held. The attackers failed to cross the existing foot-bridge and had to remain isolated and in the open for the whole day. A sapper of the 2nd Wessex Company was awarded the Military Medal for reconnoitring under heavy fire a route to the rear and then guiding up parties with ammunition.

At 2.30 p.m. orders were issued to attack that evening both Tumbitza and Virhanli Farms, the latter being about two miles to the south-east and also on the far side of the stream. This was said to be thirty feet wide, but, owing to the necessity for secrecy, no reconnaissance had been made and even the C.R.E. was not informed in time of the intention, with the result that no proper arrangements were made. A section of the 2nd Wessex Company went forward with the attack against Virhanli Farm. "The night was black as ink; there were no definite landmarks; and the sappers

reached the stream at a point where it was between fifty and sixty feet in breadth. They had been told that it was about thirty feet, and had brought only sufficient material for a bridge of that span. After reconnaissance for some distance up and down stream, no point where the Virhanli could be bridged was found, and the column was withdrawn."*

It was not until 5th December that another attempt was made. On that day Rabbit Wood, just north-west of Tumbitza, was captured with strong artillery support, and next morning after considerable difficulties caused by enemy fire, the 2nd Wessex Company had established a dump of bridging material there. They were now able to reach the stream, which they found to be 25 ft. wide and running very swiftly. At 11 a.m., again under a heavy barrage, the sappers and a platoon of infantry doubled forward with the bridging material and in less than ten minutes and under heavy fire a bridge was in position, supported in the centre by one canvas boat. Only about fifty men actually crossed, and were then held up by very heavy fire, the bridge itself being hit. Another attempt was made next morning, but again the crossing could not be made in sufficient strength. The bridge was completely destroyed, and the attackers had to return under cover of a heavy bombardment by a deep and difficult ford that had by then been discovered by the sappers. The operation was soon afterwards abandoned but had had the effect of widening the bridgehead to in front of Yeni Mahale and Osman Kamila.

In connection with these operations, a bridge was built at Gudeli by two sections of the 17th Company from Neohori under Captain Hall. It was 300 ft. long on timber piles 6 in. square, much of the other timber having been collected from ruined houses. The piles were driven from rafts made of pontoons and canvas boats under difficult conditions of continuous rain and a river in flood, which became so wide that when the bridge was finished after a fortnight's hard work on 30th November, it was standing in the middle of a vast expanse of shallow water. Traffic, however, managed to use it.

OPERATIONS BY THE XII CORPS IN THE AUTUMN OF 1916

From September onwards the XII Corps had meanwhile been very active with constant wire-cutting, bombing and raiding of the Bulgar trenches. In these raids detachments of the field companies

* *Official History*, Vol. I, p. 245.

always co-operated. A particularly successful operation took place on the night of 22nd/23rd October. The actual raiding party of about 170 all ranks of the 11th Welch Regiment, with two officers and twenty sapper other ranks, were supported by the remainder of the battalion and of the field company. Under our artillery and machine-gun fire the party after cutting the wire entered the enemy trenches, held off a counter-attack while the sappers blew up a machine-gun emplacement and finally withdrew with eighteen prisoners. Thirty-four enemy dead were counted in the trenches and more casualties were inflicted on the flanks.

THE CAPTURE OF MONASTIR

The autumn operations of the XVI and XII Corps had been subsidiary to the main attack by the French and Serbs east of the Vardar. This had progressed relentlessly and at last, after a period of bitter blizzards with deep snow on the hills and mud in the valleys, the French, on 19th November, entered Monastir. Both sides were fought to a standstill and both had suffered heavy casualties.

During the autumn General Otto von Below arrived and set up a German Army Group Headquarters at Skolpje in control of the whole Macedonian front. German reinforcements were sent to stiffen the Bulgars at Monastir and two Turkish divisions appeared on the Struma. The allied offensive had thus not only pinned down the whole of the Bulgar army but had drawn reinforcements from other theatres. On the other hand, their efforts had not saved Rumania, for Bucharest fell on 3rd December and the remnants of her army fell back into north-eastern Moldavia.

ARRIVAL OF 60TH DIVISION

Considerable regrouping took place east of the Vardar including the addition of a new French division that had arrived in November, and also of the 35th Italian Division who had been holding during the autumn a sector of the line between the XVI and XII Corps.

Early in December the XVI were reinforced by the arrival from France of the 60th (London) Division containing the following R.E. units:—

60th (London) Division C.R.E., Colonel R. Q. Henriques, with
3/3rd, 2/4th and 1/6th London (later named 519th,
521st and 522nd) Field Companies.

CHAPTER XVII

THE MACEDONIAN FRONT IN 1917

The situation in early 1917—Detachment sent to Katerini—Defences and minor operations in the spring—Bridges—Breakdown of the Seres road—Accommodation and water supply—The Greek forces—The first and second battles of Dojran—The summer withdrawal—Autumn dispositions.

THE SITUATION IN EARLY 1917

THE advent and rapid disappearance of Rumania as an ally had an important effect upon the situation in Macedonia, in that General Sarrail was now faced with a victorious German army in a position to advance against him. He was not to know how tired and depleted this army had become as the result of their Rumanian campaign. There was also another disquieting factor. The divergence in the views of the Greeks upon what should be their future attitude towards the allies had become even more marked throughout the autumn with its series of German successes. An extremely complicated situation arose which at first seemed likely to result in the appearance of a royalist and hostile Greek army able to advance into Macedonia from the south, perhaps in combination with a possible Bulgar and German offensive from the north.

The salient events leading up to this situation must be very briefly described because they had a marked effect upon the future. In September, M. Venizelos, the ex-prime minister, dismissed by King Constantine in 1915 for his pro-allied sympathies, had left Athens to foment a revolt in Crete. He arrived in Salonika in October, and set up a provisional government, soon recognized by the French and by the British on 1st December. In order to clear up the situation, the French in September had disarmed the Greek fleet and had sent a small force of French and British troops to Athens to back up the action of the French Admiral. This force had been attacked by royalist Greek troops in December with the result that an ultimatum had been presented to the Greek Government. We were thus faced with a Venizelist and pro-ally force gaining strength at Salonika, and a semi-hostile royalist Greece to the south,

in a position to use the railway from Athens through Larissa to Salonika for an advance northwards. The arming by the allies of the Venizelist troops will be described in due course, but we must first consider a small expedition dispatched to prevent a Greek advance from Larissa, where a considerable royalist force was concentrated. The British were to be responsible for the railway and coastal routes, while the French barred the roads inland to Monastir.

DETACHMENT SENT TO KATERINI

The British detachment consisted of a brigade of the newly arrived 60th Division with artillery and the 2/4th London Field Company. As the railway to Larissa had been damaged by storms, the force went by sea, landing near Katerini, about half-way to Larissa, at a fishing village called Scala-Vromeris, but the field company succeeded in getting to within five miles of the port by rail, repairing breaches in the line on its way. On 10th December they found that the jetty had been washed away with the result that the troops, who arrived next day, had to wade ashore. The field company immediately began repairs to the jetty and also other tasks, including water supply, to assist the landing of stores and transport. The brigade took up a position nine miles in length, at the foot of the snow-covered Mount Olympus, the sappers assisting with the defences. Communications were very difficult and during the next month, the company constructed nearly forty bridges, varying from large culverts upwards and including several over fifty feet long. No hostilities in fact occurred and the company returned to Salonika in March with the brigade group, having carried out a very varied programme of work.

DEFENCES AND MINOR OPERATIONS IN THE SPRING

(Map 3)

It was necessary to strengthen our line against the possible attack from the north. In the Struma valley, the line of resistance now ran in front of the villages captured during the autumn, from Fitoki ford and thence in front of Yeni-Mahale, Homondos, Yenikoi and Bairakli Juma to Haznadar. Outposts in front were held by infantry at night and yeomanry by day, and behind, small bridgeheads were constructed to cover the main crossings of the river. In this work the field companies were kept very busy in co-operation with the

infantry and also with the artillery, for although the Bulgar trenches were several miles away, our batteries were under direct observation from the hills, and assistance was often required in the strengthening of the gun positions.

At Neohori an elaborate bomb-proof battle headquarters was built by the 17th Company, who also constructed a ropeway to carry 6-in. howitzer ammunition for 1,200 ft. down the face of the mountain. The ropeway was 2 miles long, supported on trestles. It was only required to carry the ammunition downwards and was worked with a Persian wheel driven by mules. The G.O.C., 27th Division, asked for the construction of an observation post from which he could see his whole sector. This was built by the 1st Wessex Company in three stories, each 40 ft. high, made of tall poplar trees.

On the Dojran sector the XII Corps continued to strengthen their defences, which were now becoming a complete trench system reminiscent of the Western front, but for the most part hewn in solid rock with boring bars, wedges and constant blasting.

A rear line of defence about fifteen miles behind the whole front was started during the winter. The work was mostly done by civilians, supervised by army troop companies.

Numerous raids were carried out during the winter and spring, and in nearly all of them parties of sappers were used to cut gaps through the wire with Bangalore torpedoes and to carry out demolitions of machine-gun emplacements and dug-outs in the captured trenches. Some of these raids were extremely successful while others suffered heavy casualties. In the XII Corps the raids were almost identical with those so often carried out on the Western front, but in the Struma plain, where the trenches were several miles apart, the conditions were quite different and engineer parties usually had to go forward prepared to bridge the many streams, and sometimes even the Struma itself. For this purpose they carried locally made canvas boats on limbered wagons.

BRIDGES

(Map 3)

During the winter of 1916/17 the Struma bridges were strengthened to make them proof against floods and scouring.

Hall's Bridge in the Neohori gorge was replaced in order to carry heavy artillery. The river-bed was rocky and the 14-in. square

timber piles, four to a bent, could only be driven 6 ft. but lasted well. The bridge, excluding a central island, was 750 ft. long, with timber girders and was opened on 28th April, having taken seven weeks to build.

Gudeli Bridge, also built by the 17th Company, was 288 ft. long on 6-in. square piles to carry field artillery.

Komaryan Bridge, existing pre-war, would carry field guns, but was later replaced during the following winter by a bridge to carry the heaviest artillery, and even tanks in case they arrived. It was on 12-in. square piles and had composite girders made of timber and sheet iron.*

Wessex Bridge, built in sixteen days by the 1st Wessex Company, had 12-in. square piles and was later strengthened by the use of timber girders to carry 11-ton loads.

Orlyak Bridge was the pre-war crossing for the Seres road and was never replaced or strengthened, but required constant repairs as it was under enemy artillery observation. It was 450 ft. long and would take 3-tonners.

Cuckoo Bridge, three miles above Orlyak, was built in January by the 10th Division to carry field guns.

Kopriva Bridge, a pre-war crossing, would take 3-tonners but was repaired and re-decked.

Artillery Bridge, two miles above Kopriva, was made flood-proof with piles, the deck being raised 2 ft. and strengthened to carry 3-tonners.

As we have seen, all these bridges were provided with their own close defence, in the form of small bridgeheads. The two bridges built by the 85th Company for the Karajakoi operations and the two pack-bridges used for the 28th Division's attack on Bairakli Juma were dismantled to avoid any danger of their being washed down on to the other crossings.

BREAKDOWN OF THE SERES ROAD

(Map 2)

In July, 1916, that is to say as soon as the first troops had moved forward to the Struma plain, Brigadier-General H. L. Pritchard, the acting Chief Engineer, had submitted urgent requests for technical units and plant in order to maintain, or rather to recon-

* A description of this ingenious and very successful type of construction appeared in the *R.E. Journal* of April, 1921.

struct, the Seres road, which would obviously not carry the traffic for two divisions under winter conditions. His demands were backed by the Director of Works, M.E.F., who visited Macedonia in August. We find the Army Council considering the matter at the end of September as the result of representations made by the D.F.W. at the War Office. No units could be spared, but the road-rollers, stone-crushers, etc., were ordered. As the result of further telegrams from Salonika two army troops companies were eventually dispatched so as to arrive late in November, followed by two labour companies, R.E., in December and part of a fortress company in January. All were too late to prevent the occurrence of a very serious situation during the winter, but were of great service in putting matters right in the spring.

The road began to break up under lorry traffic and weather conditions in mid-December, and all available civil labour and two infantry battalions were put to work upon it, while quarrymen and mechanics were collected from fighting units to assist with stone supply. By January lorries could not get beyond Lahana and by February not beyond Likovan. In front of lorry-head divisional and unit first-line horse transport had to be used in the bitterly cold weather for the long haul to the forward troops.

During the last half of February labour on the road began to be augmented by the use of "entrenching battalions," formed from base reinforcements. Five of these were eventually working on the road, but their strength continually fluctuated as men were withdrawn for posting to units. It was also during February that the southern half of the road was put in charge of Lieut.-Colonel G. S. Pitcairn, who was later to become responsible for the whole of it. He had had pre-war experience of road-making under similar conditions and was a good organizer, driving others almost as hard as he drove himself. His camp, known as "Pitcairn Island," was sited in the main quarry where he could ensure that the deafening noise of the stone-crushers continued unceasingly throughout the night.

It was not until April, when the weather improved, that real headway began to be made, but by August the road had been reconstructed throughout its length and the next winter could be looked forward to with confidence. It had been a very near thing, and it was fortunate that the enemy never took advantage of a situation where our forward troops were virtually immobile because their first-line transport was all required to keep them supplied with bare necessities.

ACCOMMODATION AND WATER SUPPLY

In late September the hutting materials, ordered at the time of the advance to the frontier arrived from England and Egypt, and were allotted to corps, L. of C. and base areas. Near the front winter accommodation was usually made splinter-proof and occasionally even bomb-proof, but the rugged country often permitted the siting of unprotected but well camouflaged huts quite near the forward posts. Hutting was, of course, insufficient for the whole force and many men slept in tents protected from the wind by earthen walls, but it can fairly be said that the Salonika army was ready for the Vardar winds of the winter of 1916/17.

Protection against bombing was at first not attempted as we had definite air superiority, although, in February, 1916, a German air-ship had successfully blown up a large magazine at the base before she was shot down near the mouth of the Vardar. This policy was soon reversed when the famous "Richthofen's Air Circus" visited the theatre during the spring of 1917, causing considerable damage at the base, in unit horse-lines and on the railway where at least one ammunition train was hit. Passive air defence, needless to say, produced much engineer work.

Water supply presented certain difficulties, especially as the winter camp sites of a large proportion of the units in the force were different from those that had been occupied during the summer. In the valleys water was fairly plentiful and could be obtained from shallow wells or by driving tubes. In the hills, however, every available source that could be discovered had to be developed and piped by gravity or pumping to storage tanks, sometimes 300 ft. above. Watering places were constructed for the very large number of animals included in the pack transport scales, and hot shower baths were provided for the men. It was difficult to provide enough skilled men to drive and maintain the very scattered pumping plants.

THE GREEK FORCES

We have already seen that M. Venizelos, having landed at Salonika in October, 1916, had begun calling for recruits from among his adherents. It was arranged that the French and British should share the responsibility of providing arms, clothing and equipment for these Venizelist troops, who soon amounted to three divisions, named the Cretan, the Seres and the Archipelago. They were ready

for service early in 1917 and were all destined to fight as part, or on the flank, of British corps. The first regiment had been present in November, 1916, at the attacks on Tumitza Farm in the Struma valley.

In May, 1917, M. Jonnart was sent to Athens as Allied High Commissioner with very full powers, and it was largely as the result of his actions that King Constantine surrendered his throne to his son Prince Alexander on 14th June. M. Venizelos immediately returned to Athens as Prime Minister, and in October the general mobilization of the Greek regular army was proclaimed, the French appointing a strong Military Mission to help with their training, organization and equipment. Thus a second type of Greek formation came into being consisting of regular troops, but they were not ready for service until more than a year after the Venizelists. The first three regular divisions, arrived on the Struma in March, May and June, 1918, and formed the Greek I Corps who eventually took over the front of the British XVI Corps. Six further divisions were formed later.

The Greek army formed a welcome addition to the allied forces in Macedonia, the Venizelist divisions in particular fighting with very great gallantry. They were never entirely self-supporting and depended upon the French or British for all their rear services. Their engineers were equipped under the supervision of the Engineer-in-Chief, and British R.E. dumps were put at their disposal. We also provided water supply and bakeries for Greek formations in our area, Greek engineer officers attended demonstrations of engineer work and all ranks received instruction in bridging, defences, water supply and demolitions, including the making and use of Bangalore torpedoes.

THE FIRST AND SECOND BATTLES OF DOJARAN

(Sketch 6, facing page 160*)

General Sarraill had planned an offensive to take place in the spring of 1917, involving considerable co-operation from the British. His proposals were agreed to in principle at an allied conference held in April near Mont Cenis, the British representatives favouring (for the first time) a forward policy in Macedonia, provided that it

* There was no change in the fronts held in April, 1917, and September, 1918, except that before 24th April, 1917, we held no positions north-west of Doljeli.

was timed to coincide with the battle of Arras in France, the second attack on Gaza in Palestine and further offensives in Mesopotamia where Baghdad had now been occupied. They did, however, offer a warning that a failure in Macedonia would compel Great Britain to remove troops to reinforce Palestine.

The general plan was for the French and Serbs to launch an offensive between the Vardar and Monastir, while the British attacked east of Lake Dojran, this very strong front being perforce chosen because the Struma valley was too wet for successful operations in the early spring and too unhealthy later on. The British attack was to open several days *before* the main offensive, which would then, it was hoped, find the enemy committed.

On the night of 24th April, after two days' wire cutting by the artillery of the XII Corps, the 26th and 22nd Divisions attacked the very formidable Bulgar defences, named "O1" to "O6," on a front of 2½ miles. The attack was to be made in three stages, the final objective being the ridge running north and south about three miles west of Dojran. This was known as the "P" Ridge, the prominent heights along it having been originally named by the French "P1," "P2," etc. Between the "P" Ridge and the lake was the very prominent hill, called Grand Couronné, which overlooked the whole of the British position. It was hoped that it could be captured as part of the final objective.

On most of the front the attack involved the crossing of the Jumeaux Ravine, a deep and rocky valley between the opposing trenches, followed by an advance through several successive defence lines up the barren hillsides. The troops went forward at 9.45 p.m. and succeeded in entering the Bulgar trenches, but after a night of confused and very heavy fighting had to withdraw, the attack having been a complete and extremely costly failure, except for an advance by the 22nd Division to Jackson Ravine, north of Doljeli. One of the main causes of the heavy casualties was the well directed shelling by German heavy howitzer batteries, whose accurate fire came down, even before our troops had started, and converted the ravine in no-man's-land into a veritable inferno. The disappointment produced by the results of this attack was by no means lessened by the news that the allied offensive further west had been cancelled on account of bad weather and deep snow in the mountains.

Before the attack there had been the usual engineer preparations involving the construction of additional machine-gun emplacements, dug-outs, assembly and communication trenches, approach roads,

splinter-proof and bomb-proof protection for gun positions, and dressing stations. Many reconnaissances were made of the ground between the trenches to decide upon the routes to be taken by the sappers accompanying the attack. The assaulting battalions were provided with parties of engineers, carrying Bangalore torpedoes and also bridging material to help in the crossing of the ravine. The torpedo parties all reached the wire and blew their gaps, but not without considerable casualties.

The 60th Division carried out a raid on the left of the 22nd Division on the night of the attack. The wire was cut with Bangalore torpedoes and the Bulgar trenches entered, but he had withdrawn to his second line. The raiders came under very heavy artillery and trench mortar fire and had to return.

It was decided that the offensive should be resumed as soon as regrouping had taken place. The objectives were not so ambitious, and it was hoped that the advance already made by the 22nd Division would make the task easier. When the attack was launched the fighting was if anything more severe and certainly more confused. After again penetrating the enemy's line in several places we had to withdraw with no gain of ground but with heavy loss.* The allied offensive on the left began the next morning but was a complete failure. It continued for more than a week but was finally brought to an end having achieved little or nothing.

Meanwhile the XVI Corps had been co-operating by steady pressure on a fairly wide front, culminating in the taking of Kalendra, Prosenik, Kyupri, Bairakli and some Bulgar trenches north of Haznadar by 16th May (Map 3). The 38th and Northumbrian Companies assisted the 28th Division in these operations by constructing additional light bridges and ferries across the Struma, the level of which had risen 5 in. above any previous record. A party of the 38th Company helped to repulse the immediate counter-attack made by the enemy north of Haznadar.

THE SUMMER WITHDRAWAL

The British Government carried out their threat to reduce their forces in Macedonia unless the operations of April and May were

* The 60th Division had successfully advanced their line on the left of the attack, and the 2/4th London Field Company were all employed in consolidating the new front under heavy artillery and counter-attacks.

successful and, in June and August, the 10th and 60th Divisions were moved to Palestine where we shall meet them later on. This withdrawal of British forces had a serious effect upon the morale of the allies, and in spite of the fact that the loss in numbers was being compensated by the arrival of the Greek army, the Macedonian front was certainly now very vulnerable. Moreover the malaria season had arrived. It was therefore decided to withdraw from the Struma valley leaving very small garrisons on the river line, with cavalry patrols in front.

All the material in our strongly made defences in front of the villages, captured during the autumn and winter, had now to be removed, and before the middle of June thousands of wagon loads of stores were carried back across the river. During the summer the troops occupied the comparatively healthy hills overlooking the valley and the enemy did the same. Mosquito-proof sleeping quarters were provided wherever possible, streams were canalized, swamps drained and long grass cut or burnt over wide areas round the camps, but by the end of October there had been more than 21,000 admissions to hospital, nearly all suffering from malaria. It was during the summer that the light railway was built all along the Struma from Gudeli Bridge to Kopriva. This was invaluable for moving defence stores, supplies and ammunition with the employment of the minimum of personnel in the mosquito area. It was to be of great assistance during the muddy period of the next winter.

AUTUMN DISPOSITIONS

After an uneventful summer during which neither side were disposed to embark upon operations other than a few small raids in the malarial plain, it was decided to re-occupy the far bank of the Struma for the winter, but not so far forward as before. On 14th October the 27th Division surprised the garrisons in Osman Kamila and Homondos, the attack being accompanied by R.E. bridging parties. At the same time the 28th Division captured the villages (Nevolyen, Cuculuk and Elishan) that were to form their outpost line, and the foothills east of Lake Dojran were re-occupied.

Again the wagon loads of defence material crossed the Struma bridges, and again the field companies assisted the infantry and artillery in the construction of the defences and gun emplacements. The sectors had to be reorganized on account of the reduction in the British strength. The XVI Corps held, with their two divisions

and the 288th Garrison Brigade, to within half-way between Lakes Butkovo and Dojran, while the XII Corps, also now with only two divisions, at first stretched from there to the Vardar, but a French division was soon brought in to defend the east bank. This was probably a very sound move because it had never been satisfactory to make this vital river valley the boundary between two armies. It was not till the following spring that the first of the divisions of the Greek I Corps was to be ready to take over part of the long Struma front.

The usual raids took place during the autumn and winter, normally accompanied by sappers with explosives and bridging materials.

Meanwhile work at the base and on the L. of C. had been continuing steadily, every possible attempt being made to reduce the demands on shipping through the submarine infested Mediterranean by the development of local resources. A forestry organization was built up for exploiting Greek timber. A factory for making camouflage material was started and employed large numbers of Greek women. A lignite mine was opened up at Dranista, forty-five miles south of Larissa, employing Turkish prisoners of war supervised by an R.E. officer and miners from various units, organized into a mining company. The mine was served by a light railway built by the 117th Company and eventually produced 30 tons of fuel per day.

CHAPTER XVIII

1918 AND THE ALLIED OFFENSIVE

The dangerous situation in the spring—R.E. work during the spring of 1918—Preparations for the offensive—The plan for the allied offensive—R.E. preparations for the attack—The British attack—The pursuit—Epilogue.

THE DANGEROUS SITUATION IN THE SPRING

ON 15th December, 1917, Russia signed an armistice with the Central Powers, and in Macedonia, as on the Western front, it was quite clear that Germany would shortly be in a position to open strong offensives, backed by the additional troops that she would have available. In December General Sarraïl was replaced by General Guillaumat, whose first concern was to make plans for the allied defence of the Macedonian front under this new threat. Within a very few days he had gained the confidence of all the allies, and set to work to lay down a clear policy upon which to base a sound defence scheme. There was considerable argument in political circles upon whether, if a withdrawal became necessary, it should be made to the Salonika defences or whether the whole force should abandon Salonika and attempt to prevent the invasion of the south of Greece, now an ally. This discussion, however, did not affect local plans, at any rate for the British sector.

General Guillaumat appointed a Franco-British Commission to study the question of the defences necessary between the front line and Salonika, and to consider plans for withdrawing part of the forces into southern Greece by land and as a last resort the evacuation of Salonika by sea. General Milne's M.G.R.A. and E.-in-C. were the British members of this Commission. As a result it was decided that the strengthening of the front line was to be continued, but a first line of withdrawal was to be constructed some fifteen miles behind and heavy repairs and improvements carried out to the perimeter defences, while both radial and lateral communications were to be improved. In the British sector the first line of withdrawal became mainly a responsibility of Corps Chief Engineers, who used civil labour supervised and assisted by army troops

companies. The perimeter defences were under the D. of W., who used his own army troops companies, entrenching battalions, civilians and Turkish prisoners of war. Barbed wire, trenches, reinforced concrete O.Ps. and pill-boxes were erected. During the spring there began to be indications that German units were leaving the Macedonian front and that the German concentration was occurring in France, but defensive work was still continued at high pressure.

Soon after the opening of the great German spring offensive in France on 21st March it was found necessary to withdraw twelve British battalions and 10,000 French troops from Macedonia to reinforce the Western front. They travelled, as we have seen, by the overland route through Greece and Italy, but it was in actual fact some time before they could be used in France as they were still very weak from malaria. We also lost many individual officers, including some of the best field company commanders,* who were transferred to replace casualties in the B.E.F. General Sarrail had of course lost the Russian division from the Monastir front, but this was counter-balanced by the arrival of the Greek 1st Division who joined the XVI Corps on the Struma. The Serbs at this time received a welcome reinforcement that almost doubled their strength when numbers of Yugoslavs arrived. They had been conscripts in the Austrian army, but had allowed themselves to be captured by the Russians and were now free to fight for the allies. The mobilization of the Greek army, so welcome as reinforcements, had one serious effect. The civil labour force in Macedonia became severely reduced and could only be supplemented by the employment of more women and more Turkish prisoners of war from Egypt.

R.E. WORK DURING THE SPRING OF 1918

In addition to the work on rear defences, corps and divisional R.E. were kept busy on the defence of the long front, especially upon gun emplacements, reinforced concrete pill-boxes and O.Ps., shelters, water-supply schemes and mosquito-proof dug-outs and huts, which were even provided in some covered sites in the outpost

* One of these was the well-known Corps cricketer, Major G. Master, commanding the 38th Company, in which E. F. Tickell and J. D. Inglis had been subalterns together. As in 1944 they were to become Director of Works and Chief Engineer of 21 Army Group in Normandy, their early training under Major Master must have been very sound.

positions. It was at this time that the light railway was opened from near Langaza to the Struma mouth, and the line from Sarigol to Snevche was relaid. Mule haulage had been replaced on the light railways by petrol-driven tractors. Several ropeways were built on the steep hills. At the end of March there was an unusually severe blizzard, and all available labour had to be used for clearing snow from the roads and railways.

During the spring there were many minor operations in which engineer parties were included. As an example, in February the Northumbrian Company assisted in a long-distance raid carried out by the 28th Division. They built a flying ferry over the Butkovo river, with a pontoon raft on a steel cable, followed by a 200-ft. bridge on locally made canvas boats. The raiding force was accompanied by Lieutenant J. B. M. Hay and twelve sapper other ranks, who blew up enemy dug-outs, O.P.s. and buildings in villages held by the enemy. Hay was awarded the Military Cross and two of his party the Military Medal. From 14th till 18th April he and Lieutenant R. W. Peake with ten other ranks accompanied a raid south of Bairakli Juma and assisted with the defences.

PREPARATIONS FOR THE OFFENSIVE

General Guillaumat was recalled hurriedly at the beginning of June to command the Paris garrison in view of the threatening German advance, and on the 17th General Franchet d'Espérey arrived to take his place. His name was well known in the British army as the commander of the French Fifth Army at the battle of the Marne in 1914, but he was about to add considerably to his claims to fame by the victory that he was now to plan and win in Macedonia, a victory which by its timeliness and strategic skill was a major, but not *the* major, factor in bringing about the collapse of the enemy and the end of the war.

It was not until 4th September that General Milne was to receive instructions from home that he need no longer confine his army to a defensive rôle, but he learnt in June that General Franchet d'Espérey had received orders from Marshal Foch to prepare and mount a combined offensive by all the allied forces in Macedonia, to be so timed that it would add its weight to a general counter-offensive in France. When, on 4th July, General Milne agreed to collaborate in preparing plans for this attack, he knew that he could count only on the very limited resources that he had in the country. There

were now but four British divisions and an independent brigade of garrison battalions. He had just sent twelve battalions to France, and there were nearly 14,000 men in hospital with many more still weak from malaria but serving in their units. His gun power was far below the scale known to be necessary for breaking through a fortified position, and ammunition stocks were very low. Moreover, his establishment of pack transport and limbered wagons had been reduced, so that formations could not now operate except fairly near to roads. The one relieving feature was that the Greek I Corps was taking over part of the Struma front, thus enabling the XVI Corps to relieve the XII Corps as far as Lake Dojran. In August a Greek division also reinforced the XII Corps, but the 27th Division had to move west of the Vardar, where it came under French operational command.

The front was soon to be held by the Greeks from the sea to Lake Butkovo, with the British garrison brigade along the hills to the west, the 28th Division as far as Dojran, the 22nd and 26th between the lake and the Vardar, with the 27th west of the river. Three Greek divisions and a French regiment of Zouaves would be in reserve.

THE PLAN FOR THE ALLIED OFFENSIVE

(See Map 2 in pocket and Sketch 6, facing page 160)

The plan, worked out with such care and carried through with such skill, by General Franchet d'Espérey may be described very briefly as follows. It depended upon the fact that the Vardar river ran obliquely behind the long front held by the French and Serbs east of Monastir. Moreover, the railway down the Vardar valley carried nine-tenths of the traffic necessary to maintain the whole enemy force in Macedonia. The only other supply route was the light railway and road from the rail system south-west of Sofia to the Rupel Pass, with a branch running up the Strumica valley towards the Kosturino Pass, north of Lake Dojran; but even the Dojran front was fed by the Vardar railway. From the Vardar valley there were only four routes running south to the enemy front. These left the valley at the towns of Krivolak, Gradsko, Veles (Koprulu) and Skoplje (Uskub), the last of these, through Tetovo, being 100 miles long of second-class road with a light railway for only part of the distance. Krivolak and Gradsko were only forty miles behind the front, and Veles was only fifteen miles beyond Gradsko. If, therefore, the allies could once reach Gradsko they would have virtually cut

all the routes to the Monastir front except the long journey from Skoplje. They would also have cut the roads from the north-east into the Vardar valley leading through Stip, eighteen miles north-east of Gradsko. If they could then exploit their success by pressing forward along the road from Veles to Skoplje the whole front from Dojran to Monastir would be cut off from its base. A rapid advance westwards would then cut the route north from the Struma plain through the Rupel Pass.

Such was the strategy, but it entirely depended upon whether an initial tactical success could be obtained, producing a break-through sufficiently powerful to cover the vital forty miles through the mountains. The opposing forces in the theatre were almost exactly equal in guns and rifles. It was thus essential to concentrate everything possible on the front of the intended break-through, and at the same time to ensure that the enemy did not do likewise in order to counter it. This is where the British army was called upon to assist, not by making a mere demonstration, but by a determined attack on the Dojran front in order to prevent any Bulgar movement from that front to the vital sector. Their attack was also to disorganize the enemy east of the Vardar, so that the route northwards through the valley could be quickly opened up in order to maintain the allied pursuit that would, it was hoped, follow the main break-through.

One cannot but be struck by the similarity between the plan for this offensive and that for the abortive and much criticized operations eighteen months before. The conditions were, however, in many respects quite different, the greatest change probably being the deterioration in enemy morale—already clearly showing itself on the Western front. Had it not been that the Bulgars were definitely war-weary, it is doubtful whether the tactical door could have been opened to admit the forces who were to produce such decisive strategic results. On the other hand it is only fair to say that opposite the British front this Bulgar war-weariness was conspicuous by its absence so far as the picked defenders of this vital sector were concerned.

The British plan was for the XVI Corps with a Greek division to attack the Bulgar line running northwards from Lake Dojran, along the old international boundary to the Belasica, while the XII Corps, also including a Greek division, was to attack south-west of the lake, the objectives being Grand Couronné and the "P" Ridge.

There was to be a preliminary operation by the 27th Division

against a Bulgar salient on the west of the Vardar, known as Roche Noire. This, when carried out on 1st September, was a great success, but during consolidation (in which the 17th Company took part) there were heavy casualties from enemy shelling.

R.E. PREPARATIONS FOR THE ATTACK

During July, work on the defences was gradually reduced as the threat of attack receded and news from other fronts improved. Moreover, the regrouping that took place during the summer and the need to be ready for possible offensive action produced many other calls upon the engineer resources.

Before the Struma valley was finally handed over to the Greek I Corps there were several jobs to be done in order to help their engineers in case an advance should take place on this front. A second bridge at Neohori, for 6-in. guns, was built by the Greek sappers, supervised by Lieutenant Scudamore, from the staff of the Chief Engineer, and a party from the 17th Company. The Director of Railways extended the light railway in the Struma valley across Wessex Bridge to Karajakoi. The D. of W. remained responsible for work on the Seres road and took over the maintenance of the Stavros route, in order to free Greek divisional engineers, all of whom continued their training with the British, especially in the use of Bangalore torpedoes.

Having handed over work on the Struma front in July, the British sappers were free to make preparations for the Dojran attack, and there was much to do. Units and their civil labour were soon redistributed by Chief Engineers on the shortened front. Owing to the fact that serious operations were now to take place for the first time north-east of Lake Dojran, the hilly area east of the Dojran railway assumed a new importance. The light railway from Sarigol to Snevche had been relaid and now reached to Karamamudli, two miles north of Snevche, with a second railhead to the east served by a branch taking off from Gramatna. From Karamamudli the ropeway was extended by the 38th Company to Arakli, and was now nearly two miles long. From both railheads steep mountain roads were improved and extended, especially from Karamamudli to Popovo east of the lake. This road was under the supervision of Major E. O. Taylor, Senior Field Engineer to C.E., XVI Corps, the work being done by the 286th Army Troops and 95th Labour Company, R.E. (400 strong). Water supply and other services in

this area were very greatly increased to be ready for the concentration of troops, animals and transport, while dumps of engineer stores and bridges were formed at Karamamudli and at other sites. One of these at Popovo was completely destroyed when a neighbouring ammunition dump was hit by a shell, and had to be re-established further back.

The XII Corps front was already better developed, but much had to be done. "The engineer work of all kinds was necessarily on a big scale. One very heavy task for which preparations had to be made was that of putting the whole Constantinople Railway between Dojran Station and Demir Hisar into working order at the earliest possible moment. Observation posts of steel or reinforced concrete had to be prepared for both artillery and infantry; new dug-outs for command posts and telephone exchanges had to be constructed; concrete emplacements had to be made for batteries which would be situated further forward than in the days of trench warfare; light bridges had to be constructed and placed in position to enable field guns to cross the trenches and watercourses near the front line, so that there should be no delay in the advance of the artillery, and the roads in the forward area had to be prolonged for the same purpose and for the passage of supplies. Water supply had to be increased by the opening up of springs and the provision of tanks, and where these latter were in the trenches they had to be splinter-proofed. Communication trenches had to be deepened and labelled. Dumps of R.E. stores had to be formed, and wire, pickets and sandbags had to be made up into loads for pack-mules and carrying-parties. In rear areas the extra traffic on the roads called for unceasing repair."*

The Karasuli-Kilinder road was improved under the A.D.W., L. of C., who also became responsible for part of the road from Salonika towards Monastir, in order to assist the French. Work was also required on roads and water supply for the maintenance of the 27th Division west of the Vardar. The A.D.W. had moved up some of his units to work in corps areas, but now had the 37th and 139th Army Troops Companies from the base area under his orders.

In order to be ready for a possible pursuit, the base and advanced parks were stocked with stores for bridge and road repair, and a reserve of pumps, and of lorries equipped with crews and well-boring plant, was assembled under Mr. Beeby Thompson, the water supply expert. The 27th Division was provided with a pontoon

* *Official History*, Vol. II, p. 140.

bridging train sufficient to bridge the Vardar for field artillery. Just before the attack Chief Engineers were allotted sections of A.S.C. lorry and horse transport companies for moving forward engineer stores.

It was, however, upon the railways that the real responsibility would fall in the event of a break-through followed by a deep advance, which might even take the allies as far as the Danube. Although great improvements had by now been made in the railway system, the organization and staff was only sufficient for the short existing communications, and in fact during the summer of 1918 sickness (malaria, dysentery and influenza, the epidemic of which was spreading rapidly) among the railway units, combined with the greatly increased traffic, nearly produced a breakdown. Application had been made to the War Office early in the year for an increase in railway operating companies, but this had not been granted. Preparations were made to mend the line from Dojran to Demir Hisar, and construction stores were laid in for other railway repairs. In the event, these proved to be adequate for an advance as far as the Maritza, but only because enemy demolitions were brought to an end by the armistice.

THE BRITISH ATTACK

(Map 2 and Sketch 6)

General Franchet d'Espérey's great offensive began on 15th September after a very heavy bombardment, and by the 17th had progressed about seven miles on more than a twenty-five mile front about midway between the Vardar and Monastir. The British attack then opened.

The XVI Corps attacked north Lake Dojran at dawn on the 18th with the Greek (Venizelist) Crete Division, supported on the right by the 84th Brigade of the 28th Division. The approach had to be made down narrow mountain tracks and by the very steep and winding road to Popovo. Between the foothills and the enemy trenches there was flat ground for four miles, crossed by several streams. In front were the towering mountains from which could be observed every movement. Both infantry and artillery had, therefore, to advance in darkness down the steep hillside to the plain below, and deploy for an attack at dawn. The operation was a gamble depending upon complete surprise and giving either immediate success or total failure. Although the main attack by the Greeks

was supported by most of the British artillery in addition to their own, very few gaps could be cut in the wire during the short bombardment. The Crete Division, however, with very great bravery forced their way through with Bangalores, penetrated the trenches and made some progress up the hill. They were eventually driven back and had to withdraw. The gamble had failed and was not repeated.

The XII Corps attacked simultaneously, with the Greek (Venizelist) Seres Division (less one regiment) on the right, attacking towards Grand Couronné from the south-east. On their left was the 22nd Division with the remaining regiment of the Seres Division, directed against Grand Couronné and the eastern slopes of "P" Ridge. The Greeks over-ran the Bulgar front line, passing behind Petit Couronné, and reached the strong defences on the "Orb" in front of Grand Couronné, penetrating them at least one place. The 22nd Division and its Greek regiment fought their way through successive Bulgar lines and reached the forward face of Grand Couronné making for a short time contact there with the Seres Division. Strongly supported counter-attacks, however, drove them back with very heavy casualties. The attack had failed, although the Seres Division managed to hold the foothills west of Dojran. The two brigades of the 22nd Division and the Greek regiment were virtually non-existent. Nothing more could be done that day.

By this time it was known that the break-through on the left was meeting with great success, and it was clearly essential to prevent the move of Bulgar reserves against the French and Serbians. General Milne was called upon to attack again on the 19th. He realized how important it was to do so, but with what troops? He carried out a very hasty regrouping on the afternoon of the 18th, and the XII Corps deployed for the attack next day with the Seres Division again on the right and the 77th Brigade of the 26th Division, with a regiment of French Zouaves on the left. The plan was slightly different, but after very bitter fighting the result was just the same. For the fourth time had the Salonika army failed to take the practically impregnable "P" Ridge. On the other hand we now know that the defenders had been severely shaken, and, what is more important, only one regiment from the strong Bulgar reserves on our front ever moved to oppose the main break-through.

Meanwhile there had been extremely heavy fighting on our left, but by the night 21st September the Yugoslav cavalry reached the strategic point at Gradsko, and both sides of the great bulge were

being forced back. The enemy had no choice but to order his troops on the Dojran front and astride the Vardar to begin a fighting withdrawal up the valley and through the Kosturino Pass to the Strumica. Next morning the enemy began to evacuate the formidable Dojran line that he had held against us for three long years.

THE PURSUIT

At noon on the 22nd September an exultant telegram from the Allied Commander-in-Chief announced the news of the enemy retreat on the whole front from Dojran to Monastir, with orders that this must be turned into a rout by unceasing and resolute pursuit. The 27th Division were to cross the Vardar reverting to the command of General Milne, while he was also given part of the Greek 14th (Regular) Division. He was to carry out a wide right wheel, pivoted on the mountains north-east of Lake Dojran and sweeping into the Strumica valley. This was to be the right wing of the allied pursuit across the Vardar, while the left wing of the French and Serbs was to advance to Skoplje, thus cutting the one remaining escape route from Monastir. The only troops under General Milne who were ready for an immediate move were a brigade of the 28th Division south of the lake, the newly arriving Greeks and the 26th Division on their left. They all advanced on the afternoon of the 22nd with their field companies.

The XII Corps was in command of the right or pivot of the wheel, with the 22nd and 28th Divisions, the Zouaves and the Greek and Crete Division, while the XVI Corps, now on the left, was to consist of the 14th Greek and 26th Divisions, with the 27th as soon as it could cross the Vardar. The XVI Corps was to swing forward into the Strumica valley, thus getting behind the Belasica Planina mountains which would then be cleared by the XII Corps. The Crete Division was to work its way up the very steep face of the Belasica and reach the dominating height at the junction of the international boundaries, more than 4,000 feet above the plain, and always known as Signal Allemand.

The country to be traversed was extremely difficult, consisting of tangled mountains and valleys, with worn-out roads, or rather tracks, and demolished bridges, and was soon to become a sea of mud and flooded streams. We were to find that the reduction in pack transport and limbered wagons and our heavy solid-tyred lorries were to make a pursuit over this country far from rapid.

Moreover, the last-minute changes in command produced considerable confusion in the administrative arrangements, while malaria and influenza were fighting against us. Everything depended upon the rate at which roads and bridges could be repaired and all available engineer resources must obviously be used to that end.

In the XII Corps the field companies of the 22nd and 28th Divisions were employed on the improvement of the roads through the ruins of Dojran town and the battle belt to enable the attack to be made upon Signal Allemand, while the 37th and 140th Army Troops and 95th Labour Companies were to make this route fit for lorries, the first of which got through on the 23rd. In the XVI Corps the 26th Divisional Engineers had the task of making good the main route through the defile at Dedeli, Robrovo and the Kosturino Pass. It was the self-same route down which the 10th Division in an icy blizzard had been forced back three years before, but the shade temperature now reached 95 degrees. The C.R.E., Lieut.-Colonel G. B. Pears, had at his disposal five motor-lorries for leap-frogging his working parties and for moving material. The corps troops consisted of the 139th and 143rd Army Troops and 96th Labour Companies with a thousand civilians whose numbers were increased daily. The 143rd and 96th Companies repaired the Vardar bridge west of Bogdanci, finishing on the 26th. They also did preparatory work on the Pardovica bridge. The 139th Company and the civilian labour were employed on improving the routes through the battle zone.

On the 22nd September the A.D.W., L. of C., moved to Dojran Station with the 137th, part of the 287th Army Troops and the 420th Field Companies. He also took over the 286th Army Troops and later the 95th Labour Company. His tasks were to construct depots at the new railhead to be opened at Dojran Station, and to make the road forward through Dojran fit for heavy lorries. The road from the old railhead at Kilinder to Dojran Station also required heavy repairs for temporary use. The existing quarry near Yanesh, already well equipped with plant, was now worked by Turkish prisoners and proved invaluable. Tube wells were driven at Dojran Station, supplied with pumps and stand pipes, and an R.E. dump established for receipt and dispatch forward of bridging materials.

The Vardar bridges had been destroyed and a new one had therefore to be built for the 27th Division. The task of moving forward the pontoons and making the crossing fell to the 2nd Wessex Company. The bridging train was parked at Dreveno, four miles

north-west of Karasuli, and left at 11.30 p.m. on the 22nd with the field company. All night and all the next day the mile-long column struggled along the hilly track for which the wagons were unsuitable and under-horsed, having to force their way through the battered trench systems and to repair bridges as they went. The road was blocked with traffic, especially heavy artillery unable to climb one of the steep hills. They at last reached Gevgeli where they borrowed forty-four six-horse field-gun teams to replace their completely exhausted horses. The head of the 27th Division was at the bridge site waiting to cross when they arrived at 4 a.m., having taken more than twenty-seven hours to cover the eighteen miles. The bridge was more than 500 feet long, complicated by several sand-banks, but the materials required had been accurately calculated from air photographs. With the willing aid of infantrymen working in the shallow water, the bridge "was completed in about five hours, a very fine feat by men who had had no sleep for two nights and no food except their haversack rations, eaten on the move, for thirty-six hours."* The heavy artillery, who could not cross by the standard pontoon equipment, luckily found a ford and were saved a long march to the next bridge miles down the Vardar.

By the evening of 27th September the 26th Division had reached Strumica after very strenuous work on roads and bridges. Temporary bridges had been put across the trenches and a crossing made over the stream at Bogdanci. The bridge over a deep ravine north of Dedeli had been destroyed but was replaced by the 107th Company by dawn on the 25th. The pioneers made deviations round two other bridges in the Dedeli Pass while the sappers replaced them. Meanwhile the XII Corps had occupied the Signal Allemand after very heavy fighting, and the 28th Division had just reached the Strumica valley. On the left the head of the 27th Division had passed Dedeli.

There had been a breakdown in supply arrangements on the 26th, due in part to the reshuffle of units for the pursuit, but largely also to the state of the roads which were breaking up under the 3-tonners. The XVI Corps was now meeting considerable opposition and it was clear that time would have to be allowed for our allies on the left to reach the hills still held by the enemy north of Strumica, but even then there would probably be heavy resistance to our advance eastward, because the enemy were sure to make every effort to cover the retreat of their Struma forces, who were pouring

* *Official History*, Vol. II, p. 215.

northward through the Rupel Pass. The supply situation must therefore be improved before a further fighting advance could be made.

General Milne accordingly issued orders that no more troops should move through the Kosturino Pass and that all engineers, infantry and pioneers south of it and all available civil labour should be set to work on *one* lorry road from Dojran, through Dedeli and Kosturino to Strumica. Work on all other roads was to cease. All R.E. units would be co-ordinated by the E.-in-C., who would deal direct through Chief Engineers and Cs.R.E. Major-General H. A. Livingstone immediately took a grip of the situation, allotting sectors, quarrying plant and rollers to Chief Engineers, and arranging for battalions to be distributed along the road, working under the supervision of Cs.R.E. Dumps of bridging stores and materials were established. On the evening of the 28th rain began to descend in sheets and continued for several days. The roads at once became impassable for lorries.

Meanwhile, however, events were occurring elsewhere. The morale of the Bulgarian army had broken, and many of the troops were in open mutiny. Telegrams were passing from German Macedonian headquarters to Ludendorff. On the 26th and again on the 28th a motor car carrying a large white flag had passed through the British lines. On the morning of the 29th a brigade of French cavalry, under General Jouinot-Gambetta, after an unbelievably difficult march across the mountains had reached Skoplje, and if it could be held the last corps retreating from Monastir with its German commander was trapped on the road through Tetovo. An aeroplane brought news of this situation while General Franchet d'Espérey was receiving the Bulgar envoys. They had no option but to accept his terms and an armistice was signed that night.

On 3rd October Field-Marshal von Hindenburg made the following statement to the German Chancellor: "As the result of the collapse of the Macedonian front, and the weakening of the reserves in the west, which this has necessitated, and in view of the impossibility of making good the very heavy losses of the last few days, there appears to be now no possibility so far as human judgment goes, of winning peace from our enemies by force of arms . . . In these circumstances the only right course is to bring the war to an end." In his memoirs General Ludendorff has written: "The events that from 15th September onwards took place on the Bulgarian front sealed the fate of the quadruple Alliance."

EPILOGUE

On 7th October an agreed directive was issued to the effect that the future goals of the Macedonian forces were to be the liberation of Serbia, the gaining of contact with Rumania and anti-Bolshevist southern Russia and the isolation of Turkey. The last of these tasks was to be carried out by a British force, including allied detachments, under General Milne. General Franchet d'Espérey decided to deploy towards Rumania three French and one British Division under French command, while the Serbian armies having started on 1st October to liberate their country advanced with amazing speed to Belgrade and the Danube overwhelming on the way some German and Austrian divisions arriving by train, too late.

General Milne decided to use his divisions as follows: The 26th Division to move down the Strumica and up the Struma valley, entraining south-east of Sofia for journey by rail to Mustapha Pasha, near Adrianople. The 22nd Division to move by sea from Salonika to Dedeagatch. The 27th Division to move by railway, as soon as it was repaired, to the Rupel Pass and thence up the Struma valley to join the allied force destined for Rumania. The 28th Division to be held ready to occupy the Dardanelles.

By 30th October General Milne had three divisions placed ready to cross the Maritza—the 22nd at Dedeagatch, the 26th at Mustapha Pasha with the French 122nd Division between them at Demotica. The Greek I Corps was behind him in eastern Macedonia. The Turks had just suffered their crushing defeat in Palestine and Syria and could not possibly find sufficient troops to defend their capital from this new threat. They signed an armistice on the British flagship at Mudros.

The move of the divisions to the Maritza had not been easy. The 26th Division started down the Strumica on 6th October, reaching the Struma at Livunovo on the 10th. They entrained at Radomir, twenty miles south-west of Sofia, on the 20th, their transport marching to Kostenetz, fifty miles further east, and entraining there. The column contained some heavy artillery and the divisional engineers had to repair and strengthen bridges on the way. The Bulgars were very co-operative and the move by road and rail was completed before the personnel of the 22nd Division could be landed by the navy on the open roadstead at Dedeagatch. The transport of

the 22nd Division had to march by land, taking eight days from the mouth of the Struma along bad roads in bitterly cold weather.

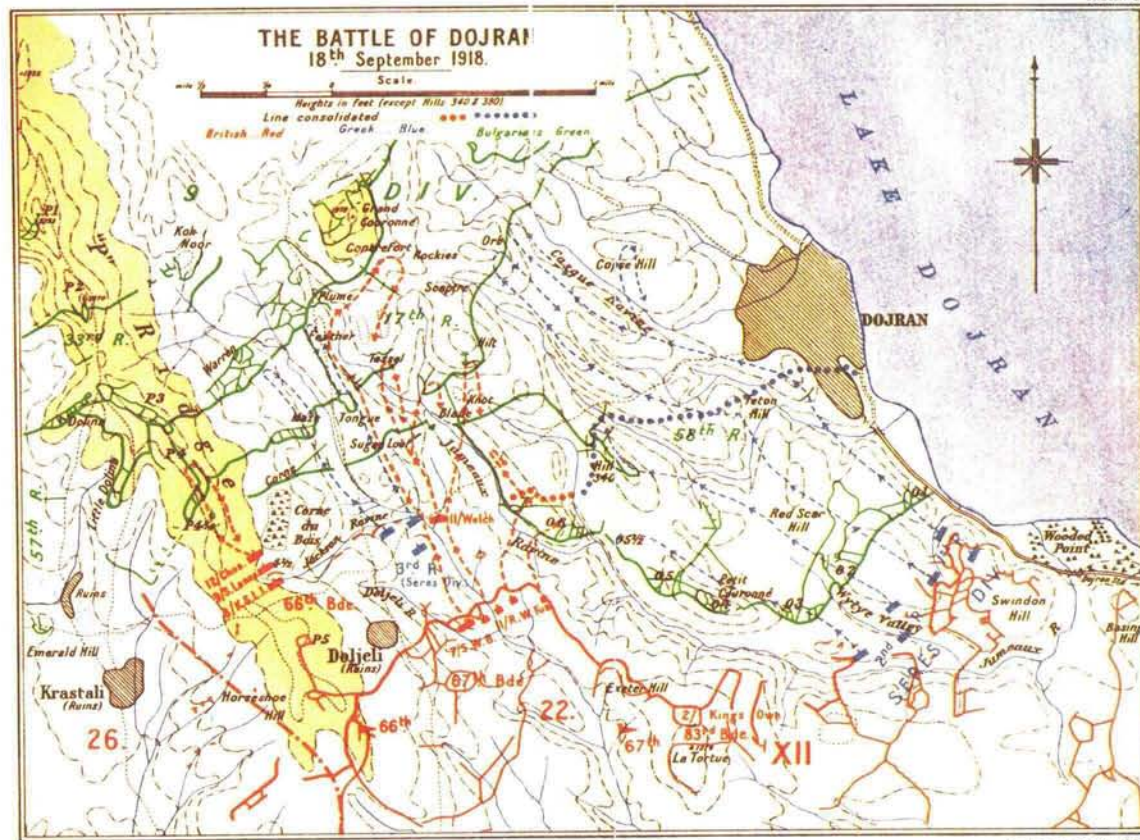
It was obviously very important to repair the line from Dojran through Seres to the Maritza at Dedeagatch and Demotica. For a length of seventy miles from Dojran to the Bulgar railhead at Porna, fifteen miles east of Seres, nearly all the rails had been removed for constructing defences in the Struma valley, many small bridges required repair and the crossing of the Struma itself south of Rupel, blown up by the French in 1916, presented a formidable task. R.E. operating personnel with Bulgar assistance opened traffic from Porna to Demotica at the end of October, although the rolling stock was in a deplorable state. A new operating company, the 217th, was formed by a further withdrawal of railway personnel from combatant units, and some Serbian technicians also became available. In November trains were running from Seres, but not till the end of January were repairs completed to the Struma bridge and the line opened to through traffic from Salonika.

On 7th November two brigades of the 28th Division with the Northumbrian Field Company sailed from Salonika and took over the forts on both sides of the Dardanelles, and the allied fleet sailed through on the 12th. On the 14th the 28th Division took over the defences of the Bosphorus and occupied Constantinople.

The 26th Division moved from Mustapha Pasha to Rustchuk to join the allied force in Rumania, and Lieut.-Colonel Pears with his three field companies were on the Danube on Armistice day.

The 27th Division left Salonika in November for Batum, and occupied the railway through the Caucasus as far as Baku. Colonel Rhodes, the Director of Railways, later handed over the Salonika-Constantinople line to the French and took over the railways of Asia Minor.

The Salonika army had now indeed outgrown its name, and General Sir George Milne now commanded "The Army of the Black Sea." His engineers were spread from Gallipoli to the Caspian, and they still had much and varied work to do.



Compiled in the Historical Section (Military Branch) 3540
GSGS Misc 2439/1

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**ROYAL ENGINEERS IN EGYPT AND PALESTINE,
1914-18**

CHAPTER XIX

THE DEFENCE OF EGYPT, 1914-15

The strategic importance of Egypt—The defence of Egypt, August to October, 1914—The entry of Turkey into the war—Defensive measures, November, 1914 to January, 1915—The Turkish attack on the Suez Canal—The development of Egypt as a military base—The Suez Canal, 1915.

(See Map 4 in pocket and Sketch 7, facing page 292)

THE STRATEGIC IMPORTANCE OF EGYPT

IN 1914, although nominally under Turkish suzerainty, Egypt, with the tacit consent of interested European powers, was in fact governed by Great Britain and had been since 1882 when long years of misrule had culminated in bankruptcy and civil war. Thirty years of good administration had placed Egypt's finances on a sound basis, established an era of law, order and prosperity unknown for centuries, restored and improved irrigation and provided excellent ports, railways and other public utilities. British authority was sustained by a garrison of some 5,000 men, and internal security by the Egyptian army and police, both trained and largely officered by the British. The Egyptian army had helped the British in the reconquest of the rebellious Sudan in 1898 and this territory had since been the subject of the joint Anglo-Egyptian condominium. A small British garrison had its headquarters at Khartoum.

The British control in Egypt was not wholly disinterested, as the strategic importance of the country in relation to the defence of the Empire shows. Egypt not only occupied the land bridge between Asia and Africa, but was also traversed by the Suez Canal which formed a vital link in the Empire's sea route between Great Britain and the east. Moreover, Egypt's situation, climate and resources combined to make her an ideal centre for the concentration and training of the Empire's military forces and a valuable source of supplies for the latter's war potential. This strategic importance had been enhanced by the development of oil in the Persian Gulf. Any threat to Egypt and, in particular, to the Suez Canal thus involved Imperial interests of the highest importance.

THE DEFENCE OF EGYPT, AUGUST TO OCTOBER, 1914

Not only her government in peace, but also her defence in war was almost entirely the responsibility of Great Britain. In August, 1914, no immediate threat of any importance existed but, in addition to naval measures, steps were taken to reduce the possibility of sabotage in the Suez Canal and in Egypt and to guard against internal unrest. The attitude of Turkey, who then ruled Palestine, was, however, a cause of considerable anxiety and in order to avoid incidents the greater part of the Sinai peninsula—the desert area between Palestine and the Nile delta—was evacuated by the police force which normally controlled it.

The plans for Empire mobilization envisaged the recall of the peace-time "Force in Egypt" to England to form part of further Regular Army divisions and the replacement of the garrison by a Territorial division. The East Lancashire Division, shortly to become the 42nd Division, was selected and began to disembark at Alexandria on 25th September. Meanwhile part of the first of the Indian divisions on their way to France was diverted temporarily to increase the garrison. The last of the British regular units left Alexandria on 30th September. A week earlier a party of armed bedouin crossed the Sinai frontier near Rafah and Lieut.-General Sir John Maxwell, an officer with long experience of Egypt, who had succeeded to the Egypt command earlier in the month, sent a column of the Egyptian coastguards to destroy the wells at Nekhl, seventy miles east of Suez, as a precautionary measure.

In October Turkey's attitude became more threatening and reports from Palestine indicated that a raid against the Suez Canal might be imminent. A considerable force of Indian troops was then ordered to Egypt; it consisted of various units equivalent to one cavalry and six infantry brigades, little artillery and no engineers, and did not begin to arrive before the middle of November.

The Chief Engineer to the Force in Egypt was Colonel H. B. H. Wright and in August, 1914, he had a small staff, the 2nd Field Company and a small works organization. Almost immediately he began to lose his staff and by the time the 2nd Field Company had left, only the clerks in his own office remained. Concurrently, he was faced not only with potential operational demands in the Canal Zone but also with a large increase in works services, due to the augmentation of the garrison. On the operational side the arrival in Cairo of the two Territorial field companies—the 1st and 2nd

East Lancs., of the East Lancashire Division—under their C.R.E., Lieut.-Colonel S. L. Tennant, relieved the C.E.'s anxieties to some extent, but both units were in need of further training.

Insufficient barrack accommodation for the considerable numbers of troops arriving caused Colonel Wright to turn to Sir Murdoch Macdonald, Director of Public Works, for assistance in providing the necessary works services and technical staff. Thus began the close co-operation between the civil and military authorities which was to prove of the utmost value throughout the war.

Tented camps were established in the relatively healthy desert areas near the larger towns, whose water services were usually able to extend their systems to meet demands. Camp structures were provided mainly by contracts supervised by the P.W.D. and R.E. organizations.

THE ENTRY OF TURKEY INTO THE WAR

On 30th October German cruisers, nominally under the Turkish flag, bombarded Russian ports in the Black Sea and on 5th November Great Britain declared war on Turkey. This notable success for German diplomacy was a serious complication for the allies and especially for Great Britain, who was to bear the brunt of the Turkish campaigns. So effective were the measures taken to calm the not unnatural excitement in Egypt that, when the Sultan of Turkey on 14th November proclaimed a Holy War against the allies and called on all Moslems to share in the defence of their faith, there was remarkably little unrest. No apprehension was felt about the Sudan, where the people remained calm and, indeed, gave many assurances of loyalty to Great Britain. On 18th December the British Government proclaimed Egypt a protectorate and next day deposed the Khedive and appointed his uncle Sultan of Egypt. The title of the British representative was also changed to High Commissioner and Sir Henry M'Mahon was appointed to this post on 9th January, 1915. These changes were on the whole received with indifference by many and restrained approval by some, with the result that internal disturbances in Egypt were almost unknown until after the war.

DEFENSIVE MEASURES, NOVEMBER, 1914 TO JANUARY, 1915

The defence of the ports and coasts was a naval responsibility and is not therefore described further. Turco-Arab forces with German assistance had recently expelled the Italians from Cyrenaica but the

potential threat to Egypt's western frontier was not yet serious. A more likely source of trouble was the fanatical Senussi tribe, which had many adherents in the Nile Valley, and the effect upon them of the Holy War needed watchful attention. The frontier post at Sollum was reinforced and other measures taken to secure the western flank.

The threat to the eastern frontier and to the Suez Canal was more serious. The peace strength of the Turkish forces in Syria and Palestine was about 60,000, with a planned expansion to 100,000 in time of war. From the Palestine frontier to the Suez Canal was 120 miles and although armies in the past had not infrequently crossed this tract of desert it was considered that difficulties of water supply and movement made it unlikely that a striking force of more than 5,000 rifles could reach the canal, possibly with further forces in support. There were three lines of approach: the historic caravan coastal route in the north leading to Qantara; a central route from the Turkish railhead then at Beersheba through El Kossaima and Bir el Hassana to Ismailia; and a southern from Ma'an on the Hejaz Railway through hilly country by way of Nekhl (the late administrative centre of Sinai Province) to Suez. Of these the central route offered least disadvantages, and as it led directly to the most important tactical point on the Suez Canal, where not only the canal, but also the water supply and railway communications with Egypt, could be controlled, it was considered the most probable line of attack. It was practicable for a large force only after the winter rains had filled the wells and ancient rock cisterns, but this factor was removed by a heavier rainfall than usual at the end of 1914.

The pre-war plan of defence took into account these considerations and also the probability that no forces sufficiently equipped and trained to undertake offensive operations in the desert would be immediately available. Somewhat reluctantly, a strategically passive defence was accepted as inevitable, the desert being used as the initial obstacle and the canal as the second. Nekhl was intended to be held by a camel force to prevent the enemy from using its water resources but this was found to be impracticable. The main disadvantage of the plan was that the canal could be reached almost anywhere by raiding parties who could then lay mines in the waterway. On the other hand, several allied warships were available to supplement the deficiency in land artillery.

By the end of November the force available to defend the canal consisted of the 42nd Division and the Indian expeditionary force.

The former was in need of further training before it was fit to take its place in the line, and its artillery was under establishment and of obsolete type. The Indian troops were formed into two divisions—the 10th and 11th—but these improvised formations had only a few obsolescent pack guns and so little transport that they were almost immobile. The absence of engineers was to some extent compensated by the presence of the 128th Pioneers, who did excellent service. Lieut.-General Maxwell appointed Major-General A. Wilson, commanding the Indian force, G.O.C., Canal Defences, and his headquarters was established at Ismailia.

The forces in Egypt now received a further important addition in the shape of the first Australasian contingent, comprising an Australian mounted brigade and infantry division and a New Zealand mounted brigade and infantry brigade. The former included three field companies and the latter a field troop. These troops should have gone to England to complete their training but accommodation difficulties led to their diversion to Egypt. They began to disembark at Alexandria on 3rd December and were sent to the Cairo area. Finally, on 22nd December No. 10 Company, 2nd Q.V.O. Sappers and Miners, arrived from India to augment the slender engineer resources.

A brief description of the Suez Canal, which was to become the focus of activity for many months, will assist in an understanding of the engineering work connected with its defence. Just under a hundred miles long, it had been cut through the desert between Lake Manzala on the Mediterranean and the Gulf of Suez inlet from the Red Sea. Its width varied from 400 feet in flat ground to rather less than 300 in the shallow cuttings which occurred in three localities. The depth of water varied slightly but at its maximum was 34 ft. The waterway passed by buoyed and dredged channels through Lake Timsah and the two Bitter Lakes. In the northern part of the canal there was little or no movement but at the south currents of up to four knots were experienced.

During the construction of the Suez Canal the Ismailia irrigation canal was restored and the Sweetwater Canal, 30 ft. wide, built parallel to and on the western side of the main canal for water supply purposes. Towns grew up at Port Said, where extensive harbour facilities were developed; at Ismailia, half-way along the canal; and at Suez in the south. The subsequently developed modern water systems were usually based on the Nile water in the Sweetwater Canal. This, however, contained the parasite of the disease

bilharziosis in the small water snails which abounded, and careful treatment was necessary to eliminate it.

On both sides of the canal there were either shallow lakes or sand dunes and desert. Absence of metalled roads and the fact that the standard-gauge railway running parallel to the Ismailia canal and thence to Zagazig to join the Egyptian State Railway (E.S.R.) system was only single track made rapid movement of troops impracticable.

Colonel Wright's task in connection with the defence works was formidable. He had fewer engineer troops than he had a right to expect, almost no staff and no reserves of engineer stores or bridging equipment. On the other hand he had several unusual assets. The General Manager of the Egyptian State Railways, Major Sir George Macauley, and two of his senior assistants—Major R. B. D. Blakeney (Deputy General Manager) and Captain G. C. M. Hall (Traffic Manager)—were retired R.E. officers with long experience of Egypt and the Sudan and gave great assistance in many ways. In the early autumn, for instance, sufficient sidings and stations were built along the canal to supply eight defence posts, and in August, 1914, an armoured train was constructed in the railway workshops. This train was designed by Captain R. E. M. Russell, R.E., of the Egyptian army and equipped with searchlights, guns and machine-guns; it consisted of ten trucks and required a crew of eighty-four men, of whom four were R.E. As the Indian troops in the crew were changed weekly the sappers were usually assumed to be in charge.

The Suez Canal Company, after a hesitant start, ultimately put all its large engineering resources, including its ferries and small craft, at Major-General Wilson's disposal, added more ferries, built three large floating bridges at Qantara, El Kubri and Ismailia, eight smaller bridges over the Sweetwater Canal and gave assistance in many other ways. The detachment of the Military Works Department of the Egyptian army of 110 men and a small camel section under Lieutenant B. T. Wilson, R.E., at Moascar was also a valuable aid.

The 1st and 2nd East Lancs. Field Companies were sent from Cairo to Ismailia as a precautionary measure on 26th and 27th October and their manifold duties included work on the defences, water supply, assistance in building and operating the three bridges mentioned above, the demolition of the native village at Qantara and the operation of searchlights. They also provided crews for

manning steam tugs and in a boiler explosion on one of them 2nd Lieutenant B. H. Woods and six sappers of the 2nd Company were killed—the first R.E. casualties in the theatre.

On 9th November Captain Russell was appointed Staff Officer, R.E., Defence Works, to the G.O.C., Canal Defences, with the object of co-ordinating all engineer work. The shortage of supervisory staff was alleviated by the appointment of R.E. officers, either temporarily commissioned or recalled as reservists, from the Egyptian Railways, Public Works and Irrigation Service.

Passive linear defence caused wide dispersion of the forces available, but the 100-mile front was in effect considerably reduced by the various lakes, which were unlikely points of attack, and by the flooding, in November, 1914, with water from the canal of a considerable tract of low-lying country in the north extending twenty miles along the canal and fifteen miles into the desert to the east. Further cuts were made, and by January, 1915, north of the Bitter Lakes, the length of canal open to attack was reduced to little more than twenty miles.

The principle upon which the defence works were based was that a series of fortified bridgeheads covering floating bridges should be built on the east bank. The bridges were required for reinforcing threatened points and for counter-attacks. The intervals between them were to be lightly held by fire trenches on the west bank. The defence posts were first increased to eighteen, with a more extensive bridgehead at Ferry Post, and extended from the Quarantine Station, south of Suez, to Port Said; each consisted of detached trenches revetted with sandbags and covered by barbed wire. When No. 10 Company, Q.V.O. Sappers and Miners, arrived in December it extended the trench systems of the redoubts on the east bank between Ismailia and Ballah, covered others by a series of small half-moon breastworks and provided some of the trenches on the west bank with overhead cover of the pre-1914 pattern. In January, 1915, twelve more posts were constructed on the west bank between Lake Timsah and the Great Bitter Lake, the shortage of barbed wire was partly overcome by using pits with sharpened stakes and, in the inner defence line at Ismailia, by a few electrically-fired land mines.

A few local aircraft formed the nucleus of the R.F.C. in this theatre and a small airfield was prepared at Moascar, near Ismailia, with a double hangar built with local materials. Searchlights were installed along the canal, the electricity generating station at

Ismailia was taken over and operated and water supply schemes were started. A new filter was built at the Ismailia waterworks, which supplied the large camp at Moascar. Suez and Port Said supplied other camps. The posts on the east bank were provided with storage for two days' supply and those at Qantara and Ismailia also received unfiltered water through 2-in. siphons laid across the canal bed. All posts were supplied with drinking water under R.E. arrangements from a water-tank steamer and barges.

Good maps existed of the canal region and for some years R.E. officers had been engaged during the winter months on survey work in Sinai, in conjunction with the Survey of Egypt. This department had had until recently a R.E. officer as its Director-General, but in 1914 this post was occupied by Mr. E. M. Dowson, while Captain S. F. Newcombe was in charge of the Sinai Survey. The Sinai maps were in process of being engraved and this was expedited during the autumn. The Survey of Egypt lent sections of surveyors which, under Captain Russell's direction, made maps to a 1/15,000 scale of a strip on the east of the canal for artillery purposes.

During this period much work was done through the agency of the P.W.D. in Egypt. The numbers of troops (70,000 by the end of 1914) had outpaced accommodation and the new camps required their own water supply, drainage and roads. Tube wells were sunk at Mena (near Cairo), Belbeis (on the Ismailia Canal) and other places.

THE TURKISH ATTACK ON THE SUEZ CANAL

By the end of 1914 Turkish detachments had been reported in Sinai, and the enemy strength in Syria and Palestine was estimated at 70,000. Turkish activity increased in January, 1915, and on the 20th small raids were repulsed at Qantara and El Kubri. A larger force was reported at Moiya Harab, twenty miles east of the Bitter Lakes. The Indian garrisons were now thoroughly on the alert. On 16th January the 3rd Field Company (Major H. O. Clogstoun, R.E.) of Australian Engineers reinforced the defence force. The two East Lancs. Field Companies had returned to Cairo on the 6th to complete their training, but the 1st Company was brought back on the 26th to enjoy the distinction of being the only R.E. unit present during the main attack.

This began early on 3rd February at Tussum and although a few gallant Turks crossed the canal on pontoons and rafts their footing

was soon eliminated. A later attack at Serapeum and various diversionary attacks elsewhere were repulsed with ease and by the afternoon the long-awaited, carefully planned attack was over, its object unattained. The Turks sustained 2,000 casualties and this number might easily have been greater had not the relative immobility of the Indian troops enabled the enemy to retire practically unmolested. Two sections of the 1st East Lancs. Field Company holding positions on the west bank lost one man killed and two wounded. The brief action proved to be decisive and no further organized attack upon the canal was ever made.

THE DEVELOPMENT OF EGYPT AS A MILITARY BASE

During the rest of 1915 the main interest moved to Egypt as the training area for large numbers of Imperial forces and as the base from which first the Dardanelles and then the Salonika expeditions were launched. Upon Lieut.-General Maxwell and his staff there gradually devolved "many of the responsibilities of a War Office conducting a campaign, but without its co-ordinating authority." The presence for a time of the C.-in-C., M.E.F. (who was considerably senior to Lieut.-General Maxwell), and his staff complicated the situation but its inconveniences were overcome by tact and goodwill. The Australian base was directly under Lieut.-General Birdwood, the Commonwealth Government's representative and commander of the Anzac Corps. General Maxwell had also to defend the Suez Canal, to watch the growing signs of trouble on the western frontier and to maintain internal security. His administrative burden was immense. Large forces were landed and re-embarked for the Dardanelles in the spring; the M.E.F. base was established in Egypt; the country became the main hospital centre for Gallipoli casualties, and throughout the year considerable numbers of troops passed through the ports. Between the outbreak of war and the end of 1915 his embarkation staff, which at the peak consisted of eight officers assisted by a few more temporarily attached, handled over 800,000 troops, with their guns and transport and nearly 180,000 animals. By the end of August, 1915, over 50,000 wounded had also been received.

Consequential engineer work was heavy but the paucity of records precludes a full description of the resource and hard work with which Colonel Wright, the C.E., and his small organization (six officers in November, 1915) met the heavy demands made upon them.

There was no D. of W. with a works organization, and no field engineers, but the P.W.D. made good many of these deficiencies in expanding engineer services at camps all over the country. Engineer stores were bought locally by a Resources Board on behalf of all users, and prices thus kept within reasonable limits. The embryonic stores organization at Alexandria was expanded to cope with the demands from Gallipoli and for minor expeditions. When the Macedonian campaign opened in October the War Office authorized the formation of the Levant Base to meet demands for resources of all kinds.

THE SUEZ CANAL, 1915

Small Turkish forces remained in Sinai throughout 1915, but a few mine-laying raids only were made against the Suez Canal, and one or two minor encounters between patrols took place. Lieutenant Wilson's camel section of the Military Works Department accompanied several reconnaissances from Moascar, assisting in water supply, draining pools and cisterns used by enemy raiding parties and preparing landing strips for aircraft. On 6th February the 2nd East Lancs. Field Company joined the 1st Company on the canal and both units did much work on the defences before they were withdrawn to resume divisional training. The 3rd Australian Field Company, which had done a great deal of bridging work, embarked for Gallipoli and No. 10 Company, Sappers and Miners, was left to carry on alone for the rest of the year, maintaining defences and bridges, building more bridges, and erecting sun shelters and a little hutting.

The bridge works carried out by various units were extensive. Chain ferries were replaced by floating bridges on barges, but the latter were poor and leaky and required much maintenance. A steel lighter bridge in two halves for easy opening was built at Qantara and several pontoon bridges made from the double iron cylinder floats used by the Canal Company to support the discharge pipes of dredgers. A considerable number of bridges, most of them of fixed types, were constructed across the Sweetwater Canal, there being at the end of March, for instance, six between Suez and Geneffe alone.

The inundated area was reduced by evaporation until at the end of March only some sixteen miles of canal were covered although the area uncovered was still almost impassable. On 21st April

the original cut was re-opened and the flood water spread considerably; a weir was built and pipes with wooden tide flaps installed to replenish the water automatically. Eventually pumps were erected to make good evaporation losses more quickly.

In October, 1915, a Topographical Section, R.E., was formed under Major W. J. Maule with a strength of nine officers, who with Egyptian other ranks, were temporarily commissioned from or supplied by the Survey of Egypt. Based on tachymetric measurements of height and distance and using the plane table for detail the section extended the 1/15,000 Canal Zone maps into Sinai. From November a few air photographs were taken to supplement ground work and on 16th December six field parties were at work. Later this survey was re-plotted and continued to the more usual scale of 1/20,000 and its value will be brought out in subsequent chapters.

Headquarters, Canal Defences, remained substantially unaltered in composition and duties, except that during the summer, when the Indian divisional organization was broken up, as one brigade after another left the Canal Zone for service elsewhere, it began to exercise direct command of the garrisons. It remained at Ismailia throughout 1915. It continued to have one staff officer R.E. only, Major R. E. M. Russell holding this appointment until 10th May, when Major T. P. Bassett, from No. 10 Company, Sappers and Miners, relieved him. Early in 1915 the Canal Zone was divided into three sections, as follows:—

No. 1 Section. From Suez to Geneffa.*

No. 2 Section. From Serapeum to Ferdan.

No. 3 Section. From north of Ferdan to Port Said.

* To become well known during World War II and subsequently as Geneifa. The spelling of place names here adopted is that used during World War I, and does not always agree with modern custom or with the spelling on Map 4, dated 1925.

CHAPTER XX

FORTIFICATION OF THE SUEZ CANAL ZONE, 1916

The evacuation of Gallipoli—The concentration in Egypt—Engineering problems in the extension of the Canal Defences—Engineer resources—Control of military works—The revised defence plan—Railway works—Light railways—Roads and quarries—Bridges, ferries, wharves and piers—Water supply—Inundations—Reorganization of the Army command—Military defence works—Formation of the Egyptian Expeditionary Force (E.E.F.)—Organization and progress to 19th March, 1916.

(Sketch 7, facing page 292)

THE EVACUATION OF GALLIPOLI

AFTER the opening of the Macedonian campaign in October, 1915, the Gallipoli peninsula was evacuated in view of the failure there of the offensive in August. The resulting situation in Egypt became serious because the pressure on Turkey was relieved and large forces released for a renewed attack on the canal. Moreover, Turkish communications with Palestine had improved and Bulgaria's entry into the war ensured quicker and more substantial German support. Before the evacuation was finally decided General Maxwell had begun to consider his new problem. Probably the best defence against the new threat would have been an offensive operation based on the Gulf of Iskanderun (Alexandretta), but political considerations caused this proposal to be abandoned. The only alternative was the direct defence of Egypt. The more serious nature of the potential threat necessitated great extension of the static defences on the Suez Canal line, mobile defence being impracticable owing to water supply and communication difficulties in Sinai.

General Maxwell estimated that he would require one cavalry and fifteen infantry divisions for the defence of Egypt, including that of the western frontier where operations against the Senussi were beginning, and for internal security. This estimate was based on defence in depth of the Suez Canal line with an advanced position at Qātiya on the northern Sinai route in order to deny to the enemy its water facilities. He considered that fifteen field companies, R.E.,

in addition to those in the M.E.F., would be required. The General Staff at the War Office considered these estimates excessive but all were agreed that large forces would have to be sent to Egypt if Gallipoli were evacuated. In November, 1915, there were 60,000 troops in Egypt but they were nearly all base details and reinforcements under training, and although this number rose in December there were still only twelve battalions on the canal. Early in December the evacuation of the Gallipoli peninsula began, and was completed with unexpected success early in January, 1916.

THE CONCENTRATION IN EGYPT

Between December, 1915, and early February, 1916, one dismounted yeomanry and ten infantry divisions reached Egypt from Gallipoli. All were weak in numbers and badly in need of rest, reorganization, training and re-equipment. In addition the 31st Division from England and the 46th from France arrived at Port Said at the turn of the year. These formations with their ancillary troops proceeded to various camps in the Cairo and Alexandria districts and in the Canal Zone, imposing a heavy strain on the railways. Almost every unit was seriously below establishment and R.E. units were no exception; for example, the 29th Divisional Engineers on 19th January numbered only thirteen officers and 203 other ranks, and the 2/1st East Anglian Field Company (54th Division) two and fifty-six respectively. Moreover, many men still with their units would have been in hospital in most other campaigns and the remainder were suffering in varying degrees from the indifferent diet and continuous strain at Gallipoli. Fortunately the excellent winter climate of Egypt, a few days' rest and some training did much to restore health and morale, but reorganization was a slower process and for many weeks transport, equipment and stores were seriously deficient.

ENGINEER PROBLEMS IN THE EXTENSION OF THE CANAL DEFENCES

On 16th November, 1915, in view of the Gallipoli evacuation, General Maxwell was informed that the defence of the canal was to "be taken seriously and in depth . . . stores and materials . . . as may be decided after study of the problem should be ordered. The work should not be delayed for want of material." But Colonel

Wright, shortly to be promoted Brigadier-General, had no information on the numbers of troops to be made available, the labour force which would be provided, the system of defence and the date by which the project was to be completed. In consultation with the General Staff it was assumed that twelve divisions would be deployed, that the forward posts of a deep defensive system would be sited on the low hills six to seven miles east of the canal (to place the latter beyond the range of Turkish artillery), that a second or support line would be required and that the existing bridgehead positions should be extended, including the Qatiya oasis. An elaborate system of metalled roads, light railways and water pipelines was then designed to supply the garrisons.

ENGINEER RESOURCES

Demands for stores and labour were large but Egypt was able to provide much of both. The Engineer Stores Depot of the Levant Base had large quantities of defence stores and a considerable mileage of 60-cm. light railway track; all available timber was bought for £500,000, together with large amounts of hurdles and matting for revetment; municipalities lent road construction plant and all available second-hand machinery was requisitioned and overhauled; Government departments placed their reserves at the disposal of the army; and the stocks of leading contractors were acquired.

Yet the quantities demanded upon the War Office remained very large, in spite of the fact that the normal rates of delivery to the Levant Base had been increased. The water stores alone included 280 miles of pipes up to six inches diameter, engines, pumps, a condensing plant for Quarantine Post and storage tanks for 150,000 gallons. Some of the pipes came from Great Britain and Holland; 130 miles from India; and the balance was bought in the U.S.A.

The movement by rail of these large quantities to the Canal Zone was complicated by the strain of moving the various formations of the M.E.F. to camps in different parts of the country, and resulted in some restrictions of supplies in the early stages.

Skilled labour was more difficult to obtain than stores. No field companies were available and execution of the works by contract was impracticable owing to shortness of time, difficulty in preparing contracts and prohibitive costs. Military labour therefore was supplemented by expanding the Egyptian Works Battalion, which

had already done good work in Egypt and Gallipoli, into the Egyptian Labour Corps (referred to as the E.L.C.). Gangs of fifty men, each under a native foreman, were recruited by villages and twelve gangs organized as one company under European officers. The E.L.C. numbered 3,000 in January, 1916, but expansion to much greater strength was rapid. Contract labour was engaged at special rates and many men were obtained by this means. An early attempt by the Ministry of the Interior to organize a labour force was less successful but after some delay considerable numbers were engaged. At the peak period 30,000 Egyptians were employed, exclusive of those engaged on railway works.

CONTROL OF MILITARY WORKS

One of Brigadier-General Wright's greatest difficulties was the acute shortage of engineer officers and staff to supervise construction and it was not until January, 1916, that he was able to obtain a staff officer—Captain L. V. Kent—in his own office. The War Office promised twenty-seven officers but thirteen only arrived before the end of January. On the other hand two or three senior officers arrived before the end of 1915 and were to be of great assistance. These included Colonel P. G. Grant, who had been Director of Works in the Sudan before the war and who had seen service in France; Lieut.-Colonel H. L. Pritchard, who had had considerable experience in Egypt and had also served on the Western front; and Lieut.-Colonel G. R. Pridham, who had commanded the first New Zealand field company in Egypt and had served at Gallipoli. Pritchard did not remain long in the Canal Zone, as he was appointed Chief Engineer of a Corps at Salonika in February, 1916.

Colonel Grant was appointed C.E., Canal Defences, and to him was allotted the purely military engineering work. Lieut.-Colonels Pritchard and Pridham were his principal assistants and the former began reconnaissance in the desert east of the canal early in December to site the new positions. He obtained assistance from the 4th Australian Division (then completing its training), the 2nd New Zealand Field Company and detachments of the Bikanir Camel Corps.

The E.S.R. became responsible for supplying materials for, and construction of all railways except decauville lines. Sir George B. Macauley was appointed Director of Railways with the rank of

colonel; Major Blakeney and Captain Hall were appointed lieutenant-colonels and retired R.E. and civilian officers of the E.S.R. were recalled or commissioned for the Railways Directorate.

The Egyptian Ministry of Public Works undertook all other works except those executed by the Suez Canal Company and Sir Murdoch MacDonald was appointed D.D.W. with the rank of colonel. Major Bassett became his Staff Officer, R.E., Mr. H. W. Molesworth and Mr. E. H. Lloyd were appointed lieutenant-colonels but the latter did not join until 18th February, 1916. The rest of the D.D.W.'s staff consisted of seconded P.W.D. officers and civil engineers who were given local and temporary commissions. Many could be spared for a limited period only from their civil duties, and within a few months were replaced by other officers. The C.E., Force in Egypt, explained the scope of the work on water supply, roads and decauville track to senior officers of the Ministry on 1st December, 1915, and three days later Colonel MacDonald opened the headquarters of this *ad hoc* organization at Ismailia. It gave valuable service and worked fast as a result of local experience, the ability to make the best use of contractors and the absence of financial restrictions.

The Suez Canal Company undertook much work on bridges, ferries and piers and placed the whole of its great resources at the disposal of the army on generous financial terms. The co-operation and advice of its chief engineer, M. Perrier, and its staff were always available and were very helpful.

THE REVISED DEFENCE PLAN

At the end of November Major-General H. S. Horne, who had been sent by Lord Kitchener to advise and report on the defence arrangements, reached Egypt and Colonel Grant accompanied him on his tour of inspection and reconnaissance. On 10th December General Horne telegraphed his proposals to the War Office. They were very similar to the existing plans but had one important variation—the omission of any reference to the occupation of Qatiya, although the possibility of some advanced works was envisaged. The new C.I.G.S., Lieut.-General Sir Archibald Murray, questioned this omission but Lieut.-General Maxwell accepted it because he felt that completion of the main defences would be delayed if Qatiya were held as an advanced position.

The line now recommended, roughly six miles from the canal, lay generally along the same range of low hills as before. New

posts were to be constructed at Ayun Musa* oasis, near Quarantine on the eastern shore of the Gulf of Suez and at a new bridgehead at Kabrit. A second line was to be constructed 4,500 yards behind the advanced line but sufficiently forward to prevent serious bombardment of the canal. The third line, as before, was to consist of mutually supporting defences covering the bridgeheads, and both the intermediate and third lines could be supported by naval gunfire.

Work was ordered to begin in January, 1916, but much had to be done in the way of siting and in the collecting of stores before this was possible. Moreover, construction had to be so organized that, as formations from Gallipoli reached the Canal Zone, plans could be handed to corps and divisions for continuing the work in their respective sectors. A Turkish attack was considered possible at the end of January and concentration upon the most urgent items was therefore necessary.

Lieut.-General Maxwell appointed Major-General Sir Herbert V. Cox to preside over a co-ordinating committee and to give decisions in his name on priorities and other matters relating to the defence works. The first meeting was held on 9th December, 1915, and by the end of January four more had been held, usually attended by all C.Es. and heads of engineer services. One of the earliest decisions was to organize a system of inland water transport under civilian A.Ds.W., one of whom was Mr. Hughes, until recently engineer at the Aswan Dam, in order to supplement the limited railway capacity. The Public Works Ministry collected ninety-seven tugs, steam barges and lighters, besides 260 sailing craft from Cairo and Alexandria, and lent all the canal and river craft of its inspection fleet. The Sudan Government lent three river tugs. The Nile was low at this season and later strong winds affected Lake Manzala so that many of the larger craft did not reach the canal for some time. The principal single commodity transported was road metal, but coal and nearly all stores, from steam rollers to tools, were distributed by water when possible. The lighters were also used to discharge the cargoes from ocean-going ships in Lake Timsah and at other points.

RAILWAY WORKS

The first works to start were those in connection with railways under Colonel Macauley. The only railway from Cairo to the Canal Zone at Ismailia was a single track standard-gauge from Zagazig,

* The traditional site of Moses' wells (*Exodus 17*), wrongly spelt on Sketch 7.

fifty miles from Ismailia, and a second track was started on 1st December, 1915, under Mr. Dukes, of the E.S.R. On an average nine and a half military trains and some ordinary traffic ran daily in each direction over this section but in spite of this the double line was opened to traffic on 6th January, 1916—a remarkable achievement. A total labour force of 15,000 men (including some Egyptian army reservists with railway experience) was employed; nearly 400,000 cubic yards of excavation was required, and over 150,000 tons of material used. Permanent way stores were supplied by the E.S.R. from stocks held for renewals. On 1st December, 1915, work also began on a considerable programme of improvements to the single line along the canal from Port Said and was planned to be finished by 15th February, 1916. The few existing sidings were much augmented, and nearly eight and a half miles of branches to the canal bridges, eight stations at camp sites, extensions to the dock facilities at Suez and passing loops were constructed. As soon as the new Ismailia track had been finished work started on a second line from Es Salihiya to Qantara in order to provide two railways to the Canal Zone from Zagazig. Much work was required at Qantara—before the war a mere halt in the desert—to equip it as the terminal for this new line; it included a marshalling yard, a triangle for turning locomotives, more platforms and several sidings for special purposes.

LIGHT RAILWAYS

East of the canal an extensive light railway system was constructed to supply railheads in the second line from depots in the bridgeheads. Tactical considerations, which had to envisage the possibility of enemy thrusts to the canal, made separate lines from each bridgehead necessary. Eventually, over eighty miles of 2-ft. gauge, exclusive of sidings, twelve and a quarter miles of 2ft. 6-in. gauge and nearly twenty-four miles of metre gauge railways were laid. The 2-ft. and metre gauge material was provided by the E.S.R. and from track taken up from little used lines in the Delta, the 2 ft. 6-in. gauge came from England.

The work was supervised by the D.D.L.R., Lieut.-Colonel G. Lubbock, R.E., and labour was at first provided by Egyptian army reservists and civilians engaged by the E.S.R. Work began in December, 1915, but in January, 1916, the 115th and 116th Railway Companies arrived from France. They worked on the Ferry Post, Ferdan and Kubri lines and a line from Esh Shatt to Quarantine.

They also laid a 2 ft. 6-in. line from Port Said for twelve miles along the coast to Qalaat. Rolling stock (thirty-three locomotives and 350 wagons) were largely provided from Egypt. Petrol locomotives and some types of wagons proved unsatisfactory for desert use, but when these difficulties had been removed trains carrying up to ninety tons of stores (usually road stone) were run. The maximum weekly lift on any one line was 2,900 tons carried on the Shallufa track in May, 1916.

The light railways were supplemented by decauville tramways from each of the bridgehead depots to the forward defences. One contractor in Egypt acted as the principal agent and supplied seventy miles of track, thirty-six locomotives and nearly 1,700 wagons; and the Egyptian Government lent a further thirty-four miles. Construction was directed by the A.D.W., Lieut.-Colonel Molesworth, and by the end of January, 1916, the principal lines had all reached the forward defence line. A detachment of the 116th Railway Company was engaged on the Ferdan line from 5th February, and by May, 1916, some ninety miles had been laid. Their main use was for the transport of road metal but water stores and, later, supplies to the forward garrisons were also carried. Sandstorms made it difficult to keep the locomotives serviceable and track maintenance was heavy.

ROADS AND QUARRIES

A 9-ft. waterbound macadam road from each of the nine bridgeheads to the first line defences, supplemented by two lateral roads were built except where the ground was hard.

Ferry Post and Esh Shatt provided small amounts of stone but larger quantities were available at the Canal Company's quarry at Ataq, ten miles south-west of Suez, taken over by the D.D.W. with its stocks, plant and three steam 600-ton hopper barges. Another quarry at Fayid, on the west side of the Great Bitter Lake, was also developed to produce 1,000-1,250 cubic yards daily. Unfortunately the pink limestone was not of very good quality, but the quarry was centrally situated and capable of a large output. Six decauville lines were laid to the lake-side and on to three stone jetties, each nearly 400 feet long, from which barges could be loaded in all weathers. These lines crossed the Sweetwater Canal on timber piled bridges and passed under the standard-gauge railway embankment in masonry subways. A labour camp with its own water supply was laid out and the quarry placed under an A.D.W., Captain

Cooper. After blasting, the stone was broken by hand and graded into pieces averaging twenty-five pounds for soling, and passing a $3\frac{1}{2}$ -in. ring for metalling.

Stone was taken along the canal by tows of barges but traffic was suspended each night and not resumed until the channel had been examined or swept for mines. Congested unloading points caused delays and heavy excavation, up to forty-five feet in depth, was required where the canal was in cutting to provide reasonable road and rail gradients. Road transport and camels were used for short hauls in conveying the stone but when the roads drew away from the canal increasing use was made of the light railways. Until decauville lines were laid progress was very slow but with their aid over a million tons of stone were ultimately transported.

The labour force, which in January, 1916, had been increased fourfold in a few weeks to some 10,000 men, was sufficient for construction to keep pace with the stone supply. On the east bank works officers were in charge but on the west most of the roads were built by contract with plant supplied by the D.D.W. The twenty-seven rollers available from Egypt were soon inadequate but twenty-four more arrived later from England; there was a shortage of water-carts and water supply was difficult. Soling was hand-pitched. Soft sand was the main constructional problem and much additional stone had to be used in the foundations; consolidation was slow on these patches and rollers often became bogged. As soon as a section of road was opened solid-tyred lorries began to use it and maintenance became very heavy.

In January, 1916, little more than a mile of road a day in all was being finished on the nine roads under construction but by the middle of April seventy-four miles had been finished on the east bank and forty-seven on the west. In addition the D.D.W. provided materials for a road from Ismailia to Port Said (forty-seven miles) and a contractor built another from Ismailia to Tel-el-Kebir (thirty-four and a half miles). Until these were completed no lateral roads on the east bank were authorized.

BRIDGES, FERRIES, WHARVES AND PIERS

Light bridges and ferries were soon supplemented by bridges for lorries and heavy artillery. The design of these had several interesting features, as they had to provide for the rise and fall of the water level (up to five feet at the southern end) and an opening span of

170 ft. By 22nd December heavy bridges of this type were being built at El Kubri, Shallufa and Qantara. On each bank short revetted embankments led to timber piled piers, which in turn were connected by moving gangways with the moored and anchored floating stages. These consisted of two flat-bottomed, steel pontoons secured by tie bars and wooden trusses. The outer pontoon on each had a bascule arrangement to operate a short lifting span to connect with the opening span. This was made of two large, flat-bottomed coal barges, stiffened internally and connected externally by heavy timber trusses. The span was operated by wire hawsers and capstans and could be opened by a trained team in five minutes.

Six medium bridges made from steel floats or native boats, six lighter pontoon bridges and five large fixed ferries were also constructed. Most of them were manned by detachments of field companies. In some cases the opening spans were arranged in two sections so that half only had to be swung for the passage of small vessels or for easier towing to other bridge sites. Stores for the initial programme were collected by Lieut.-Colonel L. H. Close, who had taken charge of the Base Depot at Alexandria towards the end of 1915. On 9th December it was decided that the Sweetwater Canal bridges should be built with the pontoon equipment of the 42nd and Australian and New Zealand Divisions.

The Canal Company improved the capacity of the ferries, built jetties, five wharves and sixteen landing stages and lent materials for bridges. Many of the wharves and piers were subsequently extended.

On the Ismailia-Port Said road a crossing had to be made of the Manzala Canal, two miles south of Port Said, where the waterway was 320 ft. wide. A special ferry, 53 ft. by 20 ft., was built of wood with wrought-iron bracing to carry two 5-ton lorries. It was operated by hand winches and wire ropes, and the gangways were balanced to allow vertical movement.

SUEZ CANAL BRIDGES AND FERRIES

November, 1916

Site	Type	Span, feet	Load- ing, tons	Remarks
Qantara	Flotteur bridge Barrel pier bridge Three large chain ferries Small chain ferry			
Ballah	Native boat bridge	329		27-ft. boats at 15-ft. centres.
	Flotteur bridge	329		
	Barrel pier bridge Chain ferry	325		Steel tank 43 by 17 by 7 ft. deep, with timber deck.
Ferdan	Native boat bridge		3	
	Flotteur bridge		3	
	Barrel pier bridge		3	
	Chain ferry		17	
Ferry Post	Native boat bridge	281	3	Timber superstructure.
	Native boat bridge	283	3	Timber superstructure.
	Flotteur bridge	269	7½	Stiffened for extra loading.
	Chain ferry		15	Flotation—16 small tanks. Hand operated by 2 chains on rollers.
Tussum	Chain ferry		10	
	Boat ferry			
Serapeum	Flotteur bridge		3	
	Barrel pier bridge			
	Composite bridge			With hinges and draw- bridge. Native boats, steel barrel piers and steel tanks (45 by 5 ft.).
	Chain ferry		10	With end windlasses.

Site	Type	Span, feet	Load- ing, tons	Remarks
Deversoir	Chain ferry		10	With end windlasses.
Shallufa	Flotteur bridge	419	3	Swinging bay, 245 ft., with opening time 16 min.
	Steel barge bridge		7	Two steel barges moored to anchors, with opening time 6 min.
	Barrel pier bridge Chain ferry (punt)			Hand operated, capacity 16 men or 10 animals. Round trip 20 min.
Gurkha Post	Chain ferry			
El Kubri	Steel barge bridge	444	3	Opening span 163 ft. Steel pontoon with service pontoons and barrel piers. Operated by 14 soldiers and 50 natives in 5 to 12 min.
	Barrel pier bridge	408		Opening section—22 piers, each 12 barrels at 12 ft. centres. Trestle piers each side, 77 ft. long with T-heads.
	Chain ferry			
Esh Shatt	Barrel pier bridge	318		Opening section towed from Kubri when required in three sections. Trestle piers at each side.

In addition there were many light floating bridges.

Ferries were only used when no bridge was available.

SUEZ CANAL WHARVES AND PIERS

November, 1916

Site	East Bank	West Bank
Qantara	Wharf with two cranes for 12-in. pipes. A.S.C. wharf Concrete jetty	Wharf.
Ballah	Wharf	Wharf.
Ferdan	Wharf on rail piles A.S.C. jetty	Wharf on rail piles.
Ferry Post	Wharf on rail piles	Wharf on rail piles.
Serapeum	Wharf	Wharf.
Geneffe	Wharf, 82 by 16 ft. Max. load landed 15 tons, served by light railway	
Kabrit	Pier 32 ft. long with pier-head	
Shallufa	Wharf, 37 by 11 ft. on trestle piers. Max. load 30 tons. Previously on barrel piers. A.S.C. wharf. Max. load 60 tons	Wharf similar to east side.
Gurkha Post	Wharf with two small piers (one of masonry)	
El Kubri	A.S.C. wharf, 97 by 70 ft., with extension 52 by 7 ft. with pier-head. 3-in. pipe piles	Pier, 60 ft. long on double Weldon trestles with pier-head. Pier 45 ft. long with pier-head. Stone wharf.
Esh Shatt	Wharf 104 by 79 ft. of earth-work and sandbags Wharf 80 by 16 ft. decked on 7-in. timber piles Personnel pier served by light railway	Pier 72 ft. long with pier-head. Personnel pier 43 ft. long with pier-head on timber and rail piles.

Site	East Bank	West Bank
Quarantine	Stone pier, 1,230 ft. long with 60-ft. pier-head, served by light railway	

The wharves and piers had a total frontage of 1,037 ft. and an area of 44,000 sq. ft.

Wharves and piers were on piles or pontoons or were revetted and sand filled.

WATER SUPPLY

Water supply works were probably the most urgent and important of any, for the forward defence positions could not be manned until a reasonable supply was assured. The responsibility for water supply was vested in the D.D.W., Colonel MacDonald, under whom Lieut.-Colonel Molesworth was in direct charge. Early in November, 1915, Dr. Hume, Director of the Geological Survey of Egypt, had advised that fresh water might be obtained east of the canal at levels just above strata bearing salt water. Boreholes were sunk, sometimes at points indicated by water diviners, but without success. Meanwhile Dr. Hume, in a further report, gave little hope of water in Sinai except in the coastal sand dunes and by the end of November it was generally accepted that water was unobtainable in quantity east of the canal.

The only practicable alternative was to utilize Nile water from the Sweetwater Canal involving elaborate works for conveying it to the east bank after removing impurities and the *bilharzia* parasites. Mr. A. McCorquodale, Director of the Cairo Water Company, not only acted as consultant but also manufactured filters and designed and installed settling tanks. While these works were in progress, temporary arrangements were necessary to increase supplies to the defence posts on the east bank. A small Bell pressure filter was transferred to Qantara; the Canal Company more than doubled the output from their three main waterworks; and a temporary 6-in. pipe-line supplied Ballah and Ferdan from Ismailia. The supply systems in the bridgeheads, supplied by water-boats,

were extended. The heavy demands upon the War Office for stores have already been mentioned.

Pending the arrival of pipes, fittings and machinery from England and elsewhere much preliminary work was done with such stores as were available or could be collected in Egypt. Two branch supply-channels from the Sweetwater Canal to the west bank of the Suez Canal at Ballah and Ferdan, $4\frac{1}{2}$ and $6\frac{1}{2}$ miles long respectively, were excavated, and, in spite of the powers of absorption of some gypsum beds in one section, water reached the pumping sites before the filters were ready.

The settling tanks at El Kubri, Serapeum, Ferdan, Ballah and Qantara were built by contract with material supplied by the Director of Works in reinforced concrete, 43 ft. in diameter, on the labyrinth principle. They were arranged in duplicate, had a capacity equal to ten hours average flow and obtained 90 per cent deposit of solids with alum treatment. Washing-out was required at about ten-day intervals. At two stations 260 ft. of 24-in. pipes were laid as a temporary measure for settlement purposes.

The type of filter adopted was similar to the Jewell mechanical gravity filter because Egyptian workmen were familiar with it and it was reasonably simple and efficient. In view of the urgent need they were made in Cairo; two were ordered at first, four more were soon added and each of the six plants was soon increased threefold. In all twenty-eight filters with hourly capacities between 1,500 and 2,750 gallons were constructed and installed. Steel plates were difficult to get and second-hand material had to be used; the screening sand came from deep pits at Abbassia. Before entering the filters the water was given a second, half-strength dose of alum solution to form a film on the filtering medium and chlorination as a bacteriological precaution followed.

The pumping machinery arrived later but the Suez Canal Company made in its workshops twenty-three siphons of two to seven-inch diameter for filtered water and several 4-in. siphons for construction and animals' drinking water, and laid them across the canal. This process was effected in three stages, in each of which one section was lowered into position by a long jib-crane on an anchored pontoon, after which the connections were made by divers. Four of the siphons required special dredging before laying.

The treated water was to be pumped across the canal through these siphons to several 50,000-gallon reinforced concrete reservoirs built by contract on the east bank to a standard design, 95 by

16 ft., divided into four compartments to minimize the effects of damage, and banked and covered with sand. When steel reinforcement became scarce the construction was changed to rubble masonry and the plan became almost square. This type was deeper and as it was partly sunk below ground-level no sub-division into compartments was undertaken. A series of columns at 9-ft. centres supported the roof. By the end of December two reservoirs had been finished, a third was nearly complete and a fourth begun.

Towards the end of January, 1916, many of the pumps and engines ordered from England arrived and were unloaded at Ferry Post for sorting and dispatch to the pumping station sites, where concrete foundations had already been laid. The crude oil and Diesel engines were of both horizontal and vertical types, with horse-powers ranging from four to thirty, the principal makes being Bates, Blackstone, Crossley, Petter, Sulzer and Tangye. Brigadier-General Wright decided that to avoid confusion tinned petroleum should be used as the standard fuel. The pumps were of widely differing makes and types; Cameron and Worthington steam pumps, Gwynne, Rees and Sulzer high-lift centrifugal pumps for the main installations, lighter American ram-types for relay stations, and small Sulzer and Tangye pumps for the filtration plants. Somewhat later special measures had to be taken at three relay stations on the east of the canal where a total lift of 450 ft. to the forward defences had to be provided. None of the pumps described was sufficiently powerful but an old force-pump was found in Egypt, repaired and installed at the Shallufa relay station where it gave good service, and two other pumps were provided for El Kubri and Esh Shatt.

Both filtration and pumping plants were housed in brick structures with flat wooden roofs covered with sandbags to give reasonable protection against the small aircraft bombs of the time. A 10,000-gallon condensing plant, made by the mechanical engineering branch of the P.W.D., was installed at Quarantine in March, 1916; it was used as a stand-by when water-boats from Suez could not be brought alongside the pier in stormy weather, and gave good service.

Very few pipes remained in private hands in Egypt and the Government stocks had all been sent to the Canal Zone and laid before the end of January, 1916, but on 5th February the principal consignment arranged by the War Office reached Port Said. Arrangements had been made to discharge the cargo in appropriate quantities at each bridgehead in turn but the ship had not been loaded in a way which made this possible. The harbour authorities estimated

that five weeks would be required for unloading with local stevedores but Lieut.-Colonel Molesworth refused to accept this delay and discharged her cargo in eighteen days (five of which were lost through lack of transport) with working parties of Scottish and New Zealand infantry working under the direction of Mr. P. S. Donald, a civil engineer sent by the War Office as adviser, and Captain Smith, R.E. The next consignment arrived in the middle of February and by the 24th the final cargoes from India and elsewhere had reached Lake Timsah. Distribution was effected by tugs and lighters. A special park for pipes and fittings was opened at Ismailia and Major Pitcairn appointed O. i/c Water Stores.

As can be imagined, the pipes were a heterogeneous collection. Those from England were gas, water and steam pipes and tubing, some being galvanized and with varying numbers of threads to the inch. The Indian pipes were light and untested and a considerable proportion arrived damaged. The American pipes had different threads, were of wrought iron and steel, but all had been tested to 1,500 lb. per sq. in. Time did not allow for sorting before dispatch to the bridgeheads, where improvised workshops were kept busy under Mr. Donald's supervision making adapters and special fittings to enable different pipes to be used on the same main.

Distribution was another difficulty. Only a very small proportion of the 4,000 camels required was available and the light railways, decauville tramways and lorries were used when possible, supplemented by horse-drawn sheet-iron sledges, G.S. wagons and even carrying parties of labourers. These transport difficulties increased as the pipe-lines lengthened. Pipe-laying was done partly by contract and partly by directly employed labour but the supply of supervising staff and skilled tradesmen was limited. In the later stages various R.E. units gave valuable assistance.

Nevertheless, the work was pressed to the maximum—so much so that in some cases leaking joints resulted. The pipes were laid in trenches with 2 ft. of cover but no expansion joints, it being hoped that the effects of temperature variations would be neutralized by having frequent curves and short stretches of straight. Regular gradients were sacrificed in the rapid laying and air locks were not uncommon. Some of the Indian pipes failed to withstand the pressure needed to supply the higher defence positions and had to be replaced. In general, however, having regard to all the circumstances, the number of joint failures and other breakdowns was surprisingly small. By June a total of 151 miles of three to six-inch

mains and a considerable mileage of smaller branch lines had been laid.

Storage on a basis of $1\frac{1}{2}$ gallons per man daily was provided in the first and second lines of defence by a large number of variously sized concrete, iron, wood and canvas tanks. Water was distributed by gravity through small pipes to stand-pipes in the various posts and where this was not possible by G.S. wagon and camel tanks.

INUNDATIONS

It was decided to maintain the inundations on the low-lying land south of Port Said and the crude arrangement of cuts in the canal bank was replaced by pipes with tide-flaps which automatically countered the effects of evaporation by inflow at high water. A further depression, three feet higher than the canal level, was flooded by installing three heavy centrifugal pumps driven by 16 and 20 H.P. engines. South of Qantara another area of six to seven square miles was flooded by a cut provided with a masonry weir at mean canal level. All these areas combined to cover a length of some forty miles of the canal on a more or less permanent basis.

THE REORGANIZATION OF THE ARMY COMMAND

While all these works were being prepared or started, Lieut.-General Sir Charles Monro with G.H.Q., M.E.F., moved to Egypt from Gallipoli and before the final stage of the evacuation was completed and the M.E.F. concentrated in Egypt, Lieut.-General Maxwell was relieved of responsibility for the defence of the eastern frontier, as it was felt that he could not efficiently control the large forces being concentrated to meet the expected attack and at the same time be responsible for the defence of the western frontier and for internal administration. General Monro's command now included not only the Suez Canal force but also the Dardanelles and Salonika armies, but he was shortly recalled to France and Lieut.-General Sir Archibald Murray, the C.I.G.S., was appointed to command the M.E.F. By the time he reached Egypt (9th January, 1916) the command at Salonika had passed to the French (his responsibilities in this theatre being henceforth limited to administration for a time of the British component), and the final evacuation

of Gallipoli had just been successfully completed. His operational command now became the Canal Zone, including the provinces of Sinai and Sharqia, and he established his G.H.Q. at Ferry Post, Ismailia, where the necessary accommodation was built by a section of the 5th Siege Company, R. Anglesey R.E., under Lieutenant A. G. Scott, and the Works Officer, Ismailia—Lieutenant S. Davies.

This reorganization involved many administrative changes. On 10th January it was decided that the M.E.F. should be organized in four corps, of which one was to be in reserve and the rest in position along the canal. Two days later it was decided that the works in the Canal Zone should remain under the C.E. Force in Egypt until their completion. Major-General G. Williams, E.-in-C., M.E.F., reached Cairo on 5th January and moved to the new G.H.Q. at Ismailia on the 23rd to take over the military defence works from Colonel Grant, C.E., Canal Defences. On 31st January the latter command ceased to exist and G.H.Q., M.E.F., assumed full control. The R.E. Order of Battle is given in Appendix III.

The new formations arrived in the Canal Zone or in Egypt at various dates and the Imperial strategic reserve had barely been formed before it began to be dispersed. Movements are accordingly somewhat difficult to record.

The 10th Indian Division (two brigades only) was already on the canal at the end of 1915 and its single field company was augmented by the arrival at El Kubri on 15th January, 1916, of the 1/1st Renfrew and 1/1st City of Edinburgh Field Companies. The former left a detachment and moved to Ayun Musa on the 19th, where it worked on the defences, water supply and the light railway from Quarantine. The latter—one of the few units to be over establishment—began an outpost line for one and a half battalions astride the track to Nekhl.

The 46th Division opened its headquarters at Shallufa on 10th January and two field companies (1/1st and 1/2nd North Midland) disembarked there a day or two later. The division quickly received orders to return to France and the third field company does not appear to have landed before the division began to leave on 4th February. This division was replaced in the IX Corps by the 42nd Division.

The R.E. of the 29th Division had arrived at Suez by 17th January for re-equipment and training and, except for detachments supervising the loading of stores at Suez, undertook no works until towards the end of February. On the 24th of that month the 1/2nd

Lowland Field Company left to join the 22nd Division and was replaced by the 1/3rd Kent Field Company.

The 5th Company R. Monmouthshire R.E. did not reach Suez until the middle of February but it then took over work on the bridgehead defences at El Kubri and the building and maintaining of bridges and landing stages there and at Shallufa. A detachment remained for a time at Suez in charge of the R.E. Park. The 133rd Army Troops Company reached Suez at the same time and was engaged on hutting, operating water-boats and minor works. It took over the R.E. Park later.

The 14th Army Troops Company joined the 1st Australian Division at Serapeum on 22nd February; it took over the partially completed bridgehead defences, consisting of one small and five large posts, from the Australian Engineers.

The 31st Division was the first formation to reach No. 3 Section, the divisional R.E. disembarking at Port Said at the end of December 1915. The 211th and 223rd Field Companies moved to Qantara on 5th January, 1916, but work on the defences (thirteen posts astride the track to El Arish) did not begin until the 17th. The 210th Company was dispersed, but most of the unit was at Port Said maintaining the bridge over the Lake Manzala cut and working in the sawmills, to which further reference will be made.

The 13th Divisional R.E. arrived at Port Said towards the end of January and went into camp to reorganize. The 88th Field Company was employed on the bridgehead defences at Ballah for one week in February but the 13th Division was ordered to Mesopotamia and by 17th February the divisional R.E. had all embarked.

The 67th and 86th Field Companies of the 11th Division reached Ferdan on 18th February; the former began work on a camp on the east bank for the 32nd Brigade and took over the bridgehead defences, and the latter took over all defences in advance of railheads from the New Zealand Engineers on the 26th. The 68th Company arrived at the Ballah railhead on 21st February and, after being employed on services for an infantry brigade camp, began work on the intermediate defences with large infantry working parties. A detachment was in charge of Ballah bridge and repaired it in two days when it broke up in a high wind on 2nd March.

The 167th Army Troops Company reached Port Said on 18th January but apart from detachments sent to lay pipe-lines at Qantara and Ballah did no work until it was attached to the 31st Division at Qantara on 6th February. It took over the floating bridge

and all works in this area, and sent a detachment to the Port Said sawmills. The 220th Army Troops Company arrived at Port Said with the 167th Company and assisted on the Qantara pipe-line until it moved to Ferdan on 30th January to take over the bridge-head defences. A detachment had already begun a road on the west bank between Ferdan Station and the site of the new pontoon bridge.

MILITARY DEFENCE WORKS

Military defence works were the principal tasks of the divisional R.E. and they presented some unusual features. Experience had shown that normal revetting methods were unsuitable in loose sand and that wooden frames backed with wire netting, hessian, matting or palm leaves were more satisfactory. A sawmill at Port Said was requisitioned, and enlarged under the direction of Captain H. L. V. Hawkins to produce these frames or hurdles in quantity, the output set for January, 1916, being 950,000. Native craft delivered them to the bridgehead depots. The matting was largely obtained from the Sudan.

Excavation in the loose sand was easy but construction of the trenches nevertheless required enormous labour. The first stage was to dig a wide cutting as deep as the finished trench and as wide as the angle of repose of the sand required—often more than thirty feet. The hurdle revetment was then erected in the centre and secured by wires to anchorages of bundles of filled sandbags or pickets in the sides of the excavation. The excavated material was then backfilled, the matting or hessian being carried up concurrently so as to prevent infiltration of sand into the trench. Filled sandbags were placed on the top to form the edge of the parapet. Much barbed and French wire entanglement was erected in front. Maintenance was heavy; the salts in the sand caused rapid corrosion of the anchorages; fine sand, when dry, trickled out of sandbags unless two, one inside the other, were used, and drifting sand either filled the trenches or buried or uprooted the wire entanglements.

The defences were constructed in stages. The forward line, for example, consisted at first of posts at the most important points; these were then increased in number and finally linked by trenches to form a more or less continuous system. The usual ancillary works, such as command and observation posts, machine-gun emplacements and splinter-proof field-gun shelters without overhead cover were

built as required. For the infantry posts a good field of fire was considered to be of greater importance than concealment.

The labour involved was very great and the Egyptian army reservists were augmented by—at one time—as many as 10,000 E.L.C. and a large amount of contract labour. The civilians were nervous about the Turks and detachments of mounted troops had to be maintained in front as covering parties to reassure them, with an attendant drain upon the numbers of camels available for work. When the field and army troops companies arrived better progress and a higher standard of work were achieved. Skeleton garrisons began to occupy the partially completed forward defences on 22nd January, but it was not until the end of March that the water supply situation permitted the line to be fully manned, and even then much work was required before the defence system could be regarded as complete. Some of the works were delayed through changes in formations and the desire of new commanders to alter previous plans, but, in spite of shortages of skilled direction, labour and materials—particularly in the early stages—and of the necessarily complex system of control, a combination of hard work, ingenuity and co-operation achieved results which were remarkable.

The basic principle of the defence—not always fully appreciated—was the use of mobile forces covered by an outpost line. The bridgehead defences were to be used as concentration points by the forward troops if forced to withdraw through reductions in their numbers by sending troops elsewhere, but were to be held at all costs as footholds on the eastern bank of the canal for counter-attack purposes. On 13th January a circular largely compiled by Colonel Grant just before he returned to France, laid down the principles to be observed in siting and constructing the defences and the functions of the various systems. It was to Colonel Grant that much of the credit was due for the successful execution of the heavy programme.

FORMATION OF THE EGYPTIAN EXPEDITIONARY FORCE

The system of dual command with its anomalies and disadvantages, caused by the continuance of G.H.Q., Force in Egypt, and the arrival of G.H.Q., M.E.F., ended on 19th March, 1916, when the two forces were combined as the Egyptian Expeditionary Force (E.E.F.) under Lieut.-General Murray. As a result Lieut.-General Maxwell returned to England with his C.E., Brigadier-General Wright,

who, however, was destined to return within a few months. The Levant Base ceased to exist, Major-General Altham becoming I.G.C., E.E.F., and the various service directors assuming functions normal to a L. of C. command.

ORGANIZATION AND PROGRESS TO 19TH MARCH, 1916

When the 46th Division left No. 1 Section of the Canal Defences it was replaced at the end of January in the left of the two sub-sections into which the area had been divided by the 42nd Division. The 10th Indian Division held the right sub-section and the 29th Division was still training at Suez. In the 42nd Division the 1/1st East Lancs. Company was made responsible for the divisional water supply, repaired a pontoon bridge over the Sweetwater Canal, maintained the pontoon bridge at Shallufa and in the middle of February took over some of the forward posts and began work on the thirteen posts in the bridgehead at Shallufa. On 31st January the 1/2nd East Lancs. Company began work on the defences at Shallufa and Geneffe and a fortnight later on two forward posts and the 6-in. pipe-line between these two places and on to the railhead. The 1/2nd West Lancs. Field Company worked on the defences in the Shallufa bridgehead and at Kabrit, on one of the forward posts early in March and on the pipe-line.

The 29th Division left for France early in March but before this the 1/1st West Riding and 1/2nd London Field Companies did a limited amount of work at El Kubri, and on 24th February the 1/2nd Lowland Field Company was interchanged with the 1/3rd Kent Field Company in the 52nd Division.

In the 10th Indian Division's sub-section the 1/1st Renfrew Field Company continued work on the defences in the rocky ground near Ayun Musa, water supply and the light railway. Lieut-Colonel A. H. Anderson, the company commander, rejoined for a month from 5th February until he became acting C.R.E. On 8th March the company moved to Esh Shatt to lay light railways, install water storage in the forward defence posts and construct defences there and at the Quarantine bridgehead. The 1/1st City of Edinburgh Field Company continued the Nekhl road defences, began work on the pipe-line forward from El Kubri railhead on 23rd February and on the inner defences on 8th March. The intermediate line was begun three days later. The 10th Indian Division was broken up in

March, but No. 10 Company, Sappers and Miners, continued to work on the defences at Ayun Musa.

The 5th R. Monmouth. continued to operate the swing bridges at El Kubri and Shallufa during March and on the 19th began to build additional pier bridges. The 133rd Army Troops Company remained at Suez on hutting and miscellaneous works.

In No. 2 Section, still held by the 1st Anzac Corps, the 14th Army Troops Company continued the bridgehead defences at Serapeum. On 6th March work began on a camp at Serapeum West and on bridges over the Sweetwater Canal at Fayid. Three days later the company took over the filtration and pumping plant, and on the 17th it began work on the incomplete posts in the forward line at Serapeum.

In No. 3 Section (XV Corps) the R.E. of the 31st Division continued work on the forward defences at Qantara and minor services at Port Said until the end of February, when all three field companies concentrated at Qantara in readiness to embark for France a few days later. Their works were continued by the 52nd Division, who after reorganizing at Cairo, began to take over the defence works at Ballah and Ferdan on 11th February. Lieut.-Colonel Waller was on leave and Major S. M. Spence, who was acting as C.R.E. until his return on 4th March, took over these works from Lieut.-Colonel Pritchard on 5th February. The 2/1st Lowland Field Company was sent to Ferdan and the 2/2nd to Ballah, where it prepared the divisional camp, but the 1/3rd Kent Field Company did not arrive from Abbassia until the 17th, when it was sent to Qantara.

On 15th February the 11th Division took over the front line at Ballah and Ferdan and the 2/2nd Lowland Field company continued to work on the camp under the C.R.E., 11th Division, until the end of the month, when it took over the forward defences at Ballah. The 1/2nd Lowland Field Company from the 29th Division arrived at Qantara and two days later the 1/3rd Kent left for Suez in replacement. When the 52nd Division relieved the 31st Division in the Qantara bridgehead the 1/2nd Lowland Company sent detachments to take over the wells being sunk at Bir ed Dueidar by the 22nd Field Company and the 2/1st Lowland the Qantara bridgehead defences, moving to the forward defences in the middle of March. The 2/2nd Lowland Company from Ballah reached Qantara on 17th March.

The 11th Division arrived in the Canal Zone in the middle of

February, the 67th and 86th Field Companies taking over the Ferdan defences and the 68th those at Ballah, including the bridgehead defences when the 2/2nd Lowland Company left on 16th March.

The 167th Army Troops Company in the Qantara bridgehead continued its miscellaneous works, including ammunition magazines, pipe-lines, repairs to jetties and a new floating bridge begun on 25th February. It took over the bridge at Port Said on the 26th and operated the pumping plants at Qantara and Ballah. The 220th Army Troops Company began work on the pontoon bridge at Ferdan on 5th March and on a boat bridge (from some of the 180 native craft brought from Lake Manzala) at Ballah two days later.

By the middle of March Colonel MacDonald, the D.D.W., had made considerable progress on the other works in the Canal Zone and his labour force had risen to its peak of 30,000 men. The initial programme of standard-gauge railways had been completed and most of the light railways had reached their railheads and were in full operation. The decauville lines were not started until February, but by the middle of March the mileage laid had outstripped the supply of locomotives. Road construction, after a slow start, was now well advanced but consolidation lagged behind formation and stone spreading. The original bridging programme had been completed and its triplication was just starting.

Water supply works were under the immediate direction of Lieutenant D. M. Baker. The first two water siphons across the canal were finished about 20th January and a consignment of eleven pumps arrived at about the same time. By the end of the month 600 round storage tanks, each holding 200 gallons, had been distributed, 400 more were in reserve at Ferry Post and over 5,000 camel tanks were available. Good progress had been made with the 50,000-gallon reservoirs, four having been finished in No. 1 Section alone by 26th February. Work on the filtration plants was slower owing to the shortage of skilled erectors, but good progress had been made on the installation of pumping sets. Pipes did not begin to reach the bridgeheads until towards the end of February, but after this, in spite of spasmodic deliveries and the need for sorting, the rate of laying was satisfactory and some pipe-lines were working to railheads and beyond by the middle of March. Operation and maintenance of all fixed water supply installations was made the responsibility of the D.D.W. (Colonel MacDonald) at Ismailia from 2nd February.

With regard to accommodation, the Co-ordinating Committee

on 17th January ruled that hutting in advance of the base would be erected by corps on the advice of their respective Chief Engineers, and on 21st February the E.E.F. Hutting Scale was issued, together with instructions that accommodation on this basis was to be actively pressed forward.

To summarize the works position in the Canal Zone when the E.E.F. was formed, it can be said that sufficient of the original programme, with its alterations and extensions, had been completed to enable the defence system to be adequately manned and supplied.

CHAPTER XXI

EGYPT IN 1916 AND THE SENUSSI CAMPAIGN

Engineer organization in Egypt, 1916—The Senussi campaign, 1915-17
—Railway works on the western frontier—The Sudan operations—
Conclusion.

(Map 4)

ENGINEER ORGANIZATION IN EGYPT, 1916

By the end of 1915 Lieut.-Colonel L. H. Close, in charge of the R.E. stores, Levant Base, Alexandria, had collected nearly £500,000 worth of stores for Gallipoli, Salonika and Egypt. The heavy new demands from the Suez Canal Zone necessitated expansion of the E.S.D. and, as one of the changes due to the arrival of the M.E.F., Colonel B. B. Russell, late R.E., was placed in charge.

The D. of W., M.E.F.—Brigadier-General E. M. Paul—became D. of W., Levant Base, with responsibilities for works and stores for the Dardanelles, Salonika and Egypt, although works for the Salonika army were soon transferred to its own C.E. In February, 1916, the boundary between the areas of the Force in Egypt and the M.E.F. was defined as the line Port Said-Zagazig-Suez, and the D. of W. then took over from C.E., Force in Egypt, all works in the area between this line and the canal. Lieut.-Colonel Close was appointed A.D.W. and the province was organized as four works areas.

The Force in Egypt was organized administratively into Cairo and Alexandria districts, whose engineer officers were respectively Lieut.-Colonels E. M. Blair and W. E. Longfield. When the E.E.F. was formed in March, 1916, the D. of W., M.E.F., took over all works in Egypt, exclusive of the operational area in the Canal Zone. In June the previous C.E., Force in Egypt, Brigadier-General Wright, returned to Egypt and became E.-in-C., E.E.F., but the D. of W. still reported directly to the I.G.C. although his responsibilities were extended to include the Canal Zone and the Western Frontier Force (referred to subsequently as W.F.F.). His stores responsibilities remained unchanged. In November the appointment of I.G.C.

ended, and the D. of W. then reported to the D.Q.M.G., M.E.F., his works responsibilities being reduced to the Delta and Alexandria districts.

Meanwhile the E.S.D. at Alexandria continued to overhaul thousands of tons of stores from the Dardanelles army, to provide for Salonika, to meet heavy demands from the Canal Zone and to supply the Senussi campaign. Work was handicapped by the retention in the Aegean Sea of the 13th Base Park Company until 26th February, 1916, but the 5th Fortress Company, R. Anglesey R.E., in the meantime carried out stores duties and minor services. The 1/3rd Devon Army Troops Company, much under strength, arrived from Mudros on 3rd February and was engaged on stores work at Wardian Sawmills for the rest of the year. The 1/3rd Lancs. Works Company was similarly occupied during the second half of February. Wardian is the timber dock of Alexandria.

The 13th Base Park Company remained at Alexandria until 1919, doing consistently useful work in unloading, making and distributing stores. Its task was heavy and in fifty-three working days from 26th February, 1916, over 1,000 tons of engineer stores were handled daily.

On his arrival in the Canal Zone Major-General Williams asked for branches of the Levant Base to be established to deal with the large quantities of stores arriving there direct from overseas. Improved staffs were set up by the D. of W. and reasonably accurate records were kept of all except timber, which was unloaded too rapidly to be checked.

The following officers at various times had specialist duties in the stores organization: Captain M. G. Taylor—in charge of sea-going craft plying between depots and works; Captain Gill—machinery; Lieutenant Percy—electrical equipment; and Lieutenant Wearne—timber. The quantities of the latter which were handled were large, and a high output of scantlings was achieved by the sawmills at Alexandria and Port Said. Between 1st April and 7th May, 1916, some 6 million linear feet were issued to the Canal Zone and works officers in Egypt, apart from supplies sent to Salonika, Basra and naval depots. A factory was established under Captain H. E. Glover at Zagazig for making grass and reed matting and well over a million square yards were issued for the canal defences and hutting. At the end of the year over 1,500 square yards were being produced daily at Zagazig, and India supplied $\frac{3}{4}$ million. Egyptian workshops were used to the utmost and large

contracts were placed for hutting, hurdles and matting. Demands on the War Office for the stores required in the early part of 1916 had been more than met by the end of March.

All railway works in Egypt were executed by the E.S.R. under the Director of Railways (Brigadier-General Macauley) and the principal roads by the Public Works Ministry. Almost all other works, comprising hutting, storage depots, hospitals, rest camps, electricity and water supply, and later, convalescent camps, ammunition depots, laundries, workshops and electric power installations were executed or supervised by the D. of W. (Brigadier-General Paul). Several small airfields were laid out and a depot and training school, with accommodation, offices and twenty-five hangars, built at Aboukir. The hutting was of various types—portable sections from England, local timber and corrugated iron, and matting on light wooden frames. The largest number of camps was in Sharqia Province, where between 1st April and 17th December nearly 1½ million square feet of mat and boarded hutting was built, of which 723,000 square feet were completed in the month ending 17th June.

Most of this work was done by contract, but the A.D.W., Sharqia Province, also had a few R.E. units placed at his disposal. The 1/1st Kent Field Company, much reduced in numbers after service at Gallipoli, arrived at Es Salihiya, north-east of Cairo, early in January, 1916, and worked on a water supply scheme until it left to join the W.F.F. on 9th February. It also sent a detachment to the railway workshops at Zagazig. On 26th February the 5th R. Anglesey R.E. was sent to Mahsarna (between Tel-el-Kebir and Ismailia), whence it sent detachments to Ismailia to build the G.H.Q., E.E.F. camp and offices and to Zagazig. The main body was engaged on a wide range of works until 18th May, when the company moved to Moascar to construct a new divisional camp. On 26th June, the detachment from Ismailia having rejoined, the company was sent to the Fayum. The 1/3rd Lincs. (Works) Company was engaged on hutting, laying decauville track, infantry camps and depots at Belbeis from the end of February until 23rd May when it moved to the Canal Zone. The 136th Army Troops Company was also similarly engaged for several weeks in the spring of 1916 in the Tel-el-Kebir area.

Two individual projects out of many must suffice for a more detailed description. The first was the new water supply scheme at Moascar camp to relieve the pressure upon the Ismailia town supply. It was designed in February, 1916, by Lieut.-Colonel Close, A.D.W., Sharqia Province, and Mr. McCorquodale, Director of the Cairo

Water Works, for a maximum daily supply of 80,000 gallons with an emergency margin of a further 25 per cent. The works, which included filters, sedimentation tanks, storage, pumping plants, 1,400 yards of 8-in. steel rising main and reservoirs, were begun, partly by contract, early in March, 1916, under the local works officer, Captain H. D. Hodgson. The greater part of the programme was finished in six weeks.

The second project was a new military bakery at Port Said which enabled the purchase of native baked bread to be avoided. The estimated time for completion was two and a half months but, under the direction of Captain R. H. Lee-Pennell, D.O.R.E., Port Said, it was finished in fifty-six working days at a cost of £7,600. Its output was 150,000 lb. in twenty-four hours and, when in operation, effected a saving of £3,000 monthly over local purchase or baking by contract.

To conclude this brief account of works services in Egypt during 1916 it should be noted that in the spring Lieut.-Colonel Blair was succeeded, on appointment as C.E., No. 3 Section, Canal Defences, by Lieut.-Colonel E. Tillard, late of the Public Works Ministry, as C.R.E., Cairo. At about the same period the 134th and 136th Army Troops Companies left Egypt.

THE SENUSSI CAMPAIGN, 1915-17

From the end of 1915 until 1917 events occurred on Egypt's western frontier in which various units and individual officers of the R.E. played an important part. The principal operations were those of the Senussi campaign.

Owing to the declaration of the Holy War, and with Turkish support, the Senussi, a Mahommedan sect living in the Libyan frontier area of the Western Desert, became a source of trouble during the autumn of 1915 and there was a danger of sympathetic unrest in Egypt. Attempts to negotiate with the leader of the movement ended abruptly in November, when the crews of two torpedoed British ships were imprisoned, and attacks on posts south-east and east of Sollum led to open war. Owing to the weakness of the Egyptian detachments a withdrawal of 120 miles was made to Mersa Matruh, a point which would serve as a suitable base for operations. Matruh was 160 miles from Alexandria and eighty-five miles from railhead at Dhabba, with which it was connected by a fair road, and was supplied with water.

In December a small force, termed the Western Frontier Force (W.F.F.), was assembled at Matruh under Major-General Wallace. Until November, 1916, its G.S.O.I was Lieut.-Colonel R. E. M. Russell, R.E., and one of the R.F.C. pilots was Captain A. J. Ross, R.E. It is unnecessary to refer in detail to the indecisive operations up to February, 1916, except to record that in the absence of R.E. the mobile section of the Egyptian Army Military Works Department was organized under Lieutenant W. S. Blunt, R.E., as a field troop and did excellent work on water supply and on the making of desert tracks passable by lorries. The troop accompanied a column which established a depot at Unjeila, a well forty-five miles west of Matruh, on 13th February. During this month Major-General Peyton took over command and Lieut.-Colonel D. M. Griffith became senior engineer officer.

The coastal road, from which a track led to Cairo through the Wadi Natrun, was not the only route by which the Senussi could threaten Egypt. Their principal centres of population were in the Siwa oasis, 170 miles south of Sollum, from which three routes led to the Nile. The northern of these, through Gara and the Wadi Moghara, led to the Wadi Natrun, which was thus of considerable strategic importance. The central route from Siwa led to the Baharia oasis, from which tracks existed to Minya, to Samalut, a hundred miles to the west on the Nile, to Beni Suef and to the Fayum, only forty miles from Cairo. The southern route ran to the Farafra oasis, from which tracks led to Assiut on the Nile and through the lesser oases of Dakhla and Kharga to the Nile at Esna and Suhag.

The first precautionary measure was to hold the Wadi Natrun area and the 53rd Division, weak in numbers and without artillery, sent the 159th Brigade and the 1/1st Welsh Field Company to Beni Selama. The R.E. fortified villages, built outposts, erected hutting and arranged water supplies. The rest of the divisional R.E., consisting of the 2/1st Welsh and 2/1st Cheshire Field Companies under the C.R.E., Lieut.-Colonel R. P. T. Hawksley, re-equipped and trained for nearly two months. On 12th February, 1916, the 2/1st Welsh was also sent to the Wadi Natrun area but was almost immediately recalled to go to the Fayum.

This change of plan was due to the occupation by the Senussi of Baharia early in February. This possibility had been foreseen and in January Major-General W. E. Peyton had been appointed to command a mixed body of troops known as Southern Force with

its headquarters at Beni Suef. Later Major-General J. Adye took over command and detachments sent to the Fayum and points on the Nile further south were strengthened. On 14th February H.Q., the 53rd Division moved to the Fayum and the 2/1st Welsh Company began work on roads, hutting and water supply. On the 16th the greater part of the 2/1st Cheshire Field Company arrived at Minya and, split into several detachments, constructed field defences at points of tactical importance. At the end of February the Senussi occupied the Dakhla oasis and then moved on to Kharga, which Southern Force had not been strong enough to hold. This represented their maximum penetration.

Meanwhile the W.F.F. had been reinforced in anticipation of taking the offensive along the coast. Among the R.E. reinforcements were the 1/2nd E. Anglian Field Company, which was sent by the 54th Division on 26th January, the 1/2nd Kent Field Company and the 1/1st Kent Field Company, which reached Mersa Matruh on 22nd February. The offensive against the Senussi was launched towards the end of this month and on the 26th a decisive success gained at Agagir,* south-east of Ras Haleima, as a result of which Sollum was recaptured on 14th March. During this advance water supply was arranged by the 1/1st Kent Company. Three days later a motorized column released the British seamen held prisoner by the Senussi. The objects of the campaign had now been largely achieved and the greater part of the W.F.F. returned to Alexandria.

Garrisons were still needed at Sollum and Matruh to control the coastal road and both Kent field companies were engaged for some time on defences, hutting, water supply, airfields (with special accommodation), roads and piers. The 1/2nd E. Anglian Company worked on camp services and defences at Dhabba and Hammam until 25th March, when it left to rejoin the 54th Division in Cairo. Further south the 1/1st Welsh Company, with its headquarters at Selama, completed the defence programme in the Wadi Natrun, improved water supplies and erected hutting.

The Senussi made no further movement against Southern Force during March but the rest of the 53rd Divisional R.E. were busily occupied. In the Fayum the 2/1st Welsh Company worked on out-post defences and water supply, and erected storage and other accommodation. The 2/1st Cheshire Company executed works for the R.F.C. at Minya and Assiut and constructed defences in the

* Almost the same site as that of the battle of Sidi Barrani in 1940.

Luxor area, at Esna, Suhag and other places opposite the Kharga oasis.

On 31st March, the W.F.F. absorbed Southern Force but was divided into two sections—N.W. and S.W. Lieut.-Colonel Hawksley, C.R.E., 53rd Division, became responsible for all engineer services in the N.W. Section, and the 1/1st and 1/2nd Kent Field Companies came under his command while continuing their wide range of works in the coastal area.

Early in April Captain H. H. Alexander and a small detachment from the 1/1st Welsh Field Company joined a column assembling at Matruh for the occupation of the Wadi Moghara, ninety-five miles west of Cairo. His main difficulty in the preparatory stage was in getting stores for water development. On 10th April Dhabba was reached and Moghara itself occupied on the 27th, an advanced base having been established at El Alamein, a small and lonely railway station destined to become famous a quarter of a century later. The rest of the 1/1st Welsh continued defence works and hutting in the Wadi Natrun during April and the 2/1st Welsh similar work in the Fayum and Upper Egypt.

Further south a section of the 2/1st Cheshire Field Company accompanied the force which re-occupied Kharga on the 15th after its evacuation by the Senussi. Company headquarters moved to Assiut on the 22nd, the rest of the unit continuing its work over a wide area. An extensive system of blockhouses and water supply was begun near Kharga, and hutting was started at the end of April.

During May in the coastal sector the 1/1st and 1/2nd Kent Field Companies continued road construction, defences, water supply and the new pier at Sollum, and the detachment of the 1/1st Welsh Field Company at El Alamein built a road to Moghara and block-house defences there. Another section of this company carried out camp services and water supply in the Wadi Natrun and the remainder, further south at Samalut, was similarly engaged and also began to build blockhouses along the proposed railway route to Baharia.

In the middle of May, 1916, the 53rd Division was ordered to the Canal Zone and the C.R.E., W.F.F., took over all works. At first one field company only—the 1/1st Welsh—accompanied the division; it was replaced in the W.F.F. by the 37th Army Troops Company, which arrived from Salonika at the end of the month. The 2/1st Cheshire Field Company remained in the Fayum until the end of

June, when it was relieved by the 5th Anglesey and moved to the Canal Zone. The third field company—the 2/1st Cheshire, with headquarters at Assiut—could not be released until November, 1916. In the meantime it continued its work, mostly in the S.W. Section, on hutting, defences and other services and suffering severely from the great heat (sixty-three all ranks were in hospital at one period).

On 20th June, 1916, the N.W. and S.W. Sections disappeared and the W.F.F. was reorganized as the Coastal and Southern Sections. Lieut.-Colonel Griffith, C.R.E., W.F.F., was admitted to hospital and on 7th July Lieut.-Colonel F. R. H. Eustace took his place. On 4th October the W.F.F. became "Western Force."

Meanwhile the main body of the 1/1st Kent Field Company left Matruh on 16th June to join the 54th Division, leaving its detachment in the Wadi Natrun until 26th August. The 1/2nd Kent Field Company completed the Sollum defences in July and continued the pier, besides operating condensing plants at Sollum and Matruh until the latter was taken over by a detachment from the 1/3rd Devon Army Troops Company. Egyptian Labour Corps replaced infantry working parties in July and was engaged with the 1/2nd Kent Company on the Matruh-Dhabba and El Alamein-Moghara roads and defences at Dhabba and Moghara. On 2nd October Major C. E. Wilson, (5th R. Anglesey) became O.C.R.E., Sollum and on 23rd December succeeded Major Davey in command of the 1/2nd Kent Field Company. Metalling the road east of Sollum began towards the end of the year.

By the summer of 1916 the Imperial Camel Corps (formed in November, 1915) and light car columns effectively controlled the western frontier, making possible further offensive operations against the weakened Senussi. Additional engineering works were needed, of which the Baharia railway was the most important. The 5th R. Anglesey R.E., which reached Samalut (the starting point of the railway) at the end of June, 1916, began an extensive water supply system designed to feed the camp and the railway, block-houses being built at intervals along it. This was finished on 9th October, and a month later was supplying 180,000 gallons weekly. The company also built a 100-ft. span pontoon bridge over the Bahr Yusuf west of Samalut, sent a detachment to Minya, extended the four blockhouses on the Baharia railway and built two more in advance of the railhead.

The last blockhouse was a hundred miles west of Samalut in

rocky desert, and, in order to provide locomotives with water, a borehole was begun near Blockhouse 5 on 10th August. It was not until 12th November that water was reached at 172 ft., and as it was not artesian boring was stopped a few weeks later. Two more bores were sunk at Blockhouse 6 and one reached water on 28th March, 1917, at 257 ft.

In October, 1916, the Senussi withdrew to Siwa and on 1st November a column, accompanied by a detachment of the 5th R. Anglesey, marched thirty miles from railhead across the sand dune belt and re-occupied the Baharia oasis. The R.E. opened up wells, developed water supplies and built shelters and defences. Towards the end of the month a patrol pushed on to Farafra, and the 5th R. Anglesey's detachment cleared tracks from railhead to the main camp at Baharia and the various outposts.

The 2/1st Cheshire Field Company took over the pontoon bridge over the Bahr Yusuf and replaced it by a barrel pier bridge. Its detachments further south carried out a wide range of work from July onwards at Assiut, Kharga and other places. On 18th August a borehole was begun at a point eighteen miles west of Kharga to supply the railway; water was reached at 287 ft. at the end of October but little use could be made of it until a deep-well pump was installed early in 1917. The only operational activity during this period was the re-occupation of Dakhla oasis by a light car column from Kharga on 17th October.

On 5th November, 1916, the 2/1st Cheshire Field Company, which had completed the hutting programme and begun defences at the Aswan dam, left for the Canal Zone and Major Glen, commanding the 5th R. Anglesey, took over all works in the Southern Section. This company was split into many detachments over a large area, including the Kharga and Dakhla oases, and its work was mainly on water supplies and defences. On 26th December its title was altered from "Fortress" to "Siege" Company.

Early in December it was decided to undertake operations from the Coastal Section to Siwa and Lieut.-Colonel Eustace reconnoitred several routes from Matruh, covering 500 miles along indifferent tracks. At the end of January, 1917, a light car column left Matruh for the oases of Siwa and Girba. The Senussi were severely defeated and withdrew to Jarabub. The column was accompanied by a detachment of the 5th R. Anglesey under Lieutenant Seymour, which cleared the tracks, partly by blasting, through the passes to Siwa and there built a camp for the garrison.

This successful operation virtually marked the end of the campaign, although the leader of the Senussi did not accept the British conditions for the cessation of hostilities until April, 1917.

The relative quietness of the western frontier during the winter enabled the British forces to be progressively reduced, and by the end of 1916 many of the outposts in Upper Egypt had been abandoned. The 2/1st Cheshire Field Company left early in November, as noted above, and the Western Force released one more field company and seven R.E. officers at the end of the year. The 1/2nd Kent Field Company began to move to Alexandria on 19th January, 1917, leaving the 5th R. Anglesey as the only R.E. unit on the western frontier from Sollum to Esna, 800 miles away up the Nile Valley. The work of the company was as varied as ever and included accommodation, water supply and metalled roads. At the end of March this unit, too, was released by Western Force, the Sollum and Matruh detachments reaching Cairo on 1st April and the rest of the company (which had been dismantling camps along the Nile) on the 4th. After reorganizing as a field company the 5th R. Anglesey left for Qantara on 13th April.

RAILWAY WORKS ON THE WESTERN FRONTIER

During the period covered by this chapter a considerable amount of railway work was carried out by the E.S.R. under the Director of Railways, Colonel Macauley, late R.E., and Lieut.-Colonel R. B. D. Blakeney, R.E., who was D.D.R. for Egypt and the western frontier. Before the operations in the coastal sector began a railway was built from Alexandria to Dhabba. Its operation was rendered difficult because the absence of water necessitated the use of tank trucks,* and load restrictions on the bridge over the Lake Mareotis channel precluded the use of heavy locomotives. Crossing loops at stations had to be lengthened to enable longer trains to be run.

In the south a 2 ft. 6-in. line ran from the Nile to the Kharga oasis, but when the Senussi occupied the latter the four locomotives and twenty-four 10-ton wagons were withdrawn to safety. After the oasis had been re-occupied in November, 1916, the line was extended for nearly twenty miles towards Dakhla in order to reach

* One truck in seven had to carry water when the line was later extended to Matruh, a restriction not overcome until the pipe-line was laid in 1940-1.

an area fairly free from drifting sand and therefore more suitable as a base for the light car patrols.

The principal railway works consisted of the 2 ft. 6-in. line begun, against R.E. advice, in August, 1916, from Samalut to Baharia. A large bridge was built over the Bahr Yusuf west of Samalut and the line reached Blockhouse No. 7, a hundred miles away, on 26th October. The E.S.R. and various Egyptian light railways supplied materials and the rolling stock consisted mainly of 5-ton wagons. The total lift of each train was 65 tons but of this much was locomotive water. By the time water had been obtained, as described earlier, reconnaissance had shown that further progress was impracticable owing to the belt of sand dunes, several miles wide, which prevented the construction of the steep gradients down to Baharia. In addition, drifting sand quickly blocked the line in high winds and in 1917 the railway was abandoned and the track lifted.

THE SUDAN OPERATIONS

Various minor operations occurred in the Sudan and a few R.E. officers, but no units, took part in them. In 1914-15 the ruler of Darfur invaded Kordofan, and in the summer of 1915 Lieutenant A. G. Rainsford-Hannay took part in a trying reconnaissance for a suitable defence line to prevent the Senussi from being supplied with arms from Darfur. He also accompanied an expedition in March, 1916, with Lieutenant G. C. Gowlland, to deal with the hostile attitude of the Sultan of Darfur. The engineers were provided by a section of Sudanese sappers of the Egyptian army under Mr. Hart, an ex-N.C.O. of the R.E., and their main task was water supply. Lieutenant Gowlland designed an aircraft hangar built with planks, hoop iron and corrugated iron, and Rainsford-Hannay erected three of them at El Nahud. Early in 1916 Gowlland raised a field company of the Egyptian army at Khartoum from men of the Military Works Department and he saw further service with it later in the year in the Nuba Mountains. Finally, in 1917, Lieutenant C. G. Martin, V.C., accompanied a punitive patrol sent against the Lau Nuers.

CONCLUSION

The Senussi campaign and the minor operations associated with it entailed a considerable military effort and the R.E. contributed in no small measure to the removal of the threat to Egypt's security

from the west. Senior R.E. officers were confronted with the problems of inadequate supplies, inexperienced troops and of administration over vast areas, while junior officers and N.C.Os. found themselves in charge of works in isolated positions where initiative and resourcefulness were in constant demand, and with responsibilities exceeding those normal to their ranks. If the element of danger was absent, many would willingly have exchanged the extreme heat, the absence of leave and recreation and the hardships of the desert for the more active conditions on the eastern front.

The campaign is of interest in that it was fought over country much of which was to become so well known in World War II. It should be noted that many of the engineer problems were the same—water supplies and piers at Matruh and Sollum, the lack of a good road between these places and from either of them to Siwa, the development of Hammam, el Alamein and Dhabba, the shifting sands east of Baharia, etc.

This part of the narrative has been continued to a much later date than that describing the principal operations in the east, and the story must now be taken back to the Sinai desert in the spring of 1916, nearly a year earlier.

CHAPTER XXII

THE ADVANCE TO ROMANI

Proposals for an advance into Northern Sinai—The railway to Romani—Advance to Romani and the affair of Qatiya—The Romani pipe-line—The Romani garrison and defence works—Wire roads—The Mahamdiyah condensing plant—Suez Canal defences, April to July, 1916—Troop movements—Minor operations in the Canal Zone—R.E. in mounted formations.

(Sketch 7, facing page 292)

PROPOSALS FOR AN ADVANCE INTO NORTHERN SINIA

LIEUT.-GENERAL MURRAY, when C.I.G.S., had considered that a more ambitious operation should be undertaken in Sinai than the proposal, mentioned previously, for occupying the Qatiya area to deny to the enemy its water facilities on the caravan route to Egypt. Even if Qatiya were occupied, eleven divisions would still be needed for the static defence of the Suez Canal, and he felt that not only control of Sinai, including the northern route, but also the defence of the Suez Canal, could be exercised with economy of force by occupying El Arish, the next area on the northern route with water facilities, and El Kossaima, forty-five miles to the south-east, where the Turkish railway from Beersheba now ended. When he reached Egypt, he began to investigate the practicability of an early departure from the policy of static defence, in spite of the great amount of work completed or still in course of execution along the canal.

Difficulties soon arose in connection with plans for an early occupation of El Arish. The yields of the shallow wells on the coastal route were scanty and brackish, and drinking water even at El Arish was an uncertain factor. For an adequate force to reach El Arish, water would have to be transported from the Canal Zone, and for this facilities were not immediately available. Similar limitations applied to the transport of other supplies, by either land and sea. In addition, the E.E.F. was not yet mobile enough to undertake the form of defence required in the El Arish-El Kossaima area. General Murray, therefore, decided to overcome the

supply difficulties by constructing a standard-gauge railway from Egypt and a water pipe-line from the Sweetwater Canal across the Sinai desert. Both were engineering undertakings of considerable magnitude and the latter, in particular, was at that time a novel and striking example of imaginative foresight. Although the first section of the railway from Salihya to Qantara had been completed, both administrative and engineering appreciations showed that the resources available were inadequate to enable both projects to follow a forward movement to El Arish in one bound.

The alternative was an advance by stages, of which the first was the occupation of the Romani-Qatiya area. Sufficient camel transport was available to maintain a force adequate for the double role of denying the water facilities to the enemy (thus rendering it unnecessary to hold the northern half of the canal defences so strongly) and of covering the construction of the railway and pipe-line to Romani. Preparations were made accordingly, and on 27th February, 1916, the C.I.G.S. approved the plan.

THE RAILWAY TO ROMANI

As soon as the XV Corps began to occupy the northern part of the canal defences early in 1916, a series of patrols and, later, more elaborate reconnaissances were pushed forward into the desert east of the canal. Only a few small parties of Turks were met, and by the end of February the Qatiya area had been reported clear of the enemy. Screened by yeomanry and Camel Corps, Major Maule's topographical sections began to extend the 1/15,000 survey of the Canal Zone; it had reached the Dueidar area early in March and almost to Qatiya by the end of May. The country between the canal and Qatiya was not merely a flat and sandy tract; in many places dunes rose to considerable heights, and in depressions there were salt or gypsum swamps and pans. Camel scrub grew sparsely and palm groves surrounded the occasional groups of shallow wells.

The construction of the railway to transport water and other supplies from Qantara to Romani, a distance of twenty-five miles, was the first priority. A single-track standard-gauge line would not only exceed the capacity of the Turkish narrow-gauge line (3 ft. 5½ in.) running south from Riyāq (north-west of Damascus), but would possess other advantages over a narrow gauge, such as the

reduction of transshipment delays, a greater availability of locomotives and rolling stock, the simplification of repairs and of provision of spare-parts and of operation. The extension of the line to El Arish was regarded as a probability and to Palestine as a more distant possibility, as was also the question of doubling the track.

No detailed survey being available, on 6th February, 1916, a detachment of the 115th Railway Company, under Captain J. May, began work for the alignment from Qantara, keeping fairly close to the coast where the levels were more favourable for the chosen ruling gradient of 1 in 100. Because survey parties were not allowed far ahead of construction, the final alignment was less direct than if detailed maps had been available. There also had to be a wide deviation from a point five miles from Qantara to near Qatiya, to avoid an area of high, shifting sand dunes near Romani.

The 115th and 116th Railway Companies supervised the work on the formation begun in mid-February by Egyptian labour supplemented by reservists from the Egyptian Railway Battalion and a limited number of E.S.R. staff. By 1st March, 500 R.E. and 600 Egyptians were employed. Drifting sand caused heavy maintenance on the short lengths of cutting and embankment which were unavoidable, although they were made wider than usual and fenced and revetted. The waterless desert had one advantage in favour of quick construction—no bridging or stone ballasting would be required until El Arish was reached.

The material consisted of 75-lb. standard British rails laid on bearing plates, with wooden sleepers, bored at Qantara and laid at 2 ft. 6 in. spacing, with rail joints staggered. Track laying was begun by the 115th and 116th Companies in the middle of March and, including sidings, 10 miles were laid by 31st March and 16 by the middle of April. Four locomotives were available at the end of March.

ADVANCE TO ROMANI AND THE AFFAIR OF QATIYA

Early in April, as soon as the railway passed the forward line of the canal defences, the 5th Mounted Brigade was ordered forward to Romani and Qatiya with a detachment of the 2/2nd Lowland Field Company (Captain M. J. B. Laird) attached for water reconnaissance and development. On the 21st two squadrons of the Worcester Yeomanry (mounted) and the 2/2nd Lowland detachments (dismounted) advanced to Oghratina, eight miles east-north-east of Qatiya, for water reconnaissance in that part of the dune area.

Two days later the Turks, alarmed by reports of these movements, sharply attacked various detachments of yeomanry and overwhelmed the parties at Qatiya and Oghratina. The attack on the latter was made in dense fog, and as there had been little time for entrenching, the yeomanry in the first line were rapidly driven back by superior numbers with nearly 150 casualties. Captain Laird's party in the second line consisted of three subalterns, with Lieutenant O. H. Little, R.E. (attached from the Egyptian Survey), Captain W. R. O'Farrell, R.A.M.C., and sixty-one other ranks. Many of their rifles soon became clogged with sand and they soon found themselves fighting at a grave disadvantage, with the camp surrounded by the enemy. Captain Laird was killed, other casualties were numerous and when at about 8 a.m. the Turks assaulted with the bayonet the position was rushed and the British survivors surrendered. It had been a gallant defence, conducted under great difficulties (the yeomanry remaining to cover the dismounted R.E.) with no prospect of support or relief. One severely wounded sapper was picked up two days afterwards when Oghratina was re-occupied but the other survivors, including all the wounded who could be moved, were taken to Damascus, where officers and other ranks were separated. Very regrettably many of the men died later from neglect and ill-treatment.

The only other R.E. engaged was a section of the 2/1st Lowland Field Company at the permanent post at Dueidar, where one sapper was wounded. The remnants of the 2/2nd Company, two officers and sixty-six other ranks (mostly drivers), were gradually re-organized at Qantara. Romani was re-occupied on 24th April and the Turks withdrew towards El Arish.

Work at railhead twenty miles from Qantara was stopped temporarily by the actions just described, but the laying of marshalling sidings at Qantara was continued. On 29th April forward construction was resumed and on 19th May Romani Station was opened to traffic. A branch line, also of standard gauge and nearly three and a half miles long, was then laid from Romani to Mahamdiyah on the coast and opened to traffic on 20th June, and early in July railhead was extended from Mile 25 to Mile 29. In April the 276th Railway Company was formed to operate the railway, and during May four trains ran daily from Qantara to Romani. In the week ending 26th May, 2,865 tons were transported, of which 150 were railway material, 420 engineer stores and 960 water (215,000 gallons). Even when the daily lift was increased to 500 tons it was barely

sufficient to maintain one division at Romani and left no margin for railway stores when the main line construction was resumed. This deficiency would, however, be met when the pipe-line—the second engineering priority—relieved the railway of the task of transporting water.

THE ROMANI PIPE-LINE

Water supply in the Romani-Qatiya area being a doubtful factor, Major-General G. Williams, the E.-in-C., recommended that the 6-in. pipe-line from Qantara to posts in front should be extended to Romani to meet the demand of 3,000 gallons per hour. There was sufficient margin in the Qantara pumping plant, which at the end of April was capable of delivering 250,000 gallons of filtered water daily from the Sweetwater Canal to storage totalling 100,000 gallons on the east bank of the Suez Canal. Work began at the end of April. Generally the pipe-line followed the railway but over certain sections was some distance from it. This retarded the delivery of materials, but 12½ miles were laid by 21st May and Romani Station was reached on 12th June. The 1/2nd Lowland Company erected a sectional steel storage tank at railhead and filling began on the 16th. Branches were run from the main line to posts in the canal defences and a 7-mile long 6-in. branch from Romani to Mahamdiyah was laid in slightly over a week at the end of May.

The railway was thus relieved of its task of transporting some 100 tons of water daily but became an important consumer of the piped supply, local water proving too saline for locomotive boilers, each of which required about 2,000 gallons a day.

THE ROMANI GARRISON AND DEFENCE WORKS

The completion of these works enabled a considerable force, which by 4th June included the 52nd Division, to be moved to the Romani-Qatiya area. The C.R.E., Lieut.-Colonel Waller, reached the Mahamdiyah area on water reconnaissance for the leading brigade (the 156th) on 5th May, and the 1/2nd Lowland Company began to sink wells from the 10th onwards. Their water soon turned brackish and a borehole proved later to be equally valueless. Efforts to obtain drinking water at Qatiya and at other points were also unavailing and reliance had to be placed entirely on the pipe-line and rail-borne water. The greater part of the 52nd Division

remained concentrated near the pipe-head with camel transport to enable it to operate in a mobile capacity if necessary.

Early in June Lieut.-Colonel F. A. K. White, C.R.E. 11th Division, sited a series of defensive positions for 6,000 rifles and by the 24th 3,000 E.L.C., supervised by the 1/2nd Lowland Company, were engaged on their construction. In all eighteen defended localities east and south of Romani were built and wired, although not continuously until after the Battle of Romani. The extension of the 2 ft. 6 in. light railway from Port Said along the sand spit between the Mediterranean and Lake Tina to Mahamdiyah, twenty-six miles long with a daily capacity of 100 tons, facilitated transport of the considerable quantities of defence stores.

The 2/1st Lowland Company, part of which reached Mahamdiyah on 18th June, and the 1/2nd Company supervised hutting and shelters, and the latter prepared an advanced landing ground at Mahamdiyah for the R.F.C. and worked on water supply. In connection with the condensing plant (to be described later) the former company erected a 50,000-gallon storage tank in July and the 2/2nd Company, which arrived on 21st July, assembled the plant.

At the end of June, Lieut.-Colonel White returned to the 11th Division, and Lieut.-Colonel Waller, C.R.E., 52nd Division, took over all works in the Romani area. Captain Jackson (2/2nd Lowland Field Company) was appointed Field Engineer, Romani, on 28th July.

WIRE ROADS

Wire netting had already been used by Brigadier-General Paul on the loose sand of the Gallipoli beaches to make the going less heavy, and it had also been used in the Western Desert to cover rushes laid on the road to Moghara where, when the rushes dried and disintegrated, the netting alone maintained a reasonable surface. After the occupation of Romani wire roads were used systematically in the Sinai desert. A large mileage was laid nine to eighteen feet wide, with netting pegged to the sand over grass or palm leaves, although these were soon found to be unnecessary. Such roads lasted well under light traffic such as marching men and occasional light cars, but heavier vehicles soon broke the netting. Considerable maintenance was required to correct stretching and rutting. After stocks of ordinary wire netting had been exhausted in 1917, heavier gauge rabbit wire from Australia was used. The origin of this novel

and useful device is difficult to ascribe to any particular individual but the R.E. may fairly claim to have originated and developed the idea.

THE MAHAMDIYAH CONDENSING PLANT

When a standing camp was authorized at Mahamdiyah it was considered desirable to install a sea-water condensing plant as a stand-by in case of a breakdown on the pipe-line, and on 16th April the War Office was asked to supply a plant with a daily output of 20,000 gallons. The boilers left England on 23rd May and the condensing apparatus a fortnight later. Captain Truscott, who had installed the smaller plant at Sollum, was sent to build the concrete foundations and to supervise the installation of the plant which arrived at the end of June. Running tests could not be made owing to the loss in transit of part of the storage tank and Captain Truscott returned to Alexandria for other work. When the plant was eventually started, trouble occurred from sand choking the intake, which was then extended 200 feet out to sea, but no solution of the difficulty had been found and no water distilled by the end of July.

SUEZ CANAL DEFENCES, APRIL-JULY, 1916

During the occupation of the Romani-Qatiya area the canal defences continued to be held in strength (although, as described later, numerous troop movements took place) and much engineering work was executed in completing the original programme with its modifications, and in providing new facilities and accommodation. On 3rd April, in anticipation of hot weather, the E.-in-C. gave hutting first priority. Shortages of any kind were to be reported to him daily and contracts were to be arranged if labour was otherwise unobtainable. Essential accommodation, e.g., food stores and cook-houses, was built first, and less important buildings followed. Construction was usually of reeds on light timber framing, roofed with thatch, securely wired to prevent damage by high winds, or two layers of matting with a 2-in. air space. The main difficulty was to get enough matting, and not until supplies began to arrive from India could the second layer be put on roofs. Because of frequent troop movements it was difficult to forecast accommodation needs and a certain amount of engineer effort was inevitably wasted.

Other works included defences, which were the responsibility of C.Es. of corps or sections, the maintenance of the inundations in

No. 3 Section, light railways, roads, bridges and water supply. The General Staff continued to attach much importance to the inundations and the inlets at Ballah and Qantara were fitted with pipes and sluice gates to maintain the water levels. The last light railway branch in the original programme was finished in June and some additional decauville track was laid, including a 3-mile branch from the Romani railway to Dueidar in May. Early in July the use of some lines was, on the other hand, discontinued.

Roads continued to make heavy demands on labour. The lateral roads between railheads had not yet been started and even by the end of May first priorities such as the Suez-Kubri West, Ismailia-Qantara and Qantara-Qatiya roads were still under construction, as were also the second priorities, which included the Tel-el-Kebir-Ismailia camp and bridge approach roads. Many new roads east of the canal needed repair, and in May hard black basalt from the Abu Zabel quarry, north of Cairo, became available for this purpose. The Fayid quarry was extended and continued to supply large quantities of limestone; on 11th April its working passed to a contractor and the military staff was thus released for other duties. To accelerate the Romani road the metre-gauge railway from Qantara was extended to Dueidar to facilitate the transport of stone.

Water supply was much more advanced; several plants were in full operation and most of the pipe-lines were finished by mid-April, but one set of filters at Shallufa remained incomplete and two pumping installations were not then working. The filtration plants produced about 1 million gallons daily, and the reservoirs on the east bank could store over $1\frac{1}{4}$ million gallons. Although the efficiency of the filters satisfied the medical authorities, they still insisted on chlorination, and storage for forty-eight hours to destroy the *bil-harzia* parasite. At the end of May construction began of 50,000-gallon reservoirs at railheads for filling camel-tanks, and during the next two months the other water supply works consisted of completing the relay pumping stations, subsidiary pipe-lines, distribution mains and storage in the forward positions.

The weather influenced the progress of work. From the cold of January the temperature rose gradually to sometimes as much as 123°F . in the shade during the unusually hot summer, and work under these conditions was most arduous. The occasional short but heavy rains in the winter had caused little delay, but spring sand-storms handicapped reconnaissance and produced heavy maintenance on the defences. Sudden and violent storms on the

Great Bitter Lake caused damage to shipping and the sinking of small craft with loss of life, although most of the stores carried were ultimately salvaged by the Suez Canal Company.

At the end of June the original works programme entrusted to the D.D.W., Colonel Macdonald, was largely complete and his appointment lapsed. He and the seventy-eight technical and clerical members of his staff, seconded from the Public Works Ministry, had executed works to the value of £2 million, excluding the cost of the defence works and of military stores imported from overseas. The Suez Canal Company, in spite of the depletion of its European staff, had continued to co-operate by repairing machinery and small craft under difficult conditions, and by supplying water-boats, but when military workshops were established at Qantara and Ismailia the need for the Company's facilities were reduced. The D.D.W. had also been assisted by the organization and co-operation of the leading contractors.

On 1st July all outstanding works and stocks of stores on both sides of the canal were transferred from the D.D.W. to C.E.s. or Sections. The responsibilities of field and corps units and of field engineers and works officers with civil staffs and labour were redefined. An inspecting staff was set up to supervise all machinery and volunteers were invited from other arms for specialist and tradesmen's duties in the army troops companies, responsible for filtration plants, pumping stations and bridges. The C. in C. was much interested in the works, carefully examining progress reports and visiting sites, and in June successfully resisted a War Office suggestion that the withdrawal of some R.E. units might be possible. All engineer stores, other than road metal, were now to be supplied through the 46th Advanced Park Company at Ismailia.

TROOP MOVEMENTS

The formation of the E.E.F. had hardly become an established fact when a number of important troop movements began, and between February and July ten divisions and several R.E. units in addition to the divisional engineers, left the Canal Zone and the Delta for other theatres. The I Anzac Corps had left for France by 6th April, 1916, and its place in No. 2 Section had been taken by the II Anzac Corps (11th British and 4th and 5th Australian Divisions, and the Anzac Mounted Division). Its C.E. was Brigadier General W. B. Lesslie, a Canadian born Regular R.E. officer who

had been C.E. at Anzac. All three infantry divisions left for France during June, and the 42nd Division and one brigade of the 54th Division from No. 1 Section and two brigades of the 53rd Division from the Delta took their place.

In No. 1 Section the 42nd Division was warned for overseas at the end of March, and after handing over all works to the 54th Division (which had just begun to reach No. 1 Section), concentrated at Suez for training. On 16th April, Lieut.-Colonel Tennant was invalided and Lieut.-Colonel E. N. Mozley succeeded him as C.R.E. On 10th May the 1/2nd West Lancs. Field Company left to join the Composite Brigade at Mudros and the 42nd Division had two field companies only until the 1/3rd East Lancs. Company reached Qantara from England on 28th June.

The 54th Division reorganized and trained at Mena Camp, near the Pyramids, after the Gallipoli evacuation until the end of March, 1916, except for one of its two field companies—the 1/2nd East Anglian—which served with the W.F.F. from 26th January until the division moved to the Suez Canal. The deficiency in engineer units was temporarily made good by the presence, as corps troops, of the 1/1st Renfrew and 1/1st City of Edinburgh Field Companies, but both left El Kubri for France in the middle of April. The 133rd Army Troops Company also left for overseas during the month. In May, Headquarters IX Corps ceased to exist, but Brigadier-General E. H. Bland remained as C.E. No. 1 Section. On 1st July the 1/1st Kent Field Company, less a detachment left in the Wadi Natrun, joined the 54th Division at El Kubri from the W.F.F.

No. 3 Section was held by the XV Corps, consisting of the 52nd Division and various mounted formations. Early in April the 52nd Division began to send detachments forward to the Romani area and the 167th Army Troops Company left Qantara for France on the 11th. The C.E., Brigadier-General P. G. Grant, also left for France and on 12th April, Headquarters XV Corps ceased to exist. Lieut.-Colonel Waller acted as C.E., No. 3 Section, until Brigadier-General E. M. Blair took over in June.

The R.E. Order of Battle at the end of July is given in Appendix IV.

MINOR OPERATIONS IN THE CANAL ZONE

Except for the occupation of the Romani area, tactical activity was confined to reconnaissances and to the destruction of wells

and rock cisterns likely to be of use to the enemy in the Sinai Desert. R.E. detachments took part in all these operations, it being a standing instruction in No. 1 Section, for instance, that any column or patrol should include a detachment of R.E. with tools and equipment for water reconnaissance and development. Lieutenant McWilliam was with a small force which reconnoitred the Nekhl road on 3rd April, 1916. In June the 1/2nd East Anglian Field Company sent out two detachments, and Major G. S. C. Cooke and a detachment of the 14th Army Troops Company accompanied a column to the Wadi um Mukhsheib on the central Sinai route to empty cisterns and drain pools, as a result of which several million gallons of water were run to waste.

Work in divisional areas was primarily on defences. The forward posts were almost finished during April, although the system was less elaborate than originally planned. E.L.C. took the place of infantry working parties on the inner defences as they were withdrawn for training. This slowed progress as the infantry had become accustomed to the work and the E.L.C. needed far more supervision. Work on the second line ceased in April; on 26th May all defence works except wiring and machine-gun emplacements were stopped in No. 3 Section; and after 9th June no more work was done on unoccupied posts. Nevertheless the defences continued to demand a considerable, although decreasing, R.E. effort from May to July—much of it devoted to maintenance.

Field Companies with E.L.C. labour erected a large number of shelters and some hutting. In May and June water storage facilities and distribution mains, principally in the forward defences, were largely completed and the minimum daily ration was increased to 3 gallons per man. Distribution had been delayed by shortages of fittings but adequate quantities began to arrive in June. On 30th March a section of the 1/1st Renfrew Company left Ayun Musa to accompany a column which occupied a new outlying position in front, where it sank two wells and helped in the defences. The 86th Company (11th Division) worked on the 6-in. pipe-line from Ferdan railhead during April, and most units were responsible for maintaining and repairing various sections of pipe-line. The 1/2nd and 2/1st Lowland Field Companies dug wells at Ducidar, and other points as the Romani railway was extended.

Army troops companies, other corps troops and the field companies of the 54th Division in No. 1 Section and of the 52nd Division in No. 3 Section did considerable work on bridge construction,

operation and maintenance. The latter was a heavy strain ; some of the materials, e.g., the native lake-boats, were of poor quality and needed constant repair, while damage from shipping in the Suez Canal frequently occurred. Field companies also carried out a limited amount of roadwork—the 68th Company (of the 11th Division) on the roads in advance of railhead at Ballah during June, and the 1/2nd East Lancs. (42nd Division) at Ferdan railhead.

The army troops companies, in addition to their bridge duties, were responsible for ferries and wharves and for the operation of the water filtration and pumping plants along the canal. Some pipe-line construction was also done to supply outposts, and the 14th Army Troops Company at Serapeum worked on the bridgehead defences during April. On 20th July they took over the pontoon and bridging factory at Ismailia. In Nos. 2 and 3 Sections the 220th Army Troops Company worked on wharves at Qantara during May, and on roads and decauville track at Ferdan during July.

In June, 1916, Major-General G. Williams, E.-in-C., E.E.F., left to take up the appointment of Director-General of Military Works in India, and Brigadier-General H. B. H. Wright returned to Egypt to succeed him, with the rank of major-general. He was to remain as E.-in-C. throughout the Palestine campaigns and his determination, breadth of vision and experience were to prove of the utmost value to the E.E.F.

R.E. IN MOUNTED FORMATIONS

Several British yeomanry and Anzac mounted formations, which had left their horses in Egypt while serving dismounted at Gallipoli, returned during the winter of 1915/16. The Anzac troops had their normal complement of field squadrons, but not so the British and, moreover, several of the brigades had not yet been formed into divisions. These formations were gradually brought up to strength and re-equipped, and by the time that the E.E.F. was formed, some independent brigades were ready to take the field again and the question of providing them with engineers arose. Early in April, 1916, four field troops, R.E. were formed in the Canal Zone from volunteers of all arms round nuclei of officer and other-rank volunteers from various field companies.

Records of the early work and experiences of some of these troops are scanty, but the 6th Field Troop joined the 6th Mounted Brigade in the coastal sector of the W.F.F. in April. The 7th was attached

soon after formation to the 5th Mounted Brigade at Ballah and was expected to execute works, whereas it was badly in need of training. The volunteers from other arms all required ordinary R.E. training, while those from the infantry could not ride and those from the R.A.M.C. could not shoot. On 5th June the troop marched to Qantara and training was done at odd intervals between work on base shelters and hutting. The full establishment in animals was not reached until 11th July.

No records of the 8th Field Troop remain, but it appears to have been formed early in April. On the 13th the 9th Field Troop was formed at Suez from volunteers from the IX Corps—some of whom (from the Edinburgh and Renfrew Field Companies) had actually embarked at Alexandria on their way to France before they were recalled. This troop had better opportunities for training than some, but when it moved to El Kubri on 17th May to join the 8th Mounted Brigade, it had to erect its own animal shelters. At the end of the month the troop moved to Ayun Musa with a detachment at Shallufa, and training continued intermittently until they moved back to Suez at the end of July.

CHAPTER XXIII

BATTLE OF ROMANI AND ADVANCE TO EL ARISH

Considerations affecting an advance from Romani to El Arish—The Battle of Romani—Field engineer equipment for desert operations—Preliminary work on the El Arish pipe-line—Resumption of railway construction—The Mahamdiyah condensing plant—Work of field units after the Battle of Romani—Reorganization of the E.E.F.—Works at Qantara—The El Arish pipe-line—The occupation of El Arish—The affair of Maghaba—The Arab revolt—The Sinai L. of C.—The Canal defences, August to December, 1916—Summary of engineer work during 1916.

(Sketch 7, facing page 292)

CONSIDERATIONS AFFECTING AN ADVANCE FROM ROMANI TO EL ARISH

It is appropriate at this stage briefly to review the strategic situation at the end of July, 1916, as it had been affected by the approval on 27th February of the plan to occupy Romani as a first step towards achieving the mobile defence of Egypt in the El Arish—El Kossaima area. The advance to Romani and Qatiya, although representing little more than one quarter of the distance from Qantara to El Arish, had achieved substantial results. It had removed any serious threat to the northern part of the Suez Canal and rendered the remainder less open to attack. A progressive reduction of the reserve in Egypt was now possible, and among the formations and units which left for other theatres during the first half of 1916 were twenty-six field and at least two army troops companies, both R.E. and Australasian. The passive defence of the east bank of the Suez Canal had become a secondary consideration, but work continued on the defence system throughout the year.

The arguments in favour of continuing the advance in Sinai still held good and in June, 1916, when the Arab revolt broke out in the Hejaz, a further reason was added. On 6th July the War Committee in London decided that this movement against the common enemy deserved support and authorized preparations for the

occupation of El Arish and Aqaba and for the requisite extension of the Qantara-Romani railway.

Although the supply position had much improved as soon as the railway had reached Romani, water was still a difficulty, and before any major advance eastward could be undertaken, adequate arrangements for its supply had to be made, both for forward troops and at Romani. The only reliable drinking supply was the 30,000 gallons daily from the 6-in. pipe-line from Qantara, the deep bore at Mahamdiyah being useless and the condenser not yet working, and the estimated daily requirements for the force of one mounted and two infantry divisions needed for the El Arish operation were 300,000 gallons with two days' supply in reserve storage along the L. of C. The engineering problem was how could this demand be met. Dr. Hume considered that small or moderate yields of fair quality from wells or shallow bores could probably be obtained for a considerable part of the way to El Arish along the coastal strip, but experience showed that, while this was generally correct, the water quickly turned so brackish that even animals would not drink it, and that only the larger dunes held water and even there the wells had to be kept shallow. A few inland wells were better but too remote to be of use.

Various steps were taken so far as the virtual exhaustion of water stores in Egypt permitted. A new 5-in. pipe-line from the Qantara pumping station to various canal defences on the way to Dueidar and disconnection of the new 4-in. branch from the Romani line increased the supply from the 6-in. pipe-line to Romani to 60,000 gallons daily in August. Shortly afterwards the completion of the installation of two new 35 H.P. pumping sets at Qantara in a pump-house built by the 5th R. Monmouth, further increased delivery to 144,000 gallons per day. The combined effect of this increase, of various lesser measures and of local supplies, barely sufficed to meet half the daily needs for the El Arish advance, and reliance upon rail-borne water for the balance would have led to such diminution of other supplies that many months would have been required to accumulate the reserves necessary for the operation.

Some much more drastic solution of the water problem was, therefore, required, and the E.-in-C. was instructed in June to investigate the practicability of a new pipe-line from the Sweetwater Canal to El Arish, ninety-five miles from Qantara, and to estimate the quantities of engineer stores required for delivering 600,000 gallons daily at any one section and 500,000

gallons at pipe-head. While this extensive project was being examined, General Murray warned the War Office on 30th June that the 6-in. pipe-line was inadequate and that a 12-in. line to El Arish would be required. The E.-in-C. reported that the daily output of the filtration plant at Qantara would have to be increased from 150,000 to 750,000 gallons, that duplicate pumping plants of 55 H.P. would have to be installed at Qantara, Romani and at two points further east, that additional storage would have to be built at the ends of each of the four pumping stages, and that the pipe-line would need to be 12-in. diameter with the final section reduced to 10-in. The necessary stores and six Holt tractors for pipe distribution were demanded on the War Office on 12th July, and arrangements made locally to start at once on the filtration plant and the first two reservoirs. The project was approved without delay but, although the machinery could be supplied from England, sufficient steel pipes were not available, and arrangements had to be made to get them from the United States. Although this was quicker than making them in England, they would not reach Egypt before autumn and therefore El Arish could not be occupied until the end of the year. The El Arish pipe-line was not only on a much larger scale than any of the extensive water supply systems already installed on this front, but was one of the biggest single engineering undertakings in any theatre. The decision to execute it was therefore a bold one.

The other major engineering work in connection with the projected operations was the extension of the standard-gauge railway from the railhead between Romani and Qatiya to El Arish. Work on this was resumed on 7th July, 1916. Further reference will be made to this work and it is sufficient here to record that on the 18th, when four more miles of track had been laid, work was suspended for a second time owing to the increasing activity of the Turks, which culminated a few days later in the Battle of Romani.

THE BATTLE OF ROMANI

During the early part of the summer of 1916, contacts with the enemy, who had withdrawn eastwards in May, were infrequent, but soon after the middle of July, Turkish troop concentrations observed east-south-east of Romani presaged an attack on the troops covering the railway. As a precautionary measure, the 158th Brigade (53rd Division) from No. 2 Section of the Canal Defences reinforced the

Anzac Mounted and 52nd Divisions at Romani on 20th July; the 5th Mounted Brigade with the 7th Field Troop moved up to Gilban Station on 5th August; and other troops, including the 42nd Division, were moved from the Ferdan-Ballah area to the old Qantara bridgehead at the end of July. The field companies of the 42nd Division were re-equipped on desert scales and on 3rd August the 127th Brigade Group, including the 1/1st and half of the 1/3rd East Lancs. Field Companies, moved to north of Dueidar. Work on the outpost defences at Romani was temporarily stopped, and the E.L.C. moved back to railhead on 21st July, but three days later they returned to resume work with the 52nd Divisional R.E.

The expected Turkish attack was slow to materialize—the delay being due to their having to wait for heavy artillery—but eventually at the beginning of August the Turks began to move eastwards from Oghratina and on the 4th attacked the British positions at Romani. These were strong and all frontal attacks were repulsed without difficulty. The main effort was directed against the right flank but the stout resistance of the Australian light horse brigades prevented any serious enemy advance. R.E. units took little part in the fighting; a detachment of the 1/2nd Lowland Company had a few men wounded from artillery fire and the camp of the 2/2nd Lowland Company was shelled by 5.9-in. guns, but they suffered no casualties.

During the afternoon of the 4th a British counter-attack was delivered by mounted troops on the left flank and by infantry from the main position. After some ground had been gained the infantry counter-attacks were suspended during the evening and portions of the 1/2nd and 2/2nd Lowland Field Companies repaired the slight damage to the defences, put out more wire and repaired one or two cuts in the 6-in. pipe-line.

Early on 5th August the main body of the enemy was seen to be withdrawing, covered by a rearguard. While the rearguard was being overwhelmed and 1,500 prisoners taken, the mounted troops, followed by troops of the 42nd and 52nd Divisions, began the pursuit. The great heat and heavy going on the sand prevented the infantry from gaining any contact with the more mobile Turks, and at night the 155th Brigade (52nd Division), with the 1/2nd Lowland Company (less one section), bivouacked slightly in advance of the abandoned railhead. For the next few days this company, and the 2/1st Company, which had also come up, were digging wells in the Qatiya area, while the 2/2nd Company was similarly occupied at railhead.

where it organized the water siding and fitted twelve wells with *shadufs*—contrivances used in Egypt, having a frame and counter-balance, for lifting buckets of water—before it returned to Mahamdiyah on 26th August. The other two field companies went back to Romani and Mahamdiyah in the middle of August, largely owing to the difficulties of watering their brigades east of Romani without undue strain on the railway.

The 127th Brigade (42nd Division) with the 1/3rd East Lancs. Company reached Qatiya on 5th August and next day the 125th Brigade and the 1/1st East Lancs. Company also arrived at this place. Both companies dug shallow wells until their brigades returned to Romani on account of water supply difficulties in the middle of August. The 126th Brigade Group, which included the 1/2nd East Lancs. Company, meanwhile moved forward from the Canal Zone and reached Dueidar on 8th August. The 5th Mounted Brigade reached Romani on the same day and a detachment of the 7th Field Troop accompanied part of the brigade to Oghratina on the 11th, but on the 15th the brigade began to move back to Dueidar.

After the Battle of Romani the Turks fell back from one prepared position to another, until they had reached El Arish, but although the mounted troops inflicted further losses on them, no further outstanding success was gained. Yet the battle was a decisive defeat for the Turks for they were never again able to mount an offensive against the Suez Canal, and the initiative in this theatre passed finally into British hands.

FIELD ENGINEER EQUIPMENT FOR DESERT OPERATIONS

Preparatory to the advance to El Arish, the establishments of all field units, R.E., were reviewed to adapt them to desert operations. The principal change was the substitution of camels for wheeled vehicles, each animal carrying an average of 350 pounds of equipment in specially arranged loads. Field companies were each reduced from six officers and 225 other ranks to seven officers, 153 other ranks and twenty-five native camel drivers, with fourteen riding horses and sixty-nine camels. Riding horses in field troops were exchanged for camels.

The most important equipment was that for developing local water supplies in the desert, and each company was organized to provide twelve detachments for well sinking. Each was equipped

with Norton tubes (see below), a lift and force pump, trough, hose, tools and lining material. The 42nd and 52nd Divisional R.E. were reorganized on this basis by August, 1916, and later the 53rd and 54th Divisions were similarly equipped, and field troops were issued with the same type of gear.

During operations these arrangements were often modified, but in general the equipment was adequate for most conditions met in northern Sinai. The pumps worked well but sand and over-enthusiastic pumping were hard on their moving parts. Worn or damaged pumps were sent back complete for repair at a special workshop established at Qantara, and replaced by spares carried by the divisional R.E. The standard storage tank was of white canvas, 11 ft. square, with a nominal capacity of 2,300 gallons, but in practice it seldom held more than 1,500 unless the sides were sandbagged. Later, green canvas tanks, 30 ft. square and known as "bucksails," were used and had a nominal capacity of 6,000 gallons.

The Norton tube wells were more useful for searching for water than as sources of supply, but a variation known as the "spear-point" (a solid steel point with perforations and sand screens developed by Australian engineers) proved most valuable. Such a well with the standard lift and force pump in reasonably good conditions could quickly deliver up to 600 gallons per hour and large numbers were made by the 46th Advanced Park, R.E. When wells had been developed, the standard equipment such as canvas troughs was replaced by semi-permanent structures as soon as time permitted and, where timber from date palms was available, pumps were replaced by *shadufs*. R.A.M.C. personnel was attached to field units, R.E., to test water for purity and salinity.

PRELIMINARY WORK ON THE EL ARISH PIPE-LINE

Much preliminary work was done on the El Arish pipe-line before the pipes began to arrive in the autumn. On 14th July a contract was placed for four new circular, reinforced concrete settling tanks, each of 32,000 gallons capacity, fed by the intake from the Sweetwater Canal at Qantara West. On 19th July the Cairo Water Company began to make the filtration plant—ten vertical, mechanical, gravity filters—and it was then erected by contract under the supervision of Captain Pardoe (5th R. Monmouth.). It was finished in October and was capable of delivering 500,000

gallons daily. The Suez Canal Company laid three 6-in. inverted steel siphons across the Suez Canal. This involved dredging and the use of divers.

A contract was also placed for the construction of two 250,000-gallon reservoirs on the east bank. Owing to a shortage of reinforcing bars they were built in masonry, except for the roofs, and rendered internally to ensure watertightness. They were substantial structures, each measuring 60 ft. square internally and over 9 ft. deep. Their construction, also supervised by Captain Pardoe, was completed in October. Another contract was placed on 14th July for two pumping stations, although the exact type of machinery was not yet known. The plant installed later consisted of duplicate sets of 66-H.P. oil engines and 5-in. centrifugal pumps each with a delivery of 27,000 gallons per hour. One set only was required to work at a time, the other being reserved for stand-by use. The suction pipes were cross-connected to enable either reservoir to be used by each pumping set. The detailed design of some of these works was undertaken in the E.-in-C's. office.

Pending the arrival of the 12-in. pipes, arrangements were made for laying them and, although no complete R.E. units could be spared, some 130 men were gradually assembled and instructed in their respective duties. In August the E.-in-C. also arranged for two reservoirs with a combined capacity of 500,000 gallons and for duplicate pumping stations to be built at Romani. These installations were very similar to those at Qantara but, as fine aggregate was available on site and to reduce the tonnages of materials to be transported from Egypt, the reservoirs were constructed in reinforced concrete.

RESUMPTION OF RAILWAY CONSTRUCTION

Reference has already been made to the railway construction effected between 7th and 18th July, 1916, when railhead reached Mile 29. This was done by the 115th Railway Company, less detachments operating the Shallufa and Ballah light railways. The 116th Company maintained the main line, built more sidings at Qantara and operated the Port Said and Ferdan light railways. Detachments of both companies assisted the 276th Railway Troops Company in operating the main line, with consequent increasing delay to construction, but at the end of July a new railway troops company—the 53rd—was formed to provide operating staff and release construction personnel.

After the Battle of Romani, the 115th and part of the 116th Railway Companies assisted by E.L.C. were able to resume construction on 10th August. Materials were available and fairly steady progress was made during the rest of the year. Mounted troops covered the survey parties (both topographical and railway), construction gangs and R.E. detachments reconnoitring for water with Norton tubes. Shallow wells were dug by field companies, but generally local supplies were almost valueless and rarely fit for locomotives until the area beyond El Arish was reached early in 1917. Consequently, tank trucks had to fetch supplies from Qantara or from the pipe-head at Romani where a special siding with stand-pipes for filling trains was built. At railhead the water was discharged by gravity into canvas tanks from which camel tanks were filled to transport the water to the covering troops. As the railway extended eastwards the lift devoted to water had to be augmented for locomotive use at the expense of railway material, and the rate of construction decreased. At one time it was feared that work would have to be suspended somewhere between Salmana and Mazar, but as a result of certain emergency measures (to be described later) a stoppage was never quite reached before the 12-in. pipe-line overtook the railway.

Local defence at successive railheads was ensured by constructing blockhouses or more elaborate defensive positions upon which the covering troops could fall back in case of need. Control of the outlying desert was carried out by several long distance raids by mounted troops, usually accompanied by R.E. detachments.

The railway alignment east of Romani was north of Qatiya and thereafter close to the coastal caravan route to El Arish. For the reasons already stated progress varied, but averaged nearly sixteen miles of track monthly, the maximum in any one month being twenty miles. Railhead at the end of August was at Mile 34, at the end of October at Mile 60 and on 4th January, 1917, the track reached El Arish, ninety-five miles from Qantara, shortly after its occupation. Throughout, Lieut.-Colonel M. E. Sowerby was D.D.R., with his headquarters at Ismailia, and from 15th October Captain Thornhill (115th Company) was in charge of construction and maintenance.

In August a detachment of the 116th Company relaid part of the Port Said-Mahamdiyah light railway where the sea had eroded the sand spit, and in September, when the 53rd Railway Troops Company took over operation, rejoined its unit. Headquarters

of the 115th and 116th Companies moved eastwards as the main line progressed, reaching El Arish on 25th January. Construction was generally uneventful, but in the heat of the summer was arduous in the extreme. On 11th November, 1916, it was decided to lay out more sidings at Romani, involving the moving of the main line southwards, where formation work was heavier than in most sections, in order to avoid the entrance to Romani. On 4th December, the 115th Company lost two sappers killed and twenty-four injured, when a works train was derailed after colliding with a camel convoy walking along the track.

On 8th November the 274th Railway Company reached Qantara from England and thereafter assisted in controlling and operating the main line. As the railway extended eastwards more rolling stock was needed and most of this was supplied by the E.S.R. The supply of suitable locomotives was exhausted in the autumn and more were demanded on the War Office; four, the first of many from England, reached Qantara in mid-December, 1916.

In August, 1916, the G.O.C., No. 3 Section, ordered the extension of the 6-in. Qantara-Romani pipe-line to Bir el Abd to expedite railway construction, pending the laying of the 12-in. line. The E.-in-C. did not favour the project and regarded it as a diversion of effort. There were many difficulties and it was not until November that the line was in satisfactory operation as far as Oghratina, but its need had almost passed.

THE MAHAMDIYAH CONDENSING PLANT

This plant, finished in July, 1916, continued to give much trouble in various ways. Sand continued to clog the intake and in November one of the pumps had to be replaced owing to a mechanical defect. After considerable difficulties the intake sump was deepened in October and November, but when the plant eventually began to operate the circulating pump had to be repaired. Not until early in December was it all working satisfactorily and producing 740 gallons per hour, but by this time the 12-in. pipe-line was in operation, and the plant was then useful merely as a stand-by.

WORK OF FIELD UNITS AFTER THE BATTLE OF ROMANI

After the Battle of Romani the divisional engineers of the 52nd Division were employed in the Romani, Mahamdiyah and Qatiya

areas on defences, camp services, hutting for the new G.H.Q. of No. 3 Section, airfield work, digging wells and installing storage at the water sidings at Qatiya. On 11th September the two field companies—2/1st and 1/2nd Lowland—in the Rabah Qatiya area were relieved by the 42nd Divisional R.E. and returned to Romani with their respective infantry brigades. Until the final advance on El Arish began in October the 52nd Division companies were engaged on the Romani defences, including a large new redoubt, water supply and miscellaneous services.

At the end of August the 42nd Division was at Romani, where the 1/3rd East Lancs. Company was supervising the work of the E.L.C. on the defences, and also those at Dueidar. By 11th September the infantry brigades and most of the divisional R.E. had relieved the 52nd Division east of Qatiya, where the 1/2nd and 1/3rd East Lancs. Companies sank forty-six more wells before the end of the month, and a detachment of the 1/1st Company installed 130,000 gallons (nominal) storage in canvas tanks at the water siding. The rest of this unit made a road with salt-marsh sand on brushwood and palm leaves from Romani to Qatiya. Early in October water difficulties compelled the reduction of the force at Oghratina and the 42nd Division moved back to Mahamdiyah and Romani, except for the 1/2nd East Lancs. Company and some 1,500 E.L.C. on water supply work. During the month a strong detachment from all three companies under Lieutenant J. M. L. Bogle (1/1st Company) made an extensive reconnaissance in the interior but found no appreciable quantities of water.

REORGANIZATION OF THE E.E.F.

In August, 1916, as the situation in Sinai was relatively quiet and internal affairs in Egypt were demanding more of his attention, General Murray decided to transfer G.H.Q. from Ismailia to Cairo. This move was delayed until the middle of October. A new corps headquarters was formed at Ismailia to direct operations on the eastern frontier and all troops east of the Suez Canal became the Eastern Frontier Force, more usually known as "Eastern Force." Lieut.-General Sir Charles Dobell was appointed to the command and Brigadier-General E. M. Blair became Chief Engineer. On 7th December, most of the troops in No. 3 Section, Canal Defences, were formed into a new mobile force, known as the "Desert Column," under Lieut.-General Sir Philip Chetwode. Its headquarters opened at Mazar as soon as this point was reached by the

railway, and Lieut.-Colonel Waller, C.R.E., 52nd Division, was appointed Chief Engineer.

Other consequential changes in organization were made. In October G.H.Q., E.E.F., absorbed H.Q., L. of C. in Egypt, and the appointment of I.G.C. lapsed, the D. of W., Brigadier-General Paul, dealing direct with the D.Q.M.G. In November a further change in engineer organization occurred when the E.-in-C. became adviser to the C.-in-C. on all engineering matters directly connected with active operations on both frontiers, while the D. of W. was responsible not only for the supply of stores to both fronts and to other theatres, including Salonika, but also for all engineer services of construction and maintenance in the Alexandria and Delta districts. The A.D.W., Sharqia Province was, however, placed at the disposal of the C.E., Eastern Force, although his office remained in Cairo. This was an unsatisfactory arrangement because Lieut.-Colonel Close was virtually subject to dual control and because it was unduly restrictive of the functions which the D. of W. could usefully fulfil. The latter was gradually called upon to take over more work in the operational areas.

On 24th November, 1916, the E.-in-C. urged that a single officer (Brigadier-General Blair was recommended), working under the G.O.C., Eastern Force, should be in charge of all water supply works from Qantara West to El Arish, and this was agreed.

Early in December, as a result of an Army Council decision, the E.-in-C. became responsible for all works affecting operations, accommodation and communications, other than railways, both in the forward areas and on the L. of C. The D. of W. then came directly under the E.-in-C., but the anomalous position of the A.D.W., Sharqia Province, still remained unchanged.

WORKS AT QANTARA

With the advance into Sinai, Qantara became increasingly important as the point from which the railway and the pipe-line to El Arish started and at which reinforcements, stores and supplies for most of Eastern Force were assembled and dispatched.

The traffic and locomotive branches of the railway were at Qantara and the 53rd Railway Troops Company, with detachments of the 115th and 116th Railway Companies, extended the standard- and metre-gauge lines into the sorting yards of the pipe depot on the east bank and adapted ballast wagons and 30-ton flats for the

transport of the pipes. When the railway reached El Arish, more sidings were built at Qantara to cope with increased traffic. Major Pitcairn was still in charge of water stores, and under his direction special workshops for adapting the screw threads of the water pipes were built and equipped. The Canal Company built a timber-pile wharf adjoining the pipe depot at which ocean-going ships could discharge their cargoes direct.

Other work at Qantara was largely executed by the 5th R. Monmouth., and included workshops, water supply, wharves, chain ferries, a hospital-ship pier, three bridges (including a heavy pontoon) over the Sweetwater Canal and accommodation of all kinds. In November, storage for 40,000 gallons was erected, and distribution arrangements made for the rapid filling of water trains. On 18th August a detachment of the 46th Advanced Park Company had been ordered to move to Qantara to facilitate the issue of stores in No. 3 Section.

THE EL ARISH PIPE-LINE

The first cargo (4,500 tons) of water pipes and fittings from the U.S.A. for the Qantara-El Arish 12-in. pipe-line reached the Suez Canal safely on 23rd September, 1916, having had special naval protection against submarines through the Mediterranean, and was unloaded by 7th October. America had been unable to supply in time the original demand for 60 miles of 12-in. and 30 miles of 10-in. pipes, and instead 100 miles of 12- to 8-in. pipes were sent—the increased mileage allowing for certain sections to be laid in duplicate. The first consignment comprised 12 miles of 12-in. pipes, the remainder being 10-in.

The 96-mile pipe-line was to deliver water, filtered at Qantara, to El Arish and it was divided into four sections, each having a pumping station capable of maintaining a working pressure of 250-ft. head, and storage reservoirs of 500,000 gallons to act as reserve supplies in an emergency. The four sections, their lengths and the dates of putting each into service were as follows :—

	<i>Miles</i>	<i>Operating from</i>
Qantara-Romani	25	19th November, 1916
Romani-El Abd	22	1st December, 1916
El Abd-Mazar	23	11th January, 1917
Mazar-El Arish	26	5th February, 1917.

Pipe-laying began on the first section on 5th October (before unloading of the first cargo had been completed) and, as construction followed a similar procedure throughout the work, a brief description of the successive phases on this section can be taken as typical of the whole.

A small survey party first chose and marked the alignment, generally following that of the standard-gauge railway except where the necessity for negotiating bends with straight pipes led to a divergence from the sharper curves. The formation party, containing 1,500 E.L.C., followed, grading the pipe-bed and forming embankments or cuttings as necessary. Formation work was light for the first fifteen miles, but the next ten miles through sand dunes to Romani required heavy filling and excavation on banks and cuttings up to twenty-two feet above or below ground level. Later an even more difficult section was met for ten miles beyond Salmana, where the dunes were often eighty feet above the formation. Time did not allow of the pipes being laid in trenches, but as a width of seven feet was needed as working space for the jointing parties, the total excavation and fill was very large.

The pipe-trains, with travelling gangs containing 150 E.L.C. for handling the pipes, usually consisted of ten 30-ton flats, and carried 500 12-in. pipes (220 tons) or larger numbers of smaller diameters. One train load of 12-in. pipes represented nearly two miles of pipe-line. Where the railway was close to the alignment the E.L.C. rolled the pipes off the trains as required, but elsewhere the pipes were off-loaded at the section concerned, stacked and hauled by tractor to the pipe alignment. Except between north of Dueidar, where the metre-gauge railway was more convenient, the standard-gauge line was used for distribution.

The screw-jointing process followed, carried out by 250 Egyptian artificers and labourers, divided into twelve parties, equipped with tripods and pipe-tongs for turning the pipes. Work was carried on simultaneously over some eleven miles of pipe-line, each pair of gangs working away from each other over a two-mile section. A small coupling party with its tools and equipment carried on a tractor then joined the various screwed sections together with special connectors, which also acted as expansion joints. Finally covering parties of some 500 men closely followed the screwing gangs and covered the empty pipes with three feet of sand to protect them as far as possible from the evil effects of widely varying temperatures.

In addition, some 500 E.L.C. were employed at the pipe depot

at Qantara, and all these parties were supervised by R.E. officers or N.C.Os. The work was organized and administered by Captain (later Major) F. W. Stephen, assisted by three officers and sixteen other ranks. During the second half of the construction from El Abd to El Arish, eighty all ranks, R.E., some 770 European and Egyptian foremen and tradesmen and over 2,300 E.L.C. were engaged; these totals include operating personnel on the "live" sections but not the labour force on the reservoirs and pumping stations. Supervision, administration and supply of the various parties, which were often widely separated and constantly moving, presented many difficulties, especially when the pipe-line was not near the railway. Animals were the only means of transport, but they were scarce, and on the second half of the line only 150 camels, sixteen horses and a few mules and donkeys could be spared for this purpose.

The pipes were of lap welded wrought iron, tested to 500 lb. per sq. in. and averaged nearly twenty feet in length. The diameters were nominal (e.g., some 12-in. were found to be 13-in.) and metal thicknesses varied considerably. As a result the 12-in. category alone included eleven different sorts of pipe. There was no time to sort by thicknesses as well as by diameters and consequently many pipes had to have their threads re-cut; even then considerable difficulties were met in obtaining satisfactory joints with the screwed collars. The 12-in. pipes weighed $\frac{1}{2}$ ton each, and special appliances were needed to turn them during jointing. An additional handicap was the dearth of screwing machines, one only having been received instead of the five originally demanded.

Although expansion joints had also been demanded, none was received. This would not have mattered had the pipes been uniform, as the screwed joints would then have been strong enough to withstand the stresses imposed by temperature variations. In the circumstances some provision had to be made and the connectors joining successive 2-mile lengths of pipe were made or adapted locally to act also as expansion joints. Valves and T pieces were also fitted at the points of connection. The first type of expansion joint was complicated, with a stuffing box and gland, but later a simpler, sleeve type with hydraulic packing was found equally effective. After the initial troubles, these were placed at roughly 1,000 yards apart, and at this spacing no drawn joints occurred, even when the pipes were not covered. As soon as pipe-laying started the General Staff began to press Brigadier-General Blair, C.E., No. 3 Section,

Canal Defences, and in charge of the work, to expedite construction to the utmost, and to this urgency some of the early troubles were due. When all the 12-in. pipes in the first consignment had been laid, instead of waiting for more of the same diameter in the next cargo, 10-in. pipes were used to complete the Qantara-Romani section, in spite of the resulting reduced delivery. Progress was slow, the E.L.C. parties (especially the screwing gangs) being largely untrained, and little more than half a mile of pipes was laid daily. Some of the joints were badly made. The standard and the speed of laying, however, improved with experience, and on the second section to El Abd nearly two miles were laid daily.

At the instance of the General Staff testing on the first section began over a fourteen-mile stretch on 10th November. Owing to defects in three of the four new settlement tanks at Qantara no fresh water was available and sea water was used, although this led to more work in cleaning out subsequently. In all twenty-five drawn or badly leaking joints were disclosed in the first section to Romani, but repairs were quickly made and by 19th November the new pumping plant at Qantara had been used to wash out the pipe-line, and water was being delivered to the Romani reservoirs. This represented a few days' delay and aroused considerable indignation on the part of the G.O.C., Eastern Force. The repair of the settlement tanks occupied several weeks but in the meantime Mr. W. H. G. Morris of the Cairo Water Company devised and constructed emergency settlement arrangements by laying a series of the 24-in. diameter pipes. These were tested, with satisfactory results, on 8th November. Their daily output was 250,000 gallons (i.e., half the quantity required) but, used in conjunction with the single round tank, 350,000 gallons of filtered water were being delivered daily by the 17th. The 5th R. Monmouth. operated the new filtration and pumping plants, and was also put in charge of the maintenance of all pipe-lines in No. 3 Section as far as Romani and of the pipe depot, stores and workshop at Qantara. A new water siding was laid near the Romani reservoirs where water trains were filled from stand-pipes, and the troops and labour force at and beyond railhead, then over fifty miles to the east, could now be supplied with water from Romani instead of from Qantara by rail. Considerable relief was thus afforded to the railway.

On 1st November General Murray asked the War Office to send to Egypt a water engineer of the highest standing to advise upon the water system generally for, although the R.E. were executing

the work to his satisfaction, his operations in Sinai were so dependent upon the pipe-line that he wished to ensure that the work was being carried out in the best and most economical manner. On the 12th Mr. E. Sandeman, an eminent water engineer, left England for this purpose. His departure coincided with a request from General Dobell, G.O.C., Eastern Force, that if a pipe-laying expert were available in Egypt he should be placed at his disposal temporarily in an advisory capacity. This request seems to have been due to the delay in the opening of the new pipe-line to Romani, which Brigadier-General Blair had estimated would take place on 8th November. Pending Mr. Sandeman's arrival and because of the defects and delays which had occurred, General Murray instructed the E.-in-C., and Colonel Macdonald, to inspect the works and submit an interim report. The E.-in-C. at once wrote a reasoned defence of Brigadier-General Blair's conduct of the works and suggested that a special adviser could not help matters at this stage. The joint report, in considerable detail, followed on 20th November. With regard to the defects, the E.-in-C. and Colonel Macdonald considered that the settlement tank trouble had caused no unreasonable delay and that the joint leakages were no more than were to be expected in the circumstances. They disapproved of the 6-in. pipe-line east of Romani and of the 4-in. main then being laid from the Mahamdiyah to Romani and recommended that the Mahamdiyah condensing plant should be regarded merely as a stand-by. The C.-in-C. regarded this report as satisfactory.

Mr. Sandeman's inspection of the Canal Zone and Sinai was made at the end of November and his very comprehensive report, dated 21st December, stated that the works had been well executed and that the results, considering the circumstances, were admirable. He considered the Qantara-El Arish system to be generally well designed, and believed that, in spite of the minor hitches which had occurred, it would prove efficient if his recommendations on a few points of detail were adopted. He considered that the rate of progress on the pipe-line was entirely satisfactory in the circumstances. He recommended certain administrative and minor practical measures, mostly in the Canal Zone, and almost all of these were taken within a short time.

These reports amounted to a vote of confidence in the Royal Engineers, and it is of interest to note that never again during the campaign was there a suggestion that civil advisers should be appointed, or that engineer services were of unsatisfactory design

or execution, or that the latter led to delay or hindrance to operations.

Meanwhile, the Romani pumping station and the reservoirs and pumping station at El Abd, which had been started in October at the terminal of the second section, were finished at the end of November. The second cargo of 1,500 tons of pipes from the U.S.A. arrived at Qantara during October and the 22-mile section from Romani to El Abd was laid with $11\frac{1}{2}$ miles of 12-in. pipes and the rest with 10-in. On test only eight defective joints were found—a considerable reduction as compared with the first section—and on 1st December the Romani plant began to deliver water to El Abd, forty-seven miles from Qantara. Work on the formation was well in advance of pipe-laying and was by this time nearing Mazar, the end of the third section. Operation of the additional pumps and maintenance of the rapidly extending pipe-line were undertaken by the 5th Company R. Monmouth.

Two reservoirs, spaced apart to reduce risk of damage from air attack, were built at each of the three desert stations. Of 250,000 gallons capacity, they were of similar design, being 66 ft. square by 9 ft. deep internally, and built in reinforced concrete for which 5,000 tons of cement, coarse aggregate and steel were brought by rail from Egypt. The desert supplied fine aggregate on site, although it was not of good quality. The roofs and walls were covered with sand, revetted with scrub to prevent drifting, in order to render them less conspicuous from the air but, owing to shadows, full concealment was impossible. Similar treatment was applied to the pumping stations, which were also built in pairs, each with a 66-H.P. oil engine and a 5-in. centrifugal pump with a nominal delivery of 27,000 gallons per hour, against a head of 250 ft. Reservoirs, mains, pumping sets and water sidings were cross-connected for direct and indirect filling of water trains and for changing over from one set to another. The reservoirs were designed and built by Messrs. Rollin, a Cairo firm of reinforced concrete specialists. Construction of the pumping stations was also by contract, and for both reservoirs and pumping stations an average labour force of 300 men, mostly Egyptians, supervised by one officer and six other ranks, R.E., was employed.

The third consignment (2,000 tons) of American pipes was not due to reach Qantara until early December and even then there would not be sufficient to reach Mazar, the end of the third section of twenty-three miles. It was therefore necessary to decide, a month

in advance, whether to complete this section with 8-in. pipes, with an appreciable reduction in capacity, or to await the arrival of the fourth and last cargo with the requisite 10-in. pipes. On 10th November the C.-in-C. decided, in the interest of speed, to adopt the first alternative. The section was laid with 7 miles of 12-in. pipes, 14 of 10-in. and 2 of 8-in. Progress was slower (only three-quarters of a mile per day) owing to the late arrival of the third consignment (which was not cleared until 15th December), shortage of rail lift due to the resumption of the El Arish advance and two breaks. Water did not begin to reach the Mazar reservoirs until 10th January, 1917, three days behind schedule. The last cargo of pipes (1,500 tons) reached Qantara at the end of December, but, as it was not used until the following year, the completion of the pipe-line to El Arish will be described in the next chapter.

The following are the technical details of the pipe-line, including the additions made in 1917 :—

PUMPING STATIONS

Qantara

Settlement tanks (west bank).—Four circular R.C. tanks each 32,000 gallons with concentric waterways.

Filters (west bank).—Ten vertical, mechanical gravity Jewell type filters, 86 in. diameter. Combined net delivery— $\frac{1}{2}$ million gallons per day, increased later by additional filters to $1\frac{1}{4}$ million gallons per day.

Suez Canal Siphons.—Three 6-in. pipes, increased later.

Storage (east bank).—Two masonry reservoirs, each $\frac{1}{4}$ million gallons.

Pumps (east bank).—Two 66-H.P. Hornsby oil engines with 5-in. Rees Rototurbo pumps, each giving 27,000 gallons per hour at 1,400 revolutions against 250-ft. head. Replaced later by two 90-H.P. Blackstone oil engines. One Pearn triple ram pump was installed giving 24,000 gallons per hour.

El Abd

Storage.—Two R.C. reservoirs each $\frac{1}{4}$ million gallons.

Pumps.—Two 66-H.P. Hornsby engines with two 5-in. Gilkes centrifugal pumps giving 27,000 gallons per hour at 1,200 revolutions against 250-ft. head.

Mazar

As for El Abd.

El Arish

Storage.—Two R.C. reservoirs each 125,000 gallons. Three R.C. reservoirs (two at Rasum) each 250,000 gallons were added later.

Pumps.—Four 5-H.P. Petter engines with three-throw Evans pumps, each giving 2,000 gallons per hour against 300-ft. head. Two were replaced later by one 66-H.P. Hornsby engine and four Hayward-Tyler Duplex pumps giving 30,000 gallons per hour.

Zowaiid

Storage.—Canvas tanks total 12,000 gallons. Delivery from El Arish was 80,000 gallons per day.

Pumps.—A 20-H.P. Tangye oil engine with 4-in. Gwynne centrifugal pump giving 5,000 gallons per hour, a 20-H.P. Ruston Proctor engine with similar pump was added later.

Rafah

Storage.—Two R.C. reservoirs each 100,000 gallons. Four more each 250,000 were added later.

Pumps.—Two 20-H.P. Blackstone engines with 4-in. Gwynne pumps each giving 5,000 gallons per hour. A third Blackstone engine with Warner pump was added later.

Abu Khatli

Storage.—Six brick-lined cisterns total 50,000 gallons.

Pumps.—One 25-H.P. Crossley and one 25-H.P. Winterthur oil engine with Gwynne pumps.

PIPE SIZES AND LENGTHS

Section of Line	Length in Miles						Total
	12-in.	10-in.	8-in.	6-in.	5-in.	4-in.	
Qantara-Romani	12	13	—	—	—	—	25
Romani-El Abd	12	10	—	—	—	—	22
El Abd-Mazar	7	14	2*	—	—	—	23
Mazar-El Arish	2	7	17*	—	—	—	26
El Arish-Zowaiid	—	—	—	14	5	1†	20
Zowaiid-Rafah	—	—	—	—	—	9†	9
Rafah-Abu Khatli	—	—	—	3	5	4†	12
Abu Khatli-Abu Bakra	—	—	—	—	8	—	8
Abu Khatli-Imara (E. of Shellal)	—	—	—	9	—	—	9
	Total						154

* Replaced later by 10-in. pipes.

† These were twin 4-in. pipes, replaced later by single 6-in.

In the original installation the total weight of pipes and machinery was 10,000 tons, the total horse-power about 700 and the storage 2 million gallons. The working pressure was 250-ft. head. When the capacity was increased in 1917, the additional weight of pipes and machinery was 3,000 tons. The total horse-power was increased to 1,500 and the storage to 4 million gallons. The working pressure was increased to 560-ft. head as far as El Arish.

The initial 6-in. pipe-line eastwards from Romani, started in August, 1916, continued to give trouble. It eventually operated for thirteen miles, but was discontinued and the pipes salvaged in February, 1917, owing to the progress of the main pipe. The 7 miles of 4-in. pipe-line from Mahamdiyah to Romani, also ordered by the G.O.C., No. 3 Section, in August, 1916, made slow progress owing to shortages of almost every requisite except pipes. It was eventually finished in December, but having been condemned by both the E.-in-C. and Mr. Sandeman was abandoned and its material salvaged in January, 1917.

THE OCCUPATION OF EL ARISH

The final advance on El Arish, preceded by a raid on Mazar, began early in October, 1916, but the movement was deliberate in order not to out-distance railway construction. As part of the policy of keeping the interior of Sinai under control, another raid was made soon after the advance began, this time against Bir el Maghara, fifty miles south-east of Romani. It was accompanied by the C.E., No. 2 Section, Canal Defences (Brigadier-General J. R. Young), the C.R.E., 54th Division (Lieut.-Colonel Hawksley) and a composite R.E. detachment under Major Cooke from the 1st Welsh Field and 14th Army Troops Companies. This operation extended over several days and the R.E. detachment watered the raiding force at wells on the route.

The methodical advance on El Arish was uneventful and the life of the troops was monotonous and arduous. Water supply preparations were extensive. Temporary storage for over 60,000 gallons was erected at Salmana, reinforced concrete tanks for 36,000 gallons being ordered on 24th November at El Abd and for 42,000 gallons at Mazar. Transport was collected for use should local supplies at El Arish prove inadequate. As, however, the 12-in. main was supplying 500,000 gallons and the 6-in. to Romani 120,000 gallons daily, there was actually nearly 50 per cent surplus to requirements (El Arish force nearly 200,000 gallons, the L. of C.

50,000 gallons and the railway up to 150,000 gallons daily) at the beginning of December.

The advance was led throughout by the Anzac Mounted Division, to which the 5th Mounted Brigade and the 7th Field Troop, R.E., were attached from 28th October to 25th November. A detachment of the 7th Troop remained with the Anzac Field Squadron during December and was among the first British troops to enter El Arish when it was eventually reached without opposition on the 21st.

The 52nd Division supplied the infantry behind the mounted troops. Its advance from Romani began on 7th October and proceeded by stages, with a fortnight's halt in the El Abd area during the latter part of October, and a somewhat longer period in the Salmana area during November. The next stage—an advance to Mazar—was postponed owing to water shortages, and in mid-November a smaller force, consisting of a brigade group of the 42nd Division, was sent instead. The field companies of the 52nd Division during this advance were mainly engaged on development of water supplies at each halting place for their respective brigade groups and a proportion of the divisional troops. Companies usually moved in two echelons, installing and picking up gear respectively, and at long halts unit equipment was replaced, as far as possible, by wooden troughs and *shadufs*. During November much supervisory work was also done on the defence works in the Salmana area. On the 24th Lieut.-Colonel L. F. Wells, promoted from a field company command in the 42nd Division, succeeded Lieut.-Colonel Waller as C.R.E., 52nd Division, on his appointment as C.E., Desert Column. On 1st December the main body of the 52nd Division resumed its advance to Mazar, where, on arrival, the 1/2nd and 2/1st Lowland Companies worked on water supply, defences, wire roads and camp services.

The 156th Brigade and the 2/1st Lowland Company reached El Arish on 22nd December and the rest of the 52nd Division followed shortly afterwards. In little over a week the three field companies sank seventeen wells (mostly shallow), put down three spear-points, developed a native well and erected storage for 25,000 gallons, the division's needs being more than met by this work.

The 42nd Division took over the defences and other works in the Romani area early in October. The 1/1st East Lancs. Company and 1,500 E.L.C. completed the outer defences, began the inner position and erected storage for 11,500 gallons at the water dump near Qatiya. The 1/2nd Company was on water duty during

November, but at the beginning of December moved to El Abd to work on the defences there. The 127th Brigade and the 1/3rd Company moved to Mazar on 15th November, followed by the rest of the division on the 23rd. The 42nd Division spent December east of Mazar, where the water dump was extended and many shallow wells were sunk. The field companies also found time for a certain amount of training.

THE AFFAIR OF MAGDHABA

On their withdrawal from El Arish the Turks fell back along the coast to Rafah and inland to Magdhaba, twenty-five miles south-east of El Arish. While R.E. units generally were developing the water supplies around El Arish, the Anzac Mounted Division and the Imperial Camel Corps Brigade marched by night up the Wadi El Arish and attacked Magdhaba at dawn on 23rd December. A sharp engagement resulted in a substantial British success. Nearly 1,300 Turks were taken prisoner, and the enemy then withdrew from the rest of Sinai. The R.E. engaged included part of the 7th Field Troop with the Anzac Division, and a small party with the Camel Brigade. An extensive system of defences was begun at El Arish.

Thus by the end of 1916, although it was not yet possible, for supply reasons, to follow the enemy's withdrawal along the coast, the Sinai peninsula was virtually clear and General Murray's plan for securing the defence of Egypt's eastern frontier and of the Suez Canal by establishing a force in the El Arish area had been achieved. The phase of passive defence had passed, but active defence had hardly been begun when the British Government began to contemplate an offensive into Palestine. The development of this plan must be left to the next chapter, and before describing it some references must be made to the Arab Revolt, the organization of the L. of C. across Sinai and works in the Canal Zone during the latter half of 1916.

THE ARAB REVOLT

Although no R.E. unit was engaged with the Arab army in the Hejaz, considerable British support was given to its operations and among the British officers who took part in them were one or two from the corps. Lieut.-Colonel S. F. Newcombe, who for much of 1915 had been in the Intelligence Branch at G.H.Q. in Cairo, and for over a year subsequently had been C.R.E., 2nd Australian

Division, was sent to the Hejaz in December, 1916. To anticipate the course of events he took part in several raids, including one with Major W. A. Davenport in July, 1917, when the Hejaz Railway was attacked 140 miles north of Medina, while Lieut.-Colonel T. E. Lawrence was taking Aqaba. Three miles of track were destroyed on this occasion. Much demolition work was carried out during the Arab army's operations. The most efficacious method of damaging the railway was found to be placing charges under sleepers, which not only cut them but distorted the rails as well. Lieut.-Colonel R. E. M. Russell devised charges with electric contact makers which were used effectively against trains in 1918. Bridges were usually of small span and some very rapid demolitions were effected.

THE SINAI L. OF C.

Due to the changed strategic situation and the extension of the L. of C. to El Arish, the three Canal Defences Sections were reduced to two—Northern and Southern; the first was extended to Romani and, after the occupation of El Arish, to Mazar. Lieut.-Colonel L. N. Cooper was appointed A.D.W., Northern Canal Section, exclusive of the main-line railway and the El Arish pipe-line.

Defence of the L. of C. was assured by transferring in September, an armoured train to operate on the Qantara-Qatiya section and, later, by bringing forward another infantry division from the Canal Zone to the Romani area, where, incidentally, it could be intensively trained for desert warfare. The 53rd Division was chosen for this duty and began to move from the canal at the end of November, its field companies being reorganized with camel transport on the way to Ferdan. The 160th Brigade with the 2/1st Cheshire Field Company reached El Abd at the beginning of December, the water dump being taken over from the 1/3rd Lancs. Works Company. The 159th Brigade and the 2/1st Welsh Field Company, which had reached Dueidar, moved to Mahamdiyah at the same time, but the 158th Brigade and the 1/1st Welsh Field Company remained at Ferdan West until early in January, 1917. The leading field companies did a considerable amount of work on water supply, defences and roads during December, and also took part in the divisional training exercises. On 16th December the 2/1st Cheshire (less one section) moved to Mazar and laid a wire road from there eastwards.

Other R.E. units were engaged on general works on the L. of C.

The 5th R. Monmouth. in addition to its work on the operation of the El Arish pipe-line, was in charge of the expense store at Romani during August, and erected hospital hutting and R.F.C. hangars in November and December. The title of this unit was changed to the 5th (Siege) Company, R. Monmouthshire R.E. towards the end of the year. The 1/3rd Lancs. Works Company moved up from Qantara early in December and on the 8th took over the Romani stores. On the 12th it took over all water supply work on the L. of C. (exclusive of the main pipe-line) east of Romani from the 2/2nd Lowland Field Company and continued on this duty, together with roads and other services, until the end of the year. The 220th Army Troops Company arrived from the Canal Defences during December, and was engaged on ammunition dumps at Mazar, water supply to the El Abd defences and a new headquarters for the Desert Column. The Topographical Section followed closely behind the leading troops to El Arish, extending the Sinai triangulation by small survey parties escorted by cars armed with machine-guns.

THE CANAL DEFENCES, AUGUST TO DECEMBER, 1916

The changed circumstances greatly reduced the work still to be done in the Canal Zone and also the resources to do it, but nevertheless a considerable amount of construction was carried out in the latter half of 1916. In August and September $7\frac{1}{2}$ miles of 2 ft. 6-in. railway was built from El Shatt to Ayun Musa through Quarantine, bringing the mileage of light railways (excluding sidings) in the Canal Zone to 86. In August passive air defence of the oil tanks at Suez was strengthened by constructing banks and drainage ditches to divert waste or burning oil from the docks. In October pipe drainage was substituted to enable the Canal Company's reclamation works to be extended. Various piers notably that at Quarantine, and wharves were extended in the autumn. The number of bridges in operation was reduced to five exclusive of those at Qantara, and more reliance was placed on ferries. From September onwards E.L.C. maintained the front-line defences, and economy of materials, especially timber, was imposed. The work of field companies was reorganized so that they could move at short notice. By the end of the year 400 miles of roads had been built but, although more were needed, shortage of came

transport limited new work to a road from Ballah through Hod el Aras to Qatiya. In December nine defence posts in the Southern Section were abandoned but in the Northern Section the outer defences and bridgehead at Ballah were retained. The Tel-el-Kebir camp was to remain a transit camp, but if heavy demands for hutting elsewhere arose, removal was authorized. In January, 1917, as a result of several representations by the E.-in-C., approval was given to discontinue pumping to maintain the inundation level at Lake Timsah, resulting in a saving of some £800 monthly.

Turning to the work of individual units, the 9th Field Troop moved with the 8th Mounted Brigade to Ayun Musa in August, 1916, and came under command of Lieut.-Colonel A. W. Stokes, C.R.E., 54th Division, No. 1 Section, for works and training. Early in September a column of this formation, accompanied by a detachment of the 2/1st E. Anglian Company, occupied an advanced post ten miles east of Suez. Defences were constructed and the 9th Field Troop built an artillery road in connection with them, before leaving in November with the 8th Mounted Brigade for Salonika.

The 2/1st and 1/2nd E. Anglian Field Companies of the 54th Division were largely occupied with maintenance of the defences, which were continually being filled with drifting sand, and of hutting, whose matting was frequently stripped by high winds. The 1/1st Kent Field Company was similarly engaged. On 27th August the section left in the Wadi Natrun rejoined, and between 14th and 21st a small party accompanied a desert column from Kubri, losing two men killed and two wounded in a brush with the Turks. From 3rd to 9th October a detachment of the 2/1st E. Anglian Company accompanied another column on a long reconnaissance. All three field companies by this time were at full strength and completely equipped, except for pontoon equipment.

On 23rd September, 1916, the appointment of C.E., No. 1 Section, lapsed and Brigadier-General E. H. Bland left for England. Lieut.-Colonel Stokes then became the senior engineer officer and, when the 53rd Division left for Romani, he became responsible for No. 2 Section as well. The 1/2nd E. Anglian Company gradually took over the whole of No. 1 Section, as No. 10 Company, Sappers and Miners, left El Shatt on 3rd November for Salmana. On 13th November 2nd Lieutenant Mendham and a detachment of the 1/2nd Company accompanied a desert column on a long reconnaissance and watered the force. In December a decauville line 10 miles long was laid to the new post east of Suez, and although some heavy earthwork

in cutting was involved, it was completed on 14th January, 1917. This line brought the total mileage of light railway in the Canal Defences to 105½.

In August No. 2 Section was garrisoned by the 53rd Division. The 1/1st Welsh Company at Ferry Post railhead and Ferdan was engaged on defences, hutting, water supply and, with E.L.C. labour, road repairs and miscellaneous works. The 2/1st Welsh Company was similarly occupied at Serapeum, Tussum and Deversoir. In September a combined detachment from both companies accompanied a column to develop water supplies ten miles eastward for use in future desert raids. On the 27th all work on forward hutting was stopped, but, until the 53rd Division left for Sinai in November, work continued much as before on other services. On 23rd October the appointment of C.E., No. 2 Section, lapsed; Brigadier-General J. R. Young, who had been appointed in August, left and Lieut.-Colonel R. P. T. Hawksley, C.R.E., 53rd Division, became the senior engineer officer. The third field company of the 53rd Division—the 2/1st Cheshire—arrived at Moascar from the Fayum on 6th November.

The 53rd Divisional R.E. began to leave for Sinai on 19th November; the 1/1st Kent Company took over the defences and hutting at Serapeum and the 2/1st E. Anglian Company did the same at Ferry Post and Ferdan. Both companies continued defence works and hutting until the end of the year.

The 14th Army Troops Company was engaged from August to December on maintaining all water supply works, surveying the forward defences and building roads and shelters at Ferry Post and Serapeum. In September it completed a new 20-ton heavy bridge over the Sweetwater Canal at Serapeum West and carried out other bridge construction and maintenance tasks. The 220th Army Troops Company at Ferdan and Ballah was engaged on similar work. It also built a relay pumping station at Ferdan railhead, constructed two new camps and did much miscellaneous work before it left, less one section at Ballah, for Mazar on 7th December.

The 1/3rd Lincs. (Works) Company moved to Ballah and Qantara from Serapeum on 27th July. It laid a decauville track and pipeline from Ballah railhead to Hod el Aras, eight miles away, before leaving for Romani on 7th September. The 5th R. Monmouth., in addition to the work described elsewhere, maintained and operated two heavy pontoon bridges and several barrel-pier bridges at Qantara, continued the defences, hutting and water supply for the

defences and carried out much other miscellaneous work, including repairing locomotives on the metre-gauge railway.

The E.S.R., under Colonel Macauley, continued to render valuable service to the E.E.F. In Egypt five hospital and ambulance and four troop trains, fifty passenger coaches and 1,200 wagons were continuously operated for the army and at one period 10 per cent of all the wagons owned by the E.S.R. were on military work. Thousands of seats were reserved daily for soldiers. During the year 2½ million troops (including sick and wounded), 274,000 animals, 28,000 guns and vehicles and nearly 1½ million tons of stores and ammunition were transported by the rail. The dispatch of locomotives and rolling stock to Sinai had considerable, but not unduly serious, effects upon the civilian services in Egypt and the increased mileages run by the remaining stock led to more repair work. Nevertheless the railway workshops, particularly those near Cairo, undertook much other work, including the construction and repair of weapons and vehicles.

SUMMARY OF ENGINEER WORK DURING 1916

Before describing the preparations which began early in 1917, it is appropriate to summarize the works completed during 1916, which enabled an active defence to be substituted for the close defence of the canal and formed the solid foundation on which General Murray's successor was to base his victorious campaigns in Palestine and Syria. A few statistics best illustrate the scope of the works. Incorporated in defences or transported to forward works were, for example, 7,000 tons of plain and barbed wire; on the L. of C. 359 miles of railway, 203 miles of metalled roads and several hundred miles of wire and other roads had been constructed; 900,000 tons of stone had been quarried; and on the water supply systems nearly 300 miles of pipes up to 12-in. diameter had been laid and filtration plants with a daily output of 1½ million gallons and reservoirs holding 3½ million gallons had been built. The R.E. had been responsible for all work and had directly carried out much of it, but great assistance had also been rendered both in civil and military capacities by the E.S.R. and the Egyptian Ministry of Public Works. Nor could this great amount of work have been executed without the help of the Egyptian Labour Corps, which in the latter half of the year numbered well over 20,000 men in the Egyptian theatre.

CHAPTER XXIV

THE FIRST AND SECOND BATTLES OF GAZA

Minor operations, January to March, 1917—Reorganization of Eastern Force—Work of field units at El Arish, January to March, 1917—The El Arish pipe-line and its extension—Railway construction, January to April, 1917—Survey—Summary of engineer work, January to February, 1917—The first battle of Gaza, 26th and 27th March, 1917—Operations on 26th March—Operations on 27th March—The situation after First Gaza—The second battle of Gaza 17th to 19th April, 1917—Operations on 17th April—Operations on 18th April—Operations on 19th April.

(Map 5 and Sketch 7, facing page 292)

MINOR OPERATIONS, JANUARY TO MARCH, 1917

AN offensive in Palestine was first considered in October, 1916, but by the end of the year the policy had been changed to one of defence, and activities on the eastern front were confined to minor operations and organization of communications. On 11th January, 1917, the C.I.G.S. informed Lieut.-General Murray that any large scale operations must be deferred until autumn as he must be prepared to release one or two divisions for France, and instructions to send one followed a week later. Nevertheless, General Murray investigated plans for operations which would be useful preliminaries to an autumn offensive. His restricted resources limited such potential action to the capture of Gaza, twenty miles north-east of the Palestine frontier and the gateway to the plain of Philistia. Gaza was covered by the Wadi Ghazzee, a watercourse which entered the sea five miles south-west of the town.

After the occupation of El Arish, the Turks fell back gradually to a strong position west of Shellal on the Wadi Ghazzee and, although it was not possible to follow this movement in force until both railway and pipe-line had been extended, mounted troops raided Rafah on 9th January, 1917, taking 1,600 prisoners. Among the R.E. engaged were the 7th Field Troop with the 5th Mounted Brigade and a section of the 2/1st Cheshire Field Company with the Camel Brigade. The latter detachment had joined the brigade at El Arish from the 53rd Division on 27th December for water supply work,

and during January pumped nearly 230,000 gallons. Water supply during the return to Rafah after the raid was assured by establishing a dump at a half-way point which was filled by camel convoy from El Arish.

From El Arish onwards stretches of young grass, wild flowers and a few cultivated tracts made a marked and pleasant contrast to the drab monotony of the Sinai desert. Between Rafah and Gaza, inland from the coastal dunes, which were as wide as three miles in places, the slightly undulating country at this season was covered with grass and early crops not yet shrivelled by the summer heat. It was treeless, except for palms and olives at Khan Yunis and Deir el Balah, until Gaza was reached.

Early in 1917, Headquarters, Eastern Force, moved to El Arish and on 23rd February mounted troops, which included the 5th Brigade and the 7th Field Troop, made a reconnaissance of Khan Yunis, six miles beyond Rafah, causing the Turks to withdraw once more, and Khan Yunis was occupied by the Desert Column on 28th February. The 7th Field Troop was kept busy clearing Turkish wells and sinking spear-points and shallow wells. When, somewhat earlier, the Turks realized that the British advance was directed upon Gaza rather than against their rail communications through Beersheba, they reoccupied Nekhl and Bir el Hassana in Sinai. Towards the end of February British columns recaptured these places, the 6th Mounted Brigade and its field troop, R.E., forming part of the Nekhl column.

The Turks then began to organize their strong Shellal position, but when the British preparations to attack it early in March were observed, the enemy retired once more, this time some fourteen miles, to the Gaza-Wadi esh Sheria line just beyond the obstacle of the Wadi Ghazze. The supply position precluded an attack upon this position until the railway had reached Rafah, but preparations were begun.

REORGANIZATION OF EASTERN FORCE

The R.E. of the 42nd Division, which had been chosen as the formation to go to France, was busy throughout January, 1917, developing water supplies in the coastal region between El Arish and El Burj, excellent water being obtained from shallow wells on the beach itself, and existing native wells being cleaned and improved. The division entrained at El Arish for Qantara early in

February and on the 12th the divisional engineers moved to Alexandria, where the C.R.E., Lieut.-Colonel Mozley, rejoined from hospital. The 1/1st, 1/2nd and 1/3rd East Lancs. Field Companies were re-numbered the 427th, 428th and 429th shortly before they left Egypt for France.

The 53rd Division, which spent most of January training in the Romani-Mahamdiyah area, replaced the 42nd Division at El Arish at the end of the month, after a certain amount of work on roads and blockhouses on the way. The 54th Division in the Southern Section of the Canal Defences, equipped with camel transport, replaced the 53rd at Romani. It was then moved forward to El Arish, brigade groups spending a week at Mazar on the march, and completed its concentration at the end of February.

A new infantry division, the 74th, was formed in March from dismounted yeomanry, to compensate for the loss of the 42nd Division, its engineers being found from the independent companies in Egypt. The 496th (previously the 1/2nd Kent Field Company) joined at Khan Yunis on 26th March, and the 5th R. Anglesey and the 5th R. Monmouth, at Deir el Balah in the middle of April, the two last units having been reorganized as field companies. On 24th March Lieut.-Colonel R. P. T. Hawksley was transferred from the 53rd Division as C.R.E., his place being taken by Lieut.-Colonel F. R. H. Eustace from Western Force.

In January, as a result of the virtual end of the Senussi campaign, the increased number of mounted brigades available enabled these troops to be reorganized as two cavalry divisions—the Anzac and Imperial Mounted Divisions. The former included the 22nd Mounted Brigade with the 6th Field Troop, and the latter the 5th and 6th Mounted Brigades with the 7th and 9th Field Troops. These two troops soon afterwards were organized with the other field troops in the formation as the Imperial Mounted Division Field Squadron.

At the beginning of February, the Territorial Force field and army troops companies were given numbers to bring them into line with regular and New Army units, and these changes are shown in Appendix V. The 5th R. Monmouth, and 5th R. Anglesey Supplementary Reserve companies retained their titles.

In January it was decided to revert to wheeled transport in the case of the 52nd, 53rd and 54th Divisions, as being more suitable than camels for operations in Palestine. This change affected the field companies, but the process of bringing forward vehicles and animals from Qantara was a gradual one. In common with many

other units, some native drivers were retained on the establishment. The mounted sections of all the field companies had rejoined their units by early March.

WORK OF FIELD UNITS AT EL ARISH, JANUARY TO MARCH,
1917

The 52nd Divisional engineers were engaged for some weeks, mainly on water supply, in the El Arish area. The 1/2nd and 2/2nd Lowland Companies developed good supplies near the shore. The 2/1st Company regularly watered 7,000 horses and 13,000 camels in the Wadi el Arish and installed a pumping plant at the stone wells in El Arish itself. At the end of the month most of the 1/2nd Company moved to El Burj to take over the beach wells there from the 42nd Division. The 1/2nd and 2/1st Lowland Companies also laid wire roads at El Arish and El Burj, and on 23rd January the 2/2nd Company, with infantry and E.L.C. working parties, began an extensive system of defences covering El Arish. Similar work continued in February. More wells were dug inland and the beach wells gradually abandoned. Hutting for Eastern Force Headquarters was started by the same unit on 1st March and the 412th (previously the 2/1st Lowland) Company continued the El Arish-El Burj wire road, the outer defences at El Arish and the water supply in the Wadi el Arish until 5th March.

When the 53rd Division relieved the 42nd Division at El Arish, it took over the wells and developed others. The 437th Company moved to El Burj with the 159th Brigade, sinking over thirty new wells there. The 436th Company also laid $5\frac{1}{2}$ miles of wire road and built strong-points and machine-gun posts in the El Arish defences. The latter were taken over by No. 10 Company, Q.V.O. Sappers and Miners, on 21st March, and before long this unit was supervising 10,000 E.L.C. on their construction.

On 20th February the 53rd Division moved to Sheikh Zowaiid, where water was to be developed for two mounted and three infantry divisions. This force would require more than $\frac{1}{2}$ million gallons daily. Existing wells at Sheikh Zowaiid were cleaned and improved by the 436th and 437th Companies and new wells were dug. The 439th Company sank over twenty wells in the vicinity for the 160th Brigade but, until the railway reached Sheikh Zowaiid on 3rd March and fifteen trucks of stores and 300 E.L.C. arrived, progress was not rapid. On the 4th, the 436th Company moved to

Er Rasum to install a water dump and, after digging wells, advanced to Rafah on the Palestine border, on the 10th with the 437th Company. The 439th Company also reached Rafah with the 160th Brigade on the same day.

The 53rd Divisional R.E., in preparation for the proposed attack, began developing water supplies between this line and Rafah. One of the most useful contributions was the repair by the 437th Field Company and a detachment of the 220th Army Troops Company of the pumping plant at the deep well at Khan Yunis, which the retreating Turks had damaged. A short pipe-line was laid to the new divisional area, the yield proving invaluable not only at this period but also in the subsequent operations against Beersheba. The 439th Company sank a large number of wells, some of them of the large sump type, 120 ft. by 28 ft., in order to reach the target of 100,000 gallons daily by 21st March. Much other work was done, the 436th Company preparing a considerable mileage of roads and tracks, and water supply work was accelerated by the arrival on the 14th of the 410th and 412th Field Companies of the 52nd Division.

The 54th Divisional R.E. were engaged during February on water supply, defences and training at El Arish, but on 8th March the 484th Field Company moved to El Burj with the 162nd Brigade, where it relieved the 410th Company. On 20th March all works at El Arish were handed over to the 220th Army Troops Company. The 52nd Divisional R.E., after reaching Sheikh Zowaid at the beginning of March, laid wire roads towards Rafah, to which the 410th and 412th Field Companies moved on the 12th, and developed water supplies. Small quantities of fairly good water were found in the hollows of the sand dunes near the sea and many tube wells were sunk. The 412th Company also erected storage for 100,000 gallons near Khan Yunis with infantry and E.L.C. labour.

The only Corps R.E. unit in the area was the 220th Army Troops Company, which had reached Mazar in December, 1916. Hutting for Headquarters, Desert Column, defences, blockhouses, wire roads, ammunition dumps, depots and camps were the main responsibilities of this unit. At the end of February the 555th Army Troops Company took over the works in the Mazar area and the 220th concentrated at El Arish, where it erected and operated workshops for repairing and assembling pumps, engines and other machinery, continued hutting for Headquarters, Eastern Force, built more ammunition dumps and roads and made other preparations for the forthcoming attack.

THE EL ARISH PIPE-LINE AND ITS EXTENSION

The final section (26 miles) of the pipe-line to El Arish was laid more quickly than the previous section to Mazar because more labour was available and 16½ miles were laid with 8-in. pipes, which were easier to handle. There were also about two miles of 12-in. and seven and a half miles of 10-in. The filling of the Mazar reservoirs began on 10th January, and on 5th February the pipe-line began to deliver water to the two El Arish reservoirs, each of 125,000 gallons. The G.O.C., Eastern Force, and his C.E., Brigadier-General Blair, were both congratulated by the C-in-C., because the water supply problem had become increasingly difficult as the railway drew ahead of the pipe-line and the successful completion of the project, coupled with the extension of the railway, had brought a British offensive into Palestine appreciably nearer. At the end of January the El Arish reservoirs were ordered to be doubled in size.

It was now possible to spare the labour (2,300 E.L.C.) and transport to cover the pipe-line permanently. In spite of brushwood revetment the sand had blown away in many places and some embankments had drifted, leaving the pipes suspended in the air. Brushwood and camel thorn were now used on both the top and side slopes of the replaced cover in order to retain drifting sand and reverse the process of denudation. A special telegraph line was installed between Romani and El Arish and new fittings and valve chambers provided at the same time. This work occupied two months.

The 96 miles of pipe-line, having become the basis of a highly developed system, storage for nearly ½ million gallons was installed at various points in addition to the reservoirs at the main pumping stations. On 27th March, 1917, the staff engaged on the operation and maintenance of the system, including the Qantara filtration plant, was made the nucleus of a new unit—the 360th (Water) Company, R.E., with its headquarters at Romani. Most of the establishment of 155 other ranks was found from tradesmen and pump hands transferred from other arms. The Turks made two or three attempts to damage the pipe-line before regular mule patrols began on 25th May. On 4th April the Romani reservoir was slightly damaged by an aircraft bomb but pumping was not interrupted. On 18th April three men who had landed from an aircraft demolished a short section of 12-in. pipe near Salmana, but swift repairs enabled pumping to be resumed within a few hours.

Although the pipe-line had been intended to end at El Arish, an extension was authorized before water began to reach the original pipe-head, because local supplies between El Arish and the Wadi Ghazzee had proved to be smaller than expected and were, moreover, usually unfit for locomotives. The main local sources were the coastal dunes, where water of good quality but limited quantity rested on the clay sub-stratum as far as the seashore, and in the gravel strata of the Wadi el Arish and its branches. For several months these supplied the needs of 150,000 men and 100,000 animals. A third source, developed less quickly, was provided by the deep wells at Khan Yunis, between the dune belt and the inland plateau. These ultimately yielded 130,000 gallons daily, and shallower wells at Deir el Balah and other points up to the Wadi Ghazzee gave surprisingly good yields and enabled the British advance to be made on a wider front than would otherwise have been possible. Later still, considerable quantities were obtained along the Wadi Ghazzee, mainly from the springs at Shellal. The inland plateau had no existing water resources, except for a few rain-filled cisterns, but although deep bores would probably have reached water the time element precluded their use. Operations on a large scale were therefore out of the question away from the coastal region. With regard to future operations, good supplies were known to exist at Gaza and Beersheba—the ancient wells at the latter having an important bearing on plans for the autumn offensive.

To meet the needs of locomotives, extension of the Qantara pipe-line from El Arish to Rafah, a distance of nearly thirty miles, was ordered on 12th February, 1917. Some 2,400 yards of 6-in. pipes formed the sole reserve in the parks, but pumps and engines from the Canal Defences and the 4-in. and 6-in. pipes from the abandoned Romani-Mahamdiyah and Romani-El Abd pipe-lines were salvaged for the new works. These stores reached El Arish in miscellaneous consignments and the extension accordingly had to be constructed in a somewhat piecemeal manner with a diversity of machinery and pipe diameters. For the same reason little work either on the extension or on the development of the Khan Yunis supplies was finished before April and thus, in both the first and second battles of Gaza, a considerable proportion of the British force was maintained on Qantara water which had been transported forty-three miles by rail from El Arish.

The extension, designed by Brigadier-General E. M. Blair, started

with a pumping station at El Arish of four units with a combined delivery of over 300,000 gallons per hour. The first fourteen of the twenty miles in the first section to Sheikh Zowaid were laid with 6-in. pipes, giving 100,000 gallons per day at El Burj. Under R.E. supervision 1,800 E.L.C. began work on the formation at El Arish on 20th February and a month later formation work had reached Rafah, 15 miles of pipe had been laid and water was being delivered five and a half miles from El Arish. Closer spacing (1,000 yards) of the expansion joints, fewer line valves and tees, and the laying of shorter sections before coupling avoided damage from temperature variations.

RAILWAY CONSTRUCTION, JANUARY TO APRIL, 1917

The first construction train on the standard-gauge main line reached El Arish (Mile 96) on 4th January, 1917, but the station and sidings were not finished until the 21st. Until El Arish could be opened as a railhead some stringency in the supply situation persisted. Main line construction was resumed towards the end of January by the 115th and 116th Railway Companies and E.L.C., and steady progress was maintained, railhead reaching Sheikh Zowaid (Mile 116) on 1st March. Rafah Station (Mile 125) was opened on 21st March but it could not be used until after First Gaza, whose operations also imposed a few days' halt in construction at Mile 133. When it was resumed, Deir el Balah (Mile 137½) was reached on 5th April and there for the moment railhead remained.

Both railway companies were also engaged in laying out the extensive marshalling yards and stations at El Arish and Rafah, building several other stations and crossing places and laying a 2-mile long water branch at Deir el Balah between 5th and 7th April and another branch, 2½ miles long, from Balah to the coast in the middle of the month.

The coastal alignment was followed by the railway because this route had been chosen for advancing into Palestine in preference to turning inland towards the Turkish railway. On 9th March, after Khan Yunis had been reached, the question of alignment was reviewed as the British communications were in the unusual position of overlapping those of the Turks. Nevertheless any change of direction inland would have had the disadvantage of making our communications parallel to the Turkish front. There was no technical advantage in a connection with the Turkish railway at

Beersheba or the Wadi esh Sheria, whereas construction, owing to the fairly level country, would be easier along the coast. The railway therefore continued to follow the sea towards Gaza.

The first watercourse to be crossed by the railway since leaving Qantara was the Wadi el Arish, where a steel girder bridge on cylindrical piers was begun in the spring. Until this was finished in the autumn before the rains began, the track was laid on an embankment on a deviation. From El Arish onwards watercourses became more frequent and later on in Palestine streams with a continuous flow began to be met. The main problems in all bridges were those of preventing scour in the soft beds and of withstanding the effect of sudden spates. Concrete inverts, deep drop walls and long abutment wings were all found necessary. The longer bridges were generally of trestle construction with timber or steel bearers on masonry foundations, while for small spans sleeper cribs filled with concrete were often used as abutments.

In March, 1917, the increased length of the railway and the growing volume of traffic made a reorganization of the operating staff desirable. The 53rd Railway Troops Company and the 274th and 276th Railway Companies were formed on 12th March into the Railway Operating Division under Lieut.-Colonel W. G. Tyrrell. Its establishment was initially thirty-seven officers and 1,602 other ranks, and the units mentioned provided two-thirds of the officers and little over half of the rank and file. The balance was made good by transfers from the 115th and 116th Railway Companies, other R.E. units and, after trade-testing, from other arms. Headquarters of the Division was at Qantara East and, starting with El Arish, where traffic control of the Qantara-Gaza section was centralized, detachments were placed at various stations as operating staff.

Improvements to the track and increased numbers of locomotives and rolling stock enabled the number of trains run daily in each direction to be raised from thirteen to sixteen, of which six were "obligatory" trains for medical purposes, railway construction and maintenance. The amount of water available prevented any further increase. In the spring the weekly locomotive mileage was 28,150 and the average weekly load transported nearly 23,000 tons. Operation was interrupted by various causes from time to time. The Turks and Arabs made four attempts at track demolition and caused minor damage and delay, but more serious were the reduced visibility and the drifts caused by sand-storms. The severe storm lasting from 10th till 15th March led to six derailments in one day.

SURVEY

Survey work by the Topographical Section continued steadily after the occupation of El Arish, and in March alone, when large scale mapping was resumed before First Gaza, nearly a hundred square miles of the coastal belt were surveyed. On 14th March the section was expanded into the 7th Field Survey Company, and on 1st April it moved forward from El Arish to Khan Yunis and on to Deir el Balah a week later. During the first fortnight in April detailed surveys were made of a further hundred square miles between Rafah and Gaza, and on the 18th the Printing Section issued copies of the partly contoured 1/40,000 sheet for this area. Other special maps issued before Second Gaza included a series of 1/15,000 sketches based on air photographs, a 1/7,500 trench map of the Gaza area, artillery maps and several photographic panoramas. Further survey work in April included a revision of the 1/2-in. map of the Sinai peninsula and a 1/30,000 map of the Aqaba district.

SUMMARY OF ENGINEER WORK, JANUARY TO FEBRUARY, 1917

Some indication of the amount of engineer work executed on the Eastern front during the first two months of 1917 is given by the following figures :—

Standard-gauge railway constructed	...	...	29 miles
Metalled roads built	...	...	17 miles
Wire roads laid (including part of 1916)	...	...	36 miles
Plain and barbed wire used in defences or transported to forward stores	...	...	535 tons
Stone quarried	...	...	61,155 tons

FIRST BATTLE OF GAZA, 26TH AND 27TH MARCH, 1917

Except for the coastal dunes, the country in front of Gaza differed greatly from that of Sinai or the El Arish area. It was undulating, covered with grass and young crops at this season, and seamed with dry watercourses, the largest of which was the Wadi Ghazze, a deep ravine with a sandy bed and steep mud banks. Although a considerable obstacle, even when dry, it provided cover and, later, water. On the British side there were palm and olive groves at Deir el Balah and Khan Yunis. Inland from Gaza the open, rolling country offered little impediment, except for the nullahs, to the

movement of mounted troops, but all the immediate approaches to Gaza were covered by tall, thick hedges of cactus—formidable obstacles that could not be penetrated without explosives or much labour with cutting tools.

In mid-March the main Turkish force was believed to be east of Gaza in the Hureira-Huj-Tel en Nejile area, near the railway, with a considerable detachment holding Gaza. The Gaza force had no extensive defences but the fields of fire were good and the cactus more than compensated for the deficiency in wire. Nevertheless, the comparative isolation of the Gaza garrison invited a similar operation to those which had proved so successful at Magdhaba and Rafah, though of course on a larger scale. General Murray decided to seize this opportunity and he directed General Dobell to cross the Wadi Ghazzee so as to cover the extension of the railway, to prevent the enemy from withdrawing unmolested and to capture Gaza and its garrison, after which a temporary withdrawal to railhead might be considered. General Dobell's plan was as follows:—The two mounted divisions were to make a wide enveloping movement to get astride the line of retreat from Gaza followed by an attack by the 53rd Division on the town itself. The remainder of Eastern Force (two infantry divisions, one camel and one infantry brigade) was to move up in support, the 54th Division being given the special task of covering the striking force during the operations against any Turkish counter-threat from the east. The date of the attack was fixed for 26th March.

During the week preceding the battle the various formations moved forward methodically to the line of the Wadi Ghazzee and to their concentration areas behind. During these movements the work of the field troops and companies was mainly in connection with water supply and the improvement of tracks. The two mounted divisions of the Desert Column advanced from Rafah, eighteen miles from Gaza, and on 25th March patrols reached and crossed the Wadi Ghazzee, with the main body at Deir el Balah. The 53rd Division moved from the Rafah defences and reached Khan Yunis on the 24th; next day the 436th and 437th Field Companies cut ramps in the banks of the wadi at the crossing places for infantry and artillery, and made and marked roads to the assembly positions, while the 439th Company prepared to water the division that night when it had marched seven miles after dusk to Deir el Balah. Advanced Headquarters, Eastern Force, reached Khan Yunis on 20th March, and by the 25th, the 52nd and 54th Divisions had reached the

Khan Yunis area. At night the 54th Division moved to two miles east of Deir el Balah and the Camel Brigade was five miles south-east of Khan Yunis.

OPERATIONS ON 26TH MARCH

The Anzac Mounted Division began the enveloping movement at 2.30 a.m. on the 26th and, despite an unexpected and dense fog, the leading brigade reached its first objective (Beit Durdis, well beyond the Beersheba road) by 9 a.m. The 22nd Mounted Brigade and the 6th Field Troop took up positions to the south of Beit Durdis. The Imperial Mounted Division also crossed the Beersheba road before 10 a.m., except for the 5th Mounted Brigade, which, with the 7th Field Troop, halted near the Wadi el Baha. The Camel Brigade and its field troop extended the outpost line of the 5th Brigade and, although a little late, the net had now been spread.

The 54th Division crossed the Wadi Ghazzee behind the mounted troops and the 162nd and 163rd Brigades, assisted by detachments of the 484th and 495th Field Companies, began to entrench a position facing east on the Sheikh Abbas Ridge, south-east of Gaza. The 486th Field Company moved to a reserve position at El Burjabye with the 161st Brigade and developed water supplies at Kh. Mansura. The main bodies of the first two companies prospected for water at Kh. Umm Jerrar with little success but drew on the supplies in cisterns there and at a well at Tell el Jemmi in the Wadi Ghazzee.

In the 53rd Division, which was to deliver the main attack, two sections of the 436th Field Company improved tracks for artillery beyond the outpost line after dark on the 25th. The division advanced from Deir el Balah after a few hours' rest in three brigade-group columns, each accompanied from the Wadi Ghazzee onwards by one section of its field company, and with a composite force on the left. The 158th and 160th Brigades reached their starting lines on the Kh. el Burjabye and Kh. Es Sire Ridges soon after 8.30 a.m. on the 26th, the engineer detachments improving the tracks by filling in ruts and laying brushwood. The rest of the field companies developed water supplies from the springs in the bed of the Wadi Ghazzee near El Breij, but the amount obtained was not large. Before the main attack, to be delivered at 7 a.m., the 159th Brigade was ordered forward to Kh. Mansura to support the 158th Brigade.

For various reasons, including the delay caused by the fog, the

actual assault did not start until nearly midday but, in spite of determined opposition and rather meagre artillery support, all the objectives in this phase, including the Ali el Muntar positions, were taken by 5 p.m. The forward R.E. sections came under heavy fire at various times but their casualties were light. Owing to the lateness of the infantry attack the Anzac Mounted Division was ordered to attack Gaza from the north and east, and by dusk the outskirts of the town had been reached. In the evening the 6th Mounted Brigade, which had moved up to Beit Durdis, repulsed, without difficulty, an attack from the east by a Turkish column marching to relieve Gaza.

Despite its repulse, this threat from the right ended the hope of capturing Gaza during the night and the Anzac Mounted Division was ordered to break off the action and to withdraw behind the Wadi Ghazzee so as not to remain between the garrison of Gaza and the relieving columns. In the evening the 53rd Division, in spite of its commander's protests, was also ordered to fall back until it had established contact with the 54th Division on its right rear. From information obtained subsequently it would seem that there was no real necessity to surrender the advantages gained during the day, but by 4 a.m. on the 27th the 53rd Division was back on the line that it had occupied at midday on the 26th. Parties of the 486th Field Company, engaged in taking ammunition forward to the Ali el Muntar area and in bringing back wounded, had seven casualties.

OPERATIONS ON 27TH MARCH

By the early morning of the 27th it was clear that the withdrawal had taken place on incomplete information, and the 53rd Division was ordered to re-occupy the Ali el Muntar position if the Turks had not already reached it. In the event both forces tried to regain their lost positions at about the same time, but confused fighting resulted in the recapture of Ali el Muntar by the enemy at 9.30, and the 53rd Division, by this time very tired, reorganized on a line north-west of Kh. Mansura.

By this time it was apparent that the British plan had failed. The line held was unsatisfactory for a sustained defence, and a fresh attack by the 52nd Division, in reserve, could not be organized in time. Shortage of water and a dust storm finally led to a decision to withdraw both the leading divisions behind the Wadi Ghazzee during the night.

The 53rd and 54th Divisional engineers spent the 27th on improvements to water supply and track maintenance, under intermittent artillery fire that caused casualties in all units. All stores and equipment were brought back safely, except that the 495th Company had to abandon its water gear (recovered two days later) and lost many stores by shell fire. The withdrawal was safely completed by 4 a.m. on the 28th.

Although the 52nd Division was in reserve at Khan Yunis during the battle, the 410th Field Company was placed under the C.E., Eastern Force, and developed water in the Balah area. The 412th Field Company remained in charge of the deep well at Khan Yunis, which was now delivering 7,000 gallons per hour.

THE SITUATION AFTER FIRST GAZA

Lieut.-General Murray's report to London appears to have given the impression that the operations had been more favourable than had actually been the case and, partly because the real situation was not known, the C.I.G.S. informed him on 30th March that his immediate objectives now should be the defeat of the Turks south of Jerusalem and the occupation of that city. General Murray repeated his demands for the troops necessary to achieve these results, and informed the C.I.G.S. that his progress would be governed by the rate of railway construction (20 miles monthly under favourable engineering conditions) and that it might be necessary to double the line from Qantara to Gaza. He pointed out that his railway material would not extend further than Deir el Balah, but that a second attack on Gaza was being prepared and after its capture he intended to advance into Palestine. He enumerated his requirements in troops and material, the former including additional army troops companies.

The Turks, realizing the threat to their Gaza outpost and also its tactical importance, quickly developed its defences, with unusual energy, into the strongest part of the system from the sea to Hureira, twelve miles from Gaza along the Beersheba road. Beersheba was lightly held but its distance from British railhead and the absence of water in the area made any attack on this flank out of the question. Another direct assault upon Gaza—of a methodical character with more artillery support—was the only alternative, and preparations for it were pressed forward during the first part of April. The

engineer programme was extensive and was only made possible by a lucky spell of relatively cool weather.

When railhead reached Deir el Balah on 5th April the additional artillery support was assured and rail-borne water could be taken close to the troops deployed for attack. No difficulties regarding water were expected after the capture of Gaza, but much had to be done in organizing supplementary supplies and distribution for the attack itself. Storage for 67,000 gallons with a pumping plant, capacity 4,000 gallons per hour, was installed at the railhead. A 4-in. pipe was laid by E.L.C. over the 200-ft. ridge at In Seirat down to the Wadi Ghazzee near Kh. Umm Jerrar, where the 486th Field Company erected storage for 90,000 gallons and facilities for filling 300 camel tanks per hour and watering 300 horses at one time. Screwing the pipes began at 4 p.m. on 7th April so that work under enemy observation on the forward slopes was done during darkness, and by 3.30 p.m. on the 8th the pipe-line was beginning to fill the forward storage. After the battle the Balah wells were connected to this pumping system to relieve the rail lift.

During this period the field companies were also extensively occupied with water supply. After First Gaza the 52nd Division took over the outpost line along the Wadi Ghazzee. The 410th and 413th Field Companies sank twenty-one wells, including some 60 ft. by 10 ft. pits in the gravel, yielding 40,000 gallons daily. The 413th Company also made or improved twenty crossings of the wadi, each wide enough for two lines of traffic. The red clay obtained from cutting ramps in the 25-ft. banks was used to compact the loose sand in the bed. The 412th Company, in reserve at Deir el Balah, was engaged on various types of work, including wire roads, the issue and transport of stores and the installation of a water dump for 80,000 gallons at In Seirat.

When the 53rd Division withdrew to Balah after First Gaza, all its field companies were largely occupied on a new defensive position two miles east of the village and on water duties. Roads were extended towards the Wadi Ghazzee and more crossings made. Just before the battle the 437th Field Company joined the 160th Brigade Group, to construct defences. Considerable difficulty was experienced in obtaining stores and in establishing the forward dumps needed for the attack.

The 54th Divisional engineers improved and sign-posted 11,000 yards of roads and tracks between In Seirat and the Wadi Ghazzee

and made ten new crossings. Several wells were sunk in the wadi, a number of ancient water cisterns at Kh. Umm Jerrar were cleaned and filled with 70,000 gallons. Storage for 100,000 gallons and horse and camel watering facilities were installed in the Wadi Ghazzee by the 486th Field Company. On 11th April the 495th Company was temporarily attached to the 74th Division at In Seirat after having worked on water supply with a section of the 484th Company at Deir el Balah.

The 74th Division was still very deficient in engineers having two sections only of the 496th Field Company at Rafah at the end of March. On 1st April the division began to move forward to Khan Yunis and Deir el Balah, where the 5th R. Anglesey, now reorganized as a field company, joined on the 13th. After the 495th Company was attached, it worked until the 16th on the roads from In Seirat, on more crossings of the Wadi Ghazzee and on filling forward dumps with defence stores brought up by camels. On the 7th, when the division relieved the 54th on the outpost line along the wadi, all work at Khan Yunis except the pumping plant was handed over to No. 10 Company, Sappers and Miners, and the 496th Company moved to Deir el Balah, where a section of the 5th R. Monmouth. was attached temporarily, water supply and work on defence stores dumps in the wadi being continued until the battle. The final arrangements for the attack were that one section of the 496th Company was attached to each of the 230th and 231st Brigades and the R. Monmouth. section to the 229th Brigade, while the remainder of the 496th Company and the 5th R. Anglesey were made responsible for water supply. The R. Anglesey also sign-posted roads and made ramps for crossing the Wadi en Nukhabir.

In the rear the 220th Army Troops Company had two sections in charge of the wells and pumps at various water areas between El Arish and Sheikh Zowaid, one section in the workshops at El Arish repairing and testing machinery and issuing water-stores, and the fourth hutting for the new Advanced G.H.Q. at El Arish and building blockhouses and ammunition dumps in the neighbourhood. On 12th April the re-erection of hangars at Rafah airfield was finished.

THE SECOND BATTLE OF GAZA, 17TH TO 19TH APRIL, 1917

The British force now had an additional infantry division—the 74th—available, although still short of its artillery and some of its

engineers. General Dobell's plan for the second attack on Gaza comprised two stages—a direct assault by three infantry divisions with the 74th in reserve, followed by alternative forms of exploitation according to the enemy's reaction to the first stage. The initial assault, covered by mounted troops on the right, was designed to reach and organize for defence a line from Sheikh Abbas along the Mansura Ridge and across the Es Sire Ridge to the sea near Tell ul Ujul. In the second phase plans were made for three alternative methods of attacking Gaza, in only one of which was it envisaged that exploitation should be by mounted troops.

The preliminary movements of the infantry divisions were completed during the afternoon of 16th April and by 5 p.m. the three leading divisions had reached the Wadi Ghazze—the 54th on the right, the 52nd in the centre and the 53rd on the left. The 74th was concentrated behind the right and centre. By 2 a.m. the Anzac Mounted Division had reached Shellal and the Imperial Mounted Division was at Tell el Jemmi.

R.E. units accompanied these movements. In the 54th Division each field company detached one section to an infantry brigade, the 484th providing the section for the 162nd Brigade and the 486th Company those for the 163rd and for the 161st in reserve. The 484th Company was in charge of the divisional dump, and the 495th was to follow the leading brigades and to improve road communications beyond the Wadi Ghazze. The 413th and 410th Companies of the 52nd Division detached two sections each to advance with the 157th and 155th Brigades to their assembly positions at El Brcij (opposite Mansura Ridge) and on the Kh. Es Sire Ridge respectively, while the 412th Company in the wadi prepared to work on roads and water supply. In the 53rd Division detachments of the 436th and 439th Companies moved with the two leading brigades and the 437th Company moved up in support. One section of the 496th Company and one of the 5th R. Monmouth. moved with the 230th and 229th Brigades respectively.

OPERATIONS ON 17TH APRIL

The first phase of the attack was completed as arranged and without untoward incidents. The 22nd and 5th Mounted Brigades with their field troops, occupied the positions overlooking Hureira before daybreak and withdrew, as arranged, at nightfall. The infantry advance began at 4.15 a.m. and within three hours all the

objectives had been reached at slight cost. Entrenching began with the assistance of the engineer detachments previously mentioned and no further attack was made during the day.

The Deir el Balah pipe-line was extended to the Wadi Nukhabir in the 54th Division sector and the 484th Field Company erected storage for 45,000 gallons and watering facilities at the pipe-head. This unit also built a new divisional battle headquarters and, with considerable difficulty, transported defence stores to the front. The 495th fitted a pump to a deep well but found no other new supply.

In the 52nd Division the 410th Company established a new dump for defence stores south-west of Es Sire at night, after working, with the 413th Company, during the day on extending roads east of the Wadi Ghazzee. The 53rd Division was unable to do much entrenching before nightfall, but after dark the forward engineer detachments were engaged on wiring from in front of Tell el Ujul to the sea. The 439th Field Company sank a new well in the Wadi Ghazzee. The 74th Divisional R.E. rested for most of the day.

OPERATIONS ON 18TH APRIL

On the 18th the mounted troops repeated their movements of the previous day and met no serious opposition. Except for the artillery bombardment for the second phase, no other operations took place but artillery was moved forward and all transport was kept fully occupied in taking supplies of all kinds beyond the wadi. There is little to record in the way of R.E. work. All field companies were occupied on road repairs and maintenance and the forward sections continued wiring and other defence works at night. The 53rd Division advanced part of its line by 300 yards and two sections of the 436th Field Company were engaged.

OPERATIONS ON 19TH APRIL

At 5.30 a.m. on the 19th the bombardment preparatory to the second phase began, followed by the infantry assaults some two hours later. The alternative adopted was for the 54th and 52nd Divisions to attack Ali Muntar and for the 53rd Division to attack Gaza from the south-west. In the 54th Division the two leading brigades, accompanied by detachments of the 486th Field Company, found progress difficult and costly, the 163rd Brigade alone losing 1,500 men. During the morning the 495th Company advanced to

Mansura Ridge and at 3 p.m. the division was ordered to stand fast on the line reached.

The 52nd Division soon became involved in a struggle to advance in the face of determined opposition, and by midday the attack had lost all momentum. At 4 p.m. the division was ordered to dig in. Most of the 412th Company had moved in the morning to help the 156th Brigade to consolidate on the right, and the 410th Company moved its stores dump two miles forward. The two leading brigades of the 53rd Division captured Umbrella Hill, Samson Ridge (north of it) and Sh. Ajlin, and the detachments of the 439th and 437th Field Companies assisted in their consolidation.

The mounted troops meanwhile covered the right flanks of the infantry by engaging the Turkish defences as far as Hureira. The 6th Field Troop, working at the wells at Kh. Abu el Hiseia, was covered by the 22nd Mounted Brigade at Tell el Fara. On the left the Imperial Mounted Division made a containing attack upon Atawine with three brigades, including the 5th, which was eventually held up by the Turkish defences. When the enemy counter-attacked the 22nd Brigade became involved and reinforcements, including the 22nd Brigade, had to be sent forward. At the end of the day both divisions withdrew as arranged to the line Kh. Abu el Hiseia-Sh. Abbas.

During the day the enemy also counter-attacked strongly nearer Gaza, and as the situation became clearer at Headquarters, Eastern Force, it was realized that owing to imperfect location of the Turkish positions and to inadequate artillery support, there would be little prospect of success if the British attacks were renewed. All three divisions were ordered to entrench on their present line but this proved impossible on the right and in the centre where the tactical situation imposed considerable withdrawals. Part of the 74th Division in reserve moved across the Wadi Ghazze and the 5th R. Anglesey and Headquarters, 496th Field Company, moved to Kh. el Burjabye. The section of the 5th R. Monmouth, with the 229th Brigade continued its work on water supply. As darkness fell the sapper detachments in the other divisions greatly helped the weary and depleted battalions to consolidate the new line, and to forward large quantities of defence stores. They were mainly employed on wiring and some of the companies sustained a few casualties from artillery and machine-gun fire. The 495th Company moved under fire from Mansura Ridge to Sh. Abbas in the 54th Division's section, and on the left two sections of the 436th Company

were sent forward to reinforce the wiring parties of the 439th Company working with the 160th Brigade. All detachments were withdrawn just before dawn.

The resumption of the attack was first postponed for twenty-four hours but when, during the night, the full toll of casualties became known, any further assault was abandoned for the time being. Second Gaza was thus a considerable success for the Turks and confirmed them in their decision to stand indefinitely on the Gaza-Beersheba position.

CHAPTER XXV

SUMMER, 1917

The situation after second Gaza—Consolidation of the defences in front of Gaza—Minor operations—Railway construction, May to September, 1917—Water supply, May to September, 1917—Miscellaneous works on the L. of C.—Survey—Change of command—Preliminary plans for a renewed offensive—Reinforcements and reorganization—The L. of C. and the Canal Defences in 1917—Works in Egypt during 1917—Stores.

(Map 5 and Sketch 7, facing page 292)

THE SITUATION AFTER SECOND GAZA

WHEN Lieut.-General Sir Philip Chetwode took over the command of Eastern Force on 21st April, 1917, he decided on a defensive policy owing to the inadequacy of the forces available for a renewed attack on Gaza. He ordered the front on the right to be held by a series of outposts from El Qamle to Sh. Abbas, with a support-line adapted from the old Turkish positions covering Shellal, but on the left by a much more elaborate system between Sh. Abbas and the coast at Sh. Ajlin. These defences, which required much labour and material, are described later in this chapter.

Reporting to the War Office on 22nd April, Lieut.-General Murray stated that for continuous offensive operations he required two more infantry divisions (he did not regard the 74th Division as sufficiently trained or equipped) and a considerable increase in artillery. He had just formed the nucleus of another division—the 75th—but this formation could not take the field for some time. Were the Turkish forces to increase, his own requirements would mount in proportion. The C.I.G.S. replied that his instructions for the capture of Jerusalem were now modified and that, although the artillery requirements would be met, the two infantry divisions could not be found, but two mounted brigades from Salonika would be transferred. This telegram, coupled with the depleted condition of the three operational divisions, made it clear that for some months there could be nothing but a defensive policy, and the work required to implement it became the first priority.

CONSOLIDATION OF THE DEFENCES IN FRONT OF GAZA

Consolidation and development of the defensive position in front of Gaza began immediately and by August a well-organized trench system was in being. Divisions relieved each other in succession in each of the three sectors of the front from El Qamle to Sh. Ajlin. Detailed accounts of the activities of individual field companies would become wearisome, but a general description will show that much hard work was carried out by all the units concerned, under trying conditions of great heat, dust storms and minor sickness from intestinal complaints and septic sores.

In the right sector, the outposts along the Wadi Ghazze from El Qamle to Tell el Jemmi and thence to a point south of Sh. Abbas were begun by the field squadrons of the mounted troops, including the 10th Field Troop with the Camel Brigade, and detachments of the 495th and 496th Field Companies. The last-named unit was replaced in the 74th Division by the 5th R. Monmouth. The company at the end of April took over thirteen posts between Shellal and Hiseia, the construction of which involved digging more than eleven miles of fire and communication trenches and the erection of a continuous wire entanglement six and a half miles long. In May a new line of nineteen outposts with a double-apron wire fence, on the far side of the Wadi Ghazze between El Qamle and Tell el Jemmi was constructed by the R. Monmouth., half the 5th R. Anglesey and the 496th Field Company, assisted by a battalion of the 23rd Sikh Pioneers and infantry working parties. As most of the work was done on two successive nights, careful organization was required. Roads and water supply also received attention; the latter work included the establishing of dumps and a start by the R. Monmouth, on a 3-ft. concrete dam to impound the water from the Shellal springs by forming a shallow reservoir holding 750,000 gallons. The 496th Company was also working on this project when the 53rd Division relieved the 74th on 18th May.

The 436th and 437th Field Companies took over the water areas, erected sun shelters, improved and extended the defences and, with some E.L.C. parties, laid out roads and made wadi crossings. Early in June the 496th Company, still working on the Shellal dam and its ancillary works with 350 E.L.C. and Maltese labour, passed from the 53rd Division to the Desert Column. It also built a trestle bridge across the Wadi Ghazze and laid out roads until it left to join the 75th Division early in July.

In the Sh. Abbas area on the right of the centre sector, the 484th and 486th Companies of the 54th Division and the 5th R. Anglesey (attached) worked for nearly a month after Second Gaza on the forward defences. The work consisted of fire and communication trenches, wire, and machine-gun emplacements, dug-outs, shelters, O.Ps., water and roads. A few casualties were sustained. In the rear the 495th Company built strong-points, transported and distributed large quantities of defence stores, and controlled water supply (20,000 gallons from local wells daily) and worked on the water development of the divisional area. It also built a line of posts termed the Retrenchment Line, designed to check any enemy penetration down the Wadi Nukhabir. The pipe-line laid before Second Gaza was extended up this wadi and storage for 50,000 gallons built in two water dumps. The 495th Company and the 5th R. Anglesey also made $7\frac{1}{2}$ miles of 18-ft. roads, in the course of which much excavation and grading were required, and a considerable length was covered with wire netting.

This sub-sector was taken over by the 74th Division at the end of May. Work on the defence system, including new redoubts, was continued by the 439th Company on the right, the 5th R. Anglesey in the centre and on the left, and by part of the 5th R. Monmouth. on the Retrenchment Line. The latter unit was also responsible for water supply and the transport of stores, besides working on roads and mined dug-outs. Works in connection with water supply included several new wells, yielding nearly 5,000 gallons per hour, in the Wadi Ghazzee and new pumps at the deep wells near El Mendur. The 74th Division was relieved on 9th July by the 52nd Division, the 412th and 413th Field Companies taking over the improvement of the forward defences, and the 410th Company, in reserve, being put in charge of sun shelters, roads and water supply. Several new wells were dug and existing ones covered, while the 413th Company also installed a pumping plant at another of the deep wells at Mendur. Although infantry brigades relieved each other at intervals, the field companies remained in their respective locations, and the two forward units sustained several casualties during their tour of nearly three months. In August a large programme of mined dug-outs was undertaken, in which work miners from the infantry and from the 1/12th Loyal N. Lancs. (Pioneers) took part. The 52nd Division had previously, between Second Gaza and 5th May, been responsible for the early defences in the left sub-sector, all three field companies being engaged at first princi-

pally on wiring. It was then relieved by the 74th Division, which later took over the whole sector as described above.

In the coastal sector all the field companies of the 53rd Division (except for two sections of the 436th Company on roads and water supply) were engaged on defence works, assisted by a pioneer battalion. In May two large redoubts were begun by the 437th Company and two more by the 439th Company. The ground was less favourable than in other sectors and, except on the extreme right, sandbag revetment was needed everywhere, and maintenance was heavy as frequent dust storms filled the trenches with sand. On 8th May the 52nd Division relieved the 53rd, but the 439th Company remained in the sector until the 25th, laying nearly five miles of wire road. During their tour of duty the new units suffered several casualties, including Major Streeten, commanding the 410th Field Company, who was wounded on the night of 25th/26th May. The 410th and 413th Companies were engaged on defences in the front line and the 412th on other defences and water duties. The 410th Company also built a rest camp of dug-outs in the cliffs south-west of the Wadi Ghazze; a detachment of the 412th Company took part in a successful raid on 11th May against the Turkish positions on the coast and the 413th co-operated by illuminating with Very lights a number of dummy figures to draw the enemy's fire. The 413th Company also converted three low hills behind the front line into defended localities.

On 13th June the 54th Division took over the sector, the 484th Field Company being put in charge of water supply and the 486th and 495th Companies the forward defences. Many of the early, hastily-sited fire trenches in the dune area were re-aligned and rebuilt. While the soft sand involved much labour in revetment and maintenance, it had the advantage of localizing the effects of shell bursts. Water storage was installed, shell-proof dug-outs and O.Ps. built and overhead traverses erected in exposed places. The 484th Company made and repaired roads and wadi crossings and installed pumps. It also provided small detachments for three raids during July. In the first a party under Lieutenant Gilpin accompanied the 1/8th Hampshire in a raid on the coast on the night of the 14th/15th and, in the five minutes allotted, demolished six dug-outs with gun-cotton charges. On the night of the 20th/21st Lieutenant Mendham and twelve other ranks raided Umbrella Hill with the 1/5th Bedfordshire; half an hour was available this time and more extensive demolitions were possible, while Sapper

Seabrook, as a side-line, bayoneted a complete machine-gun crew and captured the weapon. Two sappers were wounded. Another raid on Umbrella Hill was less successful, most of the party, including the sappers under Lieutenant Gilpin, failing to reach the Turkish trenches, although Sapper Anker managed to fire two charges.

On 4th August the 53rd Division relieved the 54th, the 437th and 495th Companies taking over in the forward area and the 439th Company the roads and water supply. Most of the R.E. work was now on dug-outs, aid posts, dressing stations and wire roads. The 437th Company continued the defences and had several casualties, two men being killed and seven wounded by a single shell on the 10th. On 28th August the 54th Division returned to relieve the 53rd.

The work of building the extensive trench system in front of Gaza between the end of April and August had now been brought to the point where efforts could be directed towards preparations for a renewed attack rather than to improvements to the defensives. This work is described in the next chapter.

The three-sector organization enabled one infantry division in turn to be relieved for rest and training, but for R.E. units the term "rest" was usually nominal. Water supply made constant demands upon them and work was also required on roads, wadi crossings, shelters, dug-outs, training facilities and a multitude of other tasks. The 436th Company of the 53rd Division, while in reserve during May, constructed a substantial part of a second defence line near the Wadi Ghazze, and in June two sections of the 495th Company of the 54th Division continued this work while attached to the 74th Division. While this division was in reserve in July and August Lieut.-Colonel Hawksley left to take up his new appointment as C.E., XXI Corps, and Major Glen acted as C.R.E. until Major W. R. Izat arrived on 24th September. The 54th Divisional engineers were reduced to two field companies—the 484th and 486th—early in August when the 495th Company was transferred to the newly formed 75th Division.

MINOR OPERATIONS

Apart from various raids on the Gaza front there were few operations during the summer of 1917 and these were of a minor character. The most noteworthy were three raids against the Turkish railway

between El Kossaima and El Auja in May, in which the engineer operations were directed by Lieut.-Colonel R. E. M. Russell. The enemy was known to be dismantling this line and the object was to prevent the withdrawal of locomotives and rolling stock. Between 7th and 14th May two companies of the Camel Brigade and a detachment of the 10th Field Troop damaged a masonry bridge on this section and destroyed several wells. On the 23rd two further attacks were made simultaneously, one by Australian mounted troops accompanied by the Imperial Mounted Division Field Squadron and the other by the Camel Brigade with the 10th Field Troop. The first started from Shellal and alternate spans in the eighteen-arch bridge at Asluj (twelve miles south of Beersheba) were destroyed and rails systematically cut along 7 miles of track. The Camel Brigade left Rafah on the 22nd and reached El Auja at midday on the 23rd; seven small bridges and culverts were demolished and 13 miles of track damaged. Both columns returned without meeting the enemy, having destroyed about fifty bridges and culverts and cut more than 4,000 rails.

Early in August a topographical party of the 7th Field Survey Company reported that the well, pipe-line and reservoir near Khelasa were still intact although the pumping plant had been removed. In order to deny this source of water to the enemy, No. 10 Company, Sappers and Miners, raided the place, demolished the installations and filled the well with rubble, although time did not permit the destruction of five other wells used by bedouin.

RAILWAY CONSTRUCTION, MAY TO SEPTEMBER, 1917

After Second Gaza the standard-gauge railhead remained at Deir el Balah for several months, the railway companies being employed on improving the existing single track, in laying branches and, later, in doubling the line from Qantara.

During the first stage, to enable future operations to be conducted on a wider front, a standard-gauge branch line was authorized in May, 1917, from near Rafah to El Qamle, seventeen miles inland up the Wadi Ghazze. It was 19 miles long and ran due east to Weli Sheikh Nuran and then south along the left bank of the wadi to El Qamle. The 116th Railway Company began preparatory work on 1st May and track-laying on the 10th. Weli Sheikh Nuran was reached on the 18th and El Qamle on 4th June. Qamle Station was finished by mid-June. A second standard-gauge branch was

then laid from near Sheikh Nuran across the wadi at Shellal. Pending the construction of a bridge over the wadi, heavy earthwork was involved in cutting ramps in the banks to carry the formation across the bed. Railhead reached Shellal, fifteen and a half miles from Rafah, on 15th June.

Main-line improvements included a 6½-mile deviation between El Rasum and Rafah laid by the 116th Company early in May. This involved constructing a new station at Rafah, two miles north of the original, and also alterations to locomotive water supply facilities. The 115th Railway Company completed a new station at El Rasum on 10th May. In the middle of June both companies moved back to Bir El Abd and by the end of the month they had built nine new stations and passing loops between there and El Arish. On 28th June the 116th Company moved up to El Arish to lay loops at the station and on 6th July a detachment went back to build another station east of Mazar.

Although the main workshops were at Qantara East, rolling stock requiring heavy repairs had to be sent to the E.S.R. workshops at Bulac, near Cairo. To make this possible a ferry capable of carrying a locomotive or four wagons was installed at Qantara early in June, proving of the utmost value until it was replaced by a heavy swing bridge in 1918.

These improvements and recent arrivals of more rolling stock increased the capacity of the single track to sixteen trains daily in each direction. This was sufficient to mount an offensive against the Beersheba-Gaza line by a force of six infantry and three mounted divisions with their corps and army troops and probably to enable Jerusalem to be reached. It was possibly insufficient to maintain the army on the Jerusalem-Jaffa line and certainly inadequate for the larger forces required for any operations beyond that line. By June, 1917, there were eighty-two locomotives, seventy-five coaches and 1,360 wagons and trucks on the Qantara Military Railway, of which the E.S.R. had provided about two-thirds and the War Office the remainder.

General Murray had already raised the question with the War Office in April, 1917, of doubling the single line, as it was the only method now open for increasing capacity. If carried out as far as Rafah, it would enable twenty-eight trains to be run daily in each direction, with sixteen trains onwards towards Gaza and twelve on the Shellal and El Qamle branches. On 7th May, when an expansion of the E.E.F. had been authorized, General Murray reviewed the

supply position in a cable to the C.I.G.S., pointing out that the single line at that time was barely sufficient to maintain five infantry divisions with the mounted and ancillary troops, and that when the 74th and 75th Divisions had taken their place in the Force the railway would be strained to its limit. He was proceeding with the improvements (already described) to the single track but, although the E.S.R. could supply no more material, he recommended doubling. After some discussion, the second track from Qantara to Rafah was eventually authorized on 31st July.

No time was lost in starting work with such material as had become available during the summer, and progress was rapid. In anticipation the 115th Railway Company had moved back to Qantara on 27th July, followed by the 116th Company, and by the 31st 2 miles of the new line had been laid and new marshalling sidings had been started at Qantara East. Lieut.-Colonel Sowerby's original lay-out of the terminal had been designed to save shunting time, and as space was unrestricted trains were handled on a huge loop so that most of them required neither re-marshalling nor had their locomotives to be turned. The additional facilities for increased traffic were thus provided without alteration of the original lay-out. The 115th Company built new sidings throughout August and then until October laid out the material for the doubling.

Captain S. T. Hay was in charge of the survey of the new alignment which was at places some distance from the original line to give easier curves and gradients. By 31st August formation work had reached Mile 20 and 7½ miles were open to traffic and by the end of September 31 miles had been laid to beyond Qatiya. The short extension of the Deir el Balah railhead to Mile 138 was constructed by the 116th Company at the end of August. Two new railway companies—the 265th and the 266th—arrived from England at the end of September and joined the 115th and 116th at Qatiya and El Abd to assist in the track duplication. The rate of construction now reached a mile a day, but towards the end of the month, when railhead had reached Mile 71, work was suspended because of the more urgent requirements in the forward area for the forthcoming offensive. During the battle and the operations which followed, the double line was working as far as Mazar, but although this achieved considerable economies, the railway capacity was not increased sufficiently to prevent serious supply problems during the pursuit that followed.

Other work executed during the summer was the extension by

the 115th Company during the first half of July of the Shellal branch for four miles to Imara and the laying of track on the bridge now built across the Wadi Ghazzee. This unit also laid out ammunition sidings at Weli Sheikh Nuran, began hospital and station sidings at Deir el Balah and laid the new track across the recently finished bridge over the Wadi el Arish. The 116th Company in August had a detachment working on alterations to Imara Station and laying a siding for the R.F.C. at Mile $7\frac{1}{2}$ on the Shellal branch. The 265th Company picked up the deviation across the Wadi Ghazzee bed near Shellal in the middle of October and thereafter the work of all railway units was directly connected with preparations for the third battle of Gaza.

WATER SUPPLY, MAY TO SEPTEMBER, 1917

After First Gaza further progress was made with the extension of the Qantara pipe-line. Delivery from the El Arish pumping plant was increased, and the pipe-line to Sheikh Zowaid (twenty miles from El Arish) was completed with 5-in. and 4-in. pipes, delivering 80,000 gallons per day to canvas storage. A relay pumping plant was installed, initially with one 20-H.P. engine and a 4-in. centrifugal pump, but duplicated later. The next stage to Rafah (nine miles) was laid with twin 4-in. pipes. On 18th May two 50,000-gallon reservoirs were ordered at El Rasum on this section to supply 80,000 gallons daily by gravity to locomotives and, to enable El Arish to pump to either Rasum or the new Rafah Station, a 4-in. pipe was laid between these two places by the 360th Water Company. Storage for 200,000 gallons at Rafah was provided by two reinforced concrete reservoirs and pumping plant similar to that at Sheikh Zowaid was installed towards the end of May. It was operated by detachments of the 14th and 220th Army Troops Companies until taken over by the 360th Water Company on 16th September.

The next section to Abu Khatli was 12 miles long and was laid with 6-in., 5-in. and twin 4-in. pipes, which limited its capacity to 3,750 gallons per hour. The line was washed out and tested on 29th May and 70,000 gallons of storage provided by repairing underground cisterns. Duplicate pumping sets of 25-H.P. engines and centrifugal pumps were installed during June to supply water by two branches, one 8 miles long and 5 in. in diameter, through Abu Sittar to Abu Bakra on the Wadi Ghazzee, and the other

9 miles long and 6 in. in diameter, across the wadi to 80,000-gallon storage tanks at Imara, two miles east of Shellal. This place, 146 miles from Qantara, was the furthest point yet reached by Nile water. By 20th July 60,000 gallons per day was being pumped to Abu Bakra and rather more to Imara.

The valuable deep wells at Khan Yunis have already been mentioned and from one of them 80,000 gallons per day was obtained after pumping plant had been erected by the 14th and 220th Army Troops Companies in April. It was then decided to lay a 6-mile 5-in. pipe-line to Abu Sittar, west of Shellal, to supplement supplies from the Qantara line. It was working by 15th May and a cross connection was then made to the Abu Khatli-Abu Bakra pipe-line to enable water to be pumped under centralized control from either Rafah or Khan Yunis to a variety of points. The 220th Army Troops also began work on 11th May on a 250,000-gallon reservoir at Khan Yunis.

On the main pipe-line the 360th Water Company completed arrangements for supplying locomotives at various stations on the railway during April and May. The limit of responsibility of the company for operating and maintenance was then settled as the Rafah reservoirs and all pipe-lines and pumping plants to the east had to be operated by some other unit. Regular patrolling of the main pipe-line by detachments mounted on mules began on 25th May and many improvements to the system, increasing pumping efficiency and distribution, were made during the summer. On 28th June the 360th Company moved to El Arish, where the workshops were situated.

Although playing no effective part in the operations until after Third Gaza, the formation of a second water company should be recorded here. The strain on the 360th was too great for efficient operation, the pipe-line network east of Rafah required central responsibility and future demands were likely to be heavy. So to overcome these difficulties the 359th Company was formed on 1st October on a cadre of transfers from the 360th Company.

The work done by the pipe-line is best indicated by a few figures. The maximum possible daily output of the Qantara pumping plant was 720,000 gallons but actual demands were slightly below the working figure of 360,000 gallons. The Romani and El Abd stations, owing to the reduction to 8-in. pipes on the last section to El Arish, had outputs of some 660,000 gallons. In the week ending 24th May the Qantara pumps worked for about a hundred hours and pumped

over 2½ million gallons, averaging 323,530 per day. Mazar pumped just over 2 million gallons in 113 hours to El Arish, where 1 million gallons were supplied to locomotives and troops, 400,000 gallons were pumped to Sheikh Zowaid and the rest carried by rail to Deir el Balah. The increased power of the El Arish pumps enabled 50 per cent more to be pumped forward to Sheikh Zowaid a few weeks later.

There was, therefore, a comfortable margin between the demand and capacity, but the demand was growing and at the end of May General Chetwode asked that the line should be duplicated with 6-in. pipes as far as El Arish. The main reason for this was that local water at El Arish and eastward was unsuitable for locomotives and the growth of rail traffic was leading rapidly to a position where the railway alone required more water than the pipe-line had been originally designed to supply for all purposes. The E.-in-C. early in June endorsed duplication, but pointed out that it would cost about £1 million and would take six months to complete. On 9th June General Murray referred the matter to the War Office. After a full report he ended by stressing the admirable work done by the R.E. in constructing the pipe-lines across 150 miles of desert and in developing local resources—work which, he stated, had been carried out with unvarying efficiency under circumstances of peculiar difficulty.

No early decision was reached on the question of duplication and a series of cables passed between the War Office and the E.-in-C. about the basis of calculation, availability of resources and railway capacity. It was eventually arranged on 9th September that 50 miles of pipes (10 of 10-in. diameter, 20 of 8-in. and 20 of 6-in.) and three pumping sets of greater power would be obtained from America and sent to Egypt in the near future. With these somewhat limited resources the Qantara pipe-line was redesigned to increase its output. The filtration plant was doubled before the end of the year, giving 1,440,000 gallons per day (maximum) and a third plant, with an output of 600,000 gallons, finished in January, 1918. Tests had shown that, as far as El Arish the working pressure could be safely increased to the equivalent of a 560-ft. head, i.e., more than doubled, and with the extra pumping power and some re-arrangement of the existing plant a much higher discharge capacity could be obtained without large scale alterations to the pipe-line proper. Nevertheless nearly all twin sections were eliminated and others replaced by pipes of slightly larger diameter.

Storage capacity was increased by building a new reservoir for 250,000 gallons at El Arish, two reservoirs with a total capacity of 500,000 gallons at Rasum and four with a total capacity of 1 million gallons at Rafah. In general, little of this work was done before the autumn and it will therefore be described later.

Local water development by the divisional R.E. in the forward area has already been mentioned, but other units took part, both on the Wadi Ghazzee and on the L. of C. Wells sunk in the gravel beneath the dry wadi bed produced plenty of brackish but just drinkable water. Springs with considerable yields existed at Shellal (nearly 250,000 gallons per day), El Qamle and Bir el Esani. The 35th Army Troops Company (see below) took over the Shellal reservoir on 1st July and fenced it to prevent pollution. On the Gaza front the El Mendur sector was partly supplied by the pipe-line to Abu Bakra but development of local wells enabled this to be discontinued. The Sheikh Abbas sector was never self-sufficient and was partly supplied by rail-borne water pumped from Deir el Balah, but sufficient wells were developed in the dune area at the mouth of the Wadi Ghazzee to supply two divisions with somewhat brackish water in an emergency. The 14th Army Troops Company, which joined Eastern Force at the end of April, was responsible, in addition to other work, for much of the water supply from Rafah to Deir el Balah throughout the summer.

The 35th Army Troops Company arrived in Egypt on 31st May from England. Its main function was deep well boring, for which it had a special section which received its final training in Cairo during June. The company reached Shellal on 1st July and until the autumn offensive its work was primarily in connection with water supply. It sank several deep bores near Mendur, laid a 4-in. pipe-line, 2,400 yards long, to the front line in September, and maintained a number of pumping plants and water areas. Early in October the company left the XXI Corps and came under command of the A.D.W., Palestine L. of C., for work on wells near Rafah. Several new ordinary wells being dug with E.L.C. labour.

The 220th Army Troops Company at El Arish was also partly engaged on water supply work. This included the erection of storage at El Arish, maintenance of several water areas, repairs to wells, installation of pumping plant and much repair work to machinery. On 11th June the 55th Army Troops Company took over the El Arish area, and on 22nd July most of the Rafah area, in accordance with the policy that it should follow up behind the corps troops

companies as the latter moved forward. The 220th Company took over the Khan Yunis water areas in June.

The work of all these units during the summer can best be summarized by the statement that by September all available water resources between Deir el Balah and Shellal had been fully developed and all suitable wells provided with pumping plants.

MISCELLANEOUS WORKS ON THE L. OF C.

Much work was done by units on the L. of C. The 6th Field Squadron (whose formation is described later) was engaged on routine water duties for the Yeomanry Mounted Division at the beginning of August, but its various field troops made a number of reconnaissances of the Tell el Fara-Bir el Esani area, to which the division moved later in the month. More reconnaissances were made in September of water possibilities in the open country on the right flank, but the field troops were also engaged in marking roads and outpost defences. On 18th September the squadron was withdrawn for training preparatory to Third Gaza.

The 14th Army Troops Company built dug-outs and ammunition shelters in the Khan Yunis-Deir el Balah area until the end of June, when it began semi-permanent bridges across the Wadi Ghazzee, improved several crossings and erected buildings for medical and supply services. The 35th Army Troops Company built roads and ammunition shelters in the Shellal-Weli Sheikh Nuran area and on 22nd September finished a twelve-bay trestle bridge for the light railway from El Qamle across the Wadi Ghazzee. The 220th Army Troops Company worked on roads and inner defences in the El Arish area from the end of April to 11th June, while the detachment of the 5th R. Monmouth. built blockhouses at El Burj, Sheikh Zowaid and Rafah. The 220th Company then worked on the Deir el Balah-Abu Sittar road and erected hangars at the latter until the end of July, after which most of this unit was engaged on the new G.H.Q. camp near Khan Yunis until September.

From July onwards a series of light railways, mostly decauville, totalling 12 miles in length, was laid under the direction of the Railway Operating Division from railhead at Deir el Balah towards the Wadi Ghazzee in order to relieve road transport. Many of these lines were under enemy observation and, occasionally, artillery fire, but no material damage was sustained. Most of the construction was done by detachments of the 265th and 266th Railway

Companies but the 14th Army Troops Company laid one branch on the coast in September and the 35th Army Troops Company with working parties of Sikh Pioneers completed a branch 4,200 yards long from railhead at El Qamle, involving 20,000 cubic yards of excavation.

SURVEY

Immediately after Second Gaza the 7th Field Survey Company continued its 1/40,000 survey as far as Rafah and later extended it to the Beersheba-Gaza line. In view of the probability of further extensions into Palestine and Trans-Jordan and of the possibility of an ultimate link with the Mesopotamian survey, two field bases were accurately measured on which to base the triangulation. Detail was completed by plane-table work and stereoscopic air photographs, the latter being used mainly for contouring. When the front was reached a series of points were intersected behind the Turkish lines to form the basis for extending the triangulation into Palestine. The printed sheets as far as Rafah were issued in July, and by the middle of August the rest of the area between Beersheba and the sea had been almost entirely covered and nine more sheets were being prepared for issue.

On 28th June all available field parties accompanied the Australian Mounted Division towards Beersheba and in two reconnaissances on 4th and 8th July made a rapid but detailed survey of the area north-west of the town.

On 22nd April eight surveyors began work on a 1/20,000 map of the area east of the Wadi Ghazze, and shortly afterwards a series was started giving much greater detail to a scale of 1/10,000. These maps were based on actual survey but were supplemented by information from air photographs and showed all the Turkish trench systems, wire and batteries. They were continuously revised as the enemy extended his positions and thirty-nine editions of the seventeen sheets were issued. Owing to the amount of work involved in revision, this scale was then discontinued in July and the trench map replotted to the 1/20,000 scale, at which eighteen sheets, covering 685 square miles, were issued before Third Gaza. This map had twenty-eight editions, nineteen of them being issued by the Printing Section of the 7th Field Survey Company in addition to its other work of reproducing a wide range of maps and plans for formation headquarters.

A considerable amount of artillery survey was also undertaken.

In May, 1917, an improvised flash-spotting section began the experimental fixing of Turkish gun positions, but as the enemy did not, as a rule, engage in much night firing the results were not particularly good. In August two sound ranging sections joined the 7th Field Survey Company at Deir el Balah. "N" Section was attached to the XXI Corps and "V" Section to the XX Corps. The first gun position was plotted on 15th September and by the end of the month 166 guns had been located between Atawineh and the sea. Finally, a Meteorological Section under Lieutenant Bamford was added to the company in June.

CHANGE OF COMMAND

In June, 1917, Lieut.-General Sir Edmund Allenby succeeded Lieut.-General Murray as C.-in-C., E.E.F. The administrative work done by the latter had formed the solid foundation on which General Allenby, as he readily admitted, was able to base the plans for operations which ultimately brought the campaign to such a brilliant conclusion. After reaching Cairo on 27th June he spent several days at the front, where he discussed the situation with General Chetwode and visited each sector and many headquarters and units. One of his first decisions was to transfer the greater part of G.H.Q. from Cairo to a new camp between Rafah and Khan Yunis. Morale at the moment was not high, as the disappointing reverses of the spring and the climatic hardships had combined to lower men's spirits to a marked degree. Possibly as much as the strong personality of the new commander, knowledge that he and his staff would henceforth share many of the discomforts of the troops in the field, instead of living in remote and relative comfort in Cairo, was responsible for improvements in outlook after the change of command. The E.-in-C. was to accompany the forward echelon of G.H.Q., leaving Brigadier-General Paul as D. of W. with the rear echelon in Cairo.

PRELIMINARY PLANS FOR A RENEWED OFFENSIVE

The War Cabinet's instructions to General Allenby were that he was to destroy the enemy in Southern Palestine, capture Jerusalem and eventually drive the Turks out of the rest of Palestine. General Chetwode had prepared an appreciation which showed the importance of the two principal engineering factors—the railway and water pipe-line. Any attack upon the strong Beersheba-Gaza

position, which the Turks clearly intended to hold, was complicated by the dearth of water in the area in front of it, and elaborate measures (some of which have already been described) were necessary to remedy this. The pursuit and destruction of the enemy forces raised questions of supply and transport. The sea was unreliable and roads were poor and infrequent; an extension of the railway was the most practicable means of increasing supply facilities but, as this could not be anything but slow, a rapid pursuit over any considerable distance was out of the question.

General Chetwode considered that an attack against the Turkish left flank near Hureira offered the best prospects of decisive success, in spite of the long approach march over almost waterless country and the necessity of capturing the valuable wells at Beersheba at a very early stage. To overcome these disadvantages the railway should be extended from Shellal or El Qamle so as to supply a force between Abu Irquaiyiq and Beersheba which could capture the latter. The water from its wells, combined with supplies from Shellal and other places near the Wadi Ghazzee and from the railway, would then enable the British to attack northwards and to the north-west towards Hureira and Tell esh Sheria.

General Allenby adopted this plan with some modifications and informed the War Office on 12th July that the Turks were expected to oppose any attack on their present line but not to take the offensive themselves. The enemy strength was habitually over-estimated, both in Egypt and London, and, when General Allenby asked for reinforcements to give him a total of three mounted and seven infantry divisions, with the usual proportion of corps and army troops, the request was not regarded as excessive. For any subsequent operations—and possibly even for maintenance on the Jerusalem-Jaffa line—General Allenby said that he would require a considerably larger force, which would involve doubling the railway as far as Rafah and, in consequence, duplicating the pipeline.

REINFORCEMENTS AND REORGANIZATION

Before the extent of General Allenby's demands or the reorganization adopted in the late summer can be realized it is necessary to trace the growth of the E.E.F. subsequently to Second Gaza. It consisted at the end of April of two mounted divisions almost at full strength, three depleted infantry divisions and a fourth (the

74th) in process of formation. Reference has already been made to reinforcements and the first of these to reach Egypt were the 7th and 8th Mounted Brigades with the 8th and 9th Field Troops which arrived from Salonika in June. The 9th Troop did a certain amount of work in the Canal Zone before both troops went to the front in July.

These reinforcements increased the number of mounted brigades to ten which were reorganized in three divisions named the Anzac, Australian, and Yeomanry Mounted Divisions, with the 7th Mounted Brigade and the 8th Field Troop as army troops: the Australian Division included the 5th Mounted Brigade and the Yeomanry (formed on 20th June) the 6th, 8th and 22nd Mounted Brigades. The last-named division also contained the 6th, 7th and 9th Field Troops and these were formed at the end of June into the 6th Field Squadron.

The 60th Division began to reach Egypt from Salonika on 14th June and the 74th Division, although possessing two field companies only, was ready to take part in operations by the end of the month. The C.R.E. of the 60th Division, Lieut.-Colonel R. Q. Henriques, was succeeded on 27th August by Lieut.-Colonel C. B. Thomson. The field companies were the 519th, 521st and 522nd and the divisional pioneer battalion was the 1/12th Loyal N. Lancs. Regiment. After reorganization on E.E.F. establishments the 60th Division relieved the 53rd Division in the Weli Sheikh Nuran area at the end of July, the R.E. taking over all water supply there and also at El Qamle.

On 21st June a new division—the 75th—was constituted from nine battalions from Egypt, Aden and East Africa. Major G. S. C. Cooke from the 14th Army Troops Company was appointed C.R.E. with the rank of lieutenant-colonel but only two field companies were available—the 495th and the 496th. The 75th Division had no artillery and would not be operational for some months.

General Allenby therefore had five infantry divisions available in July of which all but one were still below strength. His statement to the War Office that he required seven divisions was thus equivalent to a request for two more, and of these the 75th, when further reinforced, was regarded as one and the 10th Division from Salonika, promised on 10th August, as the other. Man-power and shipping difficulties prevented all his other demands from being met in full, but the two army troop companies which he required for roads, railways, water supply and hutting were sent. None

of these reinforcements were due to arrive in time for an early autumn offensive.

The 10th Division began to reach Egypt at the end of August. The C.R.E. was Lieut.-Colonel E. M. S. Charles, the three field companies were the 65th, 66th and 85th and the pioneer battalion the 5th R. Irish Regiment. The usual conversion to E.E.F. establishments took place, and by 8th October the divisional R.E. were concentrated in the Rafah area for training with detachments of the 53rd Divisional R.E. to gain local knowledge.

During August the organization of the E.E.F. was changed considerably. The Desert Column became the Desert Mounted Corps under Major-General Chauvel but the appointment of C.E. was changed to that of a C.R.E., Lieut.-Colonel R. E. M. Russell succeeding Brigadier-General R. L. Waller. The field squadron commander acted as C.R.E. in each of the three mounted divisions. The infantry were reorganized in two corps—the XX and XXI. The former consisted of the 53rd, 60th and 74th Divisions, with the 10th Division, although still nominally G.H.Q. troops, attached, and was commanded by Lieut.-General Chetwode with Brigadier-General Waller as C.E. The XXI Corps, containing the 52nd, 54th and 75th Divisions, was commanded by Lieut.-General E. S. Bulfin and the C.E. was Brigadier-General R. P. T. Hawksley, promoted from C.R.E., 74th Division.

THE L. OF C. AND THE CANAL DEFENCES IN 1917

Palestine L. of C. was formed on 2nd May and certain works came under the control of its A.D.W., Lieut.-Colonel Cooper. A few small R.E. detachments were employed at various points but the only major item worthy of record was the decision in February to cease maintaining the Romani defences. It was considered possible for 3,000 men to clear drifted sand in forty-eight hours in case of need. A similar dispensation was obtained in March in regard to the El Abd defences but work on the El Arish defence programme was continued until the summer.

In January, 1917, the 54th Division, at that time the only division remaining in the Canal Defences, was ordered to join Eastern Force but its departure was delayed by heavy rains which damaged roads and light railways. Its field companies handed over all works to the Works Directorate. The reduction in the strength of the garrison

led to the reduction of the number of bridges and ferries to be maintained in the Southern Section to four of each, the other bridges being laid up but kept in repair. Other work was largely confined to maintenance of the defences, which became the responsibility of the 1/2nd Kent (now renumbered the 496th) Field Company on its arrival from the W.F.F. on 3rd February. On reaching Moascar this unit was ordered to supply a detachment of fifty-six of all ranks to form a field troop for the Imperial Camel Corps Brigade. On 26th March the 496th Company began to move to Rafah, where it came temporarily under command of the 74th Division, after handing over to the 14th Army Troops Company. This company was the only R.E. unit in the Southern Section. It sent detachments to take part in a number of desert operations and in January and February, laid over twenty-five miles of 4-in. water pipe-lines and erected much hutting. In March some of this was dismantled and at the end of April the company left for the Eastern front.

In the Northern Section the 5th R. Monmouth. was at Qantara in charge of operating the El Arish pipe-line but in April it was reorganized as a field company and left to join the 74th Division at Deir el Balah. It also carried out a wide range of works, including moving the heavy bridge from Shallufa to Qantara to increase the cross-canal facilities for transporting stores to the main supply depot on the east bank, and dismantling the barrel pier bridge to save man-power.

Another matter which was reviewed from time to time was that of maintaining the inundations extending the area of Lake Timsah. At the end of January it was agreed that pumping should stop and in November the inlets with tide-flaps were closed to prevent the encroachment by flood water upon the increased camp area at Qantara.

Arising from the remoteness of any threat to the safety of the canal, G.H.Q. issued instructions in April that R.E. troops and material in the Canal Zone were to be progressively reduced. In the first stage much of the water supply systems was to be dismantled for re-use elsewhere and all hutting beyond railheads was to be removed. In the next stage all light railways were to be closed and their rolling stock collected at the bridgeheads; the pumping plants at bridgeheads were to be laid up but not dismantled; the boat and barrel bridges were to be broken up but the heavy bridges at Kubri and Qantara, one "flotteur" bridge at each important post and all chain ferries were to be retained.

This policy of retrenchment, in spite of the labour requirements for salvage, enabled considerable economies to be made in the Works Directorate staff of the A.D.W., Sharqia Province. In May the E.-in-C. approved the reduction of the works areas in the Southern Section to two, the release for duty elsewhere of several works officers, one army troops company, half a field company and a large number of E.L.C. The Northern Section was embodied in the Palestine L. of C. on 2nd May and the only reductions possible were on defence works. As a result, several R.E. units, a considerable labour force and large quantities of stores were made available to support the advance into Palestine.

To reduce the possibility of raids against the canal the C.-in-C. on 29th April ordered the destruction of various wells which might be of use to the enemy in crossing the Sinai Desert. Opposite the Southern Section the wells at Nekhl were the only ones not previously destroyed and a column, accompanied by a R.E. detachment under Lieutenant C. F. Mulvaney and a survey party left Serapeum for this objective on 22nd May. The R.E. cleared an emergency landing ground on the way at Bir el Giddi and this was twice used by the R.F.C. Five wells at Nekhl were demolished.

A change in the works organization in Egypt in February reduced the area of Sharqia Province and Lieut.-Colonel Close became C.R.E., Canal Zone, until May. A considerable amount of work was carried out under his direction at camps, hospitals and depots, including a cold store* with marine refrigeration plant at Port Said in readiness, for the advance into Palestine. On 10th September the 560th (Devon) Army Troops Company reached Qantara and worked under the D.O.R.E. at various places, including the new G.H.Q., until it left for Rafah at the end of October. This coincided with the arrival of the two army troops companies for which General Allenby had asked—the 570th (Devon) and the 571st (Devon). Both worked under the D.O.R.E. on various works services at the Qantara Base. Most of the 571st Company moved to Deir el Balah in the middle of December.

WORKS IN EGYPT DURING 1917

On 12th January, owing to the increasing amount of work for the R.F.C., Lieut.-Colonel A. Adams was appointed A.D.W. Aircraft Constructional Works, with his headquarters in Cairo. For normal

* Still in use during World War II.

works services there were two areas (exclusive of Sharqia Province, which was controlled by Eastern Force)—Cairo and Alexandria, each with a C.R.E. In February the C.R.E., Cairo, Lieut.-Colonel E. Tillard, became C.R.E., Delta District and L. of C. Defences, and a considerable part of Sharqia Province was absorbed. On 15th March, Western Force and Delta District were combined as Delta and Western Force; the C.R.E.'s title was changed to A.D.W. and the D. of W. became responsible for all R.E. work, both operational and static, in the new command. In June Lieut.-Colonel Close was appointed C.R.E., Alexandria.

Works for the R.F.C. included two operational airfields at Ismailia and Suez and a third nearing completion at Aboukir. Site levelling and clearing were straightforward as the airfields were small and as there were no concrete or bituminous runways. The major engineer effort required was for the extensive accommodation necessary. Work was also in progress at Abbassia, Heliopolis, Suez, and in Upper Egypt. Ismailia was completed early in August and, as part of the doubling of accommodation required in connection with the expansion of the R.F.C., a new air station was begun at Qantara. On 1st September much new work was started, and included accommodation at three places for five squadrons in the new training wing, for a fighter training squadron at Heliopolis, and at Suez and Qantara. In October a new airfield was begun at Heliopolis and by this time the A.D.W., A.C.W., had a staff of over eighty all ranks supervising a labour force of some 2,600 Egyptians.

For the greater part of the year almost the only R.E. unit engaged on works services was the 1/3rd (Devon) (569th) Army Troops Company, with detachments at various points, including those for operating the condensing plants at Mersa Matruh and Mahamdiyah. This unit moved to the Canal Zone at the end of May. Works executed by contract included prisoner-of-war camps, reservoirs, ordnance depots, hospitals and a wide range of minor services, besides dismantling unwanted structures, salvage and maintenance. Brigadier-General Paul visited Cyprus in January, Southern Egypt in April and the Western Desert in May. On 22nd May all water transport on the Suez Canal was handed over to the I.W.T. by the R.E. Advanced Park.

In September Brigadier-General Paul again visited Cyprus to inspect the forestry operations producing timber and firewood for the E.E.F. Preparations for the autumn offensive required a considerable amount of work, much of which was in connection with

camps and hospitals. The C.R.E., Alexandria, for example, was instructed to increase hospital accommodation by 3,700 beds, which he accomplished during October at the modest cost of £2,445, and the A.D.W., Delta and Western Force, completed two general hospitals.

STORES

The responsibilities of the D. of W. regarding engineer stores during 1917 remained much the same as they had been in late 1916. Supply to Salonika continued and occasionally involved difficulties when the somewhat unusual channel for demands was not followed.

The 13th Base Park Company remained at Alexandria throughout 1917, engaged on its unspectacular but valuable work in handling and making stores of all kinds. The 569th (Devon) Army Troops Company operated the sawmills at Wardian until 13th June, when it was relieved by the 13th Base Park Company. The 569th Company then took over the R.E. Park at Port Said, hitherto run by the 46th Advanced Park Company, and converted it to a timber depot. The 569th Company still had detachments at various points when it moved to Qantara in the autumn.

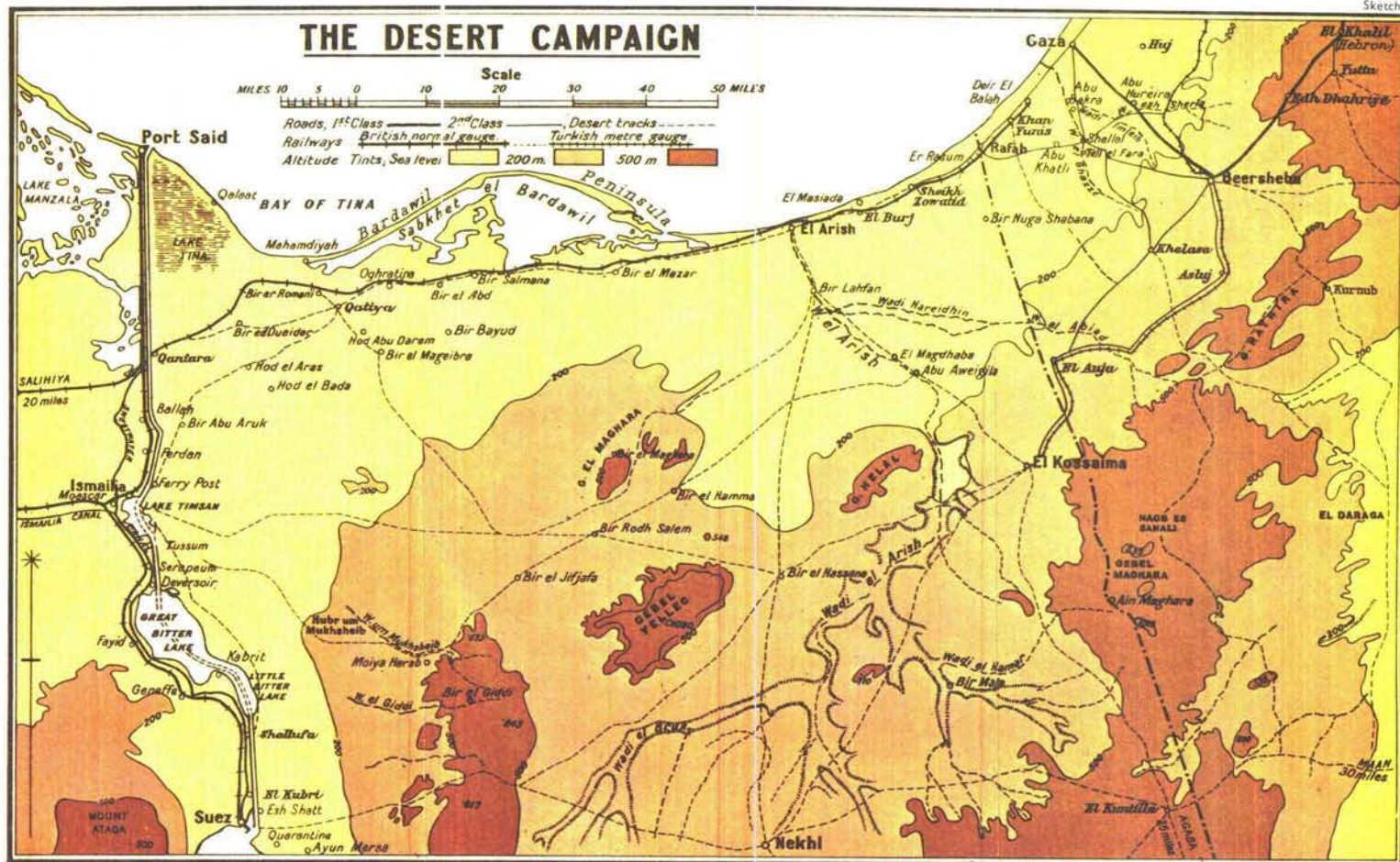
The work of the 46th Advanced Park Company in the Canal Zone continued to be heavy throughout the year and to meet the requirements of the lengthened L. of C. various changes in organization had to be made. In January a preliminary reconnaissance was made for a site for a new R.E. Park at El Arish, but by the time it was opened in March the further advance to the Gaza area made it of little value and on 28th April it was transferred to Rafah. Meanwhile the older parks on the canal continued to deal with large quantities of stores. In the first half of the year over 72,000 tons of stores were received and 70,000 tons issued, of which rather more than half were handled at Qantara. On 25th May the Port Said Park was closed and the Ferry Post Park became a salvage park.

In addition to supplying stores to the Eastern front, L. of C. and Canal Zone, and overhauling and storing salvaged materials, the 46th Advanced Park Company was also responsible for the maintenance and supply of machinery. In order to obtain the most efficient discharge of all these duties, a stores officer was sent in March to railhead, first at Rafah and later at Khan Yunis; wharfage and cross-canal facilities at Qantara were increased; more extensive use of native labour was made and a drive for economy in the use of timber in the forward area begun. One weakness, about which it

was realized action must be taken as soon as possible, was the absence of any special facilities for transporting stores from railhead to units at the front. In the case of infantry divisions the R.E. camels were usually pooled under A.S.C. control and thus the supply of stores entirely depended upon how much mechanical transport Cs.R.E. could borrow. This transport was often not available and at other times the ground was unsuitable for its use. Another difficulty was the lack of any organized method of transferring stores from an old railhead to a new one.

STORES HANDLED IN CANAL AREA AND SINAI
By the 46th Advanced Park from January to June, 1917

		Ferry Post. (Salvage Depot after 25th May)		Qantara		Port Said. (Timber Depot after 25th May)		El Arish. (Rafah after 1st May)		Total	
		in	out	in	out	in	out	in	out	in	out
January 1917	Rail Water Road	878 4,000 60	319 4,868 —	830 5,649 —	2,510 104 800	105 111 27	35 2,396 48	— — —	— — —	11,651	10,080
February	Rail Water Road	840 4,176 80	382 2,783 20	800 5,600 —	5,200 50 800	20 140 151	— 712 65	— — —	— — —	11,807	10,012
March	Rail Water Road	546 6,700 80	473 3,000 —	1,650 5,000 —	4,500 140 1,000	25 170 313	555 2,719 118	1,460 — —	760 — 550	15,944	13,815
April	Rail Water Road	160 3,875 60	157 2,858 —	1,840 2,500 50	5,445 130 500	1,246 678 —	293 910 134	1,350 — —	830 — 400	11,759	11,637
May	Rail Water Road	118 1,578 60	121 2,324 60	3,770 4,020 15	7,400 500 200	630 850 3	144 1,379 158	1,550 — —	200 — 1,000	12,594	13,406
June	Rail Water Road	27 1,205 20	47 2,890 —	2,894 3,432 12	6,552 600 150	— — —	— — —	940 — —	520 — 300	8,530	11,059
Total, 6 months		24,463	20,282	18,053	36,581	4,469	7,646	5,300	4,560	72,285	70,069



CHAPTER XXVI

PREPARATIONS FOR THE AUTUMN OFFENSIVE, 1917

Topography of Southern Palestine—The plan for the autumn offensive—R.E. preparations for the offensive—Water supply—Railways—Roads and bridges—Survey.

(Maps 5 and 6)

TOPOGRAPHY OF SOUTHERN PALESTINE

A BRIEF description of the topography of Southern Palestine is desirable to enable the operations from the third battle of Gaza in November to the end of the campaign a year later to be followed clearly and the nature of the engineering problems to be appreciated.

The country comprises five distinct belts, parallel not only with each other but also with the coast and the axis of the British advance from El Arish. The familiar strip of sand dunes, up to three miles wide, extends along the coast as far as Jaffa, with similar water potentialities as before. Inland of the dunes is the undulating Philistia Plain, some fifteen miles wide—a tract of sand, loam and black cotton soil, often overlying calcareous sandstone and intersected at right angles to the sea by several small rivers which seldom dried completely during the summer. Cultivation was general and there were many citrus groves with irrigation systems. Water is plentiful at a considerable depth but, although there were a number of deep wells, more boreholes were required for large permanent supplies. The streams are almost useless as a source of supply in summer and there are no springs. Certain areas were highly malarial. Roads were few and of poor quality. The 3 ft. 5½-in. Turkish railway from Beersheba ran northwards to Junction Station, where the Jerusalem branch line started and connection was made through Lydda, with Jaffa and with Syria via El Affule and Der'a.

Inland from the plain a much eroded and barely recognizable escarpment marks the beginning of the wild jumble of the irregularly stratified and deeply fissured limestone hills of Judea. From the plain to the abrupt escarpment of the Jordan Valley is a distance of twenty-five to thirty miles; the maximum elevation is a little under 3,000 feet above sea-level and Jerusalem, in the heart of this natural fortress, is about 2,600 feet. Communications were poor;

there were the narrow-gauge railway ending at Jerusalem, a few thinly-metalled roads and a number of tracks barely suitable for pack transport. The roads comprised a bad route from Beersheba through Hebron and Jerusalem to Nablus, one little better from Jaffa and Ramle to Jerusalem and a worse track parallel to the last and a few miles to the north of it. Rainfall was quickly absorbed by the limestone or ran off in the tangle of ravines to lower ground, and the Nubian sandstone beds beneath the limestone were not water-bearing. Springs were frequent but tended to dry quickly in the summer. The sparse population therefore relied largely upon water stored during the rains in large underground rock cisterns shaped like bottles with narrow necks. Jerusalem had a large number of these cisterns and the remnants of an ancient system of aqueducts.

To the eastward was the enormous rift valley, some ten miles wide, in which the Jordan ran much below sea-level. The Jordan fell, in the area under review, from minus 700 to minus 1,300 ft. at the Dead Sea, and Jericho, the only place of importance in the valley, was minus 850 ft. Great heat, humidity, dust, malaria and insects combined in the summer to make conditions appalling and few Europeans were believed to have endured a hot weather season in the valley.

Finally, beyond the Jordan, the Mountains of Moab rose steeply to form a rampart between the valley and the desert where the Hejaz Railway ran. Apart from one or two tracks the only semblance of a road was that from Jericho through Es Salt to Amman, a station on the Hejaz Railway, 120 miles south of Damascus.

THE PLAN FOR THE AUTUMN OFFENSIVE

On 10th August, 1917, General Allenby received fresh War Cabinet instructions on strategic policy. They were simply that, in order to gain a victory in Palestine, he was to defeat the Turks opposed to him, vigorously to follow up his success and to continue to press the enemy to the limit of his resources. No geographical objective was set and the capture of Jerusalem was not specifically mentioned.

On 15th August he issued the outline of his plans to his corps commanders. Based on General Chetwode's appreciation, the offensive was to start as soon as preparations were complete and seven infantry divisions were available. The main effort was to be made by the Desert Mounted and XX Corps against the enemy's

left, but quite vigorous operations against the enemy's centre and right by the XXI Corps were also to be undertaken. Should, however, the offensive have to be launched before the seventh division was ready, the operations of the XXI Corps were to be limited to a demonstration. The main attack was to be preceded by the capture of the essential water supplies at Beersheba. The XX Corps, covered on its right by mounted troops, would then advance to the north and north-west against the enemy's left flank and drive him from his positions at Tell esh Sheria and Hureira. The gap between the XX and XXI Corps was to be covered by mounted troops at Shellal until the second phase of the main attack. They were then to rejoin the Desert Mounted Corps in its advance on Tell en Nejile, eighteen miles north of Beersheba, to complete the destruction of the enemy's left, to threaten his line of retreat and possibly to make large captures. The later stages could not be predicted but in them the XX Corps might be required to roll up the enemy's line towards Gaza or, if this proved impracticable, the XXI Corps, supported by transport diverted from the XX Corps, would capture Gaza and advance along the coastal plain.

The attack was provisionally planned to take place in September, but it soon became apparent that the extensive administrative preparations and the desirability of the new formations becoming familiar with local conditions necessitated a postponement to the end of October. Although this would give little time for the exploitation of a successful attack before the winter rains, it was accepted as more satisfactory than a premature offensive.

The success of the attack depended finally on supply and the major factor in this was water. Unless Beersheba was captured with its wells intact on the first day, the large British forces on the right would probably have to return to their starting points. Moreover, the amount of water in the arid country beyond Beersheba could not be predicted and the risk of being unable to develop an initial success because of this and other supply difficulties had to be accepted.

Communications produced another big problem. The flanking movement was to take place some distance from the branch railhead and further still from the main line railhead, but the latter could not be advanced until Gaza had been taken, and even then plate-laying could not keep up with a successful pursuit. The condition of the tracks which served as roads made road transport an inadequate substitute for the railway but, until the rains, lorries could

not only use the tracks but could also travel across country. The small number of lorries available was supplemented, in the case of the Desert Mounted Corps, by Holt tractors for the transport of ammunition and engineer stores—a measure which was to prove of great value in the Beersheba operations. R.E. units had camel transport and a few pack mules for reaching the less accessible points. Additional water gear was carried in place of some of the more cumbrous and little used equipment.

R.E. PREPARATIONS FOR THE OFFENSIVE

From September onwards the divisional engineers were mainly occupied in preparing for the attack upon the Gaza defences. The front line was advanced in places, new assembly and communication trenches were dug, gun positions, O.Ps. and dug-outs built for the new heavy batteries, deep cables laid for intercommunication, roads and water supply systems (including pipe-lines) laid out or improved and large forward dumps of stores established. Most work of a defensive character was stopped, although various measures had to be taken, e.g., sandbag walling to existing wells in the Wadi Ghazze, or the sinking of new wells on the banks to safeguard water supplies from the effects of flooding during the wet season. Many detailed reconnaissances were made on the open right flank towards Beersheba and a considerable amount of training was done by most companies.

The following R.E. units were engaged on these tasks. The 519th, 521st and 522nd Field Companies of the 60th Division were engaged in the el Qamle area from early August. The first two companies took part in an important reconnaissance of the Wadi Hanafish and the cisterns at el Buqqar on 4th August and the 522nd Company also executed work for the R.F.C. at Sheikh Nuran and built a new corps headquarters.

The Sheikh Abbas sector was held by the 52nd Division until the middle of September and during this period E.L.C. labour was available for the first time in the forward area for road drainage, cable laying and water dump duties. Water development, however, was mainly executed by the field companies. One of the deep wells at el Mendur was now yielding 123,000 gallons daily and the 410th Company, in addition to installing several smaller pumping plants, laid 2,700 yds. of 4-in. pipe-line to storage for 40,000 gallons in the Kh. Mansura valley. The 412th Company erected canvas storage

concealed by hessian for 50,000 gallons at Kh. Mansura and the 413th Company sank several new wells, 40 ft. deep, above flood level along the Wadi Ghazzee. On 12th/13th September the 75th Division took over the Sheikh Abbas sector. While in corps reserve at Deir el Balah the 495th Field Company worked for nearly a month in the reserve divisional area and the 496th Company installed pumping plant at a deep well at the mouth of Wadi en Nukhabir and executed water supply and other works, including services for heavy artillery. When the 52nd Division was relieved the 410th Company remained, attached to the 75th Division, to make good the deficiency of the third field company in that formation until No. 10 Company, Sappers and Miners, joined on 29th September. Work continued as described previously, although handicapped by a shortage of materials and a high incidence of sand-fly fever—the 496th Company alone having fifty-nine men in hospital at one period. The Mansura water dump was increased to 72,000 gallons, new dressing stations were built, and ammunition dug-outs, gun-pits, O.Ps. and map rooms constructed for the heavy batteries. As October passed, work continued at ever increasing pressure to complete the extensive preparations in time. One of the final tasks was training infantry parties attached to each field company in water duties.

The 54th Division took over the coastal sector on the night of 25th/26th August. The first major work was the construction of a new fire trench, 1,300 yards long, which advanced the British line by a maximum of 850 yards north-west of Umbrella Hill, by 2,400 infantry supervised by detachments of the 484th and 486th Field Companies. The new line was marked on the night of the 27th/28th, and the fire-bays dug to a depth of 3 ft., the parapets sandbagged and most of the wire put out by the R.E. on the following night. The ground was heavy and the work arduous. The Turkish fire in bright moonlight exacted a toll of fifty infantry casualties although the R.E. escaped. The 484th and 486th Field Companies were mainly engaged on water-supply work during September and the last-named unit sank several wells at night near the front line. Their yields, however, were small and they were later superseded by a piped supply laid by the 35th Army Troops Company. To augment the engineer resources of the 54th Division an improvised pioneer company of some 200 selected infantry was attached permanently to each field company in September. This innovation enabled more work to be done than by ordinary working parties

and avoided the repetition of instructions associated with the previous constant changes. On 22nd September the 2/23rd Sikh Pioneers were attached to lay a decauville line from the Wadi Ghazzee to Sheikh Ajlin on the coast, and throughout most of September and October some 500 E.L.C. were also attached for work on wells, roads, the wadi crossings and stores duties. The 484th and 486th Field Companies continued preparatory work in the forward area, including the building of several shell-proof dug-outs with heavy timber roofs, 10 ft. of earth or sand cover and a bursting course of stones, and they remained in position when the 52nd Division took over the coastal sector on 29th September. Building deep dug-outs in loose sand was difficult, but this type of soil localized the effects of shell bursts, as was shown when a dug-out with only 5 ft. of cover showed no sign of collapse after a direct hit by a 4.2-in. shell. All dug-outs had two entrances. Many splinter-proof dressing stations were also built, the main stations (holding thirty-two stretcher and sixty sitting cases) being gas-proofed. The 484th Company laid a 3-in. pipe from Sheikh Ajlin to the front line and collected pipes for a 1,200-yd. extension to the enemy positions when these had been captured. The 410th and 412th Companies of the 52nd Division assisted in the forward preparations and transported great quantities of defence stores to three divisional and eight advanced dumps by nightly convoys of up to 400 camels.

From the end of August onwards one brigade after another of the 74th Division did a spell of duty in the coastal sector and, with first the 5th R. Monmouth, and from 6th October the 410th Field Company, continued the work already described in advancing the front line. The 5th R. Anglesey was engaged on preparations in the Deir el Balah area from 4th September, and on 2nd October made a detailed reconnaissance and improvement of the cisterns and catchment areas at various points in front of the right flank near El Buqqar and Sebil, and for road crossings at the Wadi el Sabe. On 8th October the 5th R. Monmouth, moved south with the 231st Brigade and on the 23rd a detachment with eighteen pumps and other water gear joined the 5th R. Anglesey for the first stage of the operations. This unit had sent five trestle wagons with water stores to the divisional dump at Shellal.

When the 52nd Division went into reserve in September the 412th and 413th Field Companies in the Wadi Nukhabir worked on headquarters for the XXI Corps Heavy Artillery group, main-

tenance and drainage of wire roads and water supply. On 28th September an infantry pioneer company of 132 of all ranks was attached to each field company, a measure which was to prove as successful during the forthcoming operations as in the 54th Division. Tests made at this time by the C.R.E., 52nd Division, of the 5-H.P. Isler/Lister pumping set, of which two were allotted to H.Q.R.E. of each infantry division, showed that under average conditions 1,000 gallons per hour could be lifted 100 ft. for a consumption of $1/3$ gallon of petrol. At the end of the month the 157th Brigade (including the 413th Company) was attached to the 54th Division and the 410th Field Company rejoined. On 7th October the 52nd Division returned to the coastal sector, where the 157th Brigade Group again came under command, but did not relieve the 54th Division until nearly the end of the month. In the meantime all three field companies, in addition to their routine duties, were busy with the final preparations for the attack and overhauling equipment. This work included making four *chursas* for each company—a *chursa* being an ancient device for lifting water from a well in a container (in this case a conical, canvas bag) and discharging it into tanks by tackle operated by mules or oxen.

On the night of 27th/28th October a sharp rainstorm flooded the Wadi Ghazzee but although no harm came to the wells or water gear some of the causeway road crossings were damaged and urgent repairs were carried out by various R.E. and E.L.C. detachments.

The work of R.E. companies outside the divisional organization falls largely within the special categories described in the pages immediately following, but it may here be mentioned that from 15th October the 35th Army Troops Company worked with 1,450 E.L.C. in the Rafah area, largely on water supply, and that the 220th Army Troops Company at Weli Sheikh Nuran on the right flank began extensive preparations for developing the Beersheba wells, laying out three roads leading to near El Qamle, erecting hangars and other accommodation for the R.F.C. and installing, by 10th October, pumping plant to supply Shellal.

On 31st October the H.Q. of the 569th (Devon) Army Troops Company reached Rafah for stores duties; this unit still had four detachments on the L. of C. and now sent two more to operate advanced R.E. Parks at Deir el Balah and Shellal.

WATER SUPPLY

The preparations for water supply on the Gaza front have already been described ; by 19th September all new pumping plants and pipe-lines were in operation and by the end of the month all the water dumps had been completed. On the eve of the offensive the water requirements of three mounted divisions, one mounted brigade, seven infantry divisions and their corps and army troops—a much larger force than at the time of the earlier Gaza battles—were being satisfactorily met.

The outcome of the operations shortly to be described very largely depended not only upon the efficient working, particularly on the right flank, of this complicated system, but also upon the rapid exploitation of the Beersheba supplies and upon successful development of local resources later. The problems involved varied with the four principal phases, which were as follows :—

- (a) The approach march from the right flank and the attack upon Beersheba.
- (b) The exploitation of the supplies from the Beersheba wells.
- (c) The attack on the Turkish left flank, closely linked with (b).
- (d) The pursuit across the Philistia Plain.

The attack on Beersheba and the concentration for subsequent operations north-west of the town involved an approach march of many miles over largely waterless country by some 45,000 men and 26,000 animals. Information on possible sources of water supply was gradually collected by reconnaissances and other means by Lieut.-Colonel R. E. M. Russell, C.R.E., Desert Mounted Corps, under whose direction the watering arrangements for the mounted troops on the right flank were made. By 27th August it had been established that a yield of 15,000 gallons per day, supplemented by 300,000 gallons in pools, could be obtained from the Wadi el Sabe and that 310,000 gallons were stored in the Wadi Imalaga near Bir el Esani. On 5th September Colonel Russell reported that, between these places and Beersheba, two divisions could be watered within a short time of reaching the Khelasa area, although the maximum supplies could not be developed until the fourth day, and that storage for 200,000 gallons was recommended. Later information did not materially alter this estimate but the E.-in-C. although in general agreement, considered that the actual quantities available and the amount of work required ought to be more accurately assessed by further reconnaissances. To take one example

of the latter made on 24th September of three wells at Khelasa which had been demolished, it was confirmed that two could be expected to yield 2,000 gallons per hour and that in the time available the 1st Australian Field Squadron could re-open them and pump 100,000 gallons to storage. This and other more detailed information agreed closely with earlier estimates.

It was decided that water development could be begun fifteen days before zero day at Abu Ghalyun, nine days before at Khelasa and six days before at Asluj (six miles south-east of Khelasa), but that the extension of the pipe-line from Shellal was not to be taken beyond Esani until 22nd October, nine days before zero. The approach march of the mounted troops towards Beersheba was to be by a circuitous route to the south through Khelasa and Asluj, but that of the XX Corps from the Wadi Ghazze between El Qamle and Shellal was to be almost direct. The XXI Corps was responsible for water supply in the Mendur-Sheikh Ajlin-Deir el Balah area and for all pumping forward from railhead.

On 22nd October, after supplying the railway, some 156,000 gallons daily were being pumped from El Arish to Rafah, where 100,000 gallons were being used. The balance, and the yields from Khan Yunis, totalling 360,000 gallons, were all being pumped to various points in the forward area. In addition 100,000 gallons were being delivered daily by rail to Shellal and El Qamle. The delivery points of the 260,000 gallons of piped supplies and the operation of the pumping stations was controlled by G.H.Q. through Captain Gibson, commanding the 359th (Water) Company at Rafah. In the early stages of the operations much of this water was directed to the right flank where elaborate storage and distribution arrangements were made to supply the three mounted and four infantry divisions concentrated between El Qamle and Hiseia. These arrangements included the concrete and masonry dam, 6 ft. high by 120 ft. long at Shellal, which impounded in a rocky basin some 14,000 gallons per hour of spring water. Three sets of 25-H.P. pumping plants were installed for local distribution and for pumping, if required, by a new 6-in. pipe-line to storage for 200,000 gallons at Karm or beyond. Each set could deliver 4,800 gallons per hour against a 200-ft. head.

At Shellal a camel-tank area with filling capacity of 2,000 tanks per hour was organized. A short length of decauville track and two branch hoses ran from each of six stand-pipes, each track being used to take the filled tanks to thirty-two sandbag platforms 6 ft.

square. Strings of twenty-four camels were led in parallel to the pipe-line and stood between pairs of platforms while their tanks were loaded. There were 192 platforms in all.

The water area at Kareim Abu el Hiseia (north of Shellal), designed to water one mounted division, was typical of development generally. Storage for 20,000 gallons was provided on the banks of the Wadi Ghazze by building four circular sunken tanks, about seven feet deep, in half-brick walling on a lightly reinforced concrete floor and covered with tarred hessian to exclude dust. They supplied a waterbottle filling area, a camel tank filling area and a horse-watering area with a head of 20 ft. The last consisted of canvas storage for 28,000 gallons supplying 720 lineal feet of horse-troughs built of masonry in cement or mud mortar from which 9,000 horses could be watered in three hours.

Other preparatory work included further high level storage tanks at El Qamle (40,000 gallons) and Hiseia (28,000 gallons), filled by pumping, and each capable of filling 250 camel tanks hourly; the establishment of a special water stores dump at Shellal; and the erection of over 3,000 lineal feet of wood and masonry watering troughs in the wadi between El Qamle and Shellal, sign-posted for specific units.

On 23rd October, after the concentration on the right flank had begun, the 6-in. pipe-line from Imara to Karm was extended. The work was carefully organized; the pipes were brought by rail to the Imara water dump and distributed thence by four tractors and sixteen buck wagons, the line was divided into sections of 275 yards and four fitters and a hundred E.L.C. were allotted to each. The complete pipe-line, over three miles long, was distributed and jointed on the first day, the sections coupled, the line washed out and tested, and the distribution arrangements at Karm completed on the second, pumping from Shellal being started that night. On the 25th distribution began at Karm and storage for 60,000 gallons was erected at Imara, followed by more storage at Karm to take rail-borne water when railhead reached this point on the 28th. Thereafter water was distributed from Karm at the daily rate of 80,000 gallons for several days. For the first two days 75 per cent was conveyed by two large camel convoys to the cleaned cisterns at Kh. Khasif, south-west of Karm. In all 30,000 camels were to be engaged on water transport during the next few days.

For the exploitation of the Beersheba wells the 220th Army Troops near Weli Sheikh Nuran, with a special mobile workshop

which arrived on 22nd October, assembled and tested the pumping plants, prepared derricks and tackle for sinking wells and tested selected infantry for operating the power pumps. The special stores were arranged in independent groups consisting of pump, oil engine (bolted to a heavy timber frame to save time as compared with concrete beds), ancillary stores, tools, seven-days' fuel, canvas storage and distribution fittings. Three pumping sets each had a capacity of 2,700 gallons per hour and two of 1,200. There were also two well-sinking sets designed for use if the wells were found demolished, and each consisting of a derrick and tackle, casing for sinking a well 6-in. in diameter to 90 ft., boring tools and explosives. Their secondary task, if new wells were found unnecessary, was to raise water with special buckets of 17 gallons capacity. The whole was to be transported to Beersheba by eight caterpillar tractors, each pump unit being accompanied by a detachment of twenty men from the 220th Company and each well unit by six sappers and eight specially trained miners from other arms. The 220th Company, with its attached troops, tractors and stores, moved to its assembly position at El Qamle on 30th October.

Preparations for water supply during the advance after the capture of Beersheba and Gaza were of a more general character and had been started some months previously. Major-General Wright, the E.-in-C., in an appreciation dated 18th June, 1917, considered that local wells, possibly supplemented by deep bores, would meet requirements as far as Jaffa and would avoid any serious water difficulties. Field squadrons and companies were trained and equipped with gear and transport to deal with local wells, but their usefulness was to be increased by providing H.Q., R.E. of divisions with two hand pumps for wells up to a hundred feet deep and two light power pumps (Isler/Lister sets) for wells up to 150 feet. An Isler/Lister set and fittings was carried by one trestle wagon. For deep bores two powerful plants, with well casings, pumps, gear and trained men, were ready; a third party and equipment was being assembled. Dr. Hume's geological advice was available, and Lieutenant Mangin, I.A.R., a deep well expert, was on his way from Mesopotamia.

The later development of water supplies in the occupied areas would fall to the army troops companies, for which thirty power pumping sets of 1,000 gallons per hour capacity and twenty of 2,000 to 6,000 gallons were allotted for wells from fifty to a hundred feet deep. The form of transport for this considerable amount of plant

was not decided until later. Several light centrifugal pumps, nineteen miscellaneous pumping sets for pipe-lines and some fifty miles of 4 to 6-in. pipes were collected for use on local distribution.

The pumping machinery came from a variety of sources and there were some thirty-two makes and sixty-eight types of engine of from $3\frac{1}{2}$ to 90-H.P. and eighty-three types of power pumps. The engines used in forward areas seldom exceeded 25-H.P. Many of the heavier deep well pumps with deliveries of 3,000 to 6,000 gallons per hour were made in Cairo, as were also a dozen duplicates of the Wagner pump (6,000 gallons) captured at Khan Yunis for the rapid repair or replacement of damaged pumps of similar design much used in Palestine. There were portable or semi-portable low lift (up to 25-ft. head) sets with deliveries of 4,000 gallons per hour and a few specially high lift up to 500-ft. head.

To handle this mass of machinery efficiently, the Ferry Post workshop was moved in September, 1917, to Rafah, where, with a much larger establishment, it became the Machinery Park, R.E. It took on charge all kinds of machinery, of which water equipment was the largest group, and unpacked, assembled, tested, repaired and issued plant. It occupied six and a half acres and its 27,000 square feet of buildings were erected in a month. It kept a register of 300 engines and 350 power pumps of different types, each of which was given a R.E. number and a list of spares. Each was recorded by drawings and sketches and, later, a history was compiled of each piece of machinery. The pattern shop was handicapped by the only wood available being a low grade of pitch pine but very many patterns and core boxes were in constant use. The moulders' shop also worked under difficulties; the sand was of poor quality and many normal items of equipment were not available. Cupolas, blowers and furnaces were built and even tools were made locally, both for the moulders' and smiths' shops. The machine shop was fairly well equipped. The Park began to function shortly before Third Gaza and rendered excellent service.

RAILWAYS

The estimated rate of construction of the main-line railway was to make it of little value for supply purposes during the first stages of the pursuit, but almost all supplies would have to be carried by it when the rains made the roads impassable by mechanical transport. Arrangements were made for the quickest possible extension of the main line as soon as the tactical situation allowed but a short

extension from Mile 141 to a dummy station beyond the Wadi Ghazzee was ordered before the battle, with the dual objects of misleading the enemy into thinking that the main effort was to be made against Gaza and of facilitating the resumption of construction after the battle. It was begun by the 265th Railway Company on 12th October and the Wadi deviation was finished on the 30th, in spite of heavy rain on two days. The 265th Company, followed by the 266th Company, then laid a new siding at Rafah Station, while the 115th and 116th Companies moved back to resume laying the second line.

The Rafah-Shellal branch was extended some six miles eastwards to Karm advancing this railhead to twenty-five miles from Rafah to assist the supply of the forces operating against the Turkish left. Construction did not start until the last possible moment so as not to give premature indication of the British plan, but it was then to be executed at the rapid rate of two miles daily. Further extensions of this and the Qamle branch, as well as a light railway from Karm, were also planned but not all these works were found necessary. The extension from Shellal was begun by the 115th Railway Company, assisted by one and a half battalions of Sikh Pioneers and 400 E.L.C. on formation work, on 21st October the 116th and 266th Companies joined the construction parties. Nearly all the work was done at night, covered by a screen of troops and both track and formation were covered with brown screening to conceal them from enemy aircraft. The 266th Company laid out Imara and Karm Stations, arriving on the site of the latter during the yeomanry action on 28th October. In spite of the rain Karm Station was opened to traffic one day ahead of schedule, on the 28th—a fine performance by all concerned.

The light railway system radiating from Deir el Balah has already been described but, under the direction of Major Jordan-Bell, some extensions were made before the battle and several thousand yards of track were laid beyond the Wadi Ghazzee, partly by the 14th Army Troops Company. They were of great value in completing the large forward dumps of supplies and ammunition which could not otherwise have been formed owing to the transfer of transport to the right flank.

ROADS AND BRIDGES

During August, roads had a lower priority than most other R.E. work, but the postponement of the offensive until shortly before the

rains made extensive improvement of roads necessary if the later operations were not to be unduly hampered by difficulties in moving supplies. There were no all-weather roads in the Gaza area but the existing tracks would serve for most purposes until the wet season. In order to prevent their becoming impassable after rain, much draining, grading and wiring of tracks was carried out by various R.E. units with E.L.C. labour during September and October.

The main natural obstacle behind the British front was, of course, the Wadi Ghazze. It was crossed with little difficulty during the dry weather by the two-way ramps cut in its 25-ft. banks with causeways across the bed, but the onset of the rains often produced an initial spate nine feet deep, subsiding to six feet with a three to four knot current. This involved bridging, but although stores were sent forward during the summer no unit could be spared for construction until the end of July, when the 14th Army Troops Company was detailed for the work. Six bridges—four for 60-pounder guns and two for 120-H.P. tractors with two trailers—were required. Captain Davies was responsible for their design and Lieutenant N. H. Craig for construction. Heavy timber was scarce and smaller scantlings had to be used in conjunction, but the design reduced the types of trestle to two, although of varying heights. Each trestle was built on piles and the bottom 3 ft. of the trestle cased in boarding and filled with stones to reduce scour. All timber was cut and the trestles assembled at the company's workshops at Deir el Balah; piling began on the first bridge on 25th July and, although pressure of other work prevented more than four bridges being under construction at the same time, the last bridge was finished on 24th September, well before the rains. The longest bridge was that at the mouth of the Wadi Ghazze (529 ft.) and both tractor bridges were 156 ft. long.

SURVEY

The Printing Section of the 7th Field Survey Company was busy preparing and issuing maps and trench diagrams up to the eve of the battle. The largest group was that giving enemy gun positions, of which 629 had been located by the sound ranging sections, R.E., before the operations began. On this information twenty-four shoots were made against the more active batteries.

CHAPTER XXVII

THE THIRD BATTLE OF GAZA AND THE PURSUIT

The final plan of attack—The concentration on the right flank—Capture of Beersheba—Development of the Beersheba water supplies—The attack on Gaza—The raid against the Hebron road—The attacks upon the Turkish left flank—Operations at Gaza, 3rd to 8th November—The pursuit and the capture of Junction Station.

(Maps 5 and 6)

THE FINAL PLAN OF ATTACK

GENERAL SIR EDMUND ALLENBY'S final orders were issued on 22nd October, 1917, and contained some modifications due to the absence of the full reinforcements for which he had asked. The orders show how the main effort and most of the subsequent operations were dependent upon the early capture of Beersheba and the rapid development of its water supply. The activities of the XXI Corps during these operations were to be restricted to a demonstration in force against the south-west defences of Gaza. As soon as the Beersheba water supply had been organized the Desert Mounted Corps was to advance northwards, attacking the Turkish left if necessary, and the XX Corps was to capture the Turkish positions called the Rushdi System, between the railway and the Wadi esh Sheria. In essence the plan was simple, although some of the details were complex. It accepted some risks, such as the twenty-mile gap between the main attack and Gaza. Through this, however, the nature of the ground and the character of the enemy made any counter-move unlikely. General Allenby at this period envisaged Jaffa, forty-five miles beyond Gaza, as the final objective and fixed the date of the main attack, starting with the assault on Beersheba, for 31st October.

THE CONCENTRATION ON THE RIGHT FLANK

The preliminary moves for the concentration on the right began ten days before the main attack, in order to give time to develop

the water supplies at Khesala and Asluj on the route of the flank-march of the Desert Mounted Corps south of Beersheba. On 21st October the 60th Division, at Qamle and Tell el Fara, moved a brigade group, with the 519th and part of the 521st Field Companies, a pioneer battalion, 1,100 E.L.C. and sixteen tractors carrying water equipment, to Bir el Esani. By the evening of the 22nd this important area was ready to water 9,000 men and many animals. Next day two portable power sets delivering together 8,000 gallons per hour, 150,000 gallons storage, distribution arrangements, several wells and 200 horse-troughs with lift and force pumps were installed, and the whole area was finished on the 26th, when the supply was 100,000 gallons per day.

Most of the 53rd Division marched from Deir el Balah to Hiseia during the night of 24th/25th October and the 155th Brigade Group to El Imara, where one section of the 436th Field Company watered the troops covering the railway extension to Karm. On the following night part of this field company helped the 158th Brigade to construct an outpost line from Imara to the Tell el Fara-Beersheba road. On the 26th the 8th Mounted Brigade and the 9th Field Troop, temporarily attached to the 53rd Division, reached Hiseia and prepared to relieve the Australian Mounted Division north of El Buqqar, where the latter had prevented interference with the Karm railway. The 9th Field Troop prepared to water the construction parties at Goz el Basal and the 437th Field Company drew defence stores from Shellal for the El Buqqar outposts.

Early on the 27th the Turks, alarmed at this activity, attacked the yeomanry posts near El Buqqar but a gallant resistance enabled work on the railway to continue, and the 437th and 439th Field Companies began work later in the day on twenty-one outposts and infantry defences in the El Buqqar line. This work was continued during the next two or three nights. On 30th October the 30th Brigade and 66th Field Company of the 10th Division reached Sebil and were attached to the 53rd Division.

Turning to the operations of the Desert Mounted Corps, Maalaga and Abu Ghalyun were occupied at daybreak on 22nd October, and shallow wells in the Wadi Khelasa soon yielded fair supplies of water. That night the Camel Brigade and the 10th Field Troop reached Khelasa and next morning restoration of its two damaged wells was started. Working in two-hour shifts the troop cleared the wells down to 40 ft., installed pumps and engines with a capacity of 4,500 gallons per hour and obtained enough water for one mounted

division. After a two-days' halt, Bir Asluj, eight miles to the south-east was occupied on the night of 25th/26th October. Enemy demolitions had been thorough and repairs and the installation of pumping plants required much labour, but by the 30th the wells were supplying a mounted division, Desert Mounted Corps Headquarters and "a considerable concentration of friendly Arabs."

Progress on water supply during the first week was better than had been expected and enabled the final moves to be expedited. The leading brigade of the Desert Mounted Corps remained at Asluj, but the 60th Division moved up to the Maalaga-Esani area, one brigade of the 74th Division filled the gap between the 60th and 53rd Divisions, the main body of the 10th Division moved to Shellal and the Yeomanry Mounted Division occupied the line of the Wadi Ghazzee between Tell el Fara and Shellal. Some minor changes in the allotment of R.E. and attached units took place but engineering activity was confined to water duties.

By the morning of 30th October the concentration had been successfully completed. It had not passed unnoticed by the enemy, who, however, partly as a result of British deceptive measures, interpreted the moves on his left flank as a feint and, assuming that the main blow was to fall on his right at Gaza, did not reinforce Beersheba. The British dispositions before the main attack were as follows:—

H.Q. Desert Mounted Corps and Anzac Mounted Division—Asluj.

Australian Mounted Division—Khelasa.

60th Division—Abu-Ghalyun, Esani and Rashid Bek.

74th Division—El Buqqar and Khan Khasif.

53rd Division and 30th Brigade Group—Wadi Hanafish.

10th Division (less 30th Brigade Group)—Shellal.

Yeomanry Mounted Division—Shellal and Tell el Fara.

CAPTURE OF BEERSHEBA

After the final stages of the long flank-march during the previous night, the attack upon Beersheba was made early on 31st October from two directions—the Anzac Mounted Division from the east and the 60th and 74th Divisions from the west. The mounted troops were to envelop the enemy's left rear and, if possible, to seize the wells before the Turks had time to destroy them. After some delay the 4th Australian Light Horse Brigade occupied the town by

6 p.m. Little damage had been done to the wells but their exploitation did not start until the C.R.E. and a field company of the 60th Division arrived early next morning.

The 60th and 74th Divisions moved to their assembly positions west of Beersheba after nightfall on 30th October. The 521st Field Company of the 60th Division built a road parallel to the Wadi Mirtaba during the night and put down two water points. In the 74th Division part of the 5th R. Monmouth., with pioneers and infantry working parties, constructed seven road crossings in the Wadi el Sabe and built an artillery road to the Wadi Abushar and an ambulance road. On the left the Camel Brigade and two battalions of the 53rd Division extended the front to the Tell el Fara-Beersheba track and the rest of the 53rd Division with the 30th Brigade Group of the 10th Division continued the line to north of Karm Station. Most of the 436th and the whole of the 437th Field Companies made road crossings and developed water supplies in the Wadi Hanafish, while the 439th Company constructed advanced posts. The main body of the 10th Division moved to Goz el Basal, where it was watered from Karm Station and from the Imara wells by the 85th Field Company.

The assault by the 60th and 74th Divisions against the Beersheba defences started at 8.30 a.m. on the 31st; the former gained all its objectives by 1 p.m. and the latter, who had the more difficult task, somewhat later. In the 60th Division, the 519th and 521st Field Companies attached sections to the leading brigades for wire cutting but their services were not actually required. The 522nd Company worked all day on roads and water supply, and in the afternoon the 519th Company moved to near Beersheba. In the 74th Division, part of the 5th R. Anglesey developed four water areas at El Buqqar with twenty-four lift and force pumps and storage for 24,000 gallons, which was filled by a camel convoy at 1.30 p.m. for watering 4,300 horses. The 436th Company of the 53rd Division worked on the Wadi Hanafish road and developed two local wells, installing a Lister/Isler set for horse-watering. The 439th Company with the 160th Brigade prepared to occupy Beersheba. At night two sections of the 66th Field Company erected wire in front of the 30th Brigade and another section was engaged on water supply.

DEVELOPMENT OF THE BEERSHEBA WATER SUPPLIES

The amount of water needed immediately at Beersheba was 400,000 gallons per day (enough to supply the mounted troops and

the two infantry divisions which had taken the town) and, as soon as possible, enough for the initial needs of the troops operating during the second phase beyond Beersheba against the Turkish left flank. The minimum requirements were that all animals should be watered and that all troops should have one day's water in hand during a phase of the operations in which local supplies were unpredictable.

The development of the Beersheba supplies began when Lieut.-Colonel Thomson, C.R.E., of the 60th Division, and the 519th Field Company reached the town at 8.20 a.m. on 1st November. Several of the seventeen principal wells were quickly found and, although most of them had been prepared for demolition, the Turks had left in such haste that two only had been destroyed, two were partially damaged and the engines (but not the pumps) at three put out of action. *Sagqias* were working at three other wells and two reservoirs containing 90,000 gallons were intact. As some of the wells were not found for some time and the yield of others was small, work was concentrated on the seven largest, all but one of which were east of the town. The maximum depth was 130 ft. and the yields appeared abundant. Provided, therefore, that the damage could be repaired and distribution organized quickly, the water situation seemed satisfactory.

No time was lost in starting work. The 519th Company began to clear debris and was soon helped by the 521st Company, who arrived at midday. The tractor-borne pumping sets appeared at 10.30 a.m. and were followed in the early afternoon by the 220th Army Troops Company, the 1/12th Loyal N. Lances (Pioneers) (60th Division) and the 439th Field Company (53rd Division). The favourable aspect of the water situation now began to be adversely affected by a series of set-backs. The incidence of a severe sand-storm with fine dust and great heat not only hindered repair work but also increased the demand for water over the next three or four days. Many of the wells were concealed in houses or by walled enclosures, two not being located until the third day and another until the fourth. Nevertheless, within a few hours one *sagqia* had been repaired and the full yield of that particular well was being utilized, but for the first three days the sappers were fighting against time to meet rapidly rising demands. Buckets and ropes, in spite of their small capacity, were used at two wells and the surface pools in a wadi near the town provided a minor but valuable supply. Storage was erected to avoid waste and to facilitate distribution, but in

spite of the most strenuous efforts the water accumulated during the night of 2nd/3rd November was exhausted early next morning and the situation became critical.

This serious situation resulted in there being no water for the 180th Brigade, who arrived at 10 a.m. on the 1st, and it had to move out of the town in the afternoon. An attempt to reduce consumption was made by limiting the drinking time for animals, but although this worked well with camels owing to their habit of drinking in two bouts, the thirst-maddened horses were very difficult to control and, had guard rails not been erected at most troughs, much damage would have resulted. Almost the last straw was added to the engineers' burden with the arrival at 4 p.m. of a mounted brigade whose horses had not been watered for two days. Fortunately another well with a damaged *saqqia* had been found at midday; when repaired by the 6th Field Troop, its yield of some 1,500 gallons per hour was sufficient to enable this brigade to start watering at midnight. During the afternoon a valuable reinforcement arrived in the shape of four pumping sets which had been used at Asluj; these were re-erected at Beersheba and early on 4th November the combined efforts of all concerned resulted in the yields of all the wells being raised to a rate of nearly 400,000 gallons per day. Distribution arrangements had also been completed and the crisis was past.

The work done on the wells included the repair of three Turkish pumps, the repair of a damaged engine by using parts of another, the replacement of two *saqqias* by pumping sets and the erection of six engines and three pumps brought up by tractor. The latter were of a type that could be installed quickly but no others were available. The timber engine beds saved some valuable time, as did the use of triangular frames, secured largely by wedges, for the pumps and rod-guides instead of the usual joists set in masonry. Nevertheless repair work was not rapid and, to quote the experience at one well 48 ft. deep, with no engine, a damaged pump and choked with rubble, the pump was repaired and the debris cleared within eight hours of the arrival of the tractor on the site, but a further forty hours was needed to install the new engine and pump and to arrange distribution. The set was then run continuously for three days with a mean delivery of 2,700 gallons per hour. The best well yielded 3,700 gallons per hour, six produced about 1,700 gallons and four 1,000 gallons. During all the operations resulting in the capture of Beersheba and the development of its water supplies thirty-three

pumps and engines with a combined H.P. of 290 were installed and storage for 1,100,000 gallons was erected. The special 17-gallon buckets made by the 220th Army Troops Company were most successful, and at one 90-ft. well delivered 1,600 gallons per hour.

THE ATTACK ON GAZA

The attack on the Gaza defences, originally intended as a feint, finally took the form of an operation which could be converted into the main British effort if the Desert Mounted Corps were successful in enveloping the Turkish left. The date of the operation was left undecided, except that it was to take place one or two days before the attack on Sheria position, behind the Turkish left flank. The date of this attack was largely dependent upon the water situation at Beersheba but, as the first reports on this were favourable, it seemed early on 1st November that it could be delivered on the 3rd or 4th. General Allenby, therefore, ordered the XXI Corps to attack at Gaza on the 2nd and adhered to this date when later reports of the Beersheba situation indicated that the Sheria attack might be delayed.

The task of the XXI Corps was rendered harder by the fact that, to help its fellow formations on the right, the element of surprise had been deliberately sacrificed. Since 27th October the heaviest artillery bombardment of the war outside the European theatres had been in progress against the Gaza defences, and the enemy had thus had ample warning that a serious attack was probable. Preliminary operations, in which its field companies were not to be engaged, were to be undertaken by the 75th Division on the right of the XXI Corps and the main assault was to be delivered by the 54th Division, with the artillery, 412th Field Company and 156th Brigade of the 52nd Division under command. On 30th October the final moves to the assembly positions took place, the field companies of both divisions put the final touches to the ambulance roads and water supply arrangements, and the R.E. detachments joined the assaulting brigades on 1st November—one section with infantry pioneers to each brigade in the 54th Division, and two sections, from the 410th and 412th Field Companies, and more infantry pioneers to the 156th Brigade.

The attack took place in four phases. The first opened at 9.30 p.m. on 1st November when a battalion of the 156th Brigade successfully assaulted Umbrella Hill in a local operation. The detachments of

the 410th and 412th Field Companies laid direction tapes from the old British front line for the second phase, helped in consolidation, and built dug-outs, barricades and flying traverses. Heavy artillery fire caused casualties, and work on a new communication trench had to be suspended.

The main attack against the Turkish front line was delivered at 3 a.m. on the 2nd, by three brigades, supported by four tanks. In spite of counter-attacks the 156th Brigade on the right captured and held almost all its objectives, but the 163rd Brigade in the centre and the 161st Brigade on the left were less successful. The Turkish artillery fire was heavy and dust made it difficult to keep direction. The fighting was severe and progress slower than had been hoped for, with the result that the third and fourth phases were delayed. At 4 a.m. two tanks, loaded with engineer defence stores, advanced to support the infantry, but both were put temporarily out of action when their sandbags were set on fire. The R.E. detachments helped in consolidation, but that of the 486th Field Company with the 163rd Brigade was not called upon until nightfall on the 2nd, owing to the insecure footing in the Turkish positions.

The fourth phase was preceded by the construction by part of the 484th Field Company and infantry pioneers of a wire road near the coast but this was delayed by the late capture of the Turkish front line. Eventually the 162nd Brigade were successful, and at 4.15 p.m. had advanced one and a half miles along the coast. Soon afterwards a tank with engineer stores arrived to assist in consolidation. The rest of the 484th Company built a new battle headquarters for the 162nd Brigade, developed water supplies at three wells and in the evening sent two more detachments and pioneers to consolidate the captured area.

Owing to heavy artillery fire and frequent counter-attacks the Imperial Service Brigade, did not succeed in exploiting the situation on the coast, but at the cost of 2,700 casualties, the objects of pinning down the enemy at Gaza and of inflicting considerable loss upon him had been gained. R.E. work during the next few days was largely devoted to consolidation and water supply.

THE RAID AGAINST THE HEBRON ROAD

Concurrently with the attack on Beersheba a small party under Lieut.-Colonel S. F. Newcombe, R.E., made a wide flanking march

east of the town and cut the telegraph line on the road to Hebron on the evening of 31st October. When Colonel Newcombe heard that Beersheba had been captured, he decided to try to hold the road and to cut off any Turkish force retreating northwards. When his tiny force was located, the enemy, coupling its presence with the movement northwards of two mounted brigades and an infantry division (53rd), assumed that a thrust through Hebron to Jerusalem was intended and began to move troops eastwards to counter it. On 2nd November part of these troops heavily attacked Colonel Newcombe's detachment, which had already caused them considerable losses. After an engagement in which he lost twenty men killed, had many wounded and had nearly all his machine-guns disabled, Colonel Newcombe surrendered. His raid had had results out of all proportion to the size of his force and, although these were at first unfavourable in that they attracted troops to the Turks' left flank, ultimately assisted in opening the gap through which the British exploited their success.

THE ATTACKS UPON THE TURKISH LEFT FLANK

The British attack on the Turkish left in the hills north of Beersheba, was delayed, first by the enemy's reaction to the loss of the town and then by the water situation. The Turks, alarmed by the British troop movements northwards and the capture of their important outpost, reinforced their left flank and offered greater opposition than had been expected. In regard to water it became clear late on 1st November that there was little prospect of an early realization of the required daily supply of 400,000 gallons at Beersheba. The country northwards was waterless until the wells and cisterns at Bir Khuweilfe (ten miles north-north-east of Beersheba) were reached. The 7th Mounted Brigade (with its field troop) and the 3rd Light Horse Brigade were ordered to occupy Khuweilfe and by nightfall on 2nd November advanced elements were in sight of their objective but not strong enough to take it.

On 1st November the 60th Division remained at Beersheba while the 74th and 53rd Divisions crossed the railway. The 5th R. Anglesey watered most of the 74th Division from a camel convoy west of Beersheba and the 436th and 437th Companies were engaged on track repairs and water supply for the 53rd Division. On the 2nd, preparations were made to meet Turkish counter-attacks,

the 436th Company assisting the 158th Brigade to organize a defensive line beyond Tuweivil Abu Jerwal, seven miles north of Beersheba.

On the 3rd, when the water crisis was at its height, the 53rd Division was ordered to advance to Ain Kohle in the hope that fresh sources of supply might be found. The advance took place in great heat over difficult country, with artillery and transport animals reduced to a minimum. The 160th Brigade on the right, with the 437th Field Company repairing tracks, reached the heights overlooking Khuweilfe but failed to reach the wells in the face of hardening opposition. On the left the 159th Brigade reached a point near Ain Kohle but could not capture the village. The 436th Company improved tracks and wadi crossings ahead of the brigade, and in the evening Major Scott reconnoitred the village, which was still occupied by the enemy. The 439th Company, in reserve, brought water gear up ready for use. This advance was covered on the right by mounted troops along the Hebron road. The 74th Division, largely because of the water shortage, was immobile and was only supplied at all by the exertions of the 5th R. Anglesey at a well in the Wadi Sufi.

The corps commander informed General Allenby on the 4th that, owing to exhaustion from thirst and the water difficulties generally, the 53rd Division could not take Khuweilfe until night and that the Sheria attack would have to be postponed until the 6th. This delay was reluctantly accepted, and the 4th was uneventful except that the 5th Mounted Brigade repulsed an attack on the right and the 160th Brigade made an abortive attack on the Khuweilfe position. The 53rd Divisional engineers were engaged on road repairs and water supply, the 436th Field Company moving back in the evening to establish a divisional water dump with equipment sent up by the 439th Company. The 437th Company, searching for water, got limited quantities from one well with lines and buckets and installed a Lister/Isler set next day. The 74th Division remained stationary, but handed over its well in Wadi Sufi to the 519th Company when most of the 60th Division moved out of Beersheba to be watered by the 522nd Company at Bir Abu Irqaiyiq.

The 5th was an equally indecisive day. Although the yield of the Beersheba wells had now reached the daily requirements the poor tracks between the town and the hills at Sheria, ten miles away, led to a continuing shortage of water at the front and the attack on Khuweilfe was again postponed in consequence. The

work of the 53rd Divisional R.E. and of a large force of E.I.C. under Brigadier-General Waller, C.E. XX Corps, on communications between Beersheba and the front, particularly on the Tell el Fara road, was, however, about to be rewarded and the improvements enabled the Sheria attack to be launched on the 6th. The better water and transport situation enabled the 10th Division to be brought up on the left, after it had exhausted the last of the 350,000 gallons of drinking water stored in the Khasif cisterns. To supplement these sources the 65th Field Company installed a deep well pump at Sebil and the 60th Company deepened the wells in the Wadi Hanafish. By the 5th the divisional R.E. had moved forward to the Wadi Imleih.

The attack on the Turkish positions two miles from Sheria, whose water supplies were one of the most important objectives, was made on the 6th by three divisions astride the railway. The right flank was to be covered by the 53rd Division, now part of the Desert Mounted Corps, advancing to a line five miles long, west of Khuweilfe. As the axis of this movement diverged from the railway the Yeomanry Division from Ain Kohle was to fill the gap as the advance progressed. The 53rd Division, in spite of hard fighting, did not gain all the Khuweilfe heights but it held large numbers of the enemy which would otherwise have attacked the right of the XX Corps or reinforced the defenders of Sheria. All three field companies were busy all day on roads and water supply, sustaining some casualties, and at night the 436th Company helped in consolidation. The Yeomanry Division had an uneventful day, although the 6th Field Squadron had to counter-march at night to water the horses sent back to Beersheba.

In the XX Corps the 74th Division attacked on the right of the railway with all three brigades in line, each with a detachment of the 5th R. Monmouth. After hard fighting all objectives were reached soon after 1 p.m. Some two hours later the 5th R. Anglesey reached Irqaiyiq and established a horse-watering area near-by. The 60th Division with two brigades, each with one section of R.E. attached, and the 31st Brigade of the 10th Division, advanced through the Rushdi System and reached their objectives by 2.30 p.m. The Turkish positions were well constructed but the lack of facilities for firing to a flank no doubt hastened their capture. At 3.30 p.m. each field company of the 10th Division sent two sections with defence stores to convert the captured positions into a series of strong-points. This had been a critical day. Every horse in the

10th and 60th Divisions had had to march twelve miles to Shellal to water, thus being absent throughout the battle, and, if the Wadi esh Sheria had not been reached by evening, the situation of at least three divisions might have compelled a hasty and serious withdrawal.

The long hoped-for water supplies varied. A reconnaissance under fire, by Lieutenant Gordon of the 5th R. Anglesey, established the welcome news that there was enough water in the Wadi esh Sheria for at least two divisions, but development could not be started until after nightfall. The 60th Division was unable to cross the wadi, in spite of several attempts, but found water south of the Hureira Redoubt. The 10th Division was short of water in spite of the supply from four wells, including one in Wadi Imleih developed by the 66th Field Company. A large camel convoy, however, brought water from Shellal.

The day's operations had been generally successful and General Allenby, counting on a gap being opened in the Turkish line when the Wadi esh Sheria was crossed during the night, released the Anzac Mounted Division from G.H.Q. reserve to enable the Desert Mounted Corps to operate behind the Turkish left in a rapid advance to Kh. Jemmame and Huj to capture the water supplies, followed by the interception or pursuit of all the Turks between Sheria and Gaza.

The Wadi esh Sheria was not, however, crossed until the morning of the 7th when two brigades of the 60th Division established a bridgehead 1,500 yards in depth. This was soon followed by the capture on the left of the strong Hurcira Redoubt by the 31st Brigade of the 10th Division. These operations widened the gap sufficiently for the two mounted divisions to pass through, after watering in the Wadi esh Sheria. Arrangements for this were made under artillery fire by the 519th and 522nd Field Companies of the 60th Division with a company of the 5th R. Irish Rifles (Pioneers) but were not finished until during the night. The 66th Field Company of the 10th Division also developed supplies in the wadi for the 29th Brigade, the 65th Company developed Bir Iteis, and the 85th Company helped to consolidate the Hureira Redoubt. On the right the 53rd Division on the Khuweilfe heights stood fast all day, the 436th Company improving tracks to the front and the 437th Company relieving the 521st Company of the 60th Division on the Beersheba wells. The R.E. of the 74th Division prepared to water the Yeomanry Division, which spent the day containing the enemy

in the hills on the right, in the Wadi esh Sheria on the 8th, the 5th R. Monmouth, digging twenty sump wells and installing twelve pumps and eighteen troughs, brought up by tractor while the 5th R. Anglesey developed supplies four miles away at Sheria and watered 8,000 horses during the night. The 7th Mounted Brigade's field troop also developed supplies in the wadi but in spite of all these exertions there was considerable difficulty in watering all the horses of the Desert Mounted Corps before it started upon its drive to the sea.

OPERATIONS AT GAZA, 3RD TO 8TH NOVEMBER

Near the coast the 3rd November was hot and dusty and there was little change in the situation of the XXI Corps. One local attack only was made and efforts were mainly directed towards consolidation of the ground already gained. Large quantities of defence stores were sent forward to the 54th Division, and detachments of the 484th and 486th Field Companies were engaged under shell fire at the front. During the following three days both companies put up barbed wire, dug communication trenches, and laid wire-netting tracks. The Turkish trenches were badly constructed, and, having no parapets, now afforded little protection. The forward R.E. sections therefore concentrated on building dug-outs for battalion and company headquarters, machine-gun teams and signallers, utilizing the material from the flimsy Turkish shelters under the parapets. Defence stores were brought up nightly by camel convoys and no shortages occurred. The 484th Company worked on water supply, repairing the forward pipe-line when damaged by shell fire, bringing a well in the old British front line at Ajlin into use and installing standard equipment on three new wells near the coast.

When Sheria had been captured and the cavalry was about to start its drive, the 75th Division was ordered to attack the defences south of Gaza during the night of 6th/7th November, and the 54th Division to resume its attack from the west next morning. The first attack fell on empty air because the Turks had evacuated the town. The 496th Field Company had two sections engaged in cutting wire during the early hours of the 7th, and, when the enemy's withdrawal was discovered, this detachment began to fill in trenches to enable wheeled transport to cross. The 54th Division occupied Ali el Muntar, and sapper patrols entered the ruined town to search for land mines and wells. Many pumping plants, but only one well,

had been damaged, but there was copious water within forty yards of the sea, and by 8 a.m. next morning the whole of the divisional transport had been watered.

In order to prevent the enemy during his withdrawal from occupying the strong Wadi el Hesi position, eight miles north of Gaza, the 157th Brigade Group, which included the 413th Company, passed through along the coast soon after midday on the 7th. One section R.E. marched with the advanced guard and after very heavy going in soft sand reached the Wadi at 7 p.m. and developed water to supply the brigade. At night the 155th Brigade and the 410th and 412th Field Companies also reached the Wadi el Hesi, and before midnight a battalion of the 157th Brigade captured the trenches north of the wadi. The three field companies worked all night to develop supplies from the running water at the wadi mouth and from shallow wells and spear-points along the shore. Next morning the water areas were shelled and although casualties were slight, the tanks and troughs were damaged.

Early on the 8th preparations were made for an attack north of the wadi by the 52nd Division. Defence stores were brought up by tractor and part of the 413th Field Company was given the unusual task of forming part of the reserve to the 157th Brigade. The attack was launched by two brigades at 4 p.m., and after stiff fighting and an initial repulse on the left the final objectives four miles north were reached just before 9 p.m. At midnight the 413th Company's detachment was released to rejoin the rest of the divisional R.E. on water supply in the Wadi el Hesi. During the afternoon the Imperial Service Brigade made contact with the Desert Mounted Corps six miles north-east of Gaza, where the pumping installation was captured intact. No charcoal could be found to operate the engine and the brigade withdrew several miles and was watered from severely damaged wells by a section of the 486th Field Company of the 54th Division. The 484th Company erected a Lister engine to operate a deep well with pump left intact.

The 75th Division remained in the Gaza area on the 7th and 8th. Detachments of the 495th and 496th Field Companies, after filling in trenches and cutting tracks through the cactus hedges, took standard pumping sets and *chiursas* into the town, and by the morning of the 8th two wells were giving good yields for the 232nd Brigade. Of eighteen wells south of Gaza examined by the 495th Company one only was suitable for development and was used to water the 234th Brigade.

THE PURSUIT AND THE CAPTURE OF JUNCTION STATION

On the right flank the passage of the Desert Mounted Corps through the gap at Sheria, in pursuit of the defeated Turks across the Philistia Plain, began on 8th November. Into the details of their operations it is unnecessary to enter except to record that they were handicapped by water difficulties and by the time they made contact with the XXI Corps the Turks had escaped the net. During their subsequent pursuit they found that most of the villages and all the Jewish agricultural colonies had wells up to a hundred feet deep, the lifting or pumping gear was found either to have been removed or damaged or to be in a decrepit condition. Field squadrons, in the interest of mobility, were equipped on a lower scale than field companies for water development and although they did well with their standard lift and force pumps and *chursas* they had to use buckets and lines on some of the deeper wells. With this equipment, the watering of even a single squadron took several hours; rapid movement became impossible and many horses went thirsty for long periods.

The Desert Mounted Corps was followed on 8th November by the 60th Division until it was immobilized at Huj by having to return its borrowed transport. The 519th Field Company reached Huj late on the 8th and the 522nd Company arrived next morning from Sheria where it had repaired a steam pumping set at the 55-ft. well at the railway station and where it was relieved by the 521st Company from Beersheba. The water situation at Huj was acute and detachments of R.E. exploited supplies at Jemmame and three other points to ease it. All three field companies of the 10th Division, less detachments in the rear, spent the 8th in developing water supplies for two divisions in the Wadi esh Sheria, south of Hureira. The Yeomanry Division was attacking the Turks in the hills near Khuweilfe when it was ordered on the 8th to break off the action and to rejoin the Desert Mounted Corps. It was watered at night in the Wadi esh Sheria by the 6th Field Squadron and the 74th Divisional R.E. and moved to Huj next morning. Owing to the water shortage the division was then ordered to Jemmame, where the 7th Field Troop began installing water facilities during the evening.

Because of water difficulties and of the departure of its borrowed transport, the XXI Corps was now more or less immobilized and took no part in the pursuit through Philistia. The 53rd Division in the

Khuweilfe area once again came under command of the XX Corps and for nearly a fortnight its field companies were mainly engaged on water supply and road work. On 11th and 12th November reconnaissances of the steep rocky track towards Hebron were made by the 439th Field Company with an escort of mounted troops and during the following week this unit with infantry working parties made considerable improvements to it. Road and water reconnaissances, sometimes under fire, were pressed on along the track. The 60th Division remained at Huj and Jemmame, but the 10th Division moved back to the Karm area on the 10th to ease the supply problem. The field companies of both formations were engaged on routine water duties and salvage. The 74th Division moved back to Abu Irqaiyiq on the 8th and 9th, leaving two sections of the 5th R. Monmouth. at Sheria until the 16th, when they handed over their water areas to the 60th Division.

On 9th November the pursuit of the retreating Turks was continued by the Desert Mounted Corps, supported by the 52nd and 75th Divisions of the XXI Corps. For supply reasons the 54th Division remained in the Gaza area. No bridging was required in the Wadi el Hesi, as it was almost dry, and similar conditions were met at both the other water obstacles between Gaza and Jaffa—Nahrs Suqreir and Rubin. Efforts to develop water at various points were made by most of the field companies—the 413th having most success in the area north of the Wadi el Hesi, where eleven wells gave a good supply, but part of the 495th with the 232nd Brigade Group met with difficulties further north.

On 10th November a great effort was made to reach Junction Station in order to cut off the considerable Turkish forces between Hebron and Et Tine from the railway and so compel them to rely upon the road from Jerusalem for supplies. To cover this movement on the right flank, the Camel Brigade with the 10th Field Troop moved up the railway north of Sheria and the 60th Division was ordered to parry any counter-attack from the right. The Yeomanry Division, after being watered by the 6th Field Squadron north of Huj, and again on the march, was to relieve the Anzac Mounted Division east of Ashkalon. The two leading divisions of the XXI Corps were ordered to reach the Nahr Suqreir. On the right the 232nd Brigade was within ten miles of Et Tine, and the advanced troops were watered by two sections of the 495th Field Company. The rest of the brigade was watered by a detachment of the 496th Company from the Wadi el Hesi. On the left the 157th Brigade

Group, which included the 413th Field Company, nearly reached the Nahr Suqreir after a trying march in great heat and a sand-storm, and ended the day by an attack after dark against unreconnoitred positions. The 413th Company watered not only its own brigade but the greater part of two mounted divisions as well. There were six wells, some a hundred feet deep, and one shallow well in the dunes, but at one only was the ramshackle lifting gear working. This sufficed to water one mounted brigade before it collapsed. The 412th Company developed supplies at Ashkalon and the neighbourhood, where, with two sections of the 413th Company, large numbers of mounted troops were watered next day from several deep wells with suction-gas and steam plants. The 410th Company advanced with the 156th Brigade.

The 11th was spent in making final preparations to reach Junction Station with mounted troops, while the 75th and 52nd Divisions, covered by the Australian Mounted Division on the right, closed up to the Nahr Suqreir. The plan was to turn the enemy's right by an advance along the coast, where the ground was easier than elsewhere, but this had the disadvantage that water was scarcer and it was only by great exertion that the sappers were able to develop supplies. In the 75th Division the two field companies—the 495th and 496th—were split into various parties to water each brigade group, but the field companies of the 52nd Division moved with their respective brigades and obtained supplies from the beach areas. Reliance had to be placed on *sagqias* at most of the wells and deliveries were slow.

The final advance on Junction Station took place on the 12th. It was preceded by an infantry attack across the Nahr Suqreir and, when the enemy counter-attacked from Et Tine, this developed into hard fighting lasting most of the day. The Yeomanry Division took over another Nahr Suqreir bridgehead established in the morning by Australian Mounted troops, and the 6th Field Troop provided a detachment prepared to join the 22nd Mounted Brigade for railway demolitions. In the 52nd Division sector the 156th Brigade with part of the 410th Field Company advanced to a line west of Et Tine. Both field companies of the 75th Division were confronted with demands far greater than the supply when, in addition to their own formation, they had to water mounted troops and part of the 52nd Division.

By 13th November all was ready for the final attack on the positions taken up by the depleted Turkish forces covering Junction

Station. The supply situation on the British side had improved ; the field companies R.E. had been rejoined by their mounted sections and fair supplies of water had been developed north-east of Ashkalon ; and not only were the roads still holding (although the rains were imminent) but the divisional trains, augmented by lorry and camel columns, were again operating. Stores were also being landed from the sea at the Wadi el Hesi.

The attack was to be made by the two infantry divisions covered on the right by the Australian Mounted Division and assisted on the left by a turning movement by the rest of the Desert Mounted Corps. Junction Station itself was to be captured by fresh troops passed through those in the initial attack. The 75th Division used two brigades, which were watered after dark from villages near the line reached, and the 234th Brigade Group, after a series of minor engagements during the night (in the course of which the 496th Field Company took fourteen prisoners) occupied Junction Station early next morning. This was later than had been hoped and led to delay in cutting the railway northwards by Lieutenant Manning and a special demolition party of the 496th Company. Meanwhile the 52nd Division, after overcoming considerable opposition, reached its objectives during the late afternoon of the 13th, most of the formation being watered by the 410th Field Company from the deep well, with a 25-H.P. Crossley gas engine. The Yeomanry Division, led by the 22nd Mounted Brigade, advanced as planned and early on the 14th the demolition party from the 6th Field Troop broke or damaged every rail along a mile of railway running north. Further demolitions were carried out by the 412th Field Company when part of the 52nd Division reached Junction Station. Enough water had been found on the previous evening by the 413th Company in the Nahr Rubin to supply two divisions.

During the 14th the field companies of the 75th Divisions examined the water possibilities at Junction Station. The speed of the final attack had saved the wells and steam pumping plants from destruction and supplies were virtually unlimited. These units also repaired several slightly damaged bridges and overhauled the two worn locomotives and sixty trucks that had been captured. Lieutenant Potter and two engine drivers found the connecting rods and valve gear that had been removed from the locomotives and were on the point of getting up steam in one of them when a detachment of a railway company arrived to take over.

On the 15th two brigades of the Yeomanry Division captured the

position covering the approaches to Ramle, after which this place, with Lydda, were occupied by the Anzac Division without meeting opposition. Most of the 6th Field Squadron reached Ramle that day, followed on the next day by the 6th and 7th Field Troops, and watered the 22nd and 8th Mounted Brigades who had just entered Jaffa.

General Allenby's objectives had now been reached. The Turks had not only been driven from their strong Beersheba-Gaza position, but their two armies had both lost heavily in the process and were now widely separated and disorganized. The supply position, especially as regards water, had hampered the pursuit, although the infantry divisions had fared rather better than the cavalry. At an early stage, for instance, the spear-points and gear carried by field companies enabled one division to be watered at the Wadi el Hesi within a few hours. Many of the deep wells inland had been prepared for demolition but were found intact, with their animal or hand-operated *saggias*, but the small initial yields were only capable of improvement if time allowed. A well ten miles north of Gaza was an example. When a field company rigged a *chursa* the original three feet of water was so much lowered that the *chursa* would not fill and the well was abandoned. An army troops company then installed a deep well pumping set with its suction only two inches from the bottom, and as a result not only were 1,200 gallons per hour produced continuously for fifty-two hours, but a useful yield was obtained for a month. The leading troops had no time to clear wells choked with debris but these gave good yields later. Many of the deep wells with oil or suction-gas pumping plants in the Ramle orange groves were found intact, but the machinery was often in a bad state of repair, sometimes for instance, wood had been substituted for brass in the bearings. When in proper working order the yields were generally good but civil needs had also to be met. In general, the field companies' hard work and ingenuity enabled the demands of infantry divisions during the advance to Junction Station to be met without undue difficulty or hardship.

CHAPTER XXVIII

THE CAPTURE AND DEFENCE OF JERUSALEM

The situation after the capture of Junction Station—The first attack on Jerusalem—Engineer preparations for a renewed attack—Engineer work on the L. of C.—The capture of Jerusalem—Operations north of Jerusalem, 14th to 29th December—Operations near Jaffa during December, 1917—Railway construction during December, 1917.

(Map 6)

THE SITUATION AFTER THE CAPTURE OF JUNCTION STATION

BEFORE Jaffa was occupied and in spite of warnings from London of possible restrictions upon his operations, General Allenby decided that the wide separation of the Turkish armies invited an immediate attempt to reach Jerusalem with such forces as could be maintained by the existing L. of C. Only four divisions could be engaged—the Yeomanry Division, supported by the 52nd and 75th Divisions, advancing through the Judean Hills to the Nablus road north of Jerusalem (so as to avoid fighting near the city), while the 54th Division on the left contained the Turks in the plain. The Australian Mounted Division was sent back to ease the supply position.

The situation in the coastal plain on 18th November, 1917, was that the Desert Mounted Corps occupied a front of some eighteen miles from east of Lydda to the Nahr el Auja, north of Jaffa. The 54th Division, after marching from Gaza in a week, watered by its field companies on the way, reached the Lydda-Ramle area by the 22nd and was there attached to the Desert Mounted Corps. That night it relieved the mounted troops round Lydda. The work of the field companies during the days that followed included the location and maintenance of water supplies, the repair and sign-posting of roads and tracks, and defence works. In rocky ground sangars were built, with rifle pits and Lewis gun posts elsewhere; all were gradually developed into a series of self-contained redoubts. Considerable discomfort was caused by skin and intestinal troubles, which were attributed to the absence of bread and vegetables from the mobile ration.

On 24th November a bridgehead was established beyond the Auja by a mounted brigade, supported by part of the 161st Brigade. The Anzac Field Squadron and one section of the 486th Field Company began to build a pontoon bridge at a place where the river is about forty feet wide, but a Turkish counter-attack next day recovered all the ground north of the river and work was stopped, although not before there had been some sapper casualties. The British line was re-established south of the river and within a few days the whole left flank was regarded as secure.

THE FIRST ATTACK ON JERUSALEM

There were three lines of supply for a force advancing into Judea—the narrow-gauge railway, the unmetalled road from Lydda and the metalled road from Ramle. Of these the railway was out of action owing to demolished bridges, the Lydda road degenerated into little more than a mule track in the hills, and the principal road was easily defensible. Elsewhere the country was a tangle of steep hills and precipitous ravines, with only a few disconnected tracks unsuitable for any form of transport except pack animals. Water supply for brief operations was less difficult, as most of the villages had supplies stored in cisterns, but permanent springs were often inaccessible and required time for development. The country was obviously ideal for defence.

The first attempt to reach Jerusalem through the defences of this natural fortress lasted from 18th to 24th November. The axis of the advance of the 75th Division on the right followed the Ramle-Jerusalem main road and that of the 52nd Division in the centre the Lydda-Jerusalem track, while the Yeomanry Division tried to move across country towards Bethel. The 52nd Division was to cut the Nablus road north of Jerusalem. On the 18th the leading troops of the 75th Division reached the foothills and the Yeomanry Division, in spite of the difficult country, were within two miles of Beit Ur el Tahta. Next day the 75th and 52nd Divisions fought their way well into the hills, but the Yeomanry Division made little progress. That night rain fell in torrents, the temperature dropped appreciably and, owing to the appalling condition of the tracks, most of the leading troops received no rations and, moreover, few got rest or shelter. On the 20th, in spite of hunger and weariness, the infantry made further progress and a yeomanry brigade captured a hill east of Beit Ur el Foca. Enemy opposition was hardening

and it seemed evident that Jerusalem was to be defended, but the relatively slow progress was equally due to the difficulties of ground and supply. Once again heavy rain and little shelter combined with iron rations to make conditions extremely trying.

On the 21st, the 75th Division advanced along a track, impassable to wheels, to within four miles west of Jerusalem, and at dusk captured the commanding height of Nebi Samweil. The 52nd Division made no progress and the Yeomanry Division, now very weak in numbers and handicapped by difficult country, the effects of the rain, short rations and a numerically superior enemy, was forced to give ground. Next day the Turks made a heavy counter-attack against Nebi Samweil, but, after hard fighting, the hill remained in British hands. The 75th Division failed to take El Jib and a second attempt on the 23rd was no more successful. Next day the 52nd Division renewed the attack on El Jib, but no progress was made in spite of artillery support. This third failure ended the first attempt to reach Jerusalem and against this background the part played by the sappers must now be described.

Most of the engineering work was devoted to improvement of the tracks to enable wheeled transport and artillery to move, and in the meantime first-line transport reverted to camels. Some idea of the condition of the Lydda road is conveyed by the fact that on 19th November one brigade of the 52nd Division took four hours to cover seven miles, guns and wagons being manhandled, or even dismantled and carried, over the worst places. The 412th and 413th Field Companies were engaged on this march. The field troops of the 6th Field Squadron organized pack detachments to help in watering the leading troops of the Yeomanry Division. The 495th and 496th Field Companies in the 75th Division did what they could to assist in the advance on the 20th, and in the centre the 412th Company tried to improve the Lydda track. On the 21st, Captain Potter (496th Company) removed a mined charge, whose fuse had failed to burn, from a bridge, and all field companies were hard at work trying to make the wild tracks passable by wheeled transport and artillery, in places existing alignments being abandoned in favour of new. The effects of the rain delayed the work, but it was continued on the 22nd by the 410th, 412th, 413th, 495th and 496th Companies, with large working parties from Outram's Rifles and the British West Indies Regiment. Their efforts enabled a few mountain guns to support the 75th Division in its renewed attack on El Jib, and by 9.30 p.m. field guns and a howitzer battery using

ten-horse teams got through. All three companies of the 52nd Division worked on the roads next day, frequently under artillery and machine-gun fire, with a few casualties. Some of the work was very heavy, as it was necessary to make ramps between the rock terraces on the hillsides.

Water supply also made heavy demands upon the 6th Field Squadron and the field companies. The 496th Company developed resources for the 75th Division at Latron, where the road enters the mountains, and in the 52nd Division the 410th Company found four or five days' supply for the 155th Brigade in the cisterns, but as soon as the hills were reached and progress became slower the cistern supplies quickly showed signs of exhaustion, and the alternative sources from the few springs in the ravines were often virtually inaccessible until tracks had been made. Nor was the search for water free from risk, as was shown on the 20th when a section of the 413th Company, on its way to a hoped-for well, was ambushed and had several casualties, including Lieutenant Dobbie wounded. Next day the 496th Company found 30,000 gallons in a concrete reservoir for the 234th Brigade, but the rest of the 75th Division was reduced to $\frac{1}{2}$ gallon per day per man. On the 22nd the 413th Company found 200,000 gallons in various cisterns, from which the 496th Company also drew for the 75th Division. These experiences showed that water supply in the hills would present serious problems if operations were prolonged.

ENGINEER PREPARATIONS FOR A RENEWED ATTACK

By 24th November it was clear that before the attack on Jerusalem could be renewed with any prospect of success, the exhausted formations in the Judean hills would have to be relieved by fresher troops, and that much road construction would be required to enable the attack to be delivered on a broader front and with artillery support. The improvements to communications now made in the Philistia Plain enabled these reliefs to be effected, but this process and a series of determined Turkish counter-attacks handicapped engineer work in the hills.

The 60th Division, which reached Gaza from the Huj-Kh Jemmame area in the middle of November, began a forced march of three days to Junction Station on 20th November. The divisional engineers watered the division on the march, and between the 24th and 27th accompanied the infantry brigades as they relieved the

75th Division and part of the 52nd Division from the main Jerusalem road to beyond Nebi Samweil. The 74th Division moved back to Deir el Balah, behind Gaza, in the middle of the month and there changed from camel to wheeled transport. It left Gaza on the 25th for Junction Station, the 5th R. Anglesey leading the march to arrange watering and the 5th R. Monmouth, bringing up the rear. The 74th Division did not begin to relieve the Yeomanry Division until the 29th.

Meanwhile the 75th Division moved back to Junction Station to rest and reorganize, R.E. work being confined to water supply. All field companies in the 60th Division were engaged on water supply, the construction of artillery roads and on reconnaissances for defiladed routes. The advanced pack detachments of the 6th Field Squadron with the Yeomanry Division were reinforced and with the meagre resources available some track improvements were effected, notably by the 6th Troop between Tahta and Foqa.

The Turkish counter-attacks began on the 27th at various points on the Judean front and south of Mulebbis on the plain, the heaviest falling upon the exhausted Yeomanry Division. They and the 60th Division lost some ground and at midnight the 410th Field Company of the 52nd Division was ordered forward to help to restore the situation when the Turks penetrated the line, but did not become involved in heavy fighting. The attack on the plain against the 54th Division met with little success. Next day the Yeomanry were driven from Foqa, and the 7th Field Troop continued its road work so assiduously that it lost all its tools in the withdrawal. By the 29th the situation was in hand and, in spite of further attacks, the 74th Division relieved the Yeomanry Division and the 157th Brigade of the 52nd Division. The 5th R. Anglesey covered twenty-three miles in twenty-four hours—a very creditable performance. Both field companies of the 74th Division sent back most of their transport owing to the bad condition of the tracks, and the 5th R. Anglesey began road work while the 5th R. Monmouth, attended to water supply. The last new division to arrive was the 10th, which began to leave Shellal on 27th November and completed the relief of the 52nd Division on 3rd December. By this date the 52nd Divisional R.E. had made considerable improvements to the roads, in spite of interference by Turkish patrols. The Ramle-Jerusalem road was fairly well graded, but as it had no drainage, side-drains and culverts were taken in hand. It was lightly metalled in places, with the soft local limestone, which became very dusty as soon as

the ground dried. It was ultimately given nine inches of soling throughout. The 10th Division took over these works on 1st December. Local British attacks to recover lost ground met with indifferent success and they were stopped on the 3rd to concentrate on preparations for a renewed general attack.

ENGINEER WORK ON THE L. OF C.

First priority in railway works was given to the opening of the Turkish narrow-gauge line from just north of Gaza to Junction Station. 2nd Lieutenant H. Campbell (266th Railway Company) was put in charge of all light-railway maintenance on 5th November, and on the 20th the first train ran into Junction Station. The supply position then began to improve, although this line was inadequate to maintain the advance into Judea. The supply problem continued to be very difficult indeed until the standard gauge reached Junction Station and was not solved until the Jerusalem branch had been repaired.

The gauge of the Turkish railway was 1.05 metres, and in spite of heavy bombing of bridges during the Beersheba fighting, very few locomotives and trucks had been captured. It was, therefore, necessary to bring up more rolling stock, which could be obtained from the Sudan, where the gauge was 3 ft. 6 in.—just over half an inch too wide. One rail of the Turkish line had, therefore to be lifted and relaid before it could be used, and this process had to be continued on all captured lines throughout the campaign. It is interesting to note that the Turks themselves had already increased the gauge of the Jaffa-Jerusalem line by about two inches, as this was originally a metre-gauge railway, built by the French.

On 21st November the detachment of the 266th Company was reinforced by one from the 116th; and the first few locomotives arrived from Egypt. On 1st December seven trains with 700 tons of supplies reached Junction Station. The rest of the 266th Company had now moved up to repair the bridge over the Wadi Surar just north of the new railhead. Captain Ross reconnoitred the Jerusalem branch on 24th November and, after the 266th Company had repaired switches, 25 miles of this line, to Artuf, were opened to traffic on the 29th. The rest of the line could not be used until four demolished bridges between Artuf and Jerusalem had been rebuilt.

On 10th November a special organization to maintain and operate

all light railways was established under Lieut.-Colonel C. E. Jordan-Bell from the Railway Operating Division, but although he reached Jaffa shortly afterwards, his H.Q. did not begin to operate until 12th December. Part of the 266th Railway Company was engaged from 7th December on light railways running north towards Jaffa.

On the Qantara main line the 115th, 116th, 265th and 266th Companies continued the second track throughout Third Gaza, but early in November progress became slower when the 115th and 116th Companies moved to Imara to extend the Shellal branch. On 10th November the extension of the main line from the Wadi Ghazzee was begun with E.L.C. labour and all four companies. Beyond Gaza the line passed through difficult dune country and the Wadi el Hesi was not reached until 27th November. As soon as a railhead was opened here, supplies could be transferred to the light railway, for which locomotives were brought forward, and the lorry link could be released for work elsewhere. The main line was continued northward in December, but the onset of the rains and the soft cotton soil made earthwork very difficult and slow. In the Wadi Ghazzee flood-water temporarily submerged the deviation across the bed and extensive repairs were needed.

On 13th November a new element was introduced into the L. of C. organization by establishing separate control over the area between the operational troops and the Palestine L. of C. The new headquarters was called Advanced Palestine L. of C., and Lieut.-Colonel E. W. Gill was appointed A.D.W. for all works, except railways and certain water supplies.

Lorries to supplement rail lift and to distribute supplies locally required a heavy road programme. The Turkish roads were seldom metalled; where they were their standard was far below that needed for British lorries and where they were not they were merely earth tracks. Until road-metal could be quarried and transported, side drainage and grading were the only means of reducing mud and delaying disintegration. Details of metalling varied but from mid-December onwards an earth path was always left for camels on the inner sides of roads on sloping ground. Although demands for labour for all types of work reached the E.-in-C. from every quarter (e.g., the C.E., XX Corps wanted 5,000 men for second-line defences), roads were given the highest priority in men and tools, including all the available E.L.C. labour (4,000 men). The limiting factor at the end of November became the transport for stone. The greater part of three army troops companies R.E. (35th, 555th and

571st), and an Egyptian artificers' company were also engaged on wadi-crossings, bridging and quarrying, while for a time during November the 14th and 220th Army Troops Companies, although corps troops, also worked in the Advanced Palestine L. of C. area on roads and other works, which included hangars for the R.F.C., operating a timber-yard at Ramle and hutting at depots. The 569th Army Troops Company, with headquarters at Rafah, continued to operate advanced parks for stores on the L. of C., and opened new parks at Karm, Gaza, Junction Station (to which H.Q. was moved on 17th December) and Jaffa.

Long-term arrangements were made to meet the water needs, not only of the troops, but also of the railways and depots. Supplies were developed and storage erected at three staging camps on the Philistia Plain, the only serious difficulty being met at a camp north-east of Ashkelon, where the 359th Water Company found the yield of the local well inadequate and supplies had to be pumped from a neighbouring Jewish colony. Temporary depots were considerable consumers until the more convenient centre of Lydda became the permanent advanced depot, and water supply there became of great importance.

A detachment of the 569th Army Troops Company took over the well-equipped Wagner pump factory at Jaffa and undertook the repair and maintenance of the numerous local deep-well pumping plants, both civil and military. The residue of the Cairo-built Wagners was used to duplicate existing plants so as to increase yields.

Much of the work thus briefly described was under the direction of Lieut.-Colonel Gill, and as an example of its extent, water gear of all kinds was installed at nine different places north of Gaza in one fairly typical week at the end of November. The 359th Water Company moved its headquarters to Gaza on 14th November, and on the 30th the boring section was transferred to it from the 35th Army Troops Company. British other ranks in the boring section were replaced gradually by natives and returned to their old unit. The 359th Company took over wells between Gaza and Et Tine as the advance moved northward, and on 3rd December took over the Junction Station area. During November the 360th Water Company began to install new pumping machinery at three stations on the Qantara pipe-line, and nearly completed the 6-in. and 8-in. pipe-lines from El Arish to the Rafah reservoirs, while early in December a new siphon across the Suez Canal at Qantara

was connected to the filtration and pumping plants and several subsidiary systems were dismantled for use elsewhere.

The 14th Army Troops Company (XXI Corps) reached Ramle from Gaza on 2nd December and took over the municipal water supply. During the advance the company had detachments working over a distance of fifty miles watering each division of the XXI Corps except the 53rd. As many as twenty pumping plants were operated simultaneously and over a period of four weeks the average quantity of water supplied daily was 300,000 gallons. The company was congratulated by General Allenby in person on its work. The 35th Army Troops Company under the Advanced Palestine L. of C. moved to north of Gaza on 15th November to supply the railway and to operate other pumping plants over a considerable area. On 24th December it handed over to the 555th Army Troops Company, which then had six water areas in its charge, and left for Ramle. The 220th Army Troops Company, less a detachment on the Beersheba wells until 10th January, 1918, reached the Junction Station area on 29th November, 1917, where it remained in charge of several water areas until the end of the year. The 571st Army Troops Company was responsible for water supply at Deir el Balah until the end of November and thereafter maintained the water areas south of Junction Station.

THE CAPTURE OF JERUSALEM

In the second effort to capture Jerusalem the principal thrust was made along the main Ramle road by the 60th and 74th Divisions, while the 53rd Division threatened Jerusalem from the south along the Hebron road. The last-named formation had been resting and reorganizing north of Beersheba and preparing for the advance northwards. The 437th Field Company, in addition to water supply at Beersheba, built a heavy trestle bridge across a large wadi on the Hebron road and, with infantry working parties, improved two roads between standard-gauge railhead now at Bir Abu Irqaiyiq and Beersheba. It also effected repairs to the railway and supplied stone to the 439th Company, which was improving the Hebron road, by extensive blasting of rock outcrops. The 436th Company was engaged on water supply and the improvement of minor roads. Covered by the Westminster Dragoons this company led the advance of the 53rd Division on Jerusalem when it began on 3rd December, removing stone road blocks and filling in mine craters.

On the main front the preliminary movements began on 4th

December. During the preceding week the divisional engineers of the 60th and 74th Divisions were engaged on extensive preparations, in spite of two days' rain and their normal water duties. The 5th R. Anglesey of the 74th Division was confronted with a heavy volume of work, as it had not only to water the whole division from widely separated wells and springs with poor yields, but also to make hill tracks for supplying the 231st Brigade and to carry out reconnaissances for new artillery roads.

On the 5th the 74th Division relieved two brigades of the 60th Division, to enable the latter to concentrate, and next day a Turkish withdrawal enabled several points of tactical value to be occupied. The troops moved to their assembly positions on the 7th during heavy rain and mist which made the tracks treacherous, especially for camels.

Before the main attack was launched on 8th December the 53rd Division was ordered to reach a line astride the Hebron road some three miles south of Jerusalem. After a trying march in rain and the defeat of a Turkish rearguard near Hebron, the ridge seven miles south-west of Jerusalem was captured on the 7th. The 436th, 437th and 439th Field Companies were engaged throughout the advance on water supply, the blasting of rock to fill mine craters and on road repairs. The perversity of the water situation was aptly demonstrated when the 436th Company took refuge from the heavy rain on the night of 7th/8th in an underground spring that was quite dry. Major Scott, commanding this unit, had made contact earlier with the 60th Division while on reconnaissance south-west of Jerusalem.

The plan for 8th December was that the 60th Division should advance on the right of the Ramle-Jerusalem road, the 74th Division on their left should attack on a four and a half mile front as far as Nebi Samweil, and the 53rd Division should make a subsidiary attack south of Jerusalem. As soon as the first Turkish defence system had been captured, the advance of both divisions was to swing to the north-east, leaving the city on their right.

The 179th Brigade on the right of the 60th Division advanced in two columns. The right-hand column was preceded by an advanced guard of one battalion, a section of the 521st Field Company with pack-mule transport, and a company of pioneers. By 4 p.m. all the first objectives had been reached. The rest of the 521st Company watered the brigade. The 180th Brigade met with more opposition and a second attack in the afternoon was necessary

before all objectives were taken. The 519th and half the 522nd Companies repaired the road forward.

The 229th Brigade made good progress on the right of the 74th Division, but the 230th Brigade on the left did not complete their tasks until the afternoon after hard fighting. The 5th R. Anglesey R.E. worked for sixteen hours, often under shell-fire, to make the road passable by artillery and the 5th R. Monmouth., R.E. worked on a track for camels.

The 60th Division was unable to start the second phase until the 53rd Division came up to cover its right flank, but this division had a disappointing day, not reaching their objectives until about 4 p.m. Under artillery fire in the morning the 436th Field Company prepared to develop the million gallons stored 42 ft. below ground in the lower of Solomon's Pools, seven miles south of Jerusalem. They erected storage at a spring yielding 3,000 gallons per hour and overhauled the pumping plant on the Jerusalem supply. The 439th Company repaired road demolitions and took over the Solomon's Pools water supply at night.

The operations on 8th December had achieved a limited success, but although the second phase had not been started the fall of Jerusalem was much nearer than was realized. At dawn on the 9th patrols found that the Turks, alarmed at the loss of their main defences, had withdrawn, and elements of the 53rd Division, including part of the 436th Field Company, which began to advance at 5.30 a.m., entered Jerusalem later in the morning. The sappers filled in mine craters and cleared road blocks and Lieutenant Hayman of the 436th Company seems to have been the first R.E. officer to reach the city. General Allenby entered with due ceremony on 11th December.

During these operations the 10th Division, which reached the front on the left of the XX Corps in the Beit Ur el Tahta area on 3rd December, was only lightly engaged, but the divisional engineers worked hard on road construction and water supply.

On reaching Jerusalem the 436th Field Company of the 53rd Division searched the city for mines and engineer material, while the 439th Company began repair work at the railway station on the 10th. A long length of the line near Jerusalem was undamaged except for a 53-ft. span girder bridge. The three field companies of the 60th Division reached Jerusalem on the 9th and 10th and concentrated on water supply. The 74th Divisional R.E. were engaged on water supply and road work north-east of the city.

OPERATIONS NORTH OF JERUSALEM, 14TH TO 29TH DECEMBER

On 14th December General Chetwode, commanding the XX Corps, outlined his plan for extending the restricted area occupied round Jerusalem northwards, to free the city from the dangers of counter-attack or artillery fire. The 53rd and 60th Divisions were to attack on the right and the 74th Division on the left of the Nablus road. The 10th Division on the left was to advance eastwards. The attack was not to be launched until much new road construction and conversion of tracks into rough roads for artillery and supplies had been undertaken and adequate water supplies organized. Water shortage in Jerusalem had already compelled the 53rd Division to send most of its transport back and also threatened the mobility of the 60th Division.

The 439th Field Company of the 53rd Division succeeded in getting water from Solomon's Pools to Bethlehem on 15th December and from the 20th made the aqueduct available for horse watering. The 436th Company was engaged on roads and water supply and on the 20th detached two sections for work on defences. The 439th Company also took part in this work from the 22nd, besides clearing an airfield site south of the city. The 437th Company was widely dispersed to maintain the road through Beersheba and Hebron—a heavy task after the rains—but on the 24th the 220th Army Troops Company took over the southern part of it.

The 60th Divisional R.E. were largely engaged on water supply from cisterns at Jerusalem, but road works were also undertaken on a considerable scale. Native labour was employed but six days of rain delayed progress. In the 74th Division both the 5th R. Anglesey and the 5th R. Monmouth, regraded and metalled roads in the area, using some local labour.

The heaviest work of all was required in the 10th Division's area on the left. Centuries of erosion and neglect caused the original rock surface of the ancient road through Tahta to stand high above the general level in many places and its improvement to take lorries involved much labour by the 85th Field Company. The 65th Company helped to metal this road and also extended it, while the 66th Company made the Foqa road passable for wheels. Short lengths of track for artillery and supplies were also made up the side valleys from the "main" road.

The date of the attack to gain elbow-room round Jerusalem was eventually fixed for 23rd December, but heavy and prolonged rain

caused a postponement till the 26th. A further postponement was then caused by the preparations made by the Turks to counter-attack on a considerable scale, General Chetwode deciding to allow this to develop so as to take advantage of the enemy's confusion and losses to facilitate his own attack.

The Turkish attacks began early on 27th December and, as no R.E. were engaged, it is unnecessary to describe the heavy fighting in which the 60th Division astride the Nablus road and, to a less extent, the 53rd Division were involved. No vital position was lost and the attacks were decisively repulsed. The assaulting troops of the 74th and 10th Divisions had reached their assembly positions on the previous night and, notwithstanding the fact that the Turkish attacks were still in progress, these two divisions advanced against the enemy's right flank early on the 27th.

On the right, the 231st Brigade of the 74th Division attacked with great success. Two officers of the 5th R. Anglesey advanced with the infantry to reconnoitre for water supplies and an extension of the road. In the centre the 31st Brigade of the 10th Division advanced over precipitous ground driving into the Turkish flank. Roads were made by the 65th and 66th Companies, assisted by the 5th R. Irish (Pioneers) and by infantry working parties. Their combined efforts, often under fire, enabled some artillery to get forward after dark. On the left the rest of the 10th Division gained all objectives.

By next morning the decisive nature of the repulse of the Turkish attacks was realized and the 60th Division, covered on its right by the 53rd Division, attacked astride the Nablus road as originally planned, while the 74th and 10th Divisions on the left continued to advance in an easterly direction. The 53rd Division, whose infantry had been busy during the night under R.E. supervision, were also successful, and this enabled the 60th Division to re-occupy, against slight opposition, the outpost positions lost on the previous day. The 522nd Field Company and two platoons of pioneers worked on forward artillery roads and developed water for the 181st Brigade, while the 521st Company and two pioneer platoons repaired the main Nablus road. The 519th Company remained in Jerusalem on water supply.

On the left the 10th Division made slower progress owing to stiffer opposition and difficult country, but all objectives were reached by 4.30 p.m. All three field companies were engaged in extending artillery roads.

The operations were continued on the 29th. The 53rd Division

advanced its left, while the 437th Company worked intensively on defences. On the right of the 60th Division the 180th Brigade was held up, until the 521st Field Company and two pioneer platoons, working under intermittent shell-fire, had extended the road to enable artillery to be brought forward. On the left the 181st, followed by the 522nd Company on artillery roads, continued their advance. Both field companies then moved up to develop water, while the 519th Company watered the 179th Brigade. The two leading brigades resumed their advance at night and Bethel was reached at 4 a.m. on the 30th. The 74th Division advanced on the left of the 60th, the sappers working hard on roads and water supply. The 10th Division stood fast all day, but, as the result of great exertions by sappers and artillery, guns were brought to bear on the dense column of enemy retreating northward. A slight advance along the Nablus road by the 60th Division on the 30th brought to a close this period of hard fighting in country which the Turks, not without reason, regarded as almost impenetrable. Jerusalem was now secure and out of artillery range.

The persistence and skill shown by the infantry would not have achieved the results gained in these operations without the hard work, often under fire, of the field companies, with pioneer and infantry working parties, engaged on the construction of the new artillery roads and supply tracks. General von Falkenhayn, in launching the Turkish attack on Jerusalem, could not have "anticipated the wonderful work of the Royal Engineers, pioneers, and infantry of the 10th Division, under the direction of its C.R.E., Lieut.-Colonel E. M. S. Charles, after the attack had been launched. He thought his right flank secured by the difficulties of the country, and was almost justified in believing that a British advance was impracticable."*

OPERATIONS NEAR JAFFA DURING DECEMBER, 1917

The improvement of communications across the Philistia Plain enabled the XXI Corps gradually to take over the front from the Judean hills to the Nahr el Auja occupied in early December by the Desert Mounted Corps and the 54th Division. The 52nd Division joined the XXI Corps at Ramle on 2nd December and soon took over the Auja line as far as Mulebbis. The 410th Field Company was engaged on defence works and the rest of the divisional R.E.

* *Official History, Egypt and Palestine*, Vol. II, p. 290.

worked on roads and water supply. The 54th Division, occupying a front running obliquely across the Lydda-Haifa railway, joined the XXI Corps on 7th December. The 484th and 486th Companies worked on defences consisting merely of machine-gun posts, short lengths of fire trench where the generally rocky ground permitted, and command and observation posts. Various road improvements, e.g., wadi crossings and drainage, were effected, and the 486th Company built a timber trestle bridge, 171 ft. long. The 75th Division took over the right of the corps front, east and north-east of Lydda, the 495th and 496th Field Companies working mainly on water supply and road construction. Maintenance of these early tracks became increasingly heavy as the rains continued. On the 7th No. 10 Company, Sappers and Miners, joined the Division at Ramle to complete its engineer organization.

Various local operations were carried out during December to improve the tactical situation. At the same time the 52nd Division was preparing to advance the left of the XXI Corps beyond the Nahr el Auja—an operation which merits a slightly more detailed description because it was the first opposed river crossing to be carried out by the E.E.F. The Nahr el Auja reached the sea three miles north of Jaffa, and the object was to free the town from artillery fire and any danger from possible counter-attack. The river was a considerable obstacle; it was about forty-five feet wide and ten feet deep, flowing at about four knots, and both the depth and the current were increasing daily as a result of the rains. Both banks were soft and muddy, the left being flat and marshy. The only bridge and a mill-dam had been destroyed, and the Turks were holding the high ground to the north, except opposite the right of the 52nd Division, where they held positions south of the river covering Mulebbis.

The engineer preparations began early in December under Lieut.-Colonel L. F. Wells, C.R.E., 52nd Division. The bridging equipment of four field companies, including twelve pontoons and six Weldon trestles, arrived from Egypt on the 17th. The only other stores received were landed from a trawler two days earlier. Local resources, involving much improvisation, had therefore to be used. The 412th Company used wine casks to make piers for the barrel bridges. Rafts, carrying fifteen to twenty men, to be used first for assault ferries, and subsequently, after being connected and decked, as components for light bridges for infantry and pack mules, were made from orange trees and canvas water tanks. The 413th Company

was similarly engaged at Jaffa and it also overhauled and repaired the pontoon equipment. The rafts were finished on the 12th and were taken by night to hidden positions in the citrus and eucalyptus groves near the river. The pontoon equipment was also taken forward at night, the poor quality of the available ropes and the awkward nature of the loads making this a wearisome task, but all was assembled under cover by the 19th. The rafts for two bridges were assembled by the 410th Company that night.

A few nights previously two infantry officers made a reconnaissance of the ford at the bar at the mouth of the Auja by swimming out to sea and landing on the Turkish side. They found the ford, which was about 120 feet long, marked it and established that the bar had some three feet of water over it and was clear of obstacles. The 410th Company reconnoitred for bridge sites and on the 18th Sapper Paton swam the river and measured its width. A number of Turkish machine-gun posts were located on the right bank. From all this information it was inferred that the crossing would probably be more hazardous than expected, and it was decided to make the attempt at night on the 20th/21st. As preliminaries the 54th Division extended its left and mounted troops occupied the 52nd Division's defences. In the initial assault the 156th Brigade, with one section of the 410th Company, to assist in consolidation, was to cross the ford at the mouth of the river and to capture a commanding sand-dune, two miles to the north. In the second phase the 155th Brigade was to cross about a mile up-stream, the leading infantry being ferried on the improvised rafts. The next detachments were to cross by the light bridges as soon as these had been erected; and when the bridgeheads had been established the pontoon bridges were to be built for the rest of the infantry and some artillery. The R.E. demonstrated the use of the rafts to the infantry before the crossing.

Rain fell heavily during the 19th and part of the 20th but clear skies and a half-moon then gave sufficient light to move fairly easily after dark. The marshy ground was very soft and the 412th and 413th Companies, helped by 300 men of the 1/12th Loyal N. Lancs. (Pioneers), had to improvise a road by laying reserve raft covers over the mud before the carrying parties could get the rafts to the bank.

At 10 p.m. the 412th Company launched four rafts, and thirty-five minutes later the 156th Brigade's covering party had been ferried across. Meanwhile the 410th Company and infantry parties began

to carry the piers for the light bridges down to the river but the loads were made heavier by the rain and became entangled in the hedges flanking the narrow tracks. More infantry was diverted to this task but considerable delay arose in reaching the river and further trouble then occurred when the canvas of some of the rafts was found to be punctured. Some reserve rafts had to be brought down before the first light-bridge could be completed just before midnight. Ferrying of infantry continued meanwhile and the attack from the bridgehead took place at 11 p.m. when two and a half battalions had crossed.

One battalion extended the bridgehead on the right while a second moved north-west to attack from the rear the defences covering the mouth of the river. As soon as the first bridge was finished the rest of the brigade, less one battalion, crossed and the objectives, after some fighting, were captured.

As soon as the ford defences had been taken the 413th Field Company was to have driven stakes and fixed a guide rope for the infantry wading across the river, but a 12-in. rise in the water level had submerged the marks fixed earlier, and there was difficulty and delay before the battalion could cross. By 3.30 a.m., however, it had carried out its task.

On the right the 155th Brigade was ferried over by the 410th Company, again after delays caused by difficulties in carrying the sodden equipment. The 410th Company then began the second barrel-pier bridge, finishing it at 6 a.m.

In spite of the delays caused by the heavy rain before the operation, the crossings had succeeded and the objectives on the north bank had been gained. The 21st was devoted by the engineers to improving the facilities for crossing the river, and a section of the 410th Company worked with the 155th Brigade on defences and water development. The 412th Company completed three more bridges (a heavy barrel-pier, a light barrel-pier and a footbridge) and began work on their approaches. The 413th Company, helped by part of the 410th Company, built two pontoon bridges. The 412th Company assembled another barrel-pier and floated it down into bridge at night. Before morning on the 22nd the 410th Company had roughly repaired the demolished stone bridge. Artillery then crossed and the situation was further improved by an advance by the 54th Division on the right. The Turks then withdrew northwards and by nightfall the XXI Corps was established on the general line Mulebbis-Arsuf.

During the next few days the construction and maintenance of roads and approaches to the Auja bridges made heavy demands on the 52nd Divisional R.E. The soft ground caused much difficulty, overcome in many places by placing thick layers of sand and brush-wood to form better foundations. Work was handicapped by shortages of tools, transport and labour, in spite of E.L.C. and natives being employed in the rear areas. By the end of the month the Jaffa flank was secure and the engineers had played no small part in achieving this result.

Elsewhere on the XXI Corps front the R.E. improved communications and provided other services during the rest of December. In the 75th Division's sector on the right, parts of both the 495th and 496th Field Companies were engaged on defences and water supply: work on the latter included burning charcoal for suction-gas pumping plants, installing new pumps, and deep well boring, by the 495th Company. The 495th Company began work on a new steel bridge and repaired the Ramle-Lyddā road, while the 496th Company was on road works south-east of Mulebbis. The 54th Division had a more difficult road problem; a belt of cotton soil, three miles wide, separated the Ramle-Jaffa road from the front, which lay on higher sandy ground, and the rains soon made the tracks across the low-lying area impassable. Shortages of transport and stone delayed attempts to metal these tracks but the 484th and 486th Field Companies built six trestle bridges over various wadis. Considerable efforts were devoted to defences and water supply, a divisional bath-house was adapted at Mulebbis and some essential accommodation, such as cookhouses, was erected.

The 14th Army Troops Company of the XXI Corps spent the latter part of December in preparing to build four semi-permanent piled trestle bridges across the Auja. Eucalyptus trees felled locally provided 12-in. piles, but as they were too heavy to float to the bridge sites, land transport had to be used. A pile-driver was improvised by decking a raft made of wine barrels and fitting a hand-operated monkey. The Royal Navy supplied a diving party to help in the pile driving.

RAILWAY CONSTRUCTION DURING DECEMBER, 1917

In spite of adverse weather conditions the 115th, 116th and 265th Railway Companies continued to extend the main line to within seventeen miles of Ramle. This railhead, 179 miles from

Qantara, was reached on Christmas Day and so became the site of a large supply depot. Work was suspended on the next section to Ramle while flood damage to the embankments, culverts and permanent way north of the Wadi Ghazzee was repaired. The recent earthwork on the light railway was badly damaged by flood water and sections of the line were out of action for several days with serious effects upon the supply situation at a critical period in the Jerusalem operations. The 265th Company was sent to help the 266th Company to re-open the line and by the 28th traffic was running again. The 266th Company repaired the first two bridges on the Jerusalem line. The 484th Company of the 54th Division laid several decauville tracks for supplies including one along the light railway running north from Lydda.

CHAPTER XXIX

THE SPRING OF 1918

The situation in January, 1918—Road construction and water supply in Judea—The capture of Jericho—The capture of Tell Asur—The passage of the Jordan—Work in Desert Mounted Corps and XXI Corps areas—Reorganization of the E.E.F.

(Map 6)

THE SITUATION IN JANUARY, 1918

EARLY in 1918 General Allenby decided upon his plan of operations for the final offensive later in the year, and his first aim, after ensuring the security of the Jerusalem-Jaffa front, was to improve his communications. As soon as the worst of the rains was over, he intended to advance his right into the Jordan Valley, then, while the Qantara railway was being extended, he proposed to operate against the Hejaz Railway and subsequently to advance his left to Tul Karm to cover a further extension of the main line. The 7th Indian Division arrived from Mesopotamia in January, 1918, and considerable discussion ensued as to objectives. Certain preliminary operations took place, but the German spring offensive in France put an end to all thought of an immediate large scale offensive.

The early part of 1918 was devoted to improving communications especially on the right flank and to preparing for the Jordan and Hejaz Railway operations.

ROAD CONSTRUCTION AND WATER SUPPLY IN JUDEA

The road programme in the XX Corps area in Judea was designed to enable the operations in the Jordan Valley to be begun at the end of January and to improve communications on other parts of the corps' front. Lateral roads were of high importance as until they were completed any movement from one flank to the other had to follow the devious Ramle-Jerusalem road. Most of the work, although not the most difficult, was carried out on the right flank between Jerusalem and Jericho, in which sector the 53rd Division was relieved by the 60th Division early in January. The worst

problems appeared in the tangle of ravines and ridges west of the Jerusalem-Nablus road. There were no roads except the rough tracks made during recent operations and the existing native paths were often so poor that laden mules could not negotiate some sections without help. The steep, rocky ridges were frequently terraced for cultivation and good alignments were difficult without heavy labour. The soft local stone was unsatisfactory for surfacing, but large quantities were used for lack of anything better. Heavy rain not only delayed new work but also increased maintenance; there were never enough tools and at first no stone crushers. The steam rollers, when they arrived, were too few for the long mileage under construction and repair, and ordinary traffic was the only means of consolidation.

Every field company in the 10th, 53rd, 60th and 74th Divisions and the 220th and 571st Army Troops Companies were engaged, and they organized and supervised large infantry working parties (at one period the 10th Division alone was using eight infantry battalions), E.L.C. and local labour (10,000 being employed in the 60th Division's sector on 21st January).

Early in 1918 the water situation began to give rise to anxiety. The supplies stored in cisterns were nearly exhausted and many were found to contain less than expected owing to being partly filled with stones. There were few wells and most of the springs were difficult to reach. All field companies had detachments on water supply duties, and to ease the situation the 5th R. Anglesey (74th Division) developed a large watering area in the foothills east of Junction Station, where reserve troops were sent. Other divisions made local arrangements to water animals well to the rear. The 521st Field Company (60th Division) operated the supply to Jerusalem from Solomon's Pools, south-west of Bethlehem.

THE CAPTURE OF JERICHO

Heavy rains delayed the advance to the Jordan Valley until 14th February, 1918, by which time the main Jericho road was opened to 60-pounder guns and tractors for a considerable distance. On this date the 60th and 53rd Divisions advanced their fronts north-east of Jerusalem, the 519th and 436th Companies improving roads to the new positions. The advance was resumed on the night of the 18th/19th when the 60th Division, covered on the right by the Anzac Mounted Division advanced east from Bethlehem, and the

53rd Division astride the Jericho road. On the right the 521st Field Company made an artillery road down a steep wadi; the 522nd Company in the centre repaired the Jericho road and began work that night on deviations at two demolished bridges; and on the left the 519th and 436th Companies extended tracks behind a further advance of the 53rd Division.

On the 20th the Anzac Mounted Division met strong resistance on the right but one brigade made its way down the steep escarpment to the Jericho plain. The 60th Division, in spite of difficult ground and considerable opposition, reached the Good Samaritan's Inn, half-way to Jericho. The 521st (less one section on water duties) and the 522nd Field Companies repaired the main road and three demolished bridges. All the cisterns at the inn were found to be empty and the water situation became acute. Next day the mounted troops entered Jericho and cleared the plain west of the Jordan, for six miles north of the town, except for two small Turkish bridge-heads. Water was plentiful in the valley at this season and good supplies were also found on the escarpment south of the road.

For the rest of the month the 521st and 522nd Field Companies continued to repair the Jericho road, began to reconstruct one of the five demolished bridges, made various roads and supply tracks and developed water supplies under difficult conditions. An ambitious project was started by the 522nd Company to pump water from the wadi running through Jericho to a watering area on the Jerusalem road 550 feet above the plains. The system was eventually extended westward and had a total lift of 916 feet.

Little work was done by field companies on defences, but, as the rocky ground usually prevented digging, the infantry was taught how to build stone sangars which were wired later.

THE CAPTURE OF TELL ASUR

General Allenby intended to capture Es Salt and make a raid on Amman towards the end of March and to attack Nablus and Tul Karm, north of Jerusalem, in April, but it was first necessary to advance north-east of and astride the Jerusalem-Nablus road. Preliminary operations began on the night of 2nd/3rd March when the 53rd, 74th and 10th Divisions advanced on both sides of the Nablus road. Four nights later the 53rd Division again advanced, two sections from each of the 437th and 439th Field Companies with pack transport accompanying the two forward brigades while the remainder improved roads in the rear.

On 2nd March the 220th Army Troops Company took over the Solomon's Pools pumping plant and pipe-line and the 521st and 522nd Field Companies of the 60th Division concentrated on bridge repairs and other work on the Jericho road.

The main attack began on the night of 8th/9th March. The object was to advance the whole front from north of Jericho to the foothills east of Mulebbis, so as to include the commanding hills round Tell Asur and Juljiya.

On the right of the XX Corps, the 181st Brigade Group of the 60th Division, including a section of the 522nd Field Company for water and bridging duties, crossed a precipitous wadi and, after considerable fighting, captured the hills beyond. Five miles to the west the 158th Brigade of the 53rd Division took the important height of Tell Asur and became involved in heavy fighting on the 9th. The 437th Field Company made a road from Bethel to Tell Asur, the 439th Company extended artillery roads and pack tracks and most of the 436th Company was engaged on water duties. The 74th Division, astride the winding Nablus road, advanced several miles, the sappers working hard on road improvements and water supply, sustaining some casualties.

On the 10th Divisional sector the whole front was advanced, involving heavy road-work before and after the attack. In particular, the 85th Field Company, with pioneers and infantry working parties, in one day converted eight miles of hill path into a track passable by artillery, thus enabling batteries to be sent forward to support the attack next day. Nothing better illustrates the extreme difficulty of the country than the fact that even then these guns had to cover nearly twenty miles in order to move a distance of three miles as the crow flies.

During the night of 9th/10th March the advance was resumed and fighting continued next day. The 74th Division luckily captured intact the bridge carrying the Nablus road across a deep gorge, and in other places where bridges had been destroyed ramps could be cut for deviations. The 10th Division captured all objectives, its field companies and pioneer battalion improving roads from the rear. The road to Juljiya with a ruling gradient of 1 in 10 took two sections of a field company, two pioneer companies and two infantry battalions five days to complete. So steep was the rocky hillside that the sole task of some of the men was to support others drilling holes for blasting.

The XXI Corps, in advancing its right to conform, had a less

difficult task, as the ground was less broken and better artillery support was possible. The 75th Division was the principal formation engaged and made an advance of four miles on a seven-mile frontage. The road-work was very heavy and involved much blasting.

These operations resulted in an advance on a front of twenty miles to a maximum depth of five miles. This area was broken and precipitous, and remarkable work was done by all field companies in the rapid clearance and improvement of paths and tracks to enable the artillery and supplies to keep pace with the infantry. The advance had obtained the degree of security which General Allenby considered necessary before executing his raid on Amman and the Hejaz Railway in order to assist the Arab army and to focus Turkish attention east of the Jordan.

THE PASSAGE OF THE JORDAN

Amman, twenty-four miles from the Jordan, was connected with Jericho by a winding and very poor road which, after crossing the Jordan by a bridge, climbed the very steep escarpment to Es Salt, after which the thin metalling ceased. Three other tracks led to Amman, crossing the Jordan by fords a few miles north and south of the bridge.

The 60th Division, the Anzac Mounted Division and various attached troops under Major-General Shea took part in the operations. The engineer units included the Army Bridging Train, R.E., an Australian bridging detachment and the 439th Field Company from the 53rd Division. The Jordan was to be crossed during the night of 19th/20th March, and, while infantry temporarily occupied Es Salt, the mounted troops and Australian engineers were to raid Amman and effect demolitions on the Hejaz Railway. No R.E. units took part in the latter operations and as one section only from each of the 519th and 521st Companies accompanied the infantry to Es Salt this narrative is mainly concerned with the Jordan bridging operations.

Lieut.-Colonel Thomson, after commanding an infantry brigade for a short time, resumed duty as C.R.E., 60th Division, on 12th March, and was in charge of the engineer operations. Preparations, including the collection of bridging material, had begun several weeks earlier. On 1st March a new engineer unit—the 13th Pontoon Park—was formed at Qantara and on the 9th it joined the Army

Bridging Train at Lydda. The bridging train had been raised by the XXI Corps from three field company sections from the 52nd and 54th Divisions and took charge of all the E.E.F. pontoon equipment. This was camouflaged before the march to the Jordan. The Australian bridging detachment, another improvised engineer unit was known as "D" Field Troop. It was equipped with light steel non-standard pontoons found in Alexandria. Material for a barrel-pier bridge, a footbridge and assault rafts, was sent forward; the 519th Field Company assembled the barrel piers and the 521st Company the rest of the stores in the Jordan Valley. The material was of a miscellaneous character and much ingenuity had to be exercised by both units.

The transport of these stores and of the pontoon equipment presented some difficulty because, although the 521st Company had reconstructed five bridges on the Jericho road by 15th March, one only was passable by tractors. Moreover, heavy rain on the 16th and 17th virtually closed parts of the road. The effects of the rain on the Jordan itself, however, forced a postponement of two days in the crossing operations and this enabled the material to reach the valley.

Lieut.-Colonel Thomson based his plans on reconnaissances and air photographs. The water was deeper and the current faster than in summer and the fords were impassable. On 7th March the Turks destroyed the bridge, but the approaches were the deciding factor in choosing the points of crossing, this was, therefore, chosen as one of the sites. The other was at the ford, three miles to the south, to which a reasonably good track led from a new road built down the Judean escarpment. The light steel pontoon bridge was to be thrown here and three bridges—a standard pontoon, a barrel-pier and a footbridge—were to be built at the old bridge site. The assault crossing was to be made by the 180th Brigade. Men were to swim the river with light lines, which were to be used to pull tow-ropes across, which in their turn were to draw the sheet rafts, each holding twelve infantry and two sappers. As soon as the bridgeheads and a covering position in the foothills had been gained, "D" Field Troop was to build the bridge at the ford and the 521st Company the footbridge of sheet rafts at the bridge site. Two brigades were to cross by these bridges while the 519th Company built the barrel-pier bridge and the Army Bridging Train the pontoon bridge. Two companies of pioneers were detailed for the approaches.

The 60th Division (less the 181st Brigade) completed its concentration north-west of Jericho on the night of 20th/21st March and was there watered by the 522nd Company. The 521st Company had twenty rafts ready and after dark on the 20th the 519th Company with thirty-six wagons of stores and one pioneer company moved to a concealed position 1,200 yards from the old bridge. Next day the enemy were observed in some force on the east bank near the bridge sites, but as the river was still falling no change was made in the plan for launching the attack that night, except that the assaulting parties were reinforced.

The story of the successful crossing at the ford is recorded in the *History of the Royal Australian Engineers*. At the old bridge the 519th and 521st Field Companies carried the sheet rafts and other equipment down to the river after dark, but the strong current defeated both swimmers and attempts to cross by raft. This activity aroused the Turks, who opened accurate small-arms fire and inflicted casualties, among the killed being 2nd Lieutenant S. C. Brightman of the 521st Company. The attempts to cross here were then abandoned until the troops who had crossed further south could clear the east bank.

The Australians completed the pontoon bridge at the ford at 8.10 a.m. on the 22nd, and part of the Army Bridging Train and a company of pioneers were moved south to build the second pontoon bridge there instead. This was finished at 2 p.m., and after dark the rest of the 180th Brigade crossed and took up a covering position astride the track. Another attempt to cross at the northern site under machine-gun and artillery fire was defeated by the strong current.

By midday on the 23rd the left bank had been cleared and the falling river enabled swimmers to cross with lines at 1 p.m. During the afternoon the 521st Company ferried one battalion across by rafts and at 3 p.m. began to build the footbridge. The 519th Company began the barrel-pier bridge (150-ft. long with fourteen piers) at the same time and finished it in just under seven hours. The west bank was steeply shelving gravel and the shore bay was supported on cribs but on the east bank, which was steep but muddy, the piles of the old bridge were utilized. Both banks were about ten feet high. The river was eleven feet deep with a five-knot current, so that trees on the banks had to be used as anchorages. The piers were finally secured by 2½-in. hemp cables to ¾-in. steel cables slung across the river on the upstream side.

At 5 p.m. the 13th Pontoon Park returned from the ford. By

midnight a pontoon bridge had also been built from surplus material obtained from the southern site.

Meanwhile more troops, including the 179th Brigade with one section of the 519th Company attached, crossed and the advance on Amman began early on the 24th—one day later than planned. This postponement was due to the bridging delays and certainly enabled the Turks to avoid the worst consequences of the operations. The 522nd Field Company began a road deviation at the northern site, and, with detachments from the 519th and 521st Companies, began to build a semi-permanent trestle bridge. The second pontoon bridge at the ford was dismantled and re-erected by two sections of the 439th Field Company at the main crossing place.

The Amman operations were only partly successful in their immediate object but had valuable strategic results. The British troops engaged did not advance beyond Es Salt, where detachments of the 519th and 521st Companies were engaged on water supply duties.

Meanwhile maintenance of the Jordan bridges became difficult. Heavy rain on the 25th caused a rapid rise in the river and the pontoon bridge was moved to a new position where pontoons could be substituted for trestles in anticipation of a further rise. The 521st Company and some pioneers completed the laying of fascines on the road deviation and began a retaining wall at the trestle bridge. On the 26th the 519th and 521st Companies had considerable trouble with the barrel-pier bridge, as there had been a rise of nearly four feet during the night and the river was widening. To meet both conditions the bridge was lengthened by crib piers at each end and six trestles with adjustable transoms were erected to keep the decking fairly level. More trouble arose from driftwood and debris fouling the cables, but by constant attention these were kept clear for eighteen hours. The river continued to rise until the 28th, when it was ten feet higher than on the evening of the 25th. The 522nd Company had to stop work on the trestle bridge and debris was accumulating so fast at the barrel-pier bridge that the pressure threatened to carry it away. Efforts to dislodge the mass with explosives were unavailing and the bridge had to be swung to free it. This was no easy task as the anchorages were submerged and the transverse steel cable had to be cut by gelignite charges. The 519th Company rebuilt the bridge on the 29th, by which date the gap was 200 feet wide. The river was then falling and as the piers grounded they were replaced by improvised trestles to allow adjustments for changes in level. The bridge was re-opened on the 30th.

The flooding of the banks on the 27th made it necessary for the pontoon bridge to be extended by the Army Bridging Train to ten pontoons with two extra trestles. At night the 522nd Field Company built a causeway, 160 yards long, in eleven hours, to connect the bridge with the metalled Jericho road at a point above flood level. Half of the 439th Field Company and two pioneer companies repaired the approaches. On the 28th the southern pontoon bridge was dismantled and all traffic concentrated on the northern crossings. Traffic was heavy, supply wagons alone averaging 450 daily in each direction. A 2-ton axle-load limit was imposed, and some vehicles, such as armoured cars, had to be lightened before crossing.

During the withdrawal, which began on the night of 1st/2nd April, two G.S. wagons went over the side of the pontoon bridge. Two bays were broken but were repaired in half an hour. The barrel-pier bridge was used by some vehicles without damage and by 8.30 p.m. on the 2nd most of the force had recrossed the Jordan. The pontoon bridge was then dismantled. The 521st Company's detachment with the 181st Brigade left Es Salt on the 1st but although it mined the Jericho road as it withdrew it was not allowed to carry out any demolitions.

The 522nd Company and a pioneer company remained on the Jordan preparing to erect a permanent suspension bridge. It also maintained the water supply areas and the barrel-pier bridge, until the Australian Field Squadron took it over on the 3rd.

WORK IN DESERT MOUNTED CORPS AND XXI CORPS AREAS

While the operations north and east of Jerusalem were in progress the situation on the front held by the Desert Mounted Corps and XXI Corps was relatively quiet, but much work was done by engineer units on defences, communications and water supply. The Yeomanry Mounted Division had a period of rest and training south of Gaza until the end of April, but the 6th Field Squadron worked on camp services and salvage. The principal works to be described are therefore those in the XXI Corps area, and as all three of its infantry divisions held much the same sectors for the first quarter of 1918 it is convenient to deal with each in turn and to conclude with an account of the work of the corps troops.

The 75th Division occupied the right sector, including Lydda. The work of both the 495th and 496th Companies was very similar throughout January. At the front detachments helped the infantry

to build sangars, erect wire and also such shelters as the limited amount of materials allowed. A second line was sited. There were ample supplies of water in wells and cisterns and the principal work was the improvement and drainage of the earth and gravel tracks which served as roads. The first priorities were the roads from Lydda to Ramle and Junction Station. The 495th Company built a divisional bath-house at Lydda, with laundry and disinfestation facilities for dealing with 750 men daily. February was marked by extensive patrolling at the front, and in a skirmish on the 17th two men of the 496th Company were taken prisoner. The second line of defences was continued and extended. Better progress was made with roads owing to the opening by the 496th Company of several quarries and to the arrival of a few steam rollers and 500 donkeys with panniers.

The 54th Division's sector was north of Lydda and Ramle and in January road improvements were the main task. On the right the soil was so soft after rain that the front was inaccessible, except on foot, and the 486th Field Company made a lateral road on higher and better drained ground. Much side drainage and stone pitching across wadis was necessary. The 484th Company at Mulebbis improved and drained roads and finished several trestle bridges. A footbridge was built across the Nahr el Auja, and the 486th Company completed the alterations to the railway bridge across the Wadi Sarar. Defence works also demanded considerable effort. The defended localities needed much drainage but, as the ground was hard, little revetment. Towards the end of January a second line, two miles to the rear, was sited among old Turkish positions. Water supply presented little difficulty, except for replacing magnetos and belts on the oil engines at the numerous pumping plants in the orange groves. On the 9th a breakdown at the main pumping station at Mulebbis was repaired in twenty-four hours by the 484th Company by fitting a new shaft from a reserve plant.

On 12th March the front was advanced south-west of Mulebbis and the company opened tracks through the hills by removing boulders and rock outcrops and developed the small quantities of water found. Several sangars were built on the new line but elaborate defences were not undertaken. On the left the 484th Company built two light bridges, a field artillery trestle bridge and a 50-ft. girder bridge for 60-pounders. During the following week the two field companies jointly laid out eleven miles of new road over rough ground where explosives had to be widely used, and improved about the same

mileage of existing tracks. By the end of the month the 484th Company had built two more bridges—one a floating infantry bridge and the other on trestles for field artillery. This bridging work was mainly in preparation for a large-scale advance, which was eventually cancelled on account of the German offensive in France.

On the left of the corps front the 52nd Division, handicapped by persistent rain, in January consolidated its new positions north of the Auja. Road-work imposed a severe strain on every company, but shortage of stone precluded permanent construction, except on the immediate approaches to the Auja bridges.

The 14th Army Troops Company began four semi-permanent bridges over the Auja between Mulebbis and the sea at the beginning of January. Two were to carry 120-H.P. Ford tractors, one 60-pounders and one 3-ton lorries. They were similar in design, except in detail, the decking being carried on braced trestles on piled foundations. Construction presented difficulties as the current ran at four knots and the depth was more than eleven feet. The average length of the bridges was 162 feet and the last was finished early in February, after some excellent construction times. A 60-pounder bridge north of Mulebbis was begun on the 19th. E.L.C. labour was used on the deep sand and brushwood foundations in the black cotton soil for the bridge approaches. Road metal was obtained by employing 1,000 E.L.C. and local labour in quarries opened at various places in the foothills and equipped with decauville track. The transport consisted of eight lorries, 700 donkeys and some local carts. During the next two months the 14th Army Troops Company built a new barrel-pier bridge for emergency use on the Auja and a quay wall at Jaffa, assisted the artillery in survey work and repaired and maintained pumping plants.

At the end of January a Corps Bridging School was established on the Auja with the double objects of training field companies and of accustoming the enemy to extensive and apparently innocent bridging activities close to his right flank—a piece of deception which was to bear fruit later in the year. Captain J. Cash (486th Field Company) was appointed commandant and took over several of the Auja bridges.

REORGANIZATION OF THE E.E.F.

Increasing man-power difficulties led to a decision in February, 1918, that, although the number of infantry divisions in the E.E.F.

was to be raised from seven to nine, British troops were to be partly replaced by Indian units. This reorganization of divisions on the Indian army pattern applied to all infantry and mounted brigades, including their engineers, but not to the Anzac formations. This change was in progress when the success of the German offensives in France in the spring caused drastic cuts in the strength of the E.E.F. Because the 7th Indian Division had recently reached Egypt from Mesopotamia, General Allenby was ordered on 23rd March to release one British division for France. He chose the 52nd from the XXI Corps, and its three field companies, the 410th, 412th and 413th, figure no more in this section of the History. A few days later General Allenby was ordered to substitute a policy of active defence for the offensive which had been discussed earlier in the year, and to send another infantry division and nine yeomanry regiments to France. This time it was the turn of the XX Corps, who gave up the 74th Division. It was relieved in the sector north of Jerusalem early in April and the 5th R. Anglesey and 5th R. Monmouth, embarked at Alexandria, after working at Qantara under the A.D.W. on the way. The 74th Division was replaced by the 3rd Indian Division, who began to reach Egypt from Mesopotamia in the middle of April. The British mounted troops were reorganized in two divisions—the Yeomanry Division becoming the 1st Mounted (later the 4th Cavalry) Division, and the 7th Mounted and Imperial Service Brigades the 2nd Mounted (later the 5th Cavalry) Division.

These changes were accompanied by "Indianization" of the engineers with the infantry divisions and by reorganization of those with the mounted divisions. Dealing first with the latter, the 6th Field Squadron passed to the 1st Mounted Division and in September, 1918, the squadron was renumbered the 4th, and the 6th, 7th and 9th Field Troops became the 10th, 12th and 11th Field Troops respectively. For the 2nd Mounted Division a new field squadron, the 7th, was formed on 8th June from the 8th and 10th Field Troops. In July the 8th Troop provided the nucleus for a new "Z" Field Troop; and on 5th September the squadron was renumbered the 5th, the three field troops becoming the 13th, 14th and 15th. Lieut.-Colonel H. D. Pearson was appointed C.R.E., Desert Mounted Corps early in 1918.

The new field company organization of each infantry division (except the 54th, which had three British companies) was accomplished gradually during the spring and summer. The engineer companies with the 3rd and 7th Indian Divisions were Bombay and

Bengal Sappers and Miners respectively and, in all, eight Indian field companies had joined the E.E.F. by the spring. The new organization was on the basis of two British and one Indian field company in each British division (except the 74th and 75th), and one British and two Indian in the 3rd and 7th Divisions. These changes, including the Indian pioneers, were as follows:—

<i>Formation</i>	<i>Field Company transferred</i>	<i>Date, 1918</i>	<i>To</i>	<i>Replacement by Sappers and Miners Company</i>	<i>Pioneer Battalions</i>
10th Division	65th	19th July	3rd (Lahore) Division	No. 18	2/155th Pioneers
53rd Division	439th	4th April	74th (Lahore) Division	No. 72	1/155th Pioneers
60th Division	522nd	18th July	7th (Meerut) Division	No. 1	2/107th Pioneers
75th Division	495th	26th May	54th (Meerut) Division	No. 16	2/32nd Pioneers

The 5th R. Irish and 1/12th Loyal N. Lancs. (Pioneer) Battalions of the 10th and 60th Divisions were sent to France with the 52nd and 74th Divisions. The Cs.R.E. of the 3rd and 7th Divisions were, respectively, Lieut.-Colonels J. A. Stack and E. F. J. Hill.

CHAPTER XXX

OPERATIONS, APRIL TO AUGUST, 1918

Operations in April—Turkish attack on the Jordan bridgehead—The second trans-Jordan raid—The Jordan Valley during the summer—Divisional engineers during the summer.

(Map 6)

OPERATIONS IN APRIL

IN early April, General Allenby started a somewhat ambitious operation in the foothills with the intention of cutting the only road supplying the Turks south of the Nahr el Faliq marshes, and thus isolating a substantial part of their forces. The 75th and 54th Divisions were to penetrate the enemy lines on a front of about twelve miles, while the 7th Indian Division in the coastal sector was to occupy part of the wide no-man's-land so as to gain artillery positions. The 163rd Brigade* on the left of the 54th Division was then to turn west into the plain east of Arsuf and let through the Australian Mounted Division, who were to sweep north up the Plain of Sharon.

During the first week of April the field companies of the 54th and 75th Divisions, in preparation for the attack, improved or built roads and established advanced dumps of water and defence stores. The 54th Divisional R.E. converted six miles of tracks to take lorries and the 484th Company arranged watering facilities east of Mulebbis for the Australian Division, who were carefully concealed in the orange groves.

The 75th Division opened the attack early on 9th April—a day of great heat. The Turks, assisted by Germans, counter-attacked vigorously, with the result that several objectives were not reached. The failure to obtain complete success reacted on the work of the engineers. The 495th Field Company could not start extending the road until 11 a.m., when some progress was made despite heavy machine-gun fire. The 496th Company tried to extend a second road, but Turkish detachments on commanding ground made work almost impossible. Some water supplies were developed.

* Brigade Major—Brevet-Major E. F. Tickell, R.E.

The 75th Division renewed its attacks next day but the Turks resisted strongly. German troops regained some of the lost ground and at the end of the day our troops were still short of their first objectives. The 496th Company alone was able to execute any road work. On the 14th General Allenby cancelled the operations owing to demands for troops to be sent to France. The operation is interesting, because, when repeated on a larger scale in the autumn, almost the same plan was to open the door for the final victory.

TURKISH ATTACK ON THE JORDAN BRIDGEHEAD

After the first raid on Amman it was decided to retain a bridgehead east of the Jordan to secure the right flank of the E.E.F. and to retain a "jumping-off" point for further operations. On 3rd April the Anzac Mounted Division and the Imperial Camel Brigade took over the defences both of the bridgehead and of the positions north of Jericho. Other troops, including the 519th and 521st Field Companies and the 13th Pontoon Park, were withdrawn and the only sappers left in the Jordan Valley were the 10th Field Troop with the Camel Brigade and the 522nd Field Company. Considerable activity was shown by the Turks east of the Jordan during the night of 10th/11th April, and next day heavy enemy attacks were made. All were repulsed and appreciable losses were inflicted on the Turks. The 522nd Company continued work on a new pontoon bridge, and, in spite of the artillery fire which persisted for a few days, finished the steel cable suspension bridge on the 18th with a few casualties. The unit co-operated in a demonstration east of the Jordan on 18th and 19th and then returned to Jerusalem.

THE SECOND TRANS-JORDAN RAID

General Allenby intended to make a second raid against Amman during May, with the long-term object of keeping the enemy's attention diverted from the coastal plain (where his final offensive was ultimately planned) and with the immediate objects of destroying the Turkish force south of Es Salt, of seizing the grain harvest and of gaining summer bivouacs out of the stifling Jordan Valley. The operation was advanced to the end of April when an Arab tribe asked for support.

A larger force was used than in the first raid—two mounted divisions, the 6th Mounted Brigade (with the 6th Field Troop), most

of the 60th Division, and an Indian brigade. The 60th Division was to attack the Turkish position astride the road to Es Salt, while the mounted troops outflanked it from the north. A diversionary attack was to be made at the south.

The engineer preparations included strengthening the pontoon bridge, for which the 13th Pontoon Park returned on 27th April with the necessary material. The bridge had a span of 143 ft. and was reopened to traffic early on the 28th after eleven and a half hours' work by the Anzac Field Squadron and a detachment of the Pontoon Park. The latter maintained the bridge during the early stages of the operations. The remaining Jordan bridges were maintained by the 519th Field Company, which returned to the valley on the 28th. The 521st Field Company watered the 179th and 180th Brigades on their way to the bridgehead.

On the 30th, the 60th Division attacked over difficult ground but, except on the left, where a strong defence work was taken, little progress was made and losses were considerable. On the left three mounted brigades advanced by different routes to Es Salt which was occupied during the evening. No R.E. were engaged with the assaulting battalions of the 60th Division but the 519th Field Company took over the maintenance of the pontoon bridge and built a footbridge. At night the 521st Company sent a detachment to help in rechessing the barrel-pier bridge.

On 1st May neither a renewed attack by the 60th Division nor an attempt by the 5th Mounted Brigade to attack from the rear down the road from Es Salt were any more successful. An Australian mounted brigade in the north was heavily counter-attacked and was only able to extricate itself with difficulty. A further attack by the 60th Division on 2nd May made some progress on the left. Lieutenant C. G. Jones of the 521st Field Company reconnoitred the northern track—the only one still open—to Es Salt, to see whether it could be improved to take wheeled traffic, and the 9th Field Troop reached it at 4.30 p.m. The 60th Division made a night attack on the right with little success and all day on the 3rd the infantry were held by heavy fire. The 181st Brigade and the 522nd Field Company arrived in the bridgehead during the morning, while Turkish counter-attacks in the hills gained some ground. On the left the 9th Field Troop and half the 519th Field Company improved the northern track. During the afternoon General Allenby decided to stop the operations and to withdraw the advanced troops, although to a larger bridgehead than previously.

The R.E. had played an important part in the improvement of communications in the north, which enabled the British force in the hills to be extricated with less difficulty and loss than had been expected. The attempted raid had been a tactical failure (although in relation to the severity of the fighting the British casualties had not been unduly high) but General Allenby's wider strategic plan had succeeded because one-third of the Turkish forces were afterwards always kept east of the Jordan. The 60th Division began to move back to the Jerusalem area on 6th May and soon afterwards the C.R.E., Lieut.-Colonel Thomson, left to take up a senior staff appointment in France.

THE JORDAN VALLEY DURING THE SUMMER

The retention of the Jordan bridgehead on strategic grounds imposed many problems. The climatic conditions—tropical heat, stagnant air, high humidity, insect plagues, virulent malaria and clouds of dust raised by the least movement—were among the worst ever endured by British troops. But for the abundance of good water the valley would probably have had to be abandoned.

The problem of permanent bridging across the Jordan was difficult to solve owing to limited resources and changes in tactical policy. After the second trans-Jordan raid the pontoon and barrel-pier bridges were maintained by the Desert Mounted Corps and the 13th Pontoon Park. Early in April Captain Kempson, O.C. 220th Army Troops Company, was instructed to design a three-span steel girder bridge, utilizing captured material found in Jerusalem, and fabrication began on the 8th. At almost the same time the War Office was asked to provide a 240-ft. heavy Inglis bridge. Including erecting gear, this bridge totalled some 1,000 separate pieces, and arrived at Alexandra on 1st July. In the meantime the 220th Company finished the improvised bridge and opened it to traffic on 19th July. The erection of the Inglis bridge was postponed for several months.

During May various changes in standard were made to the other bridges and at the end of the month a new semi-permanent barrel-pier bridge for 60-pounders designed in the 6th Field Squadron was started. It took a fortnight to build. Early in June the 9th Field Troop made a new pontoon bridge for field artillery farther south and also moved one of the existing floating bridges to this site. Some damage was inflicted by Turkish artillery on 19th June

during a demonstration by two mounted brigades. On 21st June the 6th Field Squadron began a trestle bridge to replace the pontoon bridge and completed it in just under twenty-four hours, in spite of the strong current.

As the 7th Field Squadron was still forming, the 486th Field Company (54th Division) was temporarily attached to the 2nd Mounted Division for duty in the Jordan Valley. It relieved the 6th Field Squadron on 9th July and took over all bridges and a ferry. It built no new bridges, but the tedium of maintenance was enlivened by some skirmishing on 14th July. On 19th August the 6th Field Squadron returned to relieve the 486th Field Company and to continue the maintenance of the Jordan bridges until early in September.

Bridging was not the only work in the Jordan Valley. Water supply and road-work was required, and in June extensive anti-malarial measures were undertaken, stagnant pools being drained and the dry weather flow in the wadis canalized. Defences in the bridgehead were also built. When the 486th Field Company took over the squadron's work in July, water supply continued but most of the company's efforts were devoted to building metalled lorry roads on the plain. The bridgehead defences were improved and extended to form an elaborate system with dug-outs and other refinements. When the 6th Field Squadron returned in August, road improvements and maintenance of the water areas were resumed but the demands for works were fewer and the squadron was able to do some training.

The wagons of the 13th Pontoon Park were used continuously for taking bridging, pipes and decauville from Jerusalem to the Jordan. The pipes and rails were awkward loads which damaged the wagons and put great strain on the horses. On 1st May the 35th Army Troops Company reached Jericho to erect the pumping plant and build storage for the new water supply. On 6th September the company moved to Jericho to take over all works in the Jordan Valley from the Desert Mounted Corps preparatory to the final offensive.

DIVISIONAL ENGINEERS DURING THE SUMMER

The defensive policy of the British and the reorganization of the E.E.F. resulted in relative quiet during the summer along the front from Jerusalem to the sea. There were a few British raids, one on a

large scale, a local attack by the 7th Indian Division on the coast and a Turkish attack in the foothills. But if the tactical situation was quiet, there was little respite for R.E. units. Continuous development of water supplies was needed, and this became increasingly difficult as the higher springs dried out. The general policy was to develop good sources and to install pumps and pipelines to well laid-out and accessible watering places. Work continued on defences, roads and bridges and during the short periods when companies were out of the line a certain amount of training was possible.

CHAPTER XXXI

THE L. OF C. AND EGYPT IN 1918

Palestine L. of C.—Jerusalem water supply—Anti-malarial measures—
54th Divisional Engineers at Jaffa—Water supply during 1918—
Railway works, January to September, 1918—Light railways—
Survey—Egypt and the Canal Zone.

(Map 6)

PALESTINE L. OF C.

ON 31st January, 1918, the L. of C. area extended to the general line Hebron—Lydda—Jaffa and later to the Jerusalem area. A.Ds.W. were appointed and the 35th, 555th, 569th and 571st Army Troops Companies, the 357th Water Company and a considerable labour force of E.L.C. and natives were engaged on works. Most of these units and selected E.L.C. companies were organized in March with additional transport as a special force under Lieut.-Colonel J. W. Noble for engineer services in the rear of formations during a large-scale advance, until the static L. of C. organization could be extended.

Special services on the L. of C. are described separately but routine work can be quickly summarized. The 35th Army Troops Company was engaged for the first three months of the year mainly on quarrying and road construction in the Ramle area and in April on similar work at Lydda. At the end of April, after helping the 54th Division with water supply, the company moved to Jerusalem, whence it took part in the Jordan operations and also worked on roads and water supply in the city itself during June and July. The 569th (Devon) Army Troops Company moved to near Jaffa on 3rd January, where it built a prisoners-of-war camp and worked on the Ramle—Jaffa road. It still had detachments, including some in Egypt, but these rejoined gradually until one only remained—that with the Railway Operating Division at Jaffa. The 571st (Devon) Army Troops Company worked on the Ramle—Jerusalem road, water supply and miscellaneous services. In May it moved to Jerusalem for similar work and also to operate several workshops.

The 555th (Lancs.) Army Troops Company was engaged on quarrying and road maintenance and other work in the Lydda area. Before the autumn offensive it built two permanent masonry bridges south of Mulebbis.

JERUSALEM WATER SUPPLY

The civil water supply to Jerusalem was thoroughly unsatisfactory. Underground cisterns of varying sizes with an estimated total capacity of 360 million gallons were filled with rainwater from roofs and paved areas. Many cisterns through neglect were empty and those open to the air bred mosquitoes. The quality of the water was dubious but was used by the civil population and animals. The other main source of supply was the 8-mile long aqueduct and 4-in. pipe-line from Solomon's Pools feeding a dirty reservoir outside the city and a fairly clean cistern at the Mosque of Omar, from which the army obtained 40,000 gallons daily. As water had normally to be carried into the city from considerable distances during dry years, there was little hope that the increased military demand could be met during the summer. As it was undesirable on various grounds to evacuate the 50,000 inhabitants, the E.-in-C. was instructed early in 1918 to investigate the problem of increasing supplies.

Many schemes were examined, the most promising of which was that prepared by a French engineer, M. Frangis, in 1908. This provided for the reconstruction of an ancient collecting reservoir at some springs fourteen miles south of Jerusalem, and for a pipe-line to the city. Gaugings of the springs gave an estimated daily yield of over 350,000 gallons and levels showed a fall of 105 feet between the reservoir and the Jaffa Gate. The project comprised repairs to the collecting aqueducts and reservoir, the installation of a pumping station delivering through twin 6-in. pipes to a new break-pressure 500,000-gallon reservoir, 360 feet above and two and a half miles from the springs and the laying of a 6-in. gravity main, 12½ miles long, to a new service reservoir holding 200,000 gallons just west of the city. Gravity distribution at the rate of 250,000 to 300,000 gallons per day could then be arranged as necessary. The pipe-line had an undulating profile and at one point was 338 feet below the final reservoir.

Severe weather and shortages of labour and transport postponed a start until 12th April but thereafter progress was rapid, and

water began to reach the city through the new system in a little over two months. Major F. W. Stephen was in charge of the work, which was executed in the following manner. A sapper party with local labour set profiles for the pipe-line in fifteen days, and on 22nd April E.L.C. and local labour began work on the formation. This was six feet wide, with cuttings, embankments and culverts, and was finished in a month. On 27th April a similar party began to lay a ring and subsidiary distribution mains in Jerusalem, and in spite of traffic and rocky ground seven miles of 3- and 6-in. pipes were laid in two months.

Clearance of the 1,100 yards of collecting aqueducts was begun in March but no great progress was made until 15th April, when E.L.C. and local labour in some force began the final clearance, repairs to masonry and re-roofing. The pump-house and the first half of the break-pressure reservoir were built at the same time. The latter was constructed in lime mortar masonry, was totally enclosed, and, when the second compartment was finished, held 300,000 gallons. The pump was so arranged that pumping could begin before the old reservoir had been repaired.

Pipe deliveries began in April and were mainly of screwed American make. The head for a length of two miles of the pipe-line exceeded 600 feet, and special care was taken in the examination of the pipes, fittings and joints. The distribution by twelve tractors of the 5,000 pipes occupied the whole of May but laying and jointing were begun by E.L.C. on the 14th and were finished on 10th June. The tractors could not leave the metalled road to Hebron and for some sections the pipes had to be manhandled for nearly two miles from the unloading points.

Two 66-H.P. Hornsby oil engines were brought from the Qantara pipe-line and a 3-throw ram pump with a capacity of 20,000 gallons per hour against a head of 410 feet was requisitioned in Cairo. The pump required alteration but installation of the machinery was started by a detachment of the 357th Water Company on 15th May and finished a month later. The pump could lift either directly from the aqueduct or from the reservoir when the flow from the springs slackened in dry weather.

The final reservoir was begun on 15th May by E.L.C. and local labour. A considerable amount of rock excavation was necessary and the stone so obtained was used in the masonry, which was built in cement mortar. The first of the two compartments was finished on 14th June.

Three days later the pipe-line sections were coupled together and the system washed out and tested. There were no leaks and the pump delivery was increased to 17,000 gallons. Water began to reach the reservoir on 18th June, and an assured supply of sufficient water for the inhabitants of Jerusalem in such a relatively short time was very gratifying to all concerned. Both new reservoirs proved watertight when brought into use but the ancient city reservoir required extensive cleaning and repair.

Supplementary work was soon ordered. In July a 50,000-gallon reservoir for locomotives at Jerusalem Station was authorized and extensions to the distribution system in the city were started. The system was operated by the 357th Water Company but on 28th September the 359th Water Company took over.

ANTI-MALARIAL MEASURES

In connection with the autumn offensive, General Allenby deliberately accepted the risks involved in concentrating numbers of troops in unhealthy areas but he ordered stringent anti-malarial measures. The R.E. played an important part in eliminating mosquito breeding, and reference has already been made to the work done in the Jordan Valley. The other very bad area was in the XXI Corps' Sector on the plains. Captain W. Cave-Browne (commanding No. 3 Company, Sappers and Miners) devised a way of draining the 200 acres of reed-covered marsh near Arsuf. The level of the marsh was a hundred feet above the sea, but a limestone ridge, 150 ft. high, lay in between. An ancient tunnel was discovered and by clearing it and lowering the seaward end twenty feet over 160 million gallons of water were drained in three weeks.

A swamp, fifty acres in extent and containing 6 million gallons, was drained in May by the 14th Army Troops Company by pumping over the sand dunes. In June the same unit tackled the worse problem of the marsh west of Mulebbis by using E.L.C. labour to dig a channel 5,000 yards long to the Nahr el Auja. A daily run-off of nearly 500,000 gallons was maintained for some weeks by digging 4,000 yards of subsidiary channels but the marsh never dried completely and in August the remaining boggy areas were oiled.

In May, the 14th and 569th Army Troops Companies cut all the reeds in the wadis east of Jaffa, and the beds were canalized in places. The Nahr el Auja was a heavier task, which took several months and much labour. Many mosquito-proof huts were built.

54TH DIVISIONAL ENGINEERS AT JAFFA

When the 54th Division's move to France was cancelled early in July its field companies took over various tasks from the 555th Army Troops Company under the A.D.W., Jaffa. The principal work was the conversion of the track running north from Lydda into a drained, metalled road, 19 ft. wide, with a maximum gradient for vehicles going forward of 1 in 20. The stone was obtained from neighbouring quarries and transported by lorries and donkeys at the rate of 400 tons daily. The 484th and part of the 495th Field Companies and several thousand infantry, E.L.C. and natives were employed. Retaining walls and several large culverts were built and the road was opened to traffic on 19th August. Both units were also engaged on water supply in camps and bivouac areas, on defences in the third line and on training.

WATER SUPPLY DURING 1918

During the early part of 1918 water supply work on the L. of C. was required to meet the immediate needs of the troops and railways and for this purpose work was limited to the exploitation of existing sources rather than to long-term development.

The demand for water at the Lydda railhead soon became considerable, the railways alone requiring 200,000 gallons daily. The 359th Company sank or developed six wells about 138 feet deep, from which 40,000 gallons per hour were obtained, laid 9½ miles of mains and erected two high-level storage tanks. When Jaffa was occupied the company took over pumping plants in the area and developed their yield to more than 500,000 gallons daily. In February more sets were installed, and by the end of March the 359th Company, with the 555th Army Troops Company attached, was responsible for a large number of bores and pumping plants spread from Gaza to Jaffa.

During the advance, the 359th Company had done excellent work developing potential sources for which the field units had had neither the time nor the equipment. It suffered, however, from being on the same establishment as that of the 360th Water Company engaged on the static operation of the Sinai pipe-line, and, in consequence, was unable to meet all the demands made upon it.

Early in March the formation of a third water company—the 357th—on the Palestine L. of C., was authorized, and the earlier

mistake of too little transport was largely rectified. It was designed to operate thirty stations in the area north of the Jaffa-Jerusalem road, but in July an increase in the strength was found necessary to achieve this. Early in April the boring section (Lieut. Mangin), which had finished eight bores in the Gaza area, was also moved up and re-equipped with standardized rigs.

Meanwhile the 359th Company continued to work in the Gaza-Lyddá area, increasing the yield of the wells to 240,000 gallons per day. During April the five wells at Ramle yielded 210,000 gallons daily. The boring section, after its transfer, sank thirty wells, mostly over 200 feet deep.

The railways were large consumers of water ; in March the main line from Qantara to Rafa was drawing 400,000 gallons daily from the pipe-line, on which sufficient storage was now available for three days supply when the railway was being used to full capacity. As the Turkish lines were brought into operation, special water arrangements were made to avoid having to haul water-trucks. The supplies to the Jerusalem branch were increased in the spring by the 359th Company from a spring at Artuf.

In the middle of May shortages occurred at Lydda, where the captured pumping plants were in a poor state of repair and three wells went out of action simultaneously so that no water reached the railways for two days. After immediate remedial measures had been taken, the 357th Company connected an additional well by a 6-in. pipe-line, 1,300 yards long, stand-by sets at two wells and increased the storage capacity to prevent further shortages. Spares had often to be made specially in the Machinery Park. The daily yield of the wells at Junction Station was eventually raised to more than 160,000 gallons.

At Beersheba water supplies, mainly for the railway, continued to be developed throughout the year. The 360th Water Company took over the wells from the 220th Army Troops Company at the beginning of January and operated them until 15th May, when the 359th Company relieved them and continued to increase local supplies at many places.

The 357th Water Company continued to operate over a wide area until the autumn, sinking fresh bores, installing animal watering areas and working electricity sets at the Lydda hospitals. Considerable storage facilities were erected and additional supplies laid on to G.H.Q. The most extensive works were south-east of Jaffa, where several wells were developed until their combined yield was

420,000 gallons per day. Between June and September the company's pumping plants increased from fourteen to thirty-two and the amount of water pumped from 650,000 to 1,600,000 gallons per day. To lift this quantity nearly 9,000 gallons of fuel and lubricants were used daily.

Much was done by the 360th Company to increase the capacity of the pipe-line from Qantara, where the new filtration plant was finished on 6th January. Early in February the new pumping sets at Abd, Mazar, El Arish and Sheikh Zowaid were finished, but the machinery at Mazar was not tested until 8th April. The new pump-houses were substantially built with concrete blocks, and sundry improvements, such as sand-proofing, oil sumps and bitumen vibration dampers, were made during the summer. The old engines from Mazar were sent to Jerusalem and those from El Arish to Rafah. On 1st March the concrete bed for the new 90-H.P. Blackstone engine at Qantara was begun and the installation of a new heavy pump followed; when tested on 25th May a delivery of 24,000 gallons per hour was obtained and soon afterwards the increased pumping power was put into full use. By increasing the working pressure to the equivalent of a head of 560 feet as far as El Arish a marked increase in capacity was obtained. The 147 miles of pipe-line had by this time absorbed 13,000 tons of pipes and machinery, while the total engine horse-power was 1,500 and the storage capacity over 4 million gallons.

The gradual movement of troops out of the area supplied by the pipe-line, its increased capacity and the fact that nearly all troops were now moved by rail enabled many of the subsidiary water systems in Sinai to be salved, particularly between the Suez Canal and Romani. When the final offensive opened the pipe-line was almost exclusively used for supplying the railway.

The Machinery Park at Rafah had a busy year repairing pumps and engines, including captured material. Excessive wear due to the all-pervading sand was the main cause of trouble. Some 1,000 patterns and core-boxes were in continuous use and 500 castings were produced monthly, nearly all the brass and gunmetal being obtained from captured material. Enemy mild steel was eagerly sought by the smiths' shop, as its low carbon content facilitated welding. Much ingenuity was exercised in the machine shop in producing special pieces of machinery and its peak monthly output was 1,000 items. The erecting and testing shop overhauled and repaired some 200 power pumps, 500 hand pumps and 300 engines in the year

ending in September, 1918. The wide range of machinery in use necessitated a spares stock of some 21,000 items of 3,000 types, but spares demanded from home usually took nine months to arrive, and many had to be made locally. The park also modified many pumps to work against doubled heads and designed and built several special, heavy-duty, triple-ram pumps for use in Judea. The excellent work done by this unit is all the more remarkable in view of the small proportion (one to three) of British to native tradesmen.

RAILWAY WORKS, JANUARY TO SEPTEMBER, 1918

Repair work on the main line after the floods was sufficiently advanced in early January to enable the 115th and 116th Railway Companies to resume construction at Mile 179. On the 8th a temporary supply railhead was opened at Dairan at Mile 182, seven miles from Ramle, which enabled full use to be made of the 3 ft. 6 in. line to Jerusalem when opened and, meanwhile, facilitated road supply to the troops in Judea. Operating railhead moved to Junction Station on the 18th and the supply position, although still very difficult, was eased. Between 24th January and 18th February the 115th Company laid a 4-mile branch to the sea at Nahr Suqrier, where supplies were being landed pending the opening of the port of Jaffa. During this period a detachment moved to Lydda to work on the Jerusalem line. More repair work after further floods and washouts and the considerable earth work required in the hilly country near Lydda also slowed construction on the main line, railhead not reaching Mile 188 until 31st January and two miles only being laid during February.

Doubling the main line from Mazar was continued by the 272nd Railway (Construction) Company, a new unit formed at Salonika and sent to Egypt in December, 1917. Doubling reached El Arish on 7th January.

To ease the supply situation in Judea, high priority was given to the reopening of the Jerusalem line beyond Artuf, the reconstruction of four bridges being the most important part of the work. The first two were completed by the 266th Railway Company early in January. This gave access to the others which were repaired by an intensive and continuous effort from reveille on the 25th until early on the 27th, the line to Jerusalem being opened to traffic that evening. Jerusalem was twenty-five miles from Junction Station

and for most of the way the line ran along a narrow rocky gorge which made it difficult to get materials to the bridge sites. The bridges varied in span, the longest being nearly a hundred feet. The ruling gradient of the line was 1 in 50 and the curves were only 460 feet radius.

The next most useful Turkish narrow-gauge line was that from north of Gaza to Junction Station. In January the 265th and 266th Railway Companies were responsible for its maintenance and the first-named unit laid deviations at four damaged bridges and built storm openings. Heavy rain stopped all traffic for three days from the 6th, and the 272nd Railway Company was sent up by a route march lasting a week in pouring rain and without tents to Et Tine, for repair work. Further damage was caused by heavy rain on the 13th and when the 272nd Company arrived on the 15th it found plenty to do, including the laying of a deviation at the damaged bridge across the Wadi Sarar. The line was reopened to Ramle on the 19th and on the same day the 265th Company finished the reconstruction of the first bridge. The value of the drainage work completed by both units was proved at the end of the month, when two days of heavy rain failed to close the line, although a washout south of Et Tine on 7th February caused a day's stoppage. The 265th Company finished the reconstruction of the bridges in February and repaired flood damage for a week in the middle of the month when the line had been closed again.

When Jaffa was opened the capacity of the narrow gauge line to Jerusalem was insufficient and early in February the 115th Company began the conversion to standard gauge of the 15-mile section from Lydda to Artuf. This was an interesting process because until Artuf had been rebuilt as a transhipment point, trains of both gauges had to be run over the same line—narrow gauge supplies at night and standard gauge construction trains during the day. Each day a length of old track was lifted, the formation regraded and ballasted, three rails laid and the narrow gauge reconnected for the night's traffic. On 10th March the 265th Company began to convert Junction Station to the new gauge and from the 20th helped on the Jerusalem line, with the result that nearly twenty-three miles of track were converted by the end of the month. As soon as the standard gauge was opened to Artuf, all available narrow-gauge rolling stock was concentrated on the Artuf-Jerusalem section to increase its capacity. It should be noted that the original French metre-gauge line had now been converted during the war

to 1.05 metres by the Turks, and to 3 ft. 6 in. and then to 4 ft. 8½ in. by ourselves.

When the Qantara main line reached Lydda, Junction Station was partly superseded as a transshipment point and Lydda became the point of heaviest traffic. It already had extensive railway facilities when the station was opened to traffic on 4th February, but the 116th Railway Company, assisted by two Indian pioneer battalions and the 265th Railway Company, made many improvements. The old narrow-gauge line to Jaffa had been removed by the Turks and on 15th February the 272nd Railway Company began to relay it, working from both ends. The two sections were connected on the 22nd, after nearly one and three-quarter miles per day of platelaying on the old formation, and through trains from Jaffa to Jerusalem were then run. Stores began to be landed at Jaffa almost as soon as the port was captured and a detachment of the 389th Advanced Park Company was sent there in January to handle the engineer tonnage.

Turning once more to the main line, the 115th Railway Company, assisted for short periods by the 116th and 266th Companies, resumed construction beyond Lydda on 20th March, and on the 31st railhead was at Mile 196, four miles south of Mulebbis, on the old Turkish line and as far forward as the tactical situation allowed. The 116th and 266th Companies moved back on 30th March to resume doubling the main line. Some work beyond El Arish had been done in the meantime by the newly arrived 299th (Indian) Railway Construction Company. Handicapped by inexperience and sickness, this unit was subsequently employed on maintenance and light railway construction. On 10th April the 266th Company established a new record—laying and spiking 2,647 yds. of track in six hours—and on the 19th the doubled line reached Rafah. Consequential alterations to stations were also made.

During the period of transition while railways of both gauges were in use, a considerable proportion of the total engineer effort had to be devoted to the development of transshipment facilities at various points, but by early February these were reasonably adequate for handling supplies.

The 265th Railway Company continued to improve the Jerusalem terminal and completed the reconstruction of the last two bridges, including considerable strengthening for heavier loads. On 18th April the 115th Company moved to Artuf and both units began the conversion of the final section to Jerusalem to standard gauge.

Progress was slow, because traffic (averaging 740 tons of supplies daily) had to be maintained, the widening of cuttings required much blasting, and embankments and retaining walls had to be altered and strengthened. Little improvement to gradients was possible but the sharper curves were eased. Tracklaying began on 23rd April on the same system as before, except that the narrow track was laid inside the standard gauge, which was opened to traffic to Jerusalem on 15th June. Improvements were continued by the 265th Company throughout the summer and by the 115th Company at odd periods. The narrow-gauge track was lifted in July.

In April it was decided to extend the standard-gauge branch from Karm to Beersheba with a higher priority than doubling the main line. The 116th and 266th Railway Companies moved to Karm on 19th and 18th April respectively for this work. Using the old Turkish formation beyond Irquaiyiq, Beersheba was reached on 3rd May, although its new station was not opened until the 8th.

The next stage in railway development was to convert the Beersheba-Junction Station line to standard gauge so as to have alternative routes from Rafah to Jerusalem or Lydda. The 116th Company, assisted by the 266th Company, began work early in May and on 8th June the track was through. The 266th Company remained until 18th September on maintenance, completing station loops, sidings and deviations at damaged bridges.

Little work was done on main-line construction during the summer, but many improvements were effected. The 116th Company laid the second track across the Wadi el Arish bridge in May and the 115th and 265th Companies relaid the Suqreir branch in August. On the main line the new track was of better construction and alignment than the original and it was therefore used by loaded trains while empties returned on the earlier line. The doubling of the line and the extensions to the northern railhead and Junction Station made necessary some modification of the control and signalling arrangements; a second traffic control, similar to that at El Arish, was established at Lydda for the lines north of Gaza. Single-needle block instruments were used on the double line and the electric staff on the single lines. Railway traffic increased during the summer and during the three months ending 30th June, averages of 36,000 men and 31,000 tons of supplies were conveyed weekly from Qantara to the various railheads. On 5th August the Qantara Military Railways were re-entitled "Palestine Military Railways" eastwards from Qantara.

The high tonnages handled were made possible by further developments at Qantara—already a port of considerable size with berthing and unloading facilities for large ships and an extensive railway terminal system. The latter was continuously expanded to meet the growing needs of the E.E.F. and it was due to Lieut.-Colonel Sowerby's foresight in designing the original lay-out that these extensions necessitated no material alteration to the plan or interruption of traffic. The most important single improvement was the replacement in July of the rail ferry across the Suez Canal by a swing bridge of ingenious but unorthodox design. An existing span was provided by the E.S.R. and reassembled on the new site with modifications in the design to suit the location of the turn-table at one end instead of in the middle. The other end of the moving span was so arranged that it could be transferred from a pier to a self-propelled concrete pontoon of 280 tons dead weight, which moved in a quarter circle to a position clear of the navigable waterway. Swinging occupied only ten minutes. Extensive sidings were laid out on both banks for trains waiting while ships were passing. Construction was under the D. of W., the E.S.R. acting as agents.

LIGHT RAILWAYS

To relieve the roads and to facilitate the supply position some seventy-two miles of light railway, and several miles of decauville track were laid in the forward areas, and by August nearly ninety-four miles of line were controlled by the 96th Light Railway Operating Company. This unit reached Alexandria at the end of 1917. Several men had been drowned when its transport was sunk by torpedo in the Mediterranean, and the unit was complimented by the G.O.C., Alexandria District, upon its conduct on this occasion.

The first works were on the 60-cm. track between the wharves and the station at Jaffa, in January, 1918. The reopening of the line to Lydda has already been mentioned and in February thirty-one steam and petrol locomotives reached Jaffa. The 486th Field Company altered the line running north from Lydda to decauville gauge and extended it into the supply depot at railhead. At the end of February the 272nd Railway Company relaid part of the 60-cm. line to Et Tine to 2 ft. 6-in. gauge and in March extended the line north from Lydda, often under artillery fire. In March and April forty-two more tractors and locomotives for 60-cm. and 2 ft. 6-in. gauges reached Jaffa.

The most important new line was the 2 ft. 6-in. track from Jerusalem Station to near Bethel, begun on 20th May by the 272nd Company. A labour force of 850 E.L.C. and natives was used on the formation work, including culverts, dry walling, stone packing and filling. Much blasting of the limestone rock was necessary on many sections and progress was relatively slow. It was finished early in September.

SURVEY

The work of the 7th Field Survey Company changed markedly with the resumption of open warfare after Third Gaza and the demand for smaller scale maps covering larger areas rose sharply. Large numbers of 1/100,000 to 1/500,000 maps were printed and issued. Disposition maps were often reproduced by sun printing or photography to save time. No detailed survey was made during the advance through Philistia, but triangulation was continued on two axes—Hebron—Jerusalem and along the coastal plain to Jaffa where a check base line was measured and the triangulation connected with Jerusalem. After the stabilization of the front, detailed survey along a belt five miles wide from the Jordan to the sea was undertaken, in several places almost as far as the Turkish positions and with many points beyond fixed by intersections.

The detailed maps were plotted first to the 1/20,000 scale and later to 1/40,000. They were contoured at 20-metre intervals in the hills and 10-metre intervals elsewhere, with spot heights, and printed in four colours. Overprinted sheets were issued to the artillery and special surveys made of road communications. By the end of 1917 nearly forty square miles of sketch surveys and fifty-one square miles of detailed surveys of the forward area had been issued and between 1st January, 1918, and the opening of the final offensive 1,569 square miles of detailed survey, 124 square miles of sketch survey and 51 miles of road revision survey were made. The heaviest month was July, with 405 square miles of detail survey.

The Lithographic and Letterpress Section moved to Ramle in February and continued to print maps, intelligence summaries, disposition maps, hand-books and reports. Many telephoto panoramas were taken of ground occupied by the Turks and large numbers of air photographs were used in map compilation. The amount of printing reached its height in September.

Sound ranging ceased to be of value for a short time after Third Gaza and when the front became stabilized it was handicapped

by bad weather until April. Thereafter conditions were generally good, and much useful plotting was done for the artillery.

In April, 1918, the Meteorological Section opened a second station at Jerusalem to obtain a wider range of weather data and forecasting information. Later in the year pilot balloon observations began and corrections for artillery were issued.

EGYPT AND THE CANAL ZONE

(Map 4 and Sketch 7, facing page 292)

Brigadier-General E. M. Paul continued as D. of W., G.H.Q. (2nd Echelon) throughout the year, but the organization in Egypt underwent periodic changes. At the end of January, Alexandria District took over the coastal section of the western desert and Delta, and Western Force the Southern Canal Section. In February the title of the latter was altered to Delta Force and on 8th April it ceased to exist. Instead, northern Egypt was divided into Cairo District (including the Delta) and Alexandria District (including the coastal area). The southern desert area was administered directly from Cairo. The C.R.E., Alexandria and A.D.W., Delta Force (Lieut.-Colonel E. Tillard), were little affected by these changes. The formation of the R.A.F. in April involved no change in the responsibility of the D. of W. for works for the air service, which continued to be under the immediate control of the A.D.W., Aircraft Construction Works.

Early in 1918 it was decided that the control of works and stores in both Egypt and Palestine was too extensive a territorial responsibility for a single officer and, although various disadvantages arose from the D. of W's. point of view, all works on the Palestine L. of C., with their D.D. of W. (Colonel L. N. Cooper) and various A.D.Ws. and the stores organization operated by the 389th Advanced Park Company (which arrived from England on 30th January) were transferred to the E.-in-C.

Except at Qantara, where the A.D.W., Lieut.-Colonel F. S. Lyster, had much work in hand, works during the year were of small importance. Much of it was the dismantling and repair of disused filtration and pumping plants, pipes, defence stores and other installations, and by the end of the year, all useful water and railway materials had been removed, and little remained of the extensive defences. At Qantara a considerable mileage of roads was constructed and camp services and water supply extended by the

570th (Devon) Army Troops Company and detachments of the 360th Water Company in the numerous depots, camps and hospitals.

Much general construction was in progress at the beginning of the year including four hospitals, a convalescent depot, a supply depot and bakery at Cairo, wireless stations at the Pyramids and Sollum and extensions to the large training school and to prisoners-of-war camps. The new camp at Moascar for the 7th Indian Division was finished. Later works included a transit camp for 6,600 men east of Alexandria, accommodation at Anzac, depots at Ismailia, extension of the ordnance depot at Alexandria, an Indian veterinary hospital and, in the late summer, camps for 60,000 prisoners. There are few details of interest to select from this summary of a large volume of work, except to record that mat roofs with waterproof canvas covers (removed during the summer) were found cooler and cheaper than board and felt roofing, and that ammunition huts were kept cooler by coating the roofs with lime white and cactus juice. On the Red Sea, buildings with the usual minor services, and a masonry pier were built at Aqaba.

The rapid expansion of the air force from eleven to twenty-three squadrons early in 1918 required extensive works under the A.D.W. Aircraft Construction Works, Lieut.-Colonel Adams, whose headquarters was with Middle East Brigade, R.F.C. These works included accommodation of all kinds at various stations, workshops at Aboukir and Abbassia, hangars and miscellaneous services. On 31st January the A.D.W. had a staff of 121 and a labour force of nearly 6,000 men, including 1,700 on contract works at eight stations and in October a staff of 141 in charge of 9,400 men at ten stations. In February work began on an aircraft assembly establishment at Aboukir, and in March on four training depots, more accommodation, a new bombing and navigation school and a stores park at Ferry Post. These included roads, decauville track, water supply, hutting semi-permanent buildings, hangars and the airfields themselves.

The 13th and 46th Base Park Companies remained at Alexandria and Qantara on stores duties throughout the year. The 46th Company had detachments at the timber yard at Port Said, Fayic Quarry and Port Tewfik in the Canal Zone and at various points in Palestine. After the autumn offensive the company took over the advanced parks at Lydda and Jerusalem.

The 389th Advanced Park Company was under strength when it arrived but it was quickly brought up to establishment and in February took over the R.E. Parks north of Gaza and at Junction

Station. These were gradually replaced by more permanent advanced parks at Jerusalem, Lydda and Jaffa, and the company also took over the R.E. workshop in Jaffa. The presence of this unit avoided the frequent changes which had previously occurred and resulted in more efficient distribution of stores.

With regard to supplies, the timber situation was never really satisfactory. India had undertaken to supply 1,200 standards, but deliveries often fell short during the first half of the year. A detachment, however, of the Canadian Forestry Corps in Cyprus made good part of the deficiency. A considerable tonnage of 6-in. pipes from England for the Jerusalem water supply was received and dispatched in March and much pumping machinery continued to arrive from overseas. Hutting demands increased and supplies were sent from India, while the large requirements for roofing shelters during the wet winter of 1917/18 were very largely met. Cement was used at the rate of 1,000 tons per month and there was a constant demand for road rollers and stone crushers, to meet which Egypt was combed once again. The D. of W. continued to be responsible for stores not only in Egypt and Palestine but also for the navy, and for various military services, both in this theatre and at Salonika, Cyprus, the Red Sea ports, Mesopotamia and India.

Over 255,000 tons of stores were handled during the five months ending with March, 1918. Of these 73,500, 50,000 and 29,000 tons passed through the ports of Alexandria, Port Said and Qantara respectively, 27,000 tons were handled in Cairo, 63,000 tons was stone from quarries, 8,000 tons passed through the R.E. Park at Rafah, and 2,500 tons were collected, stored and distributed by the R.E. Salvage Park.

The R.E. workshops were busy for most of the year, working in shifts for twelve hours daily and producing a wide range of articles not only for the Corps but also for the navy and Ordnance Corps. Some of the base workshops were transferred from Alexandria to Qantara, where buildings were extended and more machinery was installed. The sawmills at Wardian were fully occupied. Local parks operated at Qantara, Port Said, Ferry Post (where salvaged decauville track was reconditioned), Deir el Balah and Rafah.

The various works and other engineer activities described in this and the two preceding chapters certainly formed a substantial part of the solid foundation on which General Allenby was able to base his final and highly successful operations.

CHAPTER XXXII

THE BATTLE OF MEGIDDO AND THE PURSUIT TO ALEPPO

Plans for the final offensive—Engineer preparations—Operations on 19th September, 1918—Operations on 20th September—Operations on 21st September—Operations from 22nd to 25th September—The advance to Damascus—The occupation of Riyaq and Tripoli—The advance to Aleppo—Water supply on the L. of C. during the final advance—Railway works—Work of other L. of C. units
(Map 6)

PLANS FOR THE FINAL OFFENSIVE

EARLY in 1918 General Allenby had decided that, in order to take advantage of his superiority in mounted troops, he would deliver the main attack of his next offensive on the coastal sector and the operations during the spring and summer were therefore planned with this end in view. In early August he informed his corps commanders that he intended to pierce the Turkish front near the coast and to pass his mounted troops through this gap to reach the line Tiberias Acre. He did not at this stage disclose that he intended these operations to be decisive and to destroy all the Turkish armies in Palestine. The break-through was to be effected by five infantry divisions concentrated on the eight-mile front between the railway and the Mediterranean, and the function of the three cavalry divisions was not to be mere pursuit but the cutting of all road and railway communications behind the Turkish force south of the Der'a-Beisan-El Affule railway. Der'a Junction itself, too far to be reached by the E.E.F., was to be captured by the Arab army. The XX Corps was to exert pressure by attacking northwards along the Nablus road. The surrounded enemy force were then to be systematically destroyed.

For this ambitious plan to succeed, surprise was the first essential followed by speed and resolution in the operations themselves. For their success the R.E. would have to play an important part. Preliminary measures, for instance the Jordan operations that hav-

already been described, were taken over a long period to mislead the enemy. In the Jerusalem sector no attempt was made to conceal the extensive road and railway works, or the large R.E. store near Bethel. Elaborate precautions were taken to hide the movement of mounted troops from the Jordan Valley to the coast, and to give the impression that the forces on the right were actually being increased. Similar precautions were taken to conceal the heavy concentration of 35,000 infantry, 9,000 cavalry and 400 guns in the coastal sector. North of the Anja, where cover was scanty, existing camps and bivouacs were gradually extended some time before the extra forces occupied them. Ten bridges were required across the river on a seven-mile front. Some had been built for months and the others were constructed, as a result of the Bridging School's activities, without arousing suspicion.

ENGINEER PREPARATIONS

The engineer preparations deserve a detailed description. Begun by the E.-in-C. they were continued under the direction of Brigadier-General Paul while acting as E.-in-C. during the latter part of the summer.

These preparations were the main task of field companies in the forward areas during August and September. In the XX Corps sector the 53rd Division on the right had the 436th Field Company, two Indian pioneer battalions, E.L.C. and local labour working on the Nablus road and its bridges. One section of the field company was in charge of the divisional water area. The 437th Company completed a water supply system with a pumping plant and pipeline delivering to Tell Asur where storage for 100,000 gallons was erected. Other storage near the front, was filled by camel convoy. Work on forward roads was continued. To increase the mobility of the field companies during the advance, the numbers of vehicles and their loads were reduced and pack-mule transport substituted. On the left of the XX Corps, Lieut.-Colonel Charles, C.R.E., 10th Division, was mainly concerned with detailed preparations for constructing a two-way road leading forward, for which he allotted one field company and two infantry battalions. Construction was to begin by half this force as soon as the assaulting troops reached their assembly positions and by the remainder when the attack started. One section of engineers was to be attached to each of the two leading brigades for water duties, another was to assist one

battalion which was to advance over especially difficult country, and the third field company was to be kept in reserve.

The 220th Army Troops Company had three sections engaged on road construction and maintenance, including the re-surfacing of six miles during September. On 18th September a two-span girder bridge, completed in the workshops at Jerusalem, was sent forward for use if required on the Nablus road. The rest of the company overhauled pumping machinery and water stores, some of which went to the 389th Advanced Park Company near Bethel for extending the pipe-line to this point.

In the XXI Corps area the 54th Division was in reserve at the beginning of September and, although part of the 486th Field Company was engaged on defence works and the 495th Company on bridge and camp services, some useful training was given to both units. On the 8th, the 163rd Brigade returned to the front and on the 14th the moves to the assembly area began. The 1/34th Sikh Pioneers were attached to the 484th Company for road works.

The 65th Field Company of the 3rd Indian Division worked on water supply and, with E.L.C., laid wire roads in the Mulebbis area.

The 75th Division moved to its concentration area on the Auja early in September and on the 10th Lieut.-Colonel A. G. Turner succeeded as C.R.E. The 496th Field Company was responsible for watering several thousand troops in the Mulebbis orange groves, for constructing another large water area, for maintaining two bridges across the Auja and for making two roads on both sides of the river. This last work was started on the 12th and by the night of the 17th/18th, when the divisional artillery crossed to concealed positions opposite Mulebbis, the bridges had been screened and the approaches marked. On the following night, when the rest of the division was crossing, several mule teams panicked, damaging the barrel-pier bridge, and the 496th Field Company had to make hasty arrangements to switch traffic to the trestle bridge. Nevertheless both columns cleared the river in advance of the timetable.

Lieut.-Colonel E. F. J. Hill, C.R.E., 7th Indian Division, was instructed early in June by C.E., XXI Corps to investigate personally and in secret the feasibility of watering three cavalry and five infantry divisions near the coast. His report confirmed the feasibility of the coastal sector for the main attack and from the middle of June preparations went quietly forward. Some eighty wells were sunk, others cleaned and their yields improved, pumping plants

installed (some in dug-outs) and twelve large watering areas prepared. At the front the great width of no-man's-land was gradually reduced by advancing the line until the forward British posts were only about a hundred yards from the Turkish positions. The field companies, including the 522nd, helped by marking the new lines and erecting wire. One section was attached to each infantry brigade for the actual operations.

The infantry concentration was completed by transferring the 60th Division from the XX to the XXI Corps. It moved to south of Arsuf on the coast, all marches being made by night and the field companies watering the troops on the way. The 13th Pontoon Park came under command of the C.R.E. on 15th September. All engineer equipment was overhauled and the trestle wagons altered to take special water stores, including many canvas *chursas*.

The 14th Army Troops Company, in addition to reed cutting on the Auja and other services, carried out a heavy programme of road and water supply works. Much of the road construction was done at night and six pumping stations delivering 1,800,000 gallons weekly were maintained. The most important work was the installation of a Robson-Wagner pumping set on the Auja, the laying of 800 yds. of pipe-line to a point just beyond the British front and the preparations for extending it on the first day of the attack to a point 5,000 yards behind the Turkish front on the Lydda-Tul Karm road. All traces of the work, including the stores, were removed or camouflaged before daybreak after each night's work.

Under Lieut.-Colonel H. D. Pearson, C.R.E., Desert Mounted Corps, careful preparations were made for water and demolition arrangements, to ensure speed, mobility and the efficient execution of the task of severing the Turkish communications. Each mounted and machine-gun squadron was issued with a water bag and tackle and trained in their use, to enable them to supply themselves from wells up to forty feet deep. Each field squadron had twenty bags and more were held in reserve. They were also given Isler-Lister pumping sets and spares for repairing damaged Turkish machinery, and a system for supply of other spares was arranged. Three special demolition parties were organized to destroy the road and rail bridges including those over the Jordan at Jisr el Majami, south of Galilee. Training in rapid demolition was given and special charges for bridges, with iron dogs and rope ladders for placing them in position, were carried on pack animals. To supplement the reduced scales of equipment carried by the leading echelons of field troops,

a provisional mobile park with lorry transport was organized to follow up in rear. The 4th and 5th Field Squadrons were brought up to strength on their way to the concentration areas. On arrival the field squadrons marked the cavalry routes to the Auja and built two more pontoon bridges.

The 357th Water Company did much work in the concentration areas during September and in the week before the attack took over twenty-three pumping sets in the orange groves near Jaffa. Civil supplies were reduced, while all storage and troughing was being filled. The 359th Water Company installed water points at several places on the lines of march to the concentration areas.

Bridging requirements during the operations were given careful attention. Two possible water obstacles—the Nahr el Faliq and the Nahr Iskanderune—lay behind the Turkish front but information as to their widths and depths of water was contradictory. To meet eventualities the 13th Pontoon Park, with equipment for a 30-ft. trestle bridge and a 30-ft. pontoon bridge, was placed under command of the 60th Division, the formation which had the greatest distance to cover. One of the Australian field squadrons had a special trestle bridge substituted for its normal pontoon equipment, and all engineer units carried netting, timber and tools for cutting brushwood for use in crossing soft ground.

Road works were continued as usual behind the XXI Corps' front by the Palestine Advanced L. of C. organization; the most important of these was, of course, the road north from Lydda, on which the 569th Army Troops Company was engaged until the end of September.

In August, two topographical sections were added to the establishment of the 7th Field Survey Company for employment with XX and XXI Corps Headquarters, where they compiled and printed small five-colour maps of enemy dispositions. These were based on air photographs and intelligence reports and sometimes several hundred copies were issued within twenty-four hours of receiving new information. In seven weeks 8,800 copies of thirty-two maps were issued, including five special 1/10,000 sheets of the Turkish defences in the coastal sector.

A third sound ranging section—"NN"—was formed in August and occupied a fourth base in the foothills. Before the offensive the three sections located almost every Turkish gun position in a belt five-miles deep on a front of thirty-seven miles and a number of preliminary shoots were made against the plotted locations. The

coastal sector was left more or less undisturbed until the attack opened when, as a result of "N" Section's work, the enemy artillery was almost completely neutralized.

Flash spotting was begun in the foothills by No. 28 Observation Group, R.E., which arrived from France in August, but as the Turkish artillery seldom fired by day and almost never at night, little opportunity occurred for locating guns by this method.

OPERATIONS ON 19TH SEPTEMBER, 1918

The battle of Megiddo opened on 19th September, 1918, and in the coastal sector the attack aiming at the break-through was delivered by the XXI Corps (five divisions and the French contingent), with no corps reserve. The frontages of the 54th Division, including the French contingent, and of the 3rd Indian Division on the right, were very long but, mainly owing to the nature of the ground, parts of these sectors were thinly defended. The bombardment and infantry assault began simultaneously at 4.30 a.m., the heavy artillery being primarily engaged in counter-battery work and the other guns quickly lifting from the forward defences to give a creeping barrage.

The extreme right was one of the few places where the enemy artillery had not been completely neutralized and its fire forced the French to withdraw from one of their objectives. The 163rd Brigade of the 54th Division advanced about three miles during the night of the 19th/20th. Behind it two sections of the 484th Field Company, with pioneers and attached infantry began work, handicapped by artillery fire, on a new road north through the foothills. The 495th Company came forward to complete the road programme but owing to the rapid withdrawal of the Turks no work was necessary. On the left the 161st Brigade, advancing from forming-up tapes laid by a small party of the 496th Company, advanced about two miles, but were then held up temporarily. A detachment of the 486th Company found a pump in working order at one of the Turkish wells, and also a borehole with pumping plant. The 162nd Brigade, passing through, completed the capture of the Turkish defence system during the night.

The 3rd Indian Division broke through west of the railway, and the two leading brigades, turning eastwards, advanced eight miles into the foothills.

Next on the left the 75th Division, during the morning, successfully attacked the formidable defences on the plain, advancing five

miles. The 496th Field Company moved forward at zero hour and developed water in the captured area.

The 7th Indian Division broke through the defences covering the defile through the Nahr el Faliq marsh, and the leading brigade advanced twelve miles during the day. The two Sappers and Miners companies and pioneers made two roads through the old Turkish defences, and the 522nd Company supplied water seven miles ahead of our old front line.

The 60th Division on the extreme left was given a more strenuous task than any other infantry division. After establishing a bridge-head north of the Nahr el Faliq to enable the 5th Cavalry Division to advance northwards, the 5th Light Horse Brigade (attached) was to advance inland to Tul Karm, sixteen miles from the start line. The divisional R.E., including the 13th Pontoon Park, were to clear three routes, 300 yards apart, through the main Turkish defences immediately behind the infantry assault and to bridge the Nahr el Faliq at three points. In addition, the 521st Company on the left, with the help of 200 infantry, was to build four 70-ft. footbridges, the material for which was carried on forty-four camels. One section was attached to each infantry brigade for water duties.

The infantry assault was immediately successful and the road parties began clearing the routes forward under fire from Turkish artillery and machine-guns. The R.E. lost half their strength and those wounded included Captain H. D. McDonald. Various obstacles were removed, trenches filled and the routes flagged. The 180th Brigade made rapid progress and so little water was found in the Nahr el Faliq that no bridging was required. The main body of the 519th Company reached the Faliq at 10 a.m. and repaired a causeway which was used by the 181st Brigade to reach Tul Karm at 5 p.m. This brigade and some Australian Light Horse were watered by No. 1 Company, Sappers and Miners, during the night. The 519th and 521st Companies accompanied the 180th and 179th Brigades to the Tul Karm area. Many units marched twenty miles, mostly through heavy sand, during the day.

The 14th Army Troops Company began the Auja pipe-line extension during the afternoon and by midnight, not only had the pipes advanced seven miles, but storage for 60,000 gallons had also been erected, and distribution arranged for the 17,500 gallons of water per hour which then began to reach the new watering area. Lorries and tractors brought up pumping plant, and plants at seven wells were repaired or installed to provide nearly 200,000 gallons of water

daily. Camel convoys to water the divisions in the foothills began to use this area early on the 20th.

The XXI Corps had had an outstandingly successful day; it had virtually destroyed the Turkish right wing, pivoting on the right it had advanced quite fifteen miles over the coastal plain, and, most important of all, the way had been opened for the cavalry to execute its vast intercepting movement against the enemy's communications far to the northward.

The XX Corps in Judea attacked with two divisions towards Nablus, the 53rd on the right starting on the night of 18th/19th September and the 10th on the left one night later. The interval of five miles between these divisions was filled by a special formation known as Watson's Force. The 53rd Division, on the right of the Nablus road, made a converging attack with two brigades. On the right the 160th Brigade reached its objectives by 3 a.m. on the 19th. The 437th Field Company and two sections of the 436th Company advanced behind the infantry, extending a road and, as soon as the tactical situation allowed, developed a water area with an hourly supply of 70,000 gallons. On the left the 159th Brigade reached most of its objectives by 4.40 a.m. The enemy at first prevented No. 72 Company, Sappers and Miners from extending the new artillery road but it was completed later. The 436th Field Company made a camel track up the new front.

The 10th Division spent the day on final preparations. During the first two days until the Nablus road could be used the division was to be supplied by pack transport from dumps, for which purpose a new 20-ft. road had been constructed down a deep wadi to the front line, west of Jiljiya.

North of Jericho a composite body known as Chaytor's Force, after some delay in the early stages, executed its double task of harrying the Turkish retreat across the Jordan and of securing the bridge at the junction of the Jordan and Wadi Far'a. It contained a detachment of the 35th Army Troops Company and subsequently advanced through Es Salt to Amman, which was taken on the 25th with many thousands of prisoners and much material.

The first objective of the Desert Mounted Corps was the line Tul Karm-Caesarea, twenty miles from the old British front. On the right the 4th Cavalry Division was then to move by the Musmus Pass to El Affule, where the railway junction and the Nablus-Damascus road were to be blocked; on by the Valley of Jezreel to Beisan, from which various Jordan crossings could be stopped; and

to Jisr el Majami to occupy more crossings of the Jordan and Yarmuk Rivers. The 5th Division was to advance northwards along the coast, then, using tracks north of Megiddo, were to cross the plain of Esdraelon and raid the enemy G.H.Q. at Nazareth. The Australian Mounted Division was to advance through Musmus and one brigade was to block the Damascus road and railway at Jenin.

The 4th Division was watered as it marched to its assembly area near Arsuf by the 4th Field Squadron on the Auja during the early hours of the 19th and field troops joined their respective brigades. At about 9 a.m. the advanced guard began to move through the captured Turkish positions; by 11.15 a.m. the division had crossed the Nahr el Faliq marshes, and at 1 a.m. the brigades halted for an hour. Tul Karm was passed in the afternoon, and after watering from village wells and wadis at about 5 p.m. the division concentrated east of Caesarea at 9 p.m. Shortly before midnight the advance was resumed; no opposition was met on the historic route through the Musmus defile and the advanced guard reached the plain at 3 a.m. on the 20th.

The 5th Cavalry Division on the coast was handicapped by soft sand but the leading brigade crossed the Nahr el Faliq at 8 a.m. and shortly afterwards engaged small enemy detachments before capturing intact the bridge carrying the coast road across the Nahr Iskanderune. At about twenty-five miles from the starting point, the 13th Field Troop watered the leading brigade at about noon. The advance was resumed and the division were just north of Megiddo by 1 a.m., after a trying march along poor tracks.

The Australian Mounted Division bivouacked north of the Nahr Iskanderune during the evening of the 19th.

OPERATIONS ON 20TH SEPTEMBER

XX Corps.—During the night of 19th/20th September the 53rd Division renewed, and the 10th Division began, their respective attacks with objectives about five miles ahead. The 53rd Division met considerable resistance and the final objectives were not reached, partly because roads could not be built sufficiently quickly to enable the artillery to keep close behind the infantry. All the sappers worked on roads and water supply.

Watson's Force advanced nearly four miles, and two pioneer battalions and E.L.C., working directly under the C.E., XX Corps,

repaired the Nablus road and removed seventy-eight unexploded mined charges along it, enabling motorized heavy artillery to pass Seilun by the evening.

In the 10th Division the tasks of the field companies were to help the infantry to advance, to connect the British and Turkish road systems to enable the artillery to be brought forward and to develop water supplies. The infantry attack opened at 7.45 p.m. on the 19th and stiff fighting took place during the night. By 9 p.m. the greater part of the 66th and 85th Field Companies and working parties from two battalions began a road forward, and in spite of some artillery fire, the first rough track was linked with the Turkish road by 6 a.m. on the 20th. Improvement and extension of the road was delayed by determined enemy opposition but, as this could best be overcome by getting artillery forward, the 85th Company continued work under fire. No. 18 Company, Sappers and Miners worked on the same route, and as soon as guns could be got forward, the infantry advance was continued till it had penetrated about five miles.

The next stage of the operations of the 10th Division was to use the Turkish track leading to the main road, and then to press on to Nablus. The track had been wrongly reported after air reconnaissance as being fit for wheeled transport, but was in fact so obstructed by slabs of rock that considerable blasting was required to make it even passable. Little could be done in the time available but by great exertions, guns and transport were got forward to enable the attack to be resumed shortly before midnight. A detachment of the 220th Army Troops Company developed water supplies.

The XXI Corps ordered the 3rd and 7th (Indian) Divisions with their pack transport to push through the hills to the Nablus-Damascus road at Samaria, and the 60th Division to reach the Wadi esh Sha'ir on their left.

Neither of the Indian divisions were able to reach their final objectives, largely because of exhaustion induced by thirst. In the 3rd Division area the camel water-convoys filled at dawn from a well where the 65th Field Company had installed two Lister engines during the night, and supplies were also developed by the same company at other points, but none of this water reached the leading troops until the afternoon. In the 7th Division two brigades were watered in the afternoon from four wells in the hills by the two Indian field companies, and the 522nd Field Company developed supplies over a considerable area on the left by installing Lister

engines and repairing other plant and lifting gear. After watering, the 28th Brigade began the final movement towards Samaria shortly before midnight.

The 60th Division used the 179th Brigade with the 521st Company to advance to the Sha'ir, which was reached in spite of opposition from rearguards, at 11 a.m. While most of the field company watered the brigade, a detachment accompanied a battalion which captured intact the railway tunnel two miles west of Samaria. They found it prepared for demolition and removed the charges next day. The 519th Field Company repaired the pumps in the Tul Karm area, where three brigades were watered, and developed further supplies to the north. Their tools and equipment were delayed by poor tracks and the field companies were handicapped as a result.

The 54th Division occupied more ground, meeting little or no opposition, and the field companies were engaged on water supply and road construction.

The 75th Division remained on the plain, where watering presented few difficulties.

During the afternoon the 14th Army Troops Company took over the wells round Tul Karm, and water was taken into the town by rail by pushing tank trucks until a locomotive could be got into running order.

The Desert Mounted Corps, after some delay due to the usual difficulties of a night march in unknown country, pressed on at dawn to El Affule. The 12th Field Troop destroyed a few rails on the Damascus side and, after a brisk engagement, the leading troops of the 4th Division reached the station at 8 a.m. only to find that a regiment of the 5th Division had beaten them by a short head and had captured ten locomotives and fifty trucks. When the rest of the 4th Division arrived, the 10th Brigade advanced to Beisan, which was reached at 6 p.m., after marching seventy miles in thirty-four hours. Captain Falcon's demolition party of the 4th Field Squadron, after a short rest, marched across rough and hilly country during the night to Jisr el Majami. The Jordan was reached at 5 a.m. on the 21st and the road and rail bridges to Der'a on both the Jordan and the Yarmuk were prepared for demolition. The rest of the division moved to Beisan during the 20th.

A brigade of the 5th Cavalry Division reached the Haifa-El Affule railway early on the 20th and at 3 a.m. lieutenant Matthews of the 13th Field Troop blew a hundred-yards long gap. The 13th

Brigade raided Nazareth. Street fighting ensued and the brigade was finally ordered to withdraw, having just missed capturing Marshal Liman von Sanders who was compelled to flee hastily to Tiberias. Water supply in El Affule was difficult and the 14th Field Troop had to develop supplies outside the village.

A brigade of the Australian Mounted Division reached Jenin, after some opposition, soon after dark, and Corps Headquarters reached Megiddo. During the late evening the Mobile Park, R.E. moved through Musmus.

By this time the bulk of the Turkish armies was disintegrating and the few organized remnants were being driven into an ever decreasing area round Nablus. Their escape routes were being rapidly stopped by the cavalry and subsequent operations consisted primarily of collecting and disarming the demoralized enemy. The success of the cavalry interception was due to its long, swift marches and to these the field squadrons, R.E., had made invaluable contribution by their rapid development of water supplies. All ranks got practically no rest but their work was assisted by the fact that the enemy had made few attempts at demolition.

OPERATIONS ON 21ST SEPTEMBER

The main infantry effort on the 21st was made by the XX Corps and difficult ground and Turkish resistance made it a severe test of endurance. The 53rd Division was to reach the road from Nablus down the Wadi el Fara to the Jordan bridge (the last escape route open to the Turks) and the 10th Division was to attack Nablus. The advance began during the night of the 20th/21st.

By the evening the leading brigade of the 53rd Division was still short of its final objectives along the Wadi el Fara road. This proved unimportant because the 10th Divisional Artillery had been shelling the road since midday and R.A.F. bombers had been creating havoc in the defile even earlier. The divisional engineers spent the day on road improvements.

The 10th Division had much difficulty on the rocky track, but the Nablus road was reached at 5.30 a.m. on the 21st. The 30th Brigade, with the 66th Field Company, then took the lead and occupied Nablus during the morning, cutting off almost all enemy forces to the westward. Most important of all, the heights covering Wadi Fara road were captured at noon and shelling of the road began as soon

as the motorized artillery arrived. The 66th Field Company improved the Nablus road and developed water near Nablus, and the 85th Company also worked on roads and water supplies. A detachment of the 220th Army Troops Company began to develop water near Seilun.

In the XXI Corps opposition had almost ceased on the 21st. The 65th Field Company installed power sets to obtain water near Samaria, where a locomotive and rolling stock were captured. R.E. work with the other formations was mainly on water supply.

Desert Mounted Corps.—The Desert Mounted Corps passed a relatively quiet day except for the collection of thousands of prisoners. The 4th Field Squadron, at Beisan, developed water supplies, improved roads and began work on the railway from El Affule, on the other hand the 11th Field Troop destroyed half a mile of line north of Beisan. The 13th Field Troop of the 5th Field Squadron accompanied the force which reoccupied Nazareth.

OPERATIONS FROM 22ND TO 25TH SEPTEMBER

By 22nd September the extent of the British victory was clear; two Turkish armies had been virtually destroyed and the third, east of the Jordan, severely handled and with its rail communications cut by the Arab forces, was in full retreat northwards. General Allenby decided to exploit this situation and ordered the Desert Mounted Corps to prepare for an early advance through Syria to Damascus.

Meanwhile the engineer units with the infantry formations were far from inactive. After its fifteen-mile advance the 53rd Division of the XX Corps concentrated north of Tell Asur, involving the 436th and 437th Field Companies in a considerable amount of road construction and reorganization of water supplies, including the dismantling of redundant pipe-lines. In the 10th Division and the 66th and 85th Field Companies with pioneers and E.L.C. were similarly engaged. They widened the Jerusalem-Nablus road and cleared the Wadi Fara defile of wrecked guns, transport and other debris. The 220th Army Troops Company maintained four pumping installations and also worked on the Jerusalem-Nablus road.

In the XXI Corps the 3rd Indian Division remained round Samaria for a few days and then returned to north of Mulebbis. The 65th Field Company was continuously engaged on water duties. In the 7th Indian Division the 522nd Field Company marched

on the 25th with the 21st Brigade to Athlith, south of Haifa. In the other divisions work was mainly confined to finding and developing water in the new areas.

The Desert Mounted Corps was engaged in a few brisk engagements during this period. On the 23rd the 5th Cavalry Division was ordered to capture Haifa and Acre. The latter was occupied with little difficulty and the work of the 13th Field Troop, which formed part of the brigade group engaged, was confined to water supply. The rest of the division had to overcome opposition at the defile between the marshy Kishon and Mount Carmel. The 15th Field Troop, which had removed demolition charges on the railway bridges during the advance, was invited by Lieut.-Colonel H. Holden, commanding the Jodhpur Lancers, to join a charge against the Turkish position. Lieutenant R. C. Crawford, commanding the 15th Troop, had gone to Brigade H.Q. for instructions and Serjeant Hearne, in his absence, accepted with alacrity, armed his men with lances or swords from casualties, and took his place on the right of the line. The attack was skilfully handled, the Turkish position overrun and Haifa occupied soon afterwards. The 15th Troop then turned to the more prosaic task of watering the 15th Brigade.

On the 23rd and 24th September the 11th Brigade, accompanied by the 11th Field Troop of the 4th Cavalry Division, intercepted and captured large bodies of the enemy trying to cross the Jordan at various points south of Beisan. On the 24th an Australian brigade captured Semakh, on the sea of Galilee, after a sharp engagement and next day occupied Tiberias.

THE ADVANCE TO DAMASCUS

The 4th Cavalry Division, in its advance to Damascus, after defeating the retreating Turks east of the Jordan, was to move through Der'a, while the rest of the Desert Mounted Corps followed the more direct road west of the Sea of Galilee. In support, the 7th Indian Division was to advance along the coast to Beirut, followed by the 54th Division as soon as its supply could be organized. In executing this plan, supply difficulties were of much greater influence than potential opposition. Between the main British supply base at Lydda and Damascus lay some 150 miles of very poor roads. The main line railway was being extended rapidly but until it reached the Turkish railway at Tul Karm it was of little help. It was hoped to open the Turkish railway from Haifa to take sea-borne supplies for the 4th Cavalry Division from 27th September,

but the small amount of captured rolling stock restricted the lift beyond El Affule. Roads thus became the first priority, improvements were effected on the route to Tul Karm and a new road northwards was started. On 26th September, the Palestine L. of C. extended its administrative area to the Nahr el Faliq. Early on the 26th the 4th Division began its advance along steep and stony tracks towards Der'a, with the 10th Brigade and the 10th Field Troop leading. Opposition was met from Turkish rearguards but the two leading brigades were in sight of Der'a by the evening of the 27th. Der'a was occupied by one brigade on the 28th but, although there were two wells with steam pumps, distribution difficulties compelled the rest of the division to move northwards, where the horses watered from a lake. That night the division bivouacked eighteen miles farther on, and again abundant water was obtained from a lake although troughs were this time installed by the field troops. On the 30th a Turkish column was overtaken and destroyed with the help of Arab forces and early on 1st October the 11th Brigade reached the southern outskirts of Damascus. The 4th Division had marched 120 miles in six days over bad and stony tracks, on which the 4th Field Squadron, in addition to its water duties, effected hasty repairs to the surface and culverts.

The Australian Mounted Division followed the more direct route from Tiberias and, after a series of actions with Turkish rearguards, reached on the 29th positions overlooking the Barada Gorge, along which ran the road from Damascus to Beirut. On the way the Australian Field Squadron repaired the demolished central arch of the Jordan Bridge at Jisr Benat Yakub. A special Inglis bridge was sent here in a convoy of twenty-five lorries with a detachment from an army troops company, but it was finally not required.

The 5th Cavalry Division left Haifa on the 26th and had to fight several Turkish rearguards before reaching positions east of Damascus on 1st October. The occupation of the city followed, bringing the total of prisoners captured by the Desert Mounted Corps to 47,000. Of the Turkish armies in Palestine only 20,000, very largely disorganized, remained to retreat northwards towards Aleppo.

The concurrent infantry operations began on 27th September by the 7th Indian Division marching along the coast towards Haifa. The 522nd Field Company built an artillery bridge across the Kishon, north of the town, but settlement of the crib piers, due to scour from tidal currents, involved heavy maintenance.

Meanwhile the 7th Indian Division sent a brigade first to Nazareth,

and then, on 28th September, to Semakh. On 1st October a small advanced guard, with two R.E. officers attached, led the division's advance to Beirut. Nos. 3 and 4 Companies, Sappers and Miners, and the 121st Pioneers, left Acre next day to make the coast road fit for wheeled transport and artillery. The engineering problems involved were considerable, particularly round the limestone promontory which included the famous "Ladder of Tyre." The track degenerated until in places it was only six feet wide, with gradients of 1 in 5, a slippery rock surface and crumbling dry stone retaining walls on the cliff face. The Ladder of Tyre consisted of huge steps cut in the rock, up which field guns could barely be manhandled. In spite of the risk of rock falls, the G.O.C., XXI Corps, authorized the use of explosives and the cliff section was made passable for wheeled traffic in three days without mishap.

The main body of the 7th Indian Division left Haifa on 4th October, the 521st Field Company being used for watering on the march, building a lorry crossing over the river at Acre, improving the road where possible and helping the artillery to get forward. Beirut was reached on the 12th, four days after the advanced party. Work began on watering areas, road improvements and repair of the rack and pinion railway through the mountains to the Riyaq plain, whence the line to Damascus was already open. The special locomotives, however, were not available and supplies had, after all, to be sent by road.

The 54th Division did not enjoy October; rations were short (during the month field companies drew the equivalent of one half-day's ration of fresh meat), the sick rate from influenza and pneumonia was high and much work was expected. The 484th Field Company had the onerous task of maintaining the bridges across the Kishon and its branches until the settlement caused by scour led to their replacement by pontoon bridges. The material was brought up by forced march from Jaffa by the 13th Pontoon Park, the unit suffering considerably from sickness and exhaustion, Captain Latham and sixty-three other ranks being admitted to hospital and nine draught horses dying on the way. The 14th Army Troops Company began semi-permanent bridges across the Kishon on 5th October.

On 6th October the 495th and 484th Companies (75th Division), marched to Acre, where it began work with pioneers and E.L.C. to make the twenty-eight miles of coast road to Tyre passable by 3-ton lorries. The most difficult sections along the cliffs required

widening (a slow process, because the blasting had to be done with very small charges), new retaining and parapet walls and improved gradients. This fine piece of road engineering had taken a month and had required 33,000 man days (for a time the 495th Company worked a sixteen-hour day) and in spite of the difficulties the road was kept open for traffic throughout except for one period of ten hours.

After the fall of Damascus the supply of the three cavalry divisions in its neighbourhood presented a difficult problem. Although Haifa was quickly brought into use for landing sea-borne supplies (the average daily tonnage in the early part of October being nearly 1,000 tons) the poor state of the eighty-five miles of road to Damascus and the small number of available lorries made it impossible to clear this quantity. Little improvement was effected until the railway was in operation to Semakh. A supply depot was established there until the Yarmuk bridge was repaired, and it was not until 26th October that the first rail-borne supplies reached Damascus.

THE OCCUPATION OF RIYAQ AND TRIPOLI

Despite supply difficulties, General Allenby had ordered on 3rd October the capture of Riyāq, an important rail centre thirty miles north-west of Damascus. Here the narrow-gauge lines from Damascus and Beirut joined the standard-gauge line to Homs, Aleppo and the Taurus Mountains in Asia Minor. The narrow-gauge line between Tripoli and Homs had been dismantled and the road was merely a fair-weather track.

The first British troops to enter Riyāq on the 6th included the 14th Field Troop. Several narrow-gauge locomotives and rolling stock of both gauges, were captured. The 5th Field Squadron was busy for several days strengthening and repairing culverts, bridges, permanent way and locomotives, but a derailment in a cutting on the line to Damascus took some time to clear.

On 13th October the XXI Corps cavalry regiment reached Tripoli, fifty miles from Beirut, followed five days later by the leading troops of the 7th Indian Division. The 521st Field Company marched with its brigade group, watering it on the way and repairing the road and damaged retaining walls.

The 54th Division moved from Haifa to Beirut at the end of October, field companies watering their brigade groups on the march. Sickness was still taking a heavy toll and field companies on the 31st averaged 159 all ranks only.

THE ADVANCE TO ALEPPO

The 5th Cavalry Division occupied Homs without opposition on 16th October. The 5th Field Squadron watered the brigades on the march, meeting with few difficulties, and effected extensive repairs to the road. A detachment then began repairs with local timber to damaged bridges and culverts on the Homs-Tripoli road, which was opened to lorries on the 19th.

On 18th October the 5th Cavalry Division was ordered to reach Aleppo, 120 miles away, by the 26th, and the 4th Cavalry Division, which had reached Riyaq, to move to Homs. To maintain the requisite speed motorized troops from the XXI Corps were attached to the Desert Mounted Corps, a valuable reinforcement because the fighting strength of the 4th and 5th Divisions had been reduced by sickness to a total of only 3,700. The 15th Brigade began the advance on the 19th. One arch of the masonry bridge over the Orontes River was found to be demolished and several piers damaged. The nine-foot gap was repaired by the 5th Field Squadron in ten hours during the night of the 19th/20th, with material found in Homs and the armoured cars then continued the advance to Hama. Next day the bridge was strengthened to take 3-ton lorries and on the 26th Aleppo was occupied, the 15th Brigade fighting a stiff action with a Turkish rearguard eight miles to the north-west. From Homs onward water supply was difficult owing to the shallow depth of all the wells. On the 27th the 13th Field Troop arranged watering facilities from the river and the town supply at Aleppo. The 14th Troop made a deviation at a demolished bridge.

The 4th Field Squadron worked on the Damascus-Aleppo road and, with the 5th Squadron, made trolley reconnaissances of the railway between Riyaq and Aleppo. Enemy demolitions had been thorough, most of the station buildings, water tanks, bridges, points and crossings having been systematically destroyed or damaged, but the 5th Field Squadron began repair work towards the end of the month.

The action north-west of Aleppo marked the end of hostilities in this theatre, as the armistice sought by the Turks became effective on 31st October. In a campaign of five weeks' duration the E.E.F., at a cost of 5,700 battle casualties, had destroyed the Turkish armies in Palestine, taking over 75,000 prisoners, 360 guns, 89 locomotives, 468 railway carriages and trucks, and vast quantities of stores and transport. To the careful preparations and speed of

movement which were important factors in this decisive success the R.E. had contributed in no small measure by their continuously hard, but usually unspectacular, work in developing and maintaining water supplies, repairing bridges and improving roads. The field squadrons had the most strenuous task of all, the 5th, for example, marching 525 miles during this period, often on short rations, at a cost of two-thirds of its strength (mostly due to sickness) and one-fifth of its horses. The 4th Squadron sent sixty-five men sick to hospital during October.

WATER SUPPLY ON THE L. OF C. DURING THE FINAL ADVANCE

At the end of September the 14th Army Troops Company moved to Tul Karm, El Affule and Haifa, operating the railway station and town water supplies, and a detachment was sent to Acre also for water duties. The 357th Water Company dismantled redundant supply systems north of Jerusalem and sent pumping machinery forward. It also took over the plants in the Lydda area and the supply to Jerusalem. Detachments were sent to repair and operate water supply points on the captured railways at Tul Karm, Haifa, El Affule and elsewhere.

Farther back the 359th Water Company continued to operate many of its water areas, and carried out works at Lydda. The 360th Water Company's area was extended to include Gaza, Beer-sheba (where two pumping plants were still needed) and the operation of the Qantara pipe-line.

RAILWAY WORKS

Preparations to extend the main line began in August, when the 116th Railway Company began to lay sidings at Mile 190 for stacking the 37 kilogram E.S.R. rails and sleepers to be used. On the 14th the 115th Railway Company reached Mile 190 and Major W. E. Thornhill was appointed track construction engineer. On the 17th the 265th Railway Company also reached Mile 190 and began drainage work on the formation in advance of R.H., loading permanent way material and preparing guard rails for road crossings.

The proposed alignment for the new main line was to join the old Turkish narrow-gauge east of Mulebbis, and the 266th and 272nd Companies who had been moved there, worked from late on the 19th

almost continuously until the 24th on alterations to the track and the building of a new bridge. Meanwhile the 115th, 116th and 265th Companies moved up to railhead, and from the 20th onwards extended the main line. After reaching the old Turkish formation on the 28th, progress was quicker, an average of one and a quarter miles of track being laid daily during October. On 30th September, when railhead reached Mile 202, the 266th Company arrived for work on sidings and turn-outs at stations. By the middle of October transshipment at Tul Karm between the standard-gauge line and the narrow-gauge lines to Haifa and Damascus was possible, and on 31st October railhead reached Mile 225 east of Caesarea. The 265th Company remained at the old railhead north of Lydda till the end of October, reorganizing sidings, laying deviations, and sending material forward.

The 266th and 272nd Companies laid 2 ft 6-in track on the old Turkish formation to Tul Karm between 23rd and 27th September, and then sent a detachment to El Affule on to repair the Haifa-Der'a line. They then worked on bridge and track repairs at Der'a and on the Riyah-Beirut and Der'a-Damascus lines.

Two bridges, each of about 180-foot span, out of the four spanning the River Yarmuk on the Haifa-Der'a line, had been demolished, and the repair work was organized by Lieut.-Colonel Sowerby using the 1st Bridging Company, Canadian Railway Troops, who arrived at Semakh early in October. They were soon reduced by malaria to one-third of their strength.

On 8th October the Light Railways Directorate, now under Lieut.-Colonel P. C. Lord, and part of the 96th Light Railway Operating Company, moved to Damascus to operate all captured railways as far as Riyah and Beirut. On 25th October the Franco-Turkish Railway Company were authorized to operate the Beirut-Damascus line in order to economize British personnel. Owing to demolished bridges none of these lines were in full use until November. In Judea a detachment of the 265th Railway Company with 700 E.L.C. continued to widen the rock cuttings and improve curves on the Artuf-Jerusalem line until 28th October.

WORK OF OTHER L. OF C. UNITS

The 14th Army Troops Company at Haifa installed a disinfection plant at a factory and handed it over to the 75th Division when ordered to Beirut at the end of October. The 35th Army Troops

Company continued road and river crossing work in the Jordan Valley ; but all the Jordan bridges except one were removed later.

The 389th Advanced Park Company sent parties to take over captured stores at various points, closed its park at Jaffa and opened Parks at Haifa, Beirut and Tripoli. A detachment of the 46th Base Park Company took over the R.E. Parks at Jerusalem and Bethel.

Two road schemes of considerable magnitude, to one of which references have already been made, came directly under the C.E., XXI Corps. The first was the new lorry road from the depot at Lydda to Tul Karm, by which five infantry and three cavalry divisions with their corps and army troops were supplied for several days. The existing road had no foundations and very little metalling, and its culverts were weak ; it was therefore used by light vehicles only and the new road was built closely parallel to it. Two or three R.E. units were engaged from time to time, but most of the work was done by pioneer battalions, E.L.C., and local labour. The other road was a " hardened " track (no metalling being available) from Tul Karm to Haifa. The labour force consisted of four pioneer battalions and two E.L.C. companies, but most of these units were sent northwards as the advance continued and local labour continued the work. The track was used extensively for supply purposes until the railways were repaired.

CHAPTER XXXIII

EVENTS AFTER THE ARMISTICE

Troop movements from Palestine to Egypt—Demobilization—Railway works—Roads—Water supply—Miscellaneous works—Works in Egypt—Palestine and Syria, May to October, 1919—Survey—The withdrawal from Syria and Silicia—Review of R.E. achievements during the campaign—Final reflections.

(Map 6)

TROOP MOVEMENTS FROM PALESTINE TO EGYPT

THE favourable military situation towards the end of October enabled two divisions—the 53rd and 60th—to be moved to Egypt, in order to ease the supply problem. After the armistice it was decided that the two Indian divisions and a considerable force of cavalry should form the Army of Occupation, and by early December the 10th, 54th and 75th Divisions were also sent to Egypt. Headquarters XX Corps, was disbanded, but Brigadier-General Waller temporarily acted as C.E. until 4th February, 1919. By this time the 569th and 220th Army Troops Companies and the 13th Pontoon Park, in that order, had also returned to Egypt.

DEMOBILIZATION

In February, 1919, it was decided that the following R.E. units should be retained by the Army of Occupation :—

- 4th Field Squadron, with 4th Cavalry Division.
- 5th Field Squadron, with 5th Cavalry Division.
- 521st Field Company, sent to Mersina, December, 1918.
- 522nd Field Company, with 7th Indian Division.
- 14th, 570th and 571st Army Troops Companies.
- 265th and 266th Railway Companies.
- 357th and 360th Water Companies.
- 13th and 46th Base Park Companies.

All other R.E. units were gradually to be reduced to cadres under the demobilization plans but, until the R.E. units in the Army of Occupation had been reformed on a regular basis, they were to

retain half their strength. The change of plan for demobilization from "categories" to "age and service" was effected smoothly, although the process was delayed by the civil disturbances in Egypt in the spring of 1919. The operation of the plan made transfers on a considerable scale from one unit to another necessary, but there is no record of any disaffection at demobilization which seemed unfair or unnecessarily slow. R.E. units were, perhaps, fortunate in having a considerable amount of work, and educational classes and sports helped greatly during a difficult period.

RAILWAY WORKS

After Aleppo had been reached, it was decided that repair work on the railways should be first priority to improve the supply position. Damage to permanent way and installations had, fortunately been slight, but repairs to captured locomotives and rolling stock and to demolished bridges involved much work.

Immediately after the armistice a small R.E. detachment was sent to the Taurus Mountains to ensure that the Constantinople-Bagdad Railway was kept in operation, and Lieut.-Colonel A. J. G. Bird, C.R.E., 60th Division, was appointed C.R.E., Taurus Tunnels. These tunnels leading to the Adana plain had been pierced some months before, but standard-gauge trains did not begin to run through them until September, 1918, and much work, e.g., the completion of the linings, was still required. The rest of the railway to Aleppo was in fair order, but the track had been lifted on the branch to Alexandretta.

On 16th January, 1919, the 25th Railway Company, Sappers and Miners, arrived at Mersina, west of Alexandretta, to repair and maintain the branch and main lines to Adana, and a few weeks later moved to the Amanus Mountains section, where the high embankments required considerable maintenance during the rains. On 28th January the 521st Field Company reached Mersina and, until the end of October, was responsible for control and maintenance of a considerable section of the main line through the Taurus Mountains. It had detachments at numerous points employed on a wide variety of railway works. The O.C., Major Colson, died in hospital at Mersina on 3rd February. In February the railway was taken over as far as Nisibin, eighty miles east of Alexandretta, and Colonel W. R. Howell was appointed Chief Controller, Bagdad Railway.

On 25th November, 1918, Major W. B. Alexander was appointed Controller of Railways at Aleppo. His 5th Field Squadron had already done a considerable amount of repair work and the first construction train from Aleppo had reached a point eighty miles to the south on the 15th, after damaged points and crossings at five stations had been relaid. Three locomotives and thirty wagons were available on this section. In Aleppo itself two bridges had been demolished with tank trucks standing on them; this mass of wreckage was cleared, two unexploded charges were removed from one bridge and both were rebuilt.

The Light Railways Directorate, with its headquarters at Damascus, was in charge of the lines to Beirut and Aleppo and of repair work to the Der'a-Amman line. The 272nd Railway (Construction) Company finished the reconstruction of a bridge on the Beirut line on 7th November. Between Riyaq and Aleppo six bridges had been destroyed (although their abutments were intact) and many rails had been buckled; three of the bridges and the permanent way were repaired by the 272nd Company by 14th December, and the fourth bridge, a 26-ft. span masonry structure just north of Riyaq, was rebuilt by the 571st Army Troops Company in the latter half of the month. South of Aleppo a 100-ft. span steel bridge across the Orontes had been demolished and another bridge across the same river further south required extensive repair. On 5th February, 1919, the 571st Company finished a temporary trestle bridge across the river and the whole line between Riyaq and Aleppo became operational.

On the Haifa-Der'a-Amman line the 272nd Railway Company completed the track and emergency bridge repairs by the end of 1918, but permanent repairs to the bridges were not finished until several weeks later. The same company laid out the station and sidings at Haifa, the 265th Railway Company having taken over maintenance of the Semakh-Haifa section in the middle of January. After reconnaissance of the Der'a-Ma'an section of the Hejaz railway and some repairs to bridges, the section for a hundred miles south of Der'a was opened to traffic in March.

From 21st November until 12th January, 1919 the 265th Company maintained the 28 miles of railway from Tul Karm to El Affule, which was an important link in the supply system until the standard-gauge railway reached Haifa. A considerable amount of repair work, particularly to culverts, was effected. The 272nd Company was disbanded on 21st March, when men not due for release were

transferred to the 265th Company. This unit maintained the Haifa-Der'a line until it too was disbanded on 2nd September.

Meanwhile the Qantara line was being extended ; railhead reached Mile 245 on 30th November, and the 115th Railway Company laid the last rail into Haifa Station on 23rd December. The 116th and 266th Railway Companies were also engaged, the last-named mainly on lifting, packing and ballasting track, laying loops and on general maintenance. All three companies and the 265th Company took part in laying out Haifa Station and its sidings at the end of December, the first passenger train arriving on the 30th.

During 1919 the 116th Company was disbanded at the end of February and the 115th Company on 15th March, leaving the 266th Railway in charge of improvements and maintenance of the main line until it too was disbanded in December. The 25th and 29th Railway Companies, Sappers and Miners, who reached Egypt at the end of 1918, were also engaged from time to time on the main line.

After the 25th Indian Company returned from Alexandretta on 12th April it was employed until the end of May on dismantling the Turkish narrow-gauge line from Junction Station to Beersheba. The 29th Company assisted during May and continued the work until July.

ROADS

Although of lower priority, the repair of essential sections of road made heavy demands upon several R.E. units. The distances involved, the rapidity of the final advance and uncertainty as to future policy in the occupied areas made it difficult to decide which roads should be repaired first. In the Aleppo area the depleted 5th Field Squadron found it difficult to supervise the local labour and was also handicapped by shortages of equipment. In Aleppo itself demolished bridges on the out-skirts had to be repaired before wheeled traffic could enter the town. A brigade eighty miles north of Aleppo had to be supplied by road, on which four masonry arch bridges were repaired, the road to Alexandretta improved with two repaired rollers and side drains dug or cleared at the worst places. By February, more than 1,300 natives were being employed and the emergency programme was almost finished. The arrival at this period of the 571st Army Troops Company enabled the bridge repairs to be expedited and labour supervision to be made more efficient.

The road to Aleppo was moderately good in dry weather but

certain sections needed extensive work, which was executed by the 5th Field Squadron employing some 2,000 local labourers. A causeway, half a mile long, was built across a swamp ten miles south of Aleppo, and the rough or bare rock stretches were graded and patched. Horse rollers towed by lorries were used for consolidation and in four weeks the road was passable by light motor traffic, although the damaged bridge was not opened to traffic until early in February.

The Homs-Tripoli road was in a bad state and extensive works were required to make it available as a winter supply route. The 522nd Field Company began a deviation near Tripoli on 6th November, 1918, repaired the bridges, strengthened culverts and made good the damage done by rain. The heavy maintenance on this road led to its abandonment in March, 1919.

The Homs-Damascus road was repaired by the 4th Field Squadron, deviations with new metalling being made at the worst sections, the unmetalled sections drained and pot-holes filled. In the middle of November, two battalions of Sikh Pioneers arrived to help, and remained in charge when the 4th Field Squadron with the 4th Cavalry Division marched to Beirut at the end of the month. Some idea of the magnitude of the road problem is indicated by the facts that Lieut.-Colonel H. Pearson, C.R.E., Desert Mounted Corps, was trying to keep 560 miles of indifferent roads and tracks open to solid-tyred lorry traffic in wet weather at the end of December, and that, by February, this mileage had risen to 800.

Farther back on the L. of C. the 555th Army Troops Company repaired the Semakh road throughout November, 1918. The 14th Army Troops Company, already engaged on the coastal road, worked on surfacing and culvert repairs to the roads from Beirut to the Damascus-Aleppo road and to the Beirut-Tripoli road. It was handicapped by losing half its strength from sickness. The 4th Field Squadron and all three field companies of the 54th Division also did a considerable amount of road work in the Beirut area and on the Tripoli road. When the 54th Division returned to Egypt work on the latter route was continued by pioneers, E.L.C. and contract labour until it was fit for light motor traffic under bad weather conditions. Culverts and retaining walls were rebuilt or repaired, drainage improved and the surface patched where necessary.

Part of the 220th Army Troops Company was engaged in November on the Tul Karm road and subsequently on the Jaffa-Jerusalem

road. The 35th Army Troops Company at Jericho continued road maintenance in the Jordan Valley, re-decked the suspension bridge in January, 1919, and began the erection of an Inglis bridge, which was opened on 26th April under the name "Allenby Bridge."

The engineers of the 3rd and 7th Divisions were also occupied with road works and bridge repairs.

WATER SUPPLY

In the latter part of 1918 all water companies, R.E., were busy developing supplies in the new back areas, watering returning formations and doing salvage work. The 357th Company worked on installations at Tul Karm and El Affule stations, completed five new bores and operated nearly thirty pumping stations. The 359th Company was engaged on watering troops in transit and maintaining several pumping plants. The 360th Company continued to operate the Qantara-Gaza pipe-line, installed supplies at hospitals and dismantled redundant machinery.

MISCELLANEOUS WORKS

After the armistice most R.E. units with formations were tired and under strength but had to cope with demands for winter quarters, water supply, recreational and training facilities and various other services, in addition to their work on roads. A few of the special tasks deserve mention as examples. The 5th Field Squadron in the Aleppo area repaired the Turkish barracks; the 4th Field Squadron at Beirut laid out camps for Armenian refugees; the 65th Field Company (3rd Indian Division) was engaged on hospitals at Haifa from January, 1919 until it was disbanded in April; and the 522nd Field Company (7th Indian Division) at Tripoli and Beirut sent detachments in the spring for harbour duties and anti-malarial work.

Non-divisional units also executed many miscellaneous services. The 14th Army Troops Company (Beirut) was engaged on building repairs, a hospital at Riyāq, dock work at Beirut and Mersina, anti-malarial measures at Alexandretta and survey work. The 35th Army Troops Company (Jordan Valley) salvaged decauville track and was disbanded in May, 1919. The 555th Army Troops Company was employed on miscellaneous services at Lydda and in connection with the transfer of advanced G.H.Q. to Haifa. It was disbanded

at the end of January, 1919. The 570th Army Troops Company was sent from Egypt to Haifa in February for general works in that area.

The 389th Advanced Park Company continued with stores duties at Lydda, Haifa, Beirut and Tripoli and still operated the workshops at Jaffa. The 359th Water Company at the end of 1918 operated the electricity supply to hospitals in the Lydda area and the 360th Water Company salvaged material from the Gaza-Beersheba defences.

WORKS IN EGYPT

In Egypt the immediate result of the armistice was the imposition of economy measures and closer control, but the organization of the Works Directorate remained unchanged for several months. On the return of several infantry divisions the D. of W. acted as Chief Engineer, Egypt, in addition to his own duties; in January, 1919, he had to start the breaking down of the extensive war organization which he had so ably developed and in the spring he had to deal with some of the problems arising from the civil disturbances. He left for England on 23rd March and his duties were taken over by the E.-in-C., Major-General H. B. H. Wright, who was relieved by Major-General S. D. Wilson in May.

The A.D.W., Aircraft Construction Works, still had a large staff of 115 and a labour force, employed by contractors, of 3,230 men. These numbers diminished as works were completed or abandoned until in April, when the organization was transferred to the E.-in-C. they numbered eighty-two and nearly 900 respectively. Surveys and some work had been done for various proposed civil air routes radiating from Cairo. Other military works were either completed or abandoned and few new projects, other than a prisoner-of-war camp for 30,000 at Belbes, were undertaken. On 1st January, 1919 the Base Park at Qantara took over control of all R.E. Parks east of the Suez Canal and during the month it handled nearly 4,000 tons of new and salvaged stores.

The return of five infantry divisions to Egypt during the last two months of 1918 raised many problems; the works services organization of course helped in their solution, but construction was almost entirely effected by the field companies of these divisions. The works executed included substantial drainage and water-supply schemes and accommodation of all kinds. Various R.E.

detachments formed part of flying columns and patrols during the civil disturbances in March, 1919.

On 14th February, 1919 the 220th Army Troops at Suez was allotted to the Army of Occupation for duty in the Canal Zone: the main body moved a fortnight later to Qantara and was deployed along the canal for miscellaneous services. On 5th October the company moved to Alexandria and absorbed the 101st and 108th Field Companies. The 569th Army Troops Company was engaged on salvage and camp construction in the Canal Zone until disbanded on 7th July. The 266th Railway Company was brought back from Palestine to Qantara on 19th March to man a construction train during the riots, and in addition to patrolling the Ismailia-Tel-el-Kebir line it salvaged considerable quantities of grain and petrol.

PALESTINE AND SYRIA, MAY TO OCTOBER, 1919

In May, 1919, XXI Corps ceased to exist and was replaced by North Force, whose reduced headquarters, on which Brigadier-General Hawksley remained as C.E., opened near Haifa on 19th May. On 10th June the Desert Mounted Corps was disbanded, the recently appointed C.R.E., Lieut.-Colonel S. Boyd, becoming C.R.E., Aleppo. North Force consisted of the 4th and 5th Cavalry Divisions, the 7th Indian Division and the 19th Indian Brigade, and included the following R.E. units: 4th and 5th Field Squadrons, 522nd Field Company, 357th Water Company, and 14th, 570th and 571st Army Troops Companies. Both field squadrons were disbanded by early August, the 14th and 571st Army Troops Companies left for Egypt in the late autumn and the 522nd Field Company in December for disbandment, leaving the 357th Water and 570th Army Troops Companies in Palestine throughout the year to await the cadres of two Regular units before disbandment. The E.L.C. was progressively reduced until a few men only were left at the end of 1919.

Between May and October uncertainty as to the future of the occupied areas, demands for economy and dwindling man-power combined to reduce works to bare essentials. In May summer camps were suspended and road maintenance restricted to a few routes. Further economies were ordered in July, but some work was done on airfields, a new road was built to Riyaq and a limited amount of winter hutting was begun in September. In December the 3rd Indian Division, whose C.R.E. was now Lieut.-Colonel E. J. Loring, returned to Palestine after some months spent in the Canal Zone.

SURVEY

In the last two months of the 1918 campaign the 7th Field Survey Company made detailed surveys of 216 square miles of country. Detachments under Captain Bamford soon reached Beirut and Damascus, at the latter the printing works were taken over on 4th October and some of the maps of the Balkans used by the Salonika army in its final offensive were printed here. Little topographical work was done in December, but the latitude and longitude of Damascus, and other places were determined by astronomical observations and a party sent to the Hejaz similarly fixed several places on the railway. Wireless time signals were received from Paris and Berlin.

As soon as the final operations had begun the Palestine triangulation was extended into Syria by two parties, one working along the Nablus road and the other along the coastal plain and through the foothills, whence the survey was carried on a single belt through Nazareth to Damascus. In June a check on a Turkish base at Aleppo linked the Palestine and Syria survey with the triangulation carried by Major Lewis, R.E., from Basra through Bagdad to Syria. This joint triangulation was over 1,400 miles long. In its wake followed detailed survey by plane-table and air photography which was plotted at a scale of 1/40,000. During January and February, 1919 some 750 square miles were surveyed and during the next three months 2,150 square miles in the Damascus and Aleppo areas were covered.

The meteorological station at Jerusalem was handed over. The new peace organization was settled in March and in July Lieut.-Colonel S. F. Newcombe, who had survived his imprisonment by the Turks, took over command. On 1st August the Company H.Q. moved to Damascus and detailed survey began in the Homs area. On 24th November the company was disbanded, Lieut.-Colonel Newcombe subsequently being appointed Survey Officer, Palestine.

THE WITHDRAWAL FROM SYRIA AND CILICIA

In September, 1919 the probability that a withdrawal from Syria might result from the Peace Conference raised the important question of the disposal of stores. All those not immediately required were moved to Qantara; in October stores in excess of a mobile scale were ordered to be returned and further winter hutting

works were suspended. Consideration was also given to the possibility of damage to communications resulting from the announcement of the French mandate in Syria. On 1st November the expected withdrawal of British troops from Syria and Silicia began. Considerable quantities of the more useful stores had already been moved, but large amounts remained. Unserviceable or bulky items, including timber, buildings and fixtures, were sold to the French, Arabs and other authorities such as the Baghdad Railways. All the ports, including Mersina, were used for evacuating the remainder, but most of the stores were moved by rail. The considerable strain imposed on the railways was increased by a few attempts to derail trains but guards on the lines prevented accidents. One shipload of R.E. stores was, however, destroyed when a hulk exploded in Beirut harbour on 8th December.

REVIEW OF R.E. ACHIEVEMENTS DURING THE CAMPAIGN

Railways.—During the whole campaign 627 miles of standard-gauge track, with 748 points and crossings, were laid and eighty-six stations built under the direction of the D.R.T., Brigadier-General Sir George Macauley, late R.E. With him were associated Brigadier-General R. B. D. Blakeney, late R.E., and Colonel G. C. M. Hall, late R.E., also of the E.S.R. Colonel G. Lubbock, late R.E., was D.D.R.T. (Sinai and Palestine) until August, 1916, when he was succeeded by Colonel M. E. Sowerby, late R.E. (Sudan Government Railways), whose specially apposite experience and personal qualities made his services of the highest value.

At the peak 169 locomotives were in operation on the Palestine Military Railways, and the rolling stock included 2,573 wagons, fifty passenger coaches and ninety-eight hospital coaches. The Railway Operating Division, under Lieut.-Colonel W. G. Tyrrell, eventually comprised eighteen sections numbering in all some 5,500 all ranks. The Division continued to operate all lines east of Qantara until early in 1920. These railway works were probably the most important single factor in achieving the superiority in numbers and material resources which made the final campaign decisive.

Water Supply.—Closely allied with the railway and of no less importance was the Qantara pipe-line to Palestine, on which the railway largely depended for its water. The work involved was equivalent to the construction in two and a half years of a water-works system on civil consumption rates for a town of 35,000 people

150 miles from the source of supply. When it is remembered that the scheme was not originally designed for the use to which it was ultimately put or to take the form in which it was eventually completed, that the choice of much of the plant, equipment and labour was limited almost entirely to local resources which were quickly available, and that time—and not cost—was the ruling factor, the construction of this undertaking was an outstanding achievement. The senior officers under whose general charge the works were executed were successively Brigadier-Generals E. M. Blair and R. L. Waller, while Major F. W. Stephen was directly responsible for most of the construction.

The water supply works undertaken early in 1916 along the Suez Canal (for which Sir Murdoch Macdonald had been largely responsible) were on an extensive scale with numerous filtration and pumping plants, reservoirs and pipe-lines. They were required to provide the defence force with water which was free from *bilharzia* danger and those at Qantara formed the basis on which the Palestine pipe-line was built. The numerous borings made later in Palestine were also on a large scale. All these works required considerable resources but were essential for strategic and tactical troop concentrations.

The training and equipment of the field company, R.E., was not intended to meet the unusual demands of water supply in desert country and to fulfil requirements under these conditions special establishments with additional equipment were authorized. The basic organization of the field company was sound and enabled this expansion to be made with the minimum of difficulty.

For longer-term arrangements and for special demands, such as those from the railways, the field company was, however, unsuitable, and the development and maintenance of water supplies in all but the most forward areas were soon made the responsibility of newly formed service units with water engineers and tradesmen accustomed to such work. These special water companies, supported by army troops companies in corps areas, contributed greatly in the conquest of Palestine.

The service conditions experienced were a severe test of the various types of engines and pumps supplied. The former were nearly all satisfactory, but the Blackstone (4- to 20-H.P.), the Lister (nominally 5-H.P.) and the Petter vertical engines gave specially good service. Of the pumps the Dando, particularly the 3,000 gallons per hour type, proved the best; it was sturdy and quickly installed, its ball

valves gave a minimum of trouble with sandy water and its balancing arrangement worked well at different depths. The 1,000-gallon Isler pump issued with the Lister engine was very satisfactory in spite of not possessing the useful ball-valve feature. Various types of triple plunger, high-lift pumps, especially the Evans 300-ft. type, did well, and they were sometimes successfully converted by fitting smaller diameter plungers to work against a 500-ft. head with smaller deliveries. Centrifugal three-stage pumps, such as the 5-in. Gilkes and the 4-in. Gwynne, gave good service on pipe-lines, while for mobile work the *chaîne hélice* was popular, as it was portable, quickly installed and easy to run.

Roads.—In the early stages of the campaign, a considerable mileage of water-bound macadam roads was constructed in the Suez Canal Zone where both stone and transport were available. In the Sinai Desert the mud problem was negligible and wire netting on the sand was successfully used for light traffic. In Palestine major difficulties were met for the first time in the attempt to repair or construct roads at a time before bituminous materials had become the answer to the disintegrating effect of the tractive effort of heavy, solid-tired mechanical vehicles. The existing "roads" had little or no soling and usually consisted of a low earth embankment with a small amount of broken stone scattered on the surface and roughly rolled. If the soil was clay this type of construction stood fairly well in dry weather but broke up rapidly in rain. To make these tracks passable the first essential was to dig side drains, and mud patches were then excavated, drained and refilled with dry material. On clays at least nine inches of soling and four to six inches of metalling were required, but on sandy soils these thicknesses were reduced by one-third. Excessive camber was avoided. The supply of stone was limited and transport was even scarcer, but in spite of the inadequacy of material resources, R.E. units kept communications open by hard work and ingenuity under weather conditions which were often abominable. The most notable achievement of all was the new construction in the Judean hills during the winter of 1917-18.

Survey.—In the early days of the campaign the army owed much to the help given by the Survey Department of Egypt under Mr. Dowson. The same department also seconded the first officers and other ranks when the 7th Field Survey Company was formed, but by the end of the campaign most of the thirty-nine officers then serving with the company had been transferred or attached from British

and Australian units. The value of the company's services was in some measure reflected by its gaining three D.S.Os. and six M.Cs. Survey work also owed much to Colonel W. C. Hedley, late R.E., of the Geographical Section, General Staff, who caused experience gained on other fronts to be made available to the E.E.F. and ensured co-ordination. Technical advice of great value was also given by Colonel W. V. Nugent, R.A., of the General Staff, who, besides being an old boundary commissioner, had also served in the Geographical Section.

In Palestine an area of 1,473 square miles between the Beersheba-Gaza line and the front held during the summer of 1918 was surveyed before the armistice and subsequently a further area of 8,500 square miles was surveyed, the whole of this area being plotted at 1/40,000. Another 7,000 square miles in Syria and Transjordan were surveyed and plotted at 1/100,000 in 1919. The use of air photography to supplement ground work seems to have been relatively more extensive in this theatre than in others, and in 1918 alone nearly 16,000 photographs were taken by the R.F.C. and R.A.F. The lithographic and letterpress sections of the company issued over 120,000 publications, including geological pamphlets, and printed and issued 123,000 maps up to the time of the armistice.

FINAL REFLECTIONS

The achievements of the Royal Engineers during the campaign need to be reviewed in relation to their general background, which differed from that of other theatres. For example, as compared with the Western Front large-scale operations began much later and were less continuous; the two most important results of this were that battle casualties were lower and opportunities for training better, although R.E. units had fewer opportunities for this than those of other arms. In September, 1918 the R.E. in Egypt and Palestine totalled some 12,000 men and formed 8.27 per cent of the total strength of the force, compared with 7.72 in France and 8.74 in Salonika. A year earlier the percentages for these theatres respectively had been 7.58, 9.57 and 6.67, but the man-power savings in 1918 did not materially affect the R.E. in Palestine. Much engineer work was done under R.E. supervision by Indian field companies, British and Indian pioneers battalions, E.L.C. and local labour.

Although their battle casualties were lower, the R.E. in Egypt

and Palestine suffered many disadvantages as compared with the Western Front ; home leave was a rarity, facilities for entertainment and recreation were almost non-existent, and extremes of climate, ranging from the intense heat and dust-storms of Upper Egypt and Sinai and the even worse conditions in the Jordan Valley to the wet and cold of the Judean hills in winter, had to be endured with little prospect of relief or change. In these circumstances manual work, often handicapped by septic sores and intestinal complaints, was more arduous than in some theatres, but nevertheless some remarkable output figures were reached.

To mention further individual names would be perhaps invidious and most officers and other ranks would, no doubt, prefer the tangible results of their common efforts to be regarded as a more fitting acknowledgment. It should be noted that the E.E.F. had the same E.-in-C., Major-General H. B. H. Wright, almost throughout the campaign and the same D. of W. throughout, with obvious advantages in continuity of policy and control. C.Es. of corps and Cs.R.E. of divisions were of a high standard and many unit commanders of great ability emerged as the campaign progressed. Less senior officers and the rank and file included many specialists and tradesmen whose knowledge and skill were of great value to the whole force.

To summarize the part played by the R.E. in Egypt and Palestine, it can be stated with confidence that the work of the Corps was an indispensable factor in the successful issue of the operations, and its high standard is proved by the fact that no failure of any importance occurred in any of the engineering undertakings. No more fitting tribute can be paid to the men who contributed so much under arduous and trying conditions towards the unprecedented completeness of the E.E.F's. victory.

It should also be remembered that much of the engineering work that was carried out during the campaigns in Egypt, Sinai, Palestine, Syria and in the region of Alexandretta, created permanent improvements in those countries, and the great survey work will remain a permanent asset.

APPENDIX I

R.E. ORDER OF BATTLE--GALLIPOLI

GENERAL HEADQUARTERS

<i>Engineer Adviser</i>	Brigadier-General A. W. Roper,
<i>Engineer-in-Chief</i>	Major-General G. Williams, Sept., 1915,
<i>Director of Works</i>	Brigadier-General G. S. McD. Elliott,
	Brigadier-General A. C. de L. Joly de Lotbinière, July, 1915.

VIII CORPS (HELLS FRONT)*

<i>Chief Engineer</i>	Brigadier-General E. A. Tudor,
	Brigadier-General J. A. Gibbon, Aug., 1915.
<i>29th Division†</i> C.R.E.	Lieut.-Colonel G. B. Hington,
	Lieut.-Colonel R. K. A. Macanlay, June, 1915,
	Lieut.-Colonel A. J. Savage, July, 1915,
	Lieut.-Colonel R. K. A. Macanlay, Oct., 1915,
	Lieut.-Colonel W. M. Pyne, Nov., 1915,
	Lieut.-Colonel A. J. Wolff, Dec., 1915,
<i>1/2nd London Field Company,</i> <i>1/1st West Riding Field Company</i>	Major G. N. Dodworth,
	Major A. C. Baylay, July, 1915,
<i>1/2nd Lowland Field Company</i>	Major W. Archibald,
	Captain B. I. Rolling, June, 1915,
	Captain B. T. Wilson, Sept., 1915.
<i>42nd (East Lancs.) Division</i> C.R.E.	Lieut.-Colonel S. L. Tennant,
<i>1/1st East Lancs. Field Company,</i> <i>1/2nd East Lancs. Field Company,</i> <i>1/2nd West Lancs. Field Company.</i>	
<i>52nd (Lowland) Division</i> C.R.E.	Lieut.-Colonel T. Symington,
	Lieut.-Colonel G. B. Motherwell, June, 1915,
	Lieut.-Colonel R. L. Waller, Aug., 1915,
<i>2/1st Lowland Field Company,</i> <i>2/2nd Lowland Field Company,</i> <i>1/3rd Kent Field Company.</i>	
<i>Corps Troops</i>	
<i>1st Fortress Company,</i> <i>37th Army Troops Company,</i> <i>134th Army Troops Company</i>	Captain C. J. W. Vasey.

* Commanded by Lieut.-General Sir Aylmer G. Hunter-Weston, late R.E., from May till July, 1915.

† Commanded by Major-General A. G. Hunter-Weston, late R.E., until May, 1915. Lieut.-Colonel C. G. Fuller, R.E., was G.S.O.1 from June.

IX CORPS (SUVA FRONT)*

<i>Chief Engineer</i>	Brigadier-General A. C. Painter, Brigadier-General E. H. Bland, Aug., 1915.
<i>10th Division†</i>	
C.R.E.	Lieut.-Colonel F. K. Fair,
65th Field Company	Major A. ff. Garrett, Major B. Borradaile, Sept., 1915.
66th Field Company	Major A. S. Holme,
85th Field Company	Major R. F. Knox, Captain W. Glasgow, Aug., 1915, Lieutenant H. J. Palmer, Sept., 1915.
<i>11th Division</i>	
C.R.E.	Lieut.-Colonel E. H. Bland, Lieut.-Colonel F. A. K. White, Aug., 1915, Major G. W. Denison, Dec., 1915.
67th Field Company	Major F. W. Brunner, Captain E. Rogers, Aug., 1915.
68th Field Company	Major F. A. K. White, Captain Kent, Aug., 1915.
86th Field Company	Major G. W. Denison, Oct., 1915, Major R. L. Waller, Captain R. E. B. Pratt, Sept., 1915.
<i>13th Division‡</i>	
C.R.E.	Lieut.-Colonel G. D. Close, Lieut.-Colonel A. J. Wolff, Aug., 1915.
71st Field Company	Captain D. S. Collins,
72nd Field Company	Major A. J. Wolff, Captain W. Cracroft-Amcotts, Aug., 1915, Captain W. H. Roberts, Sept., 1915, Captain W. Cracroft-Amcotts, Nov., 1915,
88th Field Company	Major L. C. A. de B. Doucet, Captain E. U. Grimshaw, Aug., 1915.
<i>63rd (Royal Naval) Division</i>	
C.R.E.	Lieut.-Colonel A. B. Carey.
1st Field Company, Engineers,	
2nd Field Company, Engineers,	
3rd Field Company, Engineers.	
<i>Corps Troops</i>	
1st Fortress Company,	
136th (Monmouth) Army Troops Company,	
254th Tunnelling Company	Major H. W. Lane, July, 1915.
1/3rd (Lancs.) Workshop Company,	
126th Army Troops Company,	
13th Base Park Company	Captain E. H. Lane, May, 1915.

* Lieut.-Colonel F. G. Fuller, R.E., was G.S.O.1 from August, 1915.

† 10th Division left for Salonika in September.

‡ 13th Division was in the Anzac Corps till August.

ANZAC CORPS (ANZAC FRONT)

<i>Chief Engineer</i>	Brigadier-General A. C. Joly de Lotbinière, Brigadier-General G. Williams, Aug., 1915. Brigadier-General W. B. Leslie, Sept., 1915, Lieut.-Colonel E. N. Mozley.
<i>Asst. Director of Works, Anzac</i>	
<i>1st Australian Division</i> C.R.E.	Lieut.-Colonel G. C. E. Elliott, March, 1915, Major E. N. Mozley, May, 1915, Major A. M. Martyn, July, 1915.
1st Australian Field Company, 2nd Australian Field Company, 3rd Australian Field Company.	Major H. O. Clogstoun.
<i>2nd Australian Division</i> C.R.E.	Lieut.-Colonel G. C. Elliott, July, 1915, Major S. F. Newcombe, Sept., 1915.
4th Australian Field Company 5th Australian Field Company. 6th Australian Field Company.	
<i>New Zealand and Australian Division</i> C.R.E.	Lieut.-Colonel G. R. Fridham, June, 1915, Captain A. G. McNeill, April, 1915.
1st New Zealand Field Company 2nd New Zealand Field Company 3rd New Zealand Field Company.*	Major G. Barclay, June, 1915.
<i>53rd (Welsh) Division</i> C.R.E.	Lieut.-Colonel T. C. Skinner, Lieut.-Colonel H. G. Joly de Lotbinière, Sept., 1915, Lieut.-Colonel R. P. T. Hawksley, Nov., 1915.
1st Welsh Field Company, 2/1st Cheshire Field Company, 2/2nd Cheshire Field Company.	
<i>54th (East Anglian) Division†</i> C.R.E.	Lieut.-Colonel G. H. Wells,
1/2nd East Anglian Field Company, 2/1st East Anglian Field Company.	
<i>2nd Mounted Division‡</i> C.R.E.	Lieut.-Colonel E. N. Mozley, Major A. E. Coningham,
1/1st Kent Field Company 1/2nd Kent Field Company.	
<i>Corps Troops</i> 1st Fortress Company, 5th Anglesey Siege Company,	

* Originally the New Zealand Field Troop.

† 54th Division replaced 13th Division in the Anzac Corps in August.

‡ 2nd Mounted Division was in the Anzac Corps till August.

133rd Army Troops Company,
The Royal Australian Naval
Bridging Train.

Director of Works, Mudros
1st Fortress Company,
13th Base Park Company
117th Railway Company.

Asst. Director of Works, Imbros

1/3rd Lincs. Workshop Company.

Asst. Director of Works, Alexandria

WORKS

Colonel J. B. Blakeway, Nov., 1915.

Major E. N. Mozley,

Lieut.-Colonel M. R. Kennedy,

Lieut.-Colonel Galbraith,

Lieut.-Colonel L. H. Close.

APPENDIX II

R.E. ORDER OF BATTLE—SALONIKA ARMY

ARMY HEADQUARTERS*

Chief Engineer, later E.-in-C.

Director of Works

Deputy Director of Works

Director of Railways

Brigadier-General S. R. Rice,

Brigadier-General A. R. Reynolds, March,
1916,

Brigadier-General H. A. A. Livingstone, Aug.
1916, appointed E.-in-C., Jan., 1917.

Brigadier-General J. P. Blakeway, Aug., 1917,

Colonel A. R. Reynolds,

Colonel J. P. Blakeway, March, 1916,

Colonel H. C. Webb-Bowen, Aug., 1917,

Lieut.-Colonel M. E. Sowerby,

Lieut.-Colonel F. D. Hammond, July, 1916,

Lieut.-Colonel G. D. Rhodes, Oct., 1917.

XII CORPS

Chief Engineer

22nd Division

C.R.E.

99th Field Company

100th Field Company

Brigadier-General G. Godby,

Brigadier-General F. K. Fair, Jan., 1916,

Brigadier-General G. W. Walker, Aug., 1916,

Brigadier-General C. G. W. Hunter, Dec., 1917.

Lieut.-Colonel D. M. F. Hoystead,

Lieut.-Colonel P. G. Fry, July, 1917,

Major H. L. G. Bell,

Major E. M. S. Charles,

Major C. M. Spielman, 1916,

* "General Headquarters" after January, 1917.

127th Field Company	Captain G. G. Waterhouse, Major J. A. Warburton, 1917.
26th Division C.R.E.	Lieut.-Colonel C. G. W. Hunter, Lieut.-Colonel G. B. Pears, Dec., 1917, Major F. R. H. Eustace, Major H. H. E. Gosset, 1916, Major W. R. Izat, Major R. G. Prichard, 1916, Captain F. H. Budden, Major C. C. Phipps, 1916.
107th Field Company	
108th Field Company	
131st Field Company	
60th (London) Division* C.R.E.	Colonel R. Q. Henriques, Lieut.-Colonel C. B. Thomson, Aug., 1917, Lieut.-Colonel A. J. G. Bird, March, 1918.
3/3rd London, later 519th Field Company	Major D. H. Steers,
2/4th London, later 521st Field Company	Major D. E. Colson,
1/6th London, later 522nd Field Company	Major A. H. D. Moncrieff.
<i>Corps Troops</i>	
140th Army Troops Company	Captain J. R. W. Mansfield,
287th Army Troops Company	Captain G. R. Cassels,
9th Field Troop	Captain W. Falcon.

XVI CORPS

<i>Chief Engineer</i>	Brigadier-General H. L. Pritchard,
<i>Assistant Director of Works</i>	Lieut.-Colonel G. S. Pitcairn, March, 1917,
<i>Senior Field Engineer</i>	Major E. O. Taylor, Aug., 1918.
10th Division† C.R.E.	Lieut.-Colonel F. K. Fair, Lieut.-Colonel E. M. S. Charles, Feb., 1916, Major B. Borradaile, Major N. D. Noble, 1916, Major A. S. Holme, Major P. G. Spackman, Captain W. F. B. Bryant, Major A. G. Turner, 1916.
65th Field Company	
66th Field Company	
85th Field Company	
27th Division C.R.E.	Lieut.-Colonel G. W. Walker, Lieut.-Colonel R. B. Dutton, July, 1916, Major T. Gracey, Major G. B. Pears, Sept., 1917, Major J. D. Inglis, Dec., 1917.
17th Field Company	

* 60th Division arrived in December, 1916, and left in August, 1917.

† 10th Division left in June, 1917.

1st Wessex, later 500th Field
Company

2nd Wessex, later 501st Field
Company

28th Division

C.R.E.

38th Field Company

2/1st Northumbrian, later 449th
Field Company

1/7th Hampshire, later 506th
Field Company

Corps Troops

6th Field Troop

143rd Army Troops Company

286th Army Troops Company

Assistant Director of Survey

8th Field Survey Company

Indian Survey Detachments

Assistant Director of Works, Base

37th Army Troops Company

137th Army Troops Company

33rd Base Park Company

4th Advanced Park Company

Assistant Director of Works, L. of C.

420th (West Lancs.) Field Company,

138th Army Troops Company,

139th Army Troops Company

95th Labour Company,

96th Labour Company,

Mining Company

Major R. B. Dutton,

Major S. L. Harvey, Oct. 1915,

Major P. G. Fry,

Major R. B. Pitt, July, 1917.

Lieut.-Colonel E. S. Sandys,

Major G. Master,

Major J. W. Douglas,

Major W. Boyce-Brown.

Captain F. E. Fowle,

Major G. B. O. Taylor,

Captain C. A. Midgley,

Captain J. A. V. Rowe, Dec., 1916.

SURVEY

Captain Meldrum,

Lieut.-Colonel H. Wood, Dec., 1916,

Major R. H. Phillimore,

Lieutenants H. B. Symons and B. T. Wyatt.

WORKS

Lieut.-Colonel A. G. T. Cusins,

Lieut.-Colonel H. N. Hooper,

Lieut.-Colonel G. B. O. Taylor, June, 1918,

Captain C. B. Ede,

Major Galbraith,

Captain J. S. Smith,

Major A. T. Cusins,

Major L. Shingleton,

Major Hooper,

Major Morcon,

Major Hallam,

Lieutenant Macdonald,

Captain W. B. Burford.

Lieut.-Colonel G. S. Pitcairn,

Lieut.-Colonel G. B. O. Taylor,

Lieut.-Colonel H. N. Hooper, June, 1918,

Major R. H. Phillimore,

Captain S. R. Rafferty,

Captain G. Richards,

Captain Kruger.

RAILWAYS AND TRANSPORTATION

<i>Assistant Director of Railways</i>	Major M. E. Sowerby, Lieut.-Colonel F. D. Hammond, Dec., 1915, Lieut.-Colonel G. D. Rhodes, July, 1916,
117th Railway Construction Company	Captain G. D. Rhodes, Captain A. M. Close, July, 1916,
273rd Railway Construction Company	Captain J. C. Brown,
270th Railway Labour Company	Captain P. R. Sordi.
<i>Assistant Director of Transportation</i>	Major L. H. Kirkness,
Railway Transport Establishment,	
19th Railway Operating Company,	
32nd Railway Operating Company,	
217th Railway Operating Company.	

APPENDIX III

R.E. ORDER OF BATTLE—EGYPT, JANUARY, 1916

GENERAL HEADQUARTERS CANAL ZONE

<i>Engineer-in-Chief</i>	Major-General G. Williams,
Deputy Director of Works	Colonel Sir Murdoch MacDonald.

IX CORPS (No. 1 SECTION), H.Q., El Shatt

<i>Chief Engineer</i>	Brigadier-General E. H. Bland.
10th Indian Division	
C.R.E.	Lieut.-Colonel Scudamore,
No. 10 Company, Q.V.O. Sappers and Miners	Major T. P. Bassett,
1/1st Renfrew Field Company	Captain H. M. Hodgart,
1/1st City of Edinburgh Field Company	Major J. D. Park.
46th (North Midland) Division	
C.R.E.	Brigadier-General C. V. Wingfield-Stratford,
1/1st North Midland Field Company	Major McCraith,
1/2nd North Midland Field Company	Lieutenant Jones,
2/1st North Midland Field Company	Captain Izellor.
29th Division	
C.R.E.	Lieut.-Colonel W. M. Pyne,
1/1st West Riding Field Company	Major A. C. Baylay,
1/2nd Lowland Field Company	Captain B. T. Wilson,
1/2nd London Field Company	Captain E. J. Ryan.

Corps Troops

5th Fortress Company, R. Monmouth. Captain K. Digby,
 133rd Army Troops Company Major Muter.

ANZAC CORPS (No. 2 SECTION), H.Q., Ismailia

Chief Engineer Brigadier-General A. C. Joly de Lotbinière.

1st Australian Division

2nd Australian Division

New Zealand and Australian Division

Corps Troops

14th Army Troops Company Major G. S. C. Cooke,
 3rd Australian Field Company Major H. O. Clogstoun.

XV CORPS (No. 3 SECTION), H.Q., Port Said

Chief Engineer Brigadier-General P. G. Grant.

11th Division

C.R.E. Lieut.-Colonel F. A. K. White,
 67th Field Company Captain E. Rogers,
 68th Field Company Major G. W. Denison,
 86th Field Company Captain Pratt.

31st Division

C.R.E. Lieut.-Colonel H. E. G. Clayton,
 210th Field Company,
 211th Field Company,
 223rd Field Company.

13th Division

C.R.E. Lieut.-Colonel A. J. Wolff,
 71st Field Company Lieutenant G. W. Richmond,
 72nd Field Company Captain A. E. Coningham,
 88th Field Company Captain T. B. G. Forster.

Corps Troops

167th Army Troops Company Captain R. O. Jackson,
 220th Army Troops Company Captain G. W. E. Kempson.

VIII CORPS (RESERVE), H.Q., Tel el Kebir

42nd (East Lancs.) Division

C.R.E. Lieut.-Colonel S. L. Tennant,
 1/1st East Lancs. Field Company Major J. H. Mousley,
 1/2nd East Lancs. Field Company Major L. F. Wells,
 1/2nd West Lancs. Field Company Major W. F. Dixon.

52nd (Lowland) Division

C.R.E. Lieut.-Colonel R. L. Waller,

2/1st Lowland Field Company	Major S. M. Spence,
2/2nd Lowland Field Company	Captain M. J. B. Baird,
1/3rd Kent Field Company.	

WESTERN FRONTIER FORCE

53rd Division

C.R.E.	Lieut.-Colonel R. P. T. Hawksley,
1/1st Welsh Field Company	Major R. A. Neville,
2/1st Welsh Field Company	Major J. Francis,
2/1st Cheshire Field Company	Major H. E. Trubshaw.

Force Troops

1/2nd East Anglian Field Company	Captain T. H. Smith,
1/2nd Kent Field Company	Major H. W. Davey.

G.H.Q. TROOPS

Works Units

5th Fortress Company, R.	
Anglesey	Captain A. Glen,
1/1st Kent Field Company	Captain G. S. Steed,
1/3rd Lancs. Workshop Company,	
134th Army Troops Company,	
136th Army Troops Company,	
167th Army Troops Company.	

APPENDIX IV

R.E. ORDER OF BATTLE—EGYPTIAN EXPEDITIONARY
FORCE, JULY, 1916

GENERAL HEADQUARTERS

<i>Engineer-in-Chief</i>	Major-General H. B. H. Wright,
<i>Director of Works</i>	Brigadier-General E. M. Paul.

CANAL ZONE (No. 1 SECTION)

<i>Chief Engineer</i>	Brigadier-General E. H. Bland.
-----------------------	--------------------------------

42nd Division

C.R.E.	Lieut.-Colonel E. N. Mozley,
1/1st East Lancs. Field Company	Major J. H. Mousley,
1/2nd East Lancs. Field Company	Major L. F. Wells,
1/3rd East Lancs. Field Company	Major A. N. Lawford.

54th Division

C.R.E.	Lieut.-Colonel G. H. Wells,
	Lieut.-Colonel A. W. Stokes, July, 1916.

2/1st East Anglian Field Company	Major E. G. Fiegehen,
1/2nd East Anglian Field Company	Captain T. H. Smith,
1/1st Kent Field Company	Captain G. S. Steed.

10th Indian Division

C.R.E.

No. 10 Company, Q.V.O. Sappers
and Miners

Major T. P. Bassett.

8th Mounted Brigade

9th Field Troop

Captain J. Meston Reid.

CANAL ZONE (NO. 2 SECTION)

Chief Engineer Brigadier-General J. R. Young.

53rd Division (less one brigade)

C.R.E.

Lieut.-Colonel R. P. T. Hawksley,

1/1st Welsh Field Company

Major R. A. Neville,

2/1st Welsh Field Company

Major J. Francis.

Corps Troops

14th Army Troops Company

Major G. S. C. Cooke,

1/3rd Lancs. Workshop Company

Captain Bell.

CANAL ZONE (NO. 3 SECTION)

Chief Engineer Brigadier-General E. M. Blair.

52nd Division

C.R.E.

Lieut.-Colonel R. L. Waller,

2/1st Lowland Field Company

Major S. M. Spence,

1/2nd Lowland Field Company

Captain G. Streeten,

2/2nd Lowland Field Company

Captain S. Jackson,

Captain K. B. Griffith-Williams, July, 1916.

5th Mounted Brigade

7th Field Troop

Lieutenant R. C. R. Whalley.

Corps Troops

5th Siege Company, R. Monmouth.

220th Army Troops Company

Captain G. W. E. Jackson.

WESTERN FRONTIER FORCE

53rd Division (one brigade)

C.R.E.

Lieut.-Colonel D. M. Griffith,

Lieut.-Colonel F. R. H. Eustace, July, 1916,

2/1st Cheshire Field Company

Major H. E. Trubshaw,

1/2nd Kent Field Company

Major H. W. Davey,

6th Field Troop.

G.H.Q. TROOPS

Works Units

13th Base Park Company

Captain W. H. Jennings,

46th Advanced Park Company

Captain C. E. F. Wyncoll,

5th Siege Company, R. Anglesey

Captain A. Glen,

1/3rd Devon Army Troops Company

Captain H. Ganderton.

Survey Units

Topographical Section.

Railway Units

115th Railway Company

Captain W. E. Thornhill,

116th Railway Company

Captain R. C. Kirkpatrick,

276th Railway Company,

53rd Railway Troops Company

Captain W. Sharp.

APPENDIX V

R.E. ORDER OF BATTLE—EGYPTIAN EXPEDITIONARY
FORCE, APRIL, 1917

GENERAL HEADQUARTERS

Engineer-in-Chief

Major-General H. B. H. Wright,

Director of Works

Brigadier-General E. M. Paul.

EASTERN FORCE

Chief Engineer

Brigadier-General R. L. Waller.

52nd Division

C.R.E.

Lieut.-Colonel L. F. Wells,

410th (1/2nd Lowland) Field

Company

Major G. Streeten,

Captain Hodge, May, 1917.

412th (2/1st Lowland) Field

Company

Major B. I. Rolling,

413th (2/2nd Lowland) Field

Company

Major C. M. Jackson.

53rd Division

C.R.E.

Lieut.-Colonel F. R. H. Eustace,

436th (1/1st Welsh) Field Company

Major R. A. Neville,

Captain H. S. Burn, May, 1917,

Major T. C. Brown, Aug., 1917,

437th (2/1st Welsh) Field Company

Major J. Francis,

439th (2/1st Cheshire) Field Company

Major A. Leitch.

54th Division

C.R.E.

Lieut.-Colonel A. W. Stokes,

484th (1/2nd East Anglian) Field

Company

Major T. H. Smith,

486th (2/1st East Anglian) Field

Company

Major E. G. Fiegehen,

Major I. J. Thatcher, July, 1917,

495th (1/1st Kent) Field Company

Major H. W. Tyler,

Major C. S. Montefiore, Aug., 1917.

74th Division

C.R.E.

Lieut.-Colonel R. P. T. Hawksley,
Lieut.-Colonel W. R. Izat, Sept., 1917.

496th (1/2nd Kent) Field Company

Major C. E. Wilson,

5th R. Monmouth. Field Company

Major A. G. Pardoe,

5th R. Anglesey Field Company

Major A. Glen.

Force Troops

10th Field Troop

Captain C. R. Inwood,

No. 10 Company, Q.V.O. Sappers
and Miners

Major T. P. Bassett,

35th Army Troops Company

Captain W. H. A. Hunt,

220th Army Troops Company

Captain G. W. E. Kempson,

555th (1/3rd Lincs.) Army Troops
Company

Captain Bell,

360th Water Company

Captain T. W. Fairhurst.

DESERT COLUMN

Chief Engineer

Brigadier-General R. E. M. Russell.

*Imperial Mounted Division*Field Squadron (including 7th and
9th Field Troops).*Anzac Mounted Division*Anzac Field Squadron (including 6th
Field Troop).

SOUTHERN CANAL SECTION

Engineer Troops

496th Field Company,

14th Army Troops Company

Major G. S. C. Cooke,

Captain S. Davies, May, 1917.

G.H.Q. TROOPS

*Works Units*596th (1/3rd Devon) Army Troops
Company

Captain H. Ganderton,

13th Base Park Company

Captain W. H. Jennings,

46th Advanced Park Company

Captain C. E. F. Wyncoll.

Survey Unit

7th Field Survey Company

Major W. J. Maule.

*Railway Units*Railway Operating Division (53rd,
274th and 276th Railway
Companies)

Lieut.-Colonel W. G. Tyrrell,

115th Railway Company

Captain W. E. Thornhill,

116th Railway Company

Captain R. C. Kirkpatrick.

APPENDIX VI

R.E. ORDER OF BATTLE—EGYPTIAN EXPEDITIONARY
FORCE, OCTOBER, 1917

GENERAL HEADQUARTERS

Engineer-in-Chief
Director of Works

Major-General H. B. H. Wright,
Brigadier-General E. M. Paul.

DESERT MOUNTED CORPS

C.R.E.

Lieut.-Colonel R. E. M. Russell.

Anzac Mounted Division
Anzac Field Squadron.

Australian Mounted Division
A.M.D. Field Squadron (including 5th Field Troop).

Yeomanry Mounted Division
6th Field Squadron (including 6th,
7th and 9th Field Troops)

Major M. E. Morgan.

7th Mounted Brigade

8th Field Troop.

Imperial Camel Corps Brigade

10th Field Troop.

XX CORPS

Chief Engineer

Brigadier-General R. L. Waller.

10th Division

C.R.E.

Lieut.-Colonel E. M. S. Charles,

65th Field Company

Major N. D. Noble,

66th Field Company

Major W. H. Oxley,

85th Field Company

Major A. G. Turner.

53rd Division

C.R.E.

Lieut.-Colonel F. R. H. Eustace,

436th Field Company

Major A. G. Scott,

437th Field Company

Major J. Francis,

439th Field Company

Major A. Leitch.

60th Division

C.R.E.

Lieut.-Colonel R. Q. Henriques,

Lieut.-Colonel C. B. Thomson, Aug., 1917.

519th Field Company

Major D. H. Steers,

Major B. F. Nell, Nov., 1917.

521st Field Company

Major D. F. Colson,

522nd Field Company

Major A. H. D. Moncrieff.

74th Division

C.R.E.

Lieut.-Colonel R. P. T. Hawksley,

Lieut.-Colonel W. R. Izat, Sept., 1917.

5th R. Monmouth. Field Company Captain C. W. Robertson,
5th R. Anglesey Field Company Major A. Glen.

Corps Troops

" V " Sound Ranging Section (7th
Field Survey Company) Captain Cockburn, R.C.E.

XXI CORPS

Chief Engineer Brigadier-General R. P. T. Hawksley.

52nd Division

C.R.E. Lieut.-Colonel L. F. Wells,
410th Field Company Captain Hodge,
412th Field Company Major B. I. Rolling,
413th Field Company Major C. M. Jackson,
Major K. B. Griffiths-Williams, Oct., 1917.

54th Division

C.R.E. Lieut.-Colonel A. W. Stokes,
484th Field Company Major T. H. Smith,
486th Field Company Major I. J. Thatcher.

75th Division

C.R.E. Lieut.-Colonel G. S. C. Cooke,
495th Field Company Major C. S. Montefiore,
496th Field Company Captain P. Richardson, Nov., 1917,
Major A. H. B. Papillon.

Corps Troops

14th Army Troops Company Captain S. Davies,
" N " Sound Ranging Section (7th
Field Survey Company) Captain Gott, R.F.A.

PALESTINE L. OF C.

Deputy Director of Works Colonel L. N. Cooper,
No. 10 Company, Q.V.O. Sappers
and Miners Major T. P. Bassett,
35th Army Troops Company Captain W. H. A. Hunt,
220th Army Troops Company Captain G. W. E. Kempson,
555th Army Troops Company Captain G. K. Bell,
569th Army Troops Company Captain H. Ganderton,
359th Water Company Captain W. R. Gibson,
360th Water Company Captain T. W. Fairhurst.

G.H.Q. TROOPS

Works Units

570th (Devon) Army Troops
Company Captain G. Moon,
571st (Devon) Army Troops
Company Captain F. E. Bawdon,
13th Base Park Company Major V. E. J. Francis,
46th Advanced Park Company Captain C. E. F. Wyncoll.

Survey Unit

7th Field Survey Company (including Meteor. Section)

Major W. J. Maule.

Railway Units

Railway Operating Division

Light Railways Directorate

115th Railway Company

116th Railway Company

265th Railway Company

266th Railway Company

Lieut.-Colonel W. G. Tyrrell,

Lieut.-Colonel C. E. Jordan-Bell,

Captain W. E. Thornhill,

Captain R. C. Kirkpatrick,

Captain J. W. Watson,

Captain W. G. Ross.

APPENDIX VII

R.E. ORDER OF BATTLE—EGYPTIAN EXPEDITIONARY
FORCE, SEPTEMBER, 1918

GENERAL HEADQUARTERS

Engineer-in-Chief

Major-General H. B. H. Wright,

Director of Works

Brigadier-General E. M. Paul.

DESERT MOUNTED CORPS

C.R.E.

Lieut.-Colonel H. D. Pearson.

4th Cavalry Division

4th (ex-6th) Field Squadron: 10th,

11th and 12th (ex-6th, 9th and

7th) Field Troops

Major M. E. Morgan.

5th Cavalry Division

5th Field Squadron: 13th, 14th

and 15th (ex-5th, 8th and 10th)

Field Troops

Major J. H. Alexander,

Captain A. E. Fowle, Nov., 1918.

Chaytor's Force

Detachment of 35th Army Troops

Company.

Australian Mounted Division

3rd Field Troop.

XX CORPS

Chief Engineer

Brigadier-General R. L. Waller.

*10th Division**C.R.E.*

66th Field Company

Lieut.-Colonel E. M. S. Charles,

Captain A. N. Forman,

85th Field Company
No. 18 Company, 3rd Sappers
and Miners

Major W. F. B. Bryant,

Major M. Rawlence.

53rd Division

C.R.E.

436th Field Company

437th Field Company

Lieut.-Colonel F. R. H. Eustace,

Major H. S. Burn,

Major J. Francis,

Major M. D. Noble, Nov., 1918,

No. 72 Company, 3rd Sappers and
Miners

Major M. G. G. Campbell.

Corps Troops

220th Army Troops Company

Captain C. W. Ingram,

Captain E. B. Jory, Nov., 1918,

Captain A. C. Duff, Dec., 1918,

" V " Sound Ranging Section (7th
Field Survey Company)

Captain Cockburn, R.C.E.

XXI CORPS

Chief Engineer

Brigadier-General R. P. T. Hawksley.

54th Division

C.R.E.

484th Field Company

486th Field Company

Lieut.-Colonel A. W. Stokes,

Major T. H. Smith,

Major J. N. Cash,

Major G. C. Chester, Dec., 1918,

Major C. E. Wilson.

495th Field Company

60th Division

C.R.E.

519th Field Company

Lieut.-Colonel A. J. G. Bird,

Major B. F. Nell,

Major W. M. Lee, Dec., 1918,

Major D. F. Colson,

521st Field Company

No. 1 Company, 1st (K.G.O.)

Sappers and Miners

Major H. A. Joly de Lotbinière.

75th Division

C.R.E.

496th Field Company

No. 10 Company, 2nd (Q.V.O.)

Sappers and Miners

No. 16 Company, 2nd (Q.V.O.)

Sappers and Miners

Lieut.-Colonel A. G. Turner,

Major G. W. E. Kempson,

Major T. P. Bassett,

Major T. B. Harris.

3rd (Indian) Division

C.R.E.

65th Field Company

Lieut.-Colonel J. A. Stack,

Lieut.-Colonel E. J. Loring, Dec., 1918,

Major C. E. Gill,

Major C. E. F. Wyncoll, Sept., 1918,

No. 20 Company, 3rd Sappers and Miners	Major S. Boyd,
No. 21 Company, 3rd Sappers and Miners	Major M. Everett.
7th (Indian) Division C.R.E.	Lieut.-Colonel E. F. J. Hill,
522nd Field Company	Captain R. C. Case, Major G. H. Latham, Nov., 1918, Major C. E. Wilson, Jan., 1919,
No. 3 Company, 1st (K.G.O.) Sappers and Miners	Major W. Cave-Browne,
No. 4 Company, 1st (K.G.O.) Sappers and Miners	Major E. L. Farley, Captain H. M. Hame, Aug., 1918.
<i>Corps Troops</i>	
14th Army Troops Company	Captain E. L. Stainbank, Captain E. L. Edge, Aug., 1918,
13th Pontoon Park	Captain G. H. Latham, Captain W. R. James, Oct. 1918,
" N " Sound Ranging Section	Captain Gott, R.F.A.
" V " Sound Ranging Section	
" NN " Sound Ranging Section	
28th Observation Group	

PALESTINE L. OF C.

<i>Deputy Director of Works</i>	Colonel L. N. Cooper,
35th Army Troops Company	Captain A. E. Freeland, Captain J. K. Tickell, Dec., 1918.
555th (Lancs.) Army Troops Company	Captain G. K. Bell,
569th Army Troops Company	Captain H. Ganderton,
570th (Devon) Army Troops Company	Captain G. Moon,
571st (Devon) Army Troops Company	Captain F. E. Bawdon,
357th Water (Works) Company	Major C. B. McRitchie, Major S. Davies, Aug., 1918, Major H. C. Wightman,
359th Water Company	Captain T. W. Fairhurst,
360th Water Company	
No. 1 Company, Egyptian Sappers,	
No. 2 Company, Egyptian Sappers.	

G.H.Q. TROOPS

<i>Works Units</i>	
13th Base Park Company	Major V. E. J. Francis, Major R. M. Macrory, Jan., 1919,

46th Base Park Company	Major C. E. F. Wyncoll,
389th Advanced Park Company	Major C. E. F. Wyncoll,
	Major C. E. Gill, Jan., 1918,
	Major H. F. B. S. Moore, Oct., 1918.
Machinery Park (Kafah).	
<i>Survey Units</i>	
7th Field Survey Company (Topo., Litho. and Meteor. Sections)	Major W. J. Maule,
Military Printing Section (Government Press, Cairo).	
<i>Railway Units</i>	
Five Railway Transportation Sections,	
Railways Operating Division (Nos. 71-79, 94, 95, 99-103, 201 and 205 Operating Sections)	
115th Railway Company	Lieut.-Colonel W. G. Tyrrell,
116th Railway Company	Major W. E. Thornhill,
265th Railway Company	Major R. C. Kirkpatrick,
	Captain E. Lake,
	Captain H. C. Boulton, Oct., 1918,
266th Railway Company	Major W. G. Ross,
272nd Railway (Construction) Company	Captain Nimmo,
106th Railway Survey and Recon- naissance Section,	
25th Railway Company, Sappers and Miners	Captain H. L. Woodhouse,
20th Railway Company, Sappers and Miners	Captain R. F. Scrivener,
299th (Indian) Railway Construction Company,	
Light Railways Directorate	Lieut.-Colonel C. E. Jordan-Bell, Lieut.-Colonel P. C. Lord, Oct., 1918,
96th L.R. Operating Company,	
203rd L.R. Operating Company,	
98th L.R. Train Crew Company,	
1st Bridging Company, Canadian Railway Troops.	

APPENDIX VIII

PORTRAITS OF SOME SENIOR OFFICERS MENTIONED IN THIS VOLUME

Portraits of some of the distinguished officers mentioned in this Volume are reproduced on the following pages.

These portraits are taken from the 1914-18 War Portrait Gallery now hung in the Officers Mess at Gordon Barracks, Gillingham.

Details of some of the more important posts held by these officers are given in an Appendix to Volume VII. This Appendix also includes details of certain other officers who held important positions before and during the 1914-18 War.



Brig Gen F G Fuller, CB, CMG



Maj Gen Sir M Graham E Bowman-Manifold,
KBE, CB, CMG, DSO



**Maj Gen Sir Hubert A A Livingtone
KCMG, CB**



Maj Gen Sir Godfrey Williams, KCIE, CB



Maj Gen H B H Wright, CB, CMG

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Note.—It is regretted that, owing to considerations of space, it has been impossible to index the references to each of the many R.E. units mentioned in the book. The index refers to all or a number of units, e.g., that for "Field Companies" refers to matters of organization, etc., affecting a number of such units.

The rank mentioned against a person's name usually indicates the highest rank mentioned in this book. This is not necessarily the highest rank obtained.

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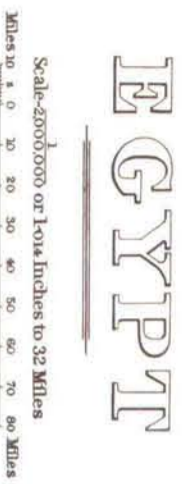
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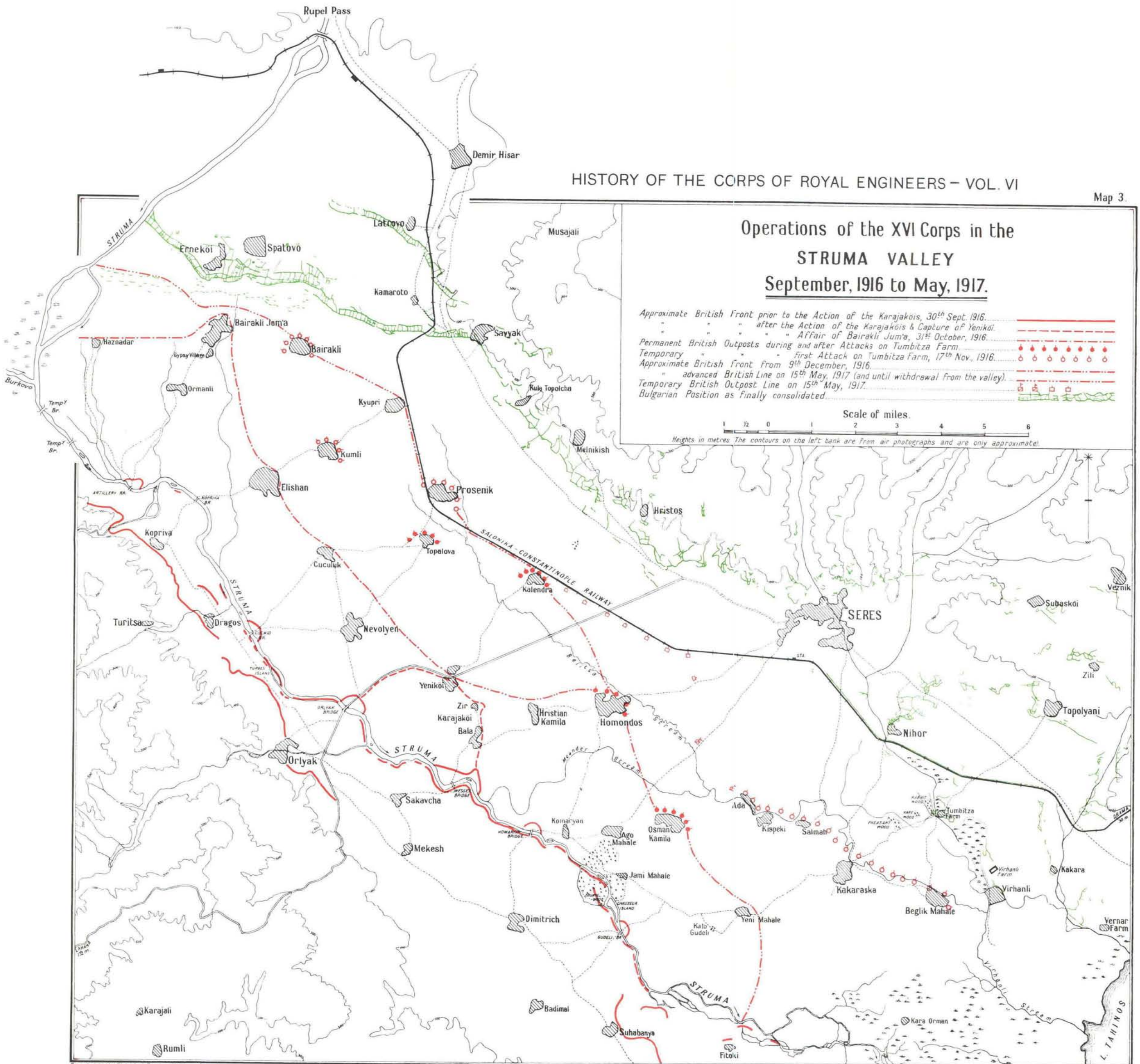


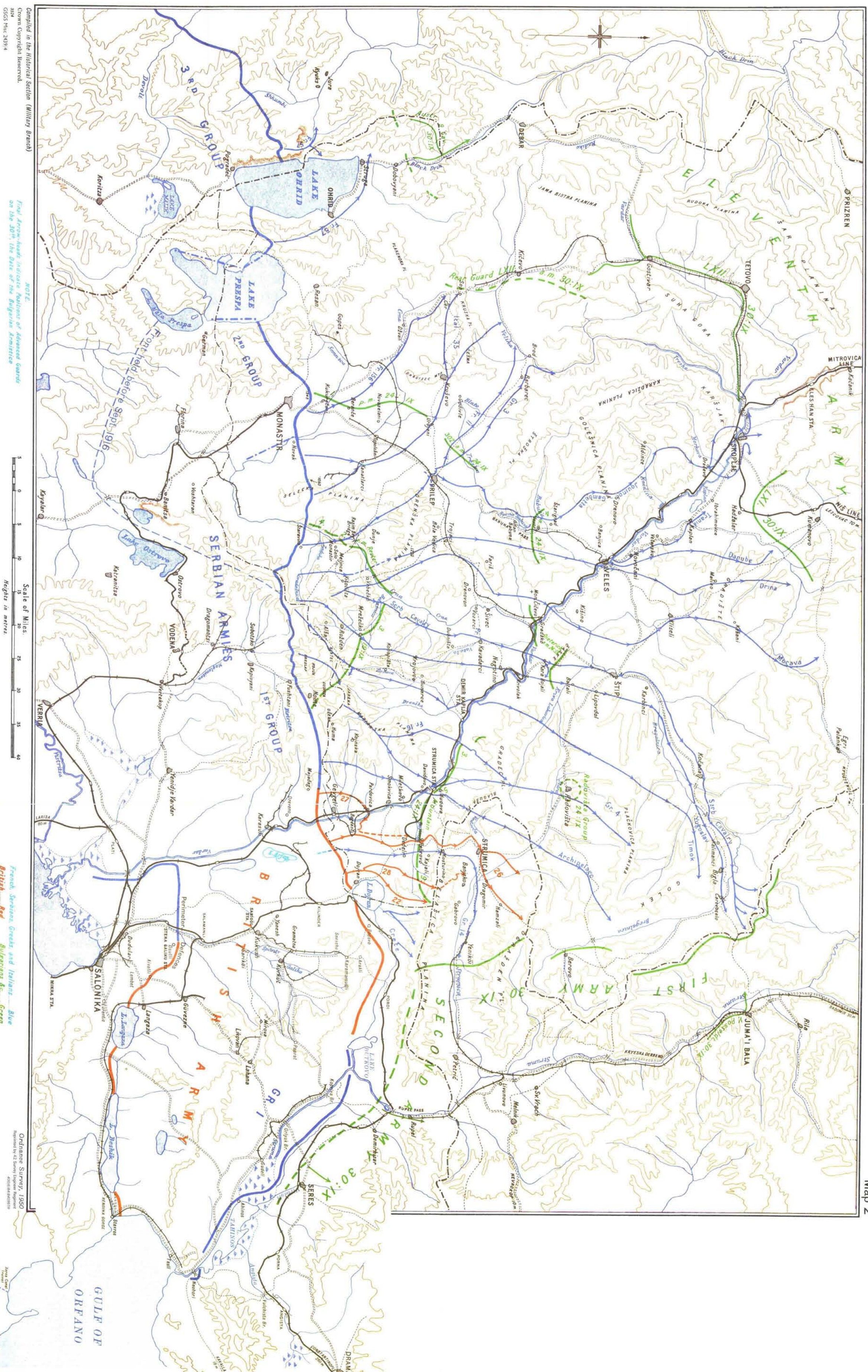
Operations of the XVI Corps in the STRUMA VALLEY September, 1916 to May, 1917.

Approximate British Front prior to the Action of the Karajakoi, 30th Sept. 1916.
" " " " after the Action of the Karajakoi & Capture of Yenikoi.
" " " " Affair of Bairakli Juma, 31st October, 1916.
Permanent British Outposts during and after Attacks on Tumbitza Farm.
Temporary " " First Attack on Tumbitza Farm, 17th Nov., 1916.
Approximate British Front from 9th December, 1916.
" " advanced British Line on 15th May, 1917 (and until withdrawal from the valley).
Temporary British Outpost Line on 15th May, 1917.
Bulgarian Position as finally consolidated.

Scale of miles.
1 1/2 0 1 2 3 4 5 6

Heights in metres. The contours on the left bank are from air photographs and are only approximate.

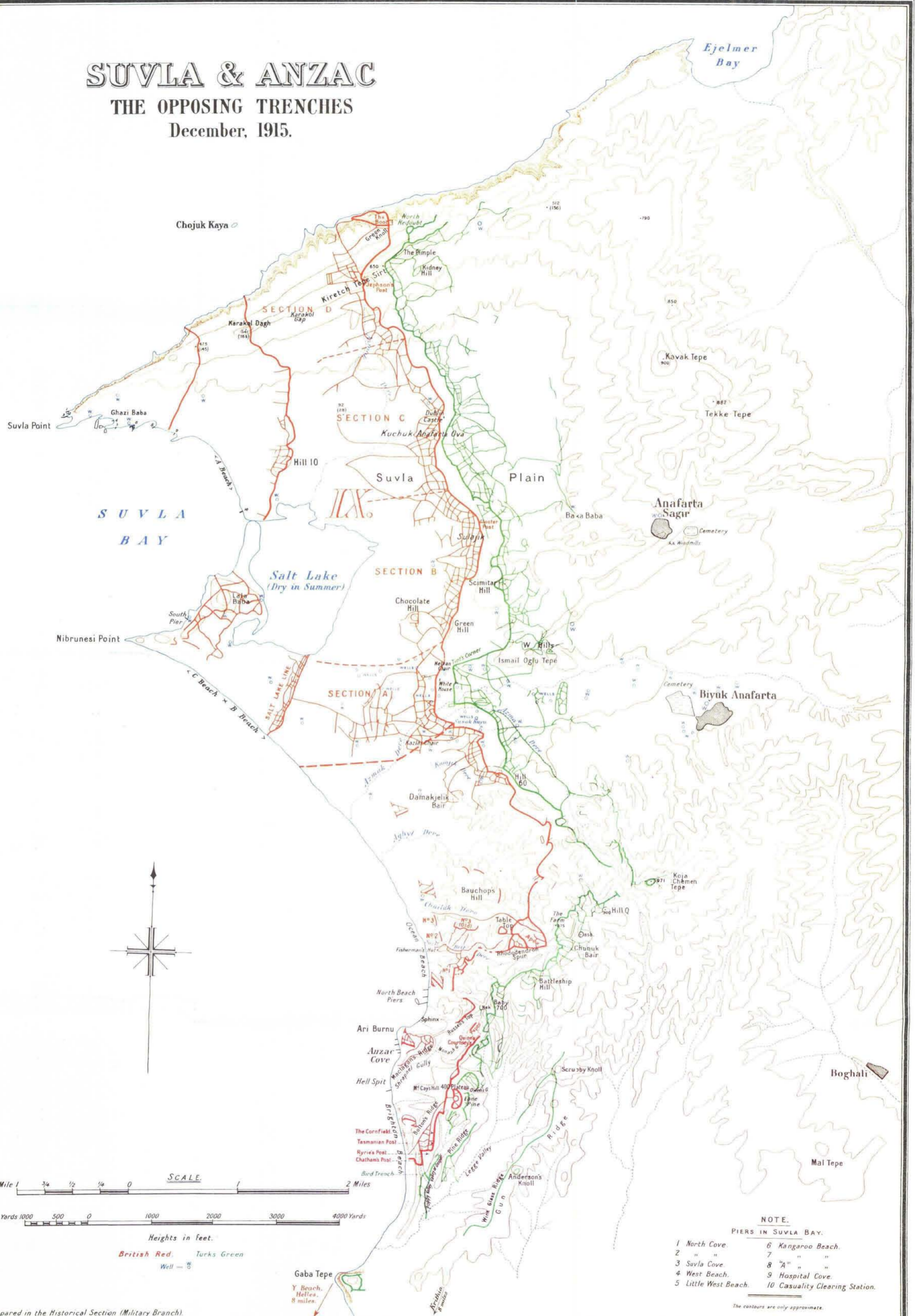




SUVLA & ANZAC

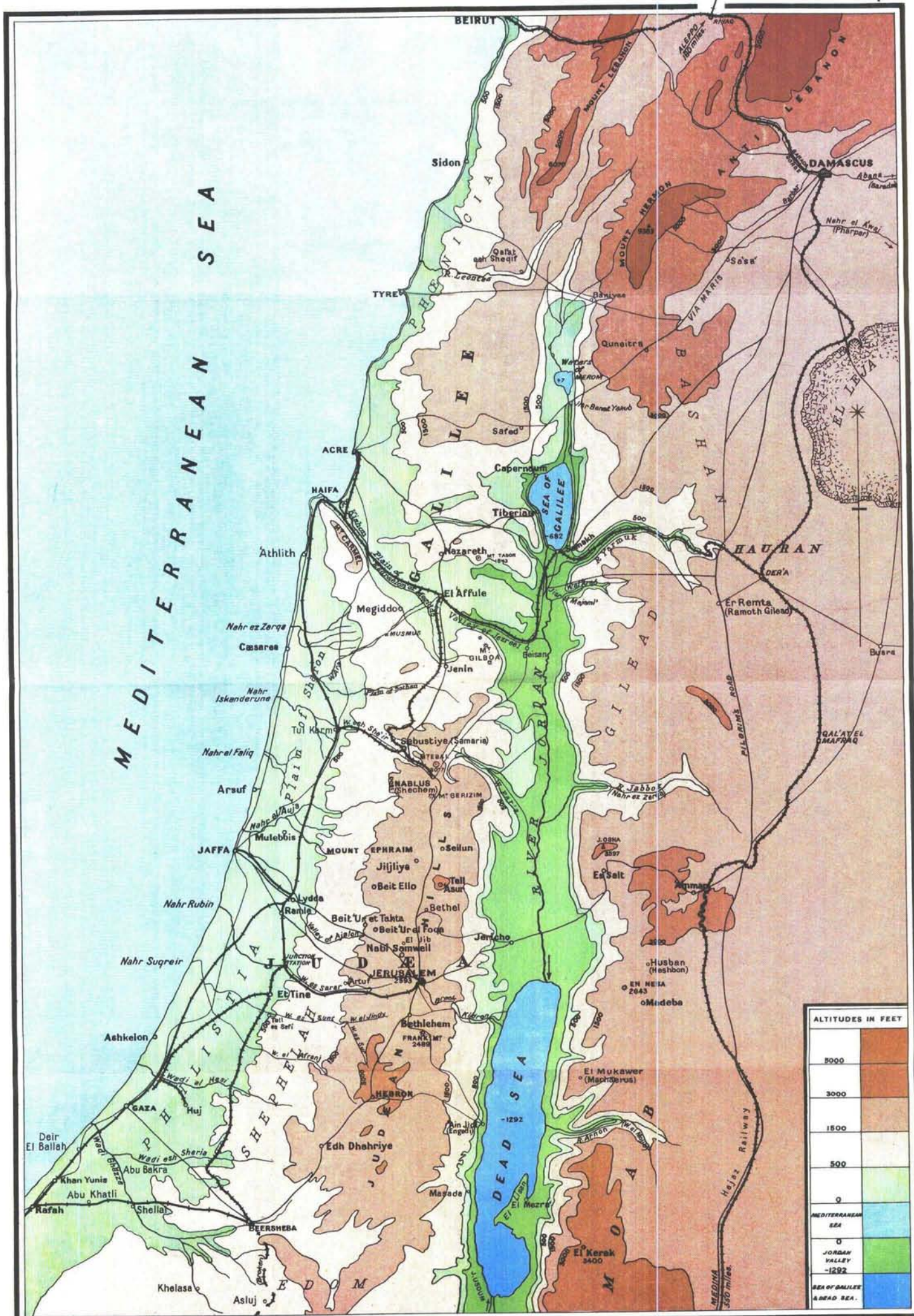
THE OPPOSING TRENCHES

December, 1915.



PALESTINE.

Map 6



Map compiled by Historical Section (Military Branch)

3545
GSGS Misc 2439/8

Scale of Miles.



Railways { British normal gauge. —————
Metre gauge..... —————
Main roads..... —————

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