JUL 1922

JUL 1922

GAZETTE

BIRTHS

ADAMSON – On 11 Apr 04 at the Great Western Hospital, Swindon, to TARA (neé HAYWARD) and Maj IAIN ADAMSON, a son (OLIVER HAMISH RICHARD) a brother for HENRY.

DIAMOND WEDDINGS

HAMILTON – BUXTON – On 28 March 44 at the Parish Church, Northam N.Devon. Maj (now Brigadier) HUGH HAMILTON to CLAIRE BUXTON (Sister QAIMNS). Now living at Chipping Warden, Northamptonshire.

MOORE – TAYLOR – On 6 March 44 at Chatham. Lance Corporal (later Captain) THOMAS IRVINE MOORE to JOAN MARIE TAYLOR. Now living at Cam, Gloucestershire.

GOLDEN WEDDINGS

STEWART – RYCROFT – On 29 May 1954 at Holy Trinity, Brompton, London. Lt KEITH V STEWART (now Lt Col retired) to ANN CATHERINE RYCROFT. Now living at Limpsfield, Surrey

SILVER WEDDINGS

DARGAVEL – COLES – On 9 Jun 79 at All Saints Church, Bloxwich. LCpl (now Maj) JOHN DARGAVEL to MAUREEN COLES. Best wishes from KIRSTY, RICHARD and all family members

DEATHS

BEATTIE – On 22 Feb 04, HELEN GRIZEL. Aged 83. Widow of the late Maj ALEXANDER RICHARD BEATTIE (who died on 19 May 1979).

CAPLEHORNE – On 30 Mar 04, ANN. Aged 47. Died peacefully after a long illness. Dearly loved and devoted wife of ROCKY and much loved mother of FAYE.

CHESHIRE – On 26 Feb 04, 1876514 WO2 MIKE P CHESHIRE. Aged 80. An REA member since 1987 and a Life Member of Headquarters Branch.

COUPLAND – On 16 Apr 04, ZOE Died peacfully in the Mater Hospital, North Sydney, Australia. The much loved wife for over fifty years and companion of Maj JOHN COUPLAND (retd), and mother of four loving children.

EVANS – On 4 Apr 04, ELIZABETH MARY (neé FOX) wife of Maj ARTHUR EVANS. A brave woman, a wonderful wife and mother. Has gone for a well deserved rest.

FISHER – On 5 Apr 04, Maj JOHN ANTHONY THACKERY. Aged 82. Sadly missed by his wife WENDY.

GEHRMANN – On 29 Feb 04 in Australia, Lt Col AUGUST SHAW (Gus) CBE DSO ED BE (RAE).

GLUBB – On 3 Apr 04. FARIS. Aged 64. Beloved husband of SALWA, father of MUBAREK, SARAH and DARINA. Much loved son of Lady ROSEMARY and the late Lt Gen Sir JOHN GLUBB (GLUBB PASHA).

HASILDON – ON 16 APR 04. Aged 88. Lt Col KENNETH RICHARD, Died quietly at his home in Mazowe, Zimbabwe. Sadly missed by his nephew NICHOLAS.

HARTE – On 16 Jan 04. Maj JOHN DUDLEY. Aged 87. A wartime officer and lately HM Coroner of Bedfordshire. Sadly missed by his son JAMES.

LOCKYER – On 25 Feb 04, JACK HAMILTON MC. Beloved husband of CECILY, loving father of

NOTICE.

THE ROYAL ENGINEERS JOURNAL.

It has been decided that, after the completion of the present volume, the ROYAL ENGINEERS JOURNAL *shall be published quarterly instead of monthly. In January and February,* 1923, *no* JOURNAL *will be issued, and the first quarterly* JOURNAL *will be published on 1st March,* 1923. *The size of the quarterly* JOURNAL *will be considerably greater than that of the monthly one, and its price has been fixed at 5/-.*

AN OUTLINE OF THE EGYPTIAN AND PALESTINE CAMPAIGNS 1914—1918.

By MAJOR-GENERAL SIR M. G. E. BOWMAN-MANIFOLD, K.B.E., C.B., C.M.G., D.S.O., *p.s.c.*

PREFACE.

THIS outline of the campaigns which took place in Egypt, Sinai and the Western Desert in 1914, 1915 and 1916, Palestine in 1917, and which culminated in Syria and Cilicia in 1918, presents the main features only of those campaigns, and their relation to the events in adjoining theatres of operations. Originally, it was prepared as a course of lectures for the Staff College, Camberley; and in response to numerous requests, it is now re-drafted and published in the hope that it will serve as a concise narrative of an interesting and progressive series of campaigns. Most of the maps and plates, compiled from official sources, were printed by the Ordnance Survey for that course of lectures and have been reproduced for this book with the kind permission of the Controller of His Majesty's Stationery Office.

I am grateful to many brother officers for their helpful suggestions, and particularly to Major-General G. P. Dawnay, Brig.-General J. E. Edmonds, and Colonels W. H. Bartholomew and T. E. Lawrence for the valuable information which they put at my disposal.

CHAPTER I.

THE SITUATION BEFORE TURKEY JOINED IN THE WAR.

THE SITUATION BEFORE TURKEY JOINED IN THE WAR.—Growth of German Influence in Turkey—Causes which led to Turkey entering the War—The Turkish Empire—The Immediate Effects of Turkey's Declaration of War—Railways in Turkey and Syria—The Turkish Army; its lack of Homogeneousness—Qualities of the Turkish Soldier—Initial Concentration—Egypt; Peculiar Political Conditions—Attitude of the Population—Desert Frontiers—The Suez Canal—Troops in Egypt: 42nd Division—Indian Divisions, Australian and New Zealand Divisions—The Egyptian Army and Coastguards.

TURKEY declared war on Great Britain on 30th October, 1914. Her neutrality before that date was distinctly benevolent towards Germany. It is known now that, on 4th August, the Kaiser had informed the Greek Minister in Berlin that an alliance existed between Germany and Turkey. However, at the outset Turkey advertised her neutrality; but, even in August, it was evident that she was preparing for an invasion of Egypt.

For many years back Germany had been working for influence in Constantinople. The Kaiser had visited Abdul Hamid; and in 1898 had toured in Palestine, conducted by Mr. Cook. Krupp's had large contracts for the Turkish Army; and von der Goltz, and the German Military Mission under Liman von Sanders, were engaged in reorganizing the Turkish forces. The Bagdad Railway Concession had been secured; and work on that line was in full swing. German colonies in Palestine were thriving. German trade in Egypt was booming. The peaceful penetration of Turkey had been accomplished before 1914.

In 1914, German influence was paramount in Constantinople, and that Turkey did not enter the war at once was merely because it did not appear convenient to the Central Powers to bring her in. It may be surmised that, if Germany had brought off her coup in 1914 successfully, the Turkish Army—intact—would have been a very valuable weapon in Germany's hands to use against either Russia or Great Britain to back up German demands and peace terms.

Many factors combined to influence the operations in Egypt. Egypt occupies a unique position; it is a connecting link between Europe, Asia and Africa; it is the meeting-ground of East and West; and so it was peculiarly sensitive to events in both distant and adjacent theatres.

The war in Europe, to begin with, did not go as smoothly as Germany had forecasted. Great Britain came in. Russia's expedited mobilization, and prompt invasion of East Prussia, was another upset, Germany's reverse on the Marne in September, a third; and, she had made no effective progress during October. It was disappointing that reinforcements for Britain were pouring

in from overseas Dominions and India. The Austrians had been hammered at Lemberg, and were finding the Russians too much for them. Germany felt that the attention of Great Britain, and of Russia, must be diverted from Europe, and so brought Turkey into the War at the end of October, 1914.

Turkey had mobilized in August. The arrival of the *Goeben* and *Breslau* at Constantinople had greatly strengthened her in the Black Sea. Turkish opinion was indignant with Great Britain for commandeering the battleships approaching completion for Turkey in her shipyards. Public subscriptions had been raised for these vessels, and the Turks had been conscious of their naval weakness as regards both Russia and Greece. An excuse for hostilities with Russia was easily found by interfering with Russian vessels in the Black Sea. The moment was not altogether advantageous to Turkey, as Rumania, Bulgaria and Greece were still neutral and the supply of war material across these countries was hampered as soon as Turkey became an open belligerent.

Turkey to-day is but the remnant of a great empire, but one with a brilliant history of conquest. Her sway once had extended to Vienna and Odessa, the Caucasus, Persia and into Central Africa. The Turks of Europe and Asia Minor are proud of their fighting powers, and are willing to be led to repeat their exploits. Their Empire is built up of many races, but there is one predominant creed. Turk and Arab and Kurd in the main are sincere Moslems.

The Turks recognized Russia as their traditional enemy. She stood as the liberator of Non-Moslem territories from their rule. She aimed at supplanting them in Constantinople. Great Britain was conniving in Russia's aims. Although the Turk is naturally apathetic, he will respond when Russia is the immediate enemy, and his religion can be worked upon.

In Turkey itself, the political situation was that she possessed liberal institutions only in name. Power was centred in a small military group, of whom Enver and Talaat were the moving spirits. This group was tied to Germany, and in her control. The moderate parties were powerless to interfere.

Turkey did not enter the War for nothing: the incentives put before her were:—The recovery of her lost provinces from Russia and from Great Britain; and territorial gains from Persia—always under the tutelage of Germany.

The immediate effects of Turkey joining into the War were:—To close the Black Sea trade of the *Entente* with Russia and Rumania; to oblige Russia to retain more troops in the Caucasus; and to compel Great Britain to take more active steps to safeguard the Suez Canal, Egypt, and her great oil interests in Southern Persia. Also, there seemed a fair prospect that Moslem sympathies might be raised in Egypt, and in India, and revolts ensue.

The Turkish Empire geographically is very extended, and it contains remarkable physical features—mountain ranges, great rivers, lakes and vast deserts—which separate its fertile and populated spaces. In time of peace, Turkey was largely dependent upon transport by sea. Constantinople itself is at an extreme end of the Empire, and owes its strategical importance to the control it can exercise upon sea communication.

Turkey's artificial means of communication are poorly developed, and incomplete. Her great highways are those of Alexander, and have not been altered much, apparently. River transport is still in a medieval condition. Railways were very inadequate. A glance at the map will show how her main routes are hindered. Towards Armenia and the Caucasus, the railway stops 400 miles short of Erzerum, and troops must be maintained either by sea through Trebizond, or by poor roads over 5,000 ft. passes.

The Bagdad railway through Cilicia was a patchwork in 1914. It barely entered Mesopotamia. It was continuous only to Bozanti. (See *Plate* I.). The tunnels through the 11,000 ft. Taurus and 6,000 ft. Amanus ranges had not been pierced, nor was the formation drained. Traffic over these great mountain obstacles went by road; and, in the winter, was liable to prolonged interruption. Through trains were only able to run three weeks before the armistice. The railway stopped at Nisibin, 100 miles west of Mosul on the Tigris. Road and River transport had to be used to Tekrit, whence another railway extended to Bagdad. Coal was almost unobtainable, and the wood fuel was very inefficient. There were no proper workshops east of the Taurus, and the line was cumbered with locomotives and wagons awaiting repair. South of Aleppo, the broad gauge extended only to Rayak. There it met the Beirut-Damascus line, also French-owned, which is of 3 ft. 6 in. gauge with much rackwork over the Lebanon. From Damascus to Palestine and Arabia, the Hedjaz Railway and its branches furnished fairly good transportation: on 3 ft. 6 in. gauge. But these lines suffered also from fuel and water difficulties. The Hedjaz Railway stopped at Medina, 250 miles from Mecca, the desired terminus. In Palestine, there was one branch line from Deraa down the Yarmuk valley to Haifa, also a French-owned line from Jaffa to Jerusalem. Observe how all the railways avoided the coast; the Turk had a wholesome respect for our disembarking propensities.

The Turkish Army was organized to form 15 divisions; and 15 more were rapidly raised when war broke out. This gave nearly 300,000 men to start with. Ultimately, Turkey had nearly 50 divisions—never complete—approximately 800,000 men. But, many of the best fighting troops, the peasants of Anatolia, had been expended in the last Balkan wars. The equipment of the army, too, had been dissipated, and had not been made up. Besides, there were

the hindrances due to having to cross neutral territory, which impeded the completion of the army in war material, when hostilities commenced.

The army was not homogeneous in race, religion, or language. It comprised, besides Turks:—Arabs, Armenians, Circassians, Kurds, Syrians and Levantines of mixed European breed. Generally, the impression was that the troops were illiterate, and the officers scarcely educated and taken from the cities chiefly because they could read, write and add. Officer desertions were frequent.

The outstanding features of the Turkish soldier are his patience, hardiness and stubbornness in defence. But he seldom succeeded in the offensive; partly because he was poorly led and cared for. He did not like the German element in the army.

The fighting equipment of the troops was intended to be good, but their transport and supply system was poor; and the prevalence of corruption resulted in the field armies often being miserably deficient in clothing, food, and medical and technical stores. As the War progressed, the control of these services was taken over more and more by Germans and Austrians. They supplied the Flying Corps, Telegraphs, Mechanical Transport and Railways. The Austrians specialized in the Artillery and Medical Branch.

In 1916, special reinforcement troops were organized in Germany—the "Pasha" formations—and, during 1917 and 1918 three of these were sent to Palestine or Mesopotamia, and also an Asia Corps.

A Pasha Group consisted of:—

1 Battery. 1 Battalion. 1 Squadron. Technical Detachments.	About 1,700 men in all.

The Turkish troops which were already mobilized were in two main groups at the end of October, 1914. In Armenia, about Erzerum, Isset Pasha had four army corps, about 180,000 men, destined to invade the Caucasus. In Syria and Cilicia, Jemal Pasha had about 140,000 men. These were grouped about Aleppo and Damascus to protect the coast, or to operate in Mesopotamia, Arabia, or towards Egypt, as required.

Lord Milner summed up Egypt truly as "the land of paradox." Many things there are peculiar: our position in the country was certainly anomalous. Egypt was a recognized dependency of Turkey, to whom she was paying an annual tribute; and yet Great Britain had been occupying, and in fact controlling, this nominal Turkish Dominion for 32 years.

The Khedive, Abbas II, was obviously inimical to Great Britain, as he supported the Nationalist party in Egypt, and was intriguing with the Germans. When war broke out he was in Constantinople.

His uncle, Hussein, was proclaimed Sultan, the suzerainty of Turkey was repudiated, and in mid-December, 1914, Great Britain announced a protectorate over Egypt. Martial law had been declared previously, and the Egyptians were informed that the British would defend their country.

The Egyptians, having been governed by the Turk, regarded him with mixed feelings. They stood in awe of Pashas, and yet had admiration for their Oriental methods of government. As good Moslems they reverence the Sultan as the temporal head of the Mohammedan world, and as keeper of the Holy Places. But, they do not want the Turk back as ruler in the land.

Towards the British, the mass of the people were apathetic. Our control was tolerated, not appreciated, and certainly not popular. Their interests were agricultural—not fleets, armies, or European squabbles. The political cry of "Egypt for the Egyptians" (before the War) met with little response from the masses—Fellahin or Bedouin.

The articulate and urban population of Egypt contains a large proportion of Europeans; it is very cosmopolitan—French, Italian, Greek, German, and the indefinite Levantine. The sympathies of this European element were not always pro-British and it provided fine soil for espionage and propaganda.

Fertile and habitable Egypt is merely the Nile Delta and its river banks, cultivated by the Fellahin. The rest is desert, some of which is occupied—sparsely—by nomad Arab tribes. The deserts on the east and south-east (Sinai and Red Sea Littoral) are mountainous. Except near the coast, water is scarce. To the west and south-west the barrier is illimitable sand, but it is remarkable for a belt of oases about 100 miles west of the Nile.

Egypt is peculiar in its communications. It possessed no metalled roads, except in the chief cities. Its chief means of transport were its railways (of many gauges), the Nile and its canals, the camel and the donkey.

Egypt is often called "rainless," but the northern coast gets a regular rainfall in January and February; and in both east and west the hills hold the rain for several weeks. There are many rock cisterns of very ancient origin, formerly known only to the Arabs. The movement of troops in these northern deserts is quite practicable for those who know their resources and limitations.

It is a popular fallacy that the Suez Canal is in Egypt itself. Actually, the Canal is some 30 miles from the habitable Delta, and it traverses the wilderness. The military aspects of the Suez Canal will be dealt with later on, but in connection with Egypt, two features of it may be mentioned now.

The towns along the Canal—Suez, Ismailia and Port Said—are entirely dependent on Nile water brought from Cairo, 100 miles

by the "Sweet Water Canal," which is also navigable for Nile boats as far as Ismailia. At Ismailia this canal branches north and south to serve Suez and Port Said.

The Canal ports were connected to Egypt proper by a single line of railway from Zagazig (doubled from Zagazig to Ismailia only in December, 1915). No roads for vehicles existed either from the Delta to the Canal, nor along its banks.

When war ensued, Egypt became of immense importance to the Allies. Troops and supplies from India and the Dominions were streaming through the Suez Canal. The cable communications to the East passed through her territory. Egypt herself furnished many necessaries—cotton, grain, sugar and oil fuel. She was to serve as a rest camp and training ground; for the country had natural advantages, it was central, and it seemed difficult to assail.

The pre-war British garrison in Egypt was about 5,000 men; but the regular units comprised in it were soon required elsewhere. To replace them the 42nd (East Lancs.) Division (T.F.) was sent out from home by the end of September. India, too, was requested to furnish troops; and besides, the overseas troops from Australia and New Zealand were dispatched to Egypt to complete their equipment and training.

India sent off the Indian Expeditionary Forces—known officially as I.E.F. (E) and (F)—which later were formed into the 10th and 11th Indian Divisions. These began to arrive in the middle of November. The first Australian and New Zealand troops disembarked at Suez early in December. At the end of 1914, Egypt contained about 70,000 British, Dominion, and Indian troops, of whom only the Indian had completed their training.

The Egyptian Army, of Egyptians and Sudanese, about 22,000 in all, was necessarily employed almost entirely in the Sudan. Only its training depôts, and a few troops for guards, are normally stationed in the Delta. Still, the Egyptian Army was able to provide some artillery, and later several battalions for service in Egypt and Sinai.

The Egyptian coastguard was a body on a military basis, but not under the army. It was used to check smuggling over the desert, and was well equipped with camels. It contained a certain foreign element, and proved unreliable when tried in service. The camels, however, were kept on with the army.

CHAPTER II.

THE TURKISH ATTACK ON THE SUEZ CANAL IN 1915.

THE TURKISH ATTACK ON THE SUEZ CANAL IN 1915.—The Checks to Turkey in Southern Persia and in the Caucasus—Commencement of the Move towards Egypt—Lines of Advance available—Some Military Aspects of the Suez Canal—The British Dispositions to meet the Attack—Organization of the Suez Canal Defences—The Turkish Advance in January, 1915—Attempts to force a Crossing at Serapeum on 3rd February—Retirement of the Turks—Absence of Pursuit—Observations.

THE Germans had early appreciated the importance to the *Entente* of the Suez Canal and Egypt. They realized how sensitive Great Britain would be even to a threat to hinder the free passage of her ships. They had called the Canal "the throat of England," and soon began to try and throttle her there. Ineffectual attempts were made to scuttle neutral vessels passing through the Canal. As a result an officer's guard was placed on every vessel and attempts to drop mines astern were specially watched for.

When Turkey was brought into the war, immediately she was set the task of raiding the Canal, with the further possibility of raising revolt in Egypt. She was also directed to engage Russia in the Caucasus; and, there was to be her own little enterprise into Persia. All three undertakings were soon under way; and Germany provided substantial aid for the first two in material and staff.

The move on Southern Persia was forestalled by India. The 6th Indian Division disembarked in the Persian Gulf on 6th November—a quick piece of work—and on 15th November Sir A. Barrett's troops defeated the Turks at Sahil, and opened the way to Busra. On 9th December the Turkish garrison of Kurna on the Tigris surrendered.

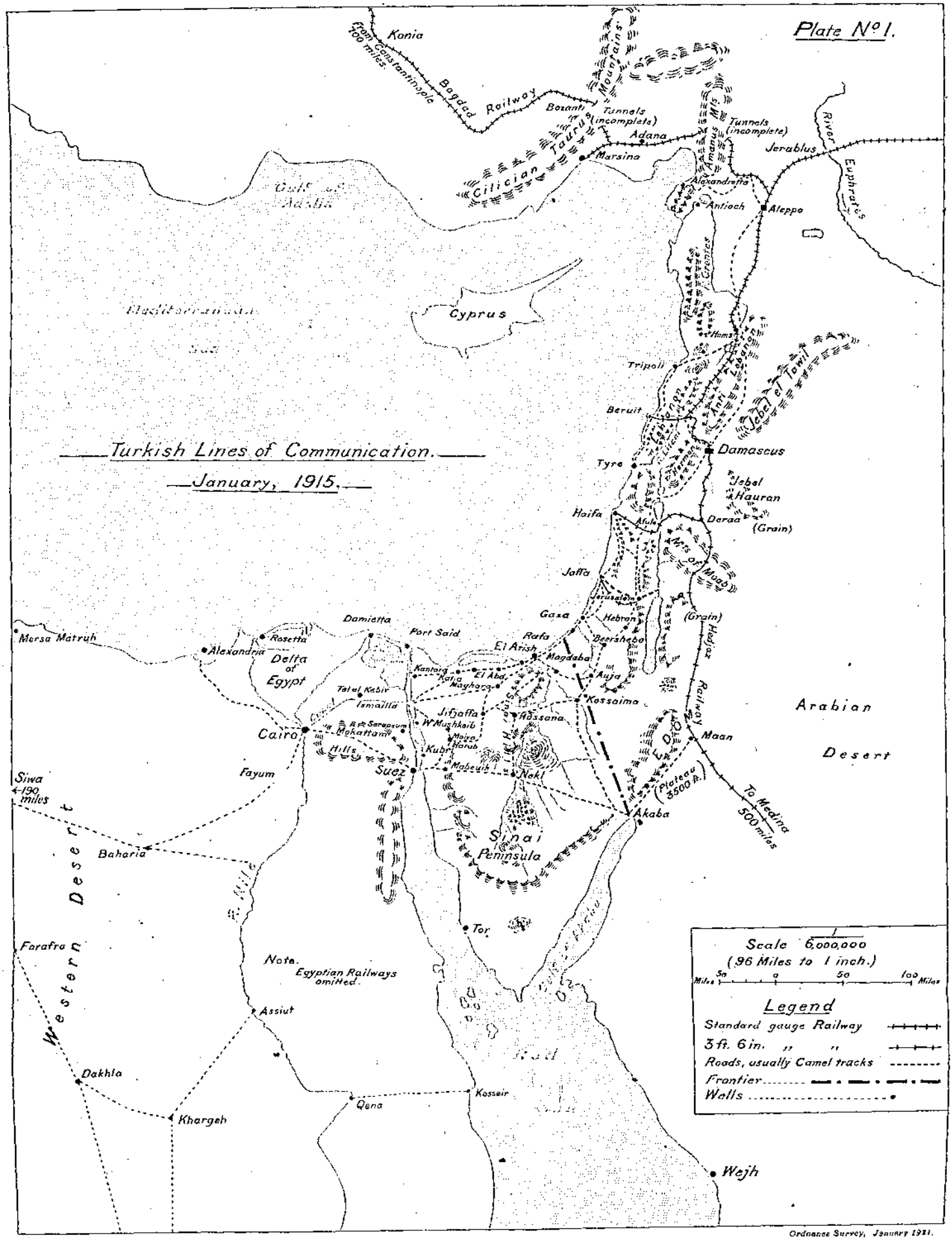
On the Caucasus border, the four army corps of Isset Pasha set out in November from Erzerum. A surprise march on Kars was planned. The Turkish lines of advance were very difficult, the snow was against them. The Russians had the advantage of railways and fair roads. General Vozonov fell on three corps in turn, and this group of the Turkish forces was almost destroyed.

The raid on Egypt was well organized, and carried through with rapidity and determination. The Turkish troops for this enterprise began to move early in November. Jemal Pasha had the 8th and 12th Corps, about six divisions, in south and central Syria. Of these, the force destined for Egypt comprised:—

10th Division
23rd Division } 3 Divisions, or 21 Battalions, and a large number
25th Division } of Arab auxiliaries.
29th Cavalry Regiment.
2 6-in. howitzers.
2 Machine-gun Companies.
2 Engineer and Pontoon Companies.

Map No 324.

Plate No 1.

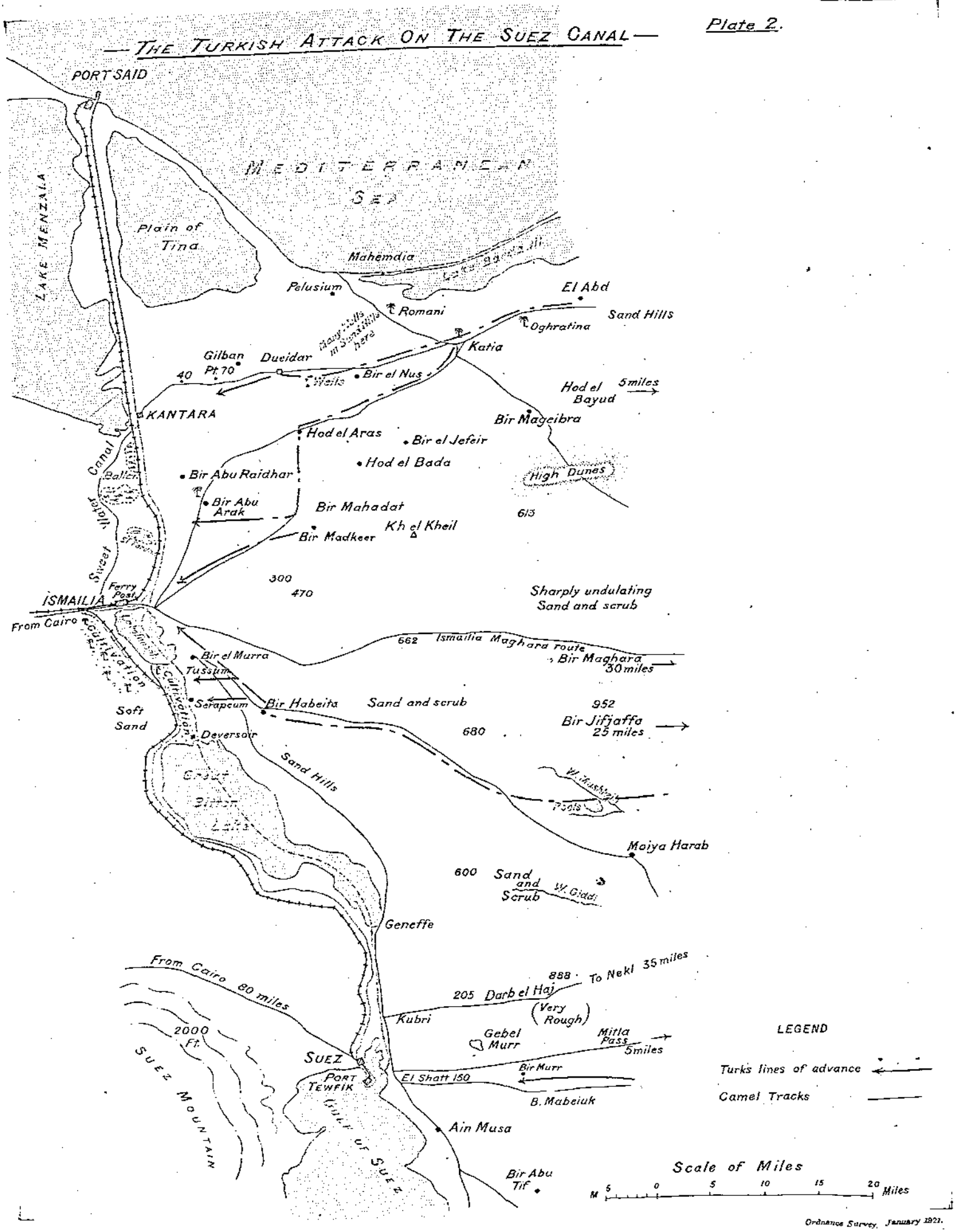


Ordnance Survey, January 1921.

Map No 325

Plate 2.

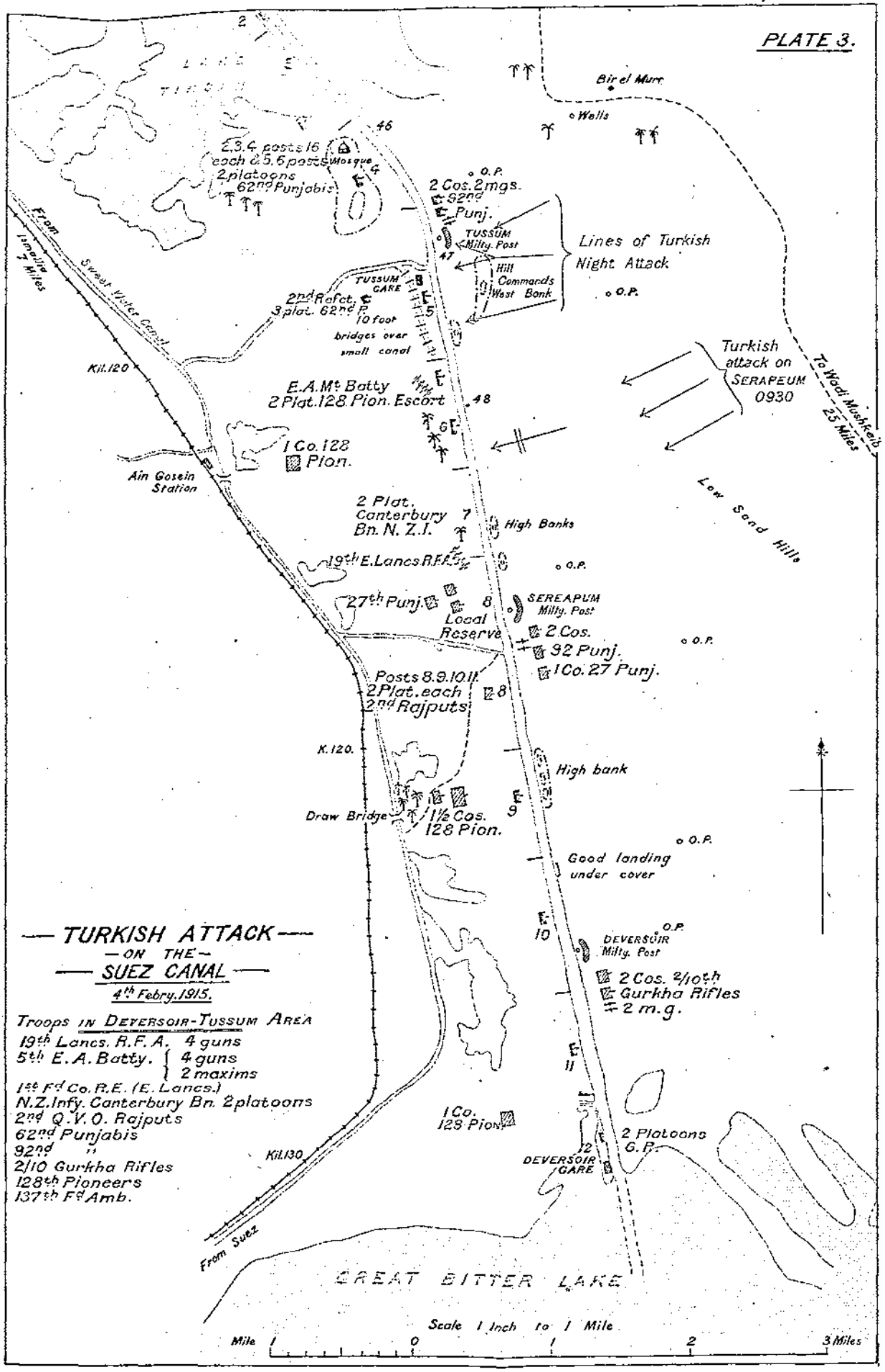
— The Turkish Attack On The Suez Canal —



Ordnance Survey, January 1921.

Map No 326.

PLATE 3.



— TURKISH ATTACK —
— ON THE —
— SUEZ CANAL —

4th Febry. 1915.

Troops in Deversoir-Tussum Area

19th Lancs. R.F.A. 4 guns
5th E.A. Batty. { 4 guns / 2 maxims
1st Fd Co. R.E. (E. Lancs.)
N.Z. Infy. Canterbury Bn. 2 platoons
2nd Q.V.O. Rajputs
62nd Punjabis
92nd "
2/10 Gurkha Rifles
128th Pioneers
137th Fd Amb.

Ordnance Survey. January 1921.

In all, about 30,000 men, of whom 15,000 were to cross the Sinai Desert first. Jemal's Chief of Staff was a Bavarian, Colonel Kress von Kressenstein, a capable and energetic officer.

From their group position about Damascus, to the Sinai frontier, the Turks had the 3 ft. 6 in. gauge railway, Deraa–Afule–Haifa; also they had the Palestine backbone road, Afule–Nablus–Jerusalem–Hebron–Beersheba; and the Coast Road, Jaffa–Gaza–El Arish.

Beersheba was selected as the advanced base. The Hedjaz railway could be of no assistance beyond Deraa; the transport difficulties overland from Ma'an through Akaba were too great to render an advance from that direction possible.

The Sinai Desert consists on the north of a narrow coastal plain with sand dunes; and is from 5 to 15 miles wide. The sand carries a scrub suitable for camel grazing, but the going is very heavy for infantry or vehicles. The dune country merges into barren, stony hills rising to 3,000 feet in the centre; while the southern mass of the Peninsula is still more rough and precipitous. There are no roads for wheels anywhere. Water is scanty, except in the winter. Nomad Arabs occupy Sinai with their camel herds.

The Wadi el Arish—the Biblical "River of Egypt"—is a very extensive water channel. It is dry for nearly all the year; but usually has three or four spates, between December and February, when it comes down in a broad torrent for two or three days at a time. The town of El Arish is near its outlet, about two miles inland. It is the trade centre of Sinai, and is just 100 miles from the Suez Canal. The only other town in Sinai is Nekl, 60 miles east of Suez on the Akaba pilgrim track. Nekl also is on the Wadi el Arish and gets its water from rock wells.

Three lines of advance were at the choice of the Turks:—

(*i*) Along the coast from El Arish through El Abd and Katia;
(*ii*) Over the Sinai hills, from Beersheba or El Arish, by various tracks through El Hassana and Jifjaffa and Bir Hamme;
(*iii*) Part of the Pilgrim's Road from Nekl to Suez.

The coastal route has been used by armies from time immemorial. There are many wells, water is obtainable by digging on the beach. The inner tracks were more difficult, and normally the water is less assured.

But the Turkish Expedition was setting out just as the winter rains were due; and, until March, there would be pools on the *wadis*, and the wells and rock cisterns would be full. (One such pool and large rock cisterns were found in the Wadi Mushkeib). This central route was not liable to interference from the sea, and it was the one the British would least expect a large force to use.

Jemal Pasha elected to use all three routes, but to send the principal part of his force across the centre of the Sinai Hills. The selection of the centre of the Suez Canal as his intended point of crossing also, doubtless, influenced the use of the hill routes for the main body.

The initial distribution of the Turkish column was approximately :–

Nekl Road.—Three battalions of infantry; mountain battery: 3,000.

Centre Road.—Six battalions infantry; heavy artillery; pontoon train: 6,000 or 7,000.

Coast Road.—Two battalions infantry; mounted troops and artillery: 3,000.

The Suez Canal is a formidable obstacle. The banks generally are raised from 5 to 25 feet above the desert level. The ship canal flows with a strong stream, whose direction varies with the wind, at a rate of about five miles per hour. The sweet water canal is only about 30 ft. across, and from 4 to 6 ft. deep.

The Suez Canal may be regarded in four subdivisions.

First, from Suez to the north end of the Great Bitter Lake; for some 40 miles the Canal traverses bare desert, and the two Bitter Lakes. The sweet water canal does not run close to the ship canal; and on the west side, except at Suez, there is no cultivated or habitable territory until the Nile is reached 80 miles away.

Next, between the north end of the Great Bitter Lake, and the north end of Timsah, at Ferry Post, for about 15 miles, the ship canal and the sweet water canal run close together; and there is a belt of irrigated land about half a mile wide along the latter; and this belt extends to Ismailia and Tel-el-Kebir, widening to over a mile about Ismailia.

Ismailia is an important town, the administrative centre of the canal. The Company's head offices and dockyard are there; besides, it is a railway junction, and has the lock gates and sluices for controlling the fresh water to Suez and Port Said. The Eastern Telegraph Company's land lines, from Alexandria and Cairo pass through Ismailia to Suez.

The *Third* subdivision extends from Ferry Post (Ismailia) to Kantara. At first the canal enters a deep cutting for two miles; then it runs through a very sandy stretch of desert for 18 miles. The sweet water canal is five miles away, until it rejoins the ship canal at Kantara. Beyond the sweet water canal is the bare desert—soft sand for 20 miles to the Delta.

The *Fourth* subdivision is the 25 miles from Kantara to Port Said. The two canals run close alongside each other, separated from Lake Menzala on the west by a narrow embankment. On the

east lies the Plain of Tineh (mud!); much of it is below the sea level, and able to be inundated.

Considered from the enemy point of view, the choice of objectives on the canal reduces to a very few points.

(1) Suez to north of Bitter Lake—no good. A force which seized Suez would be in the air, 80 waterless miles from the Nile, and with its water cut off at Ismailia.

(2) Port Said to Kantara, similarly, the Lake Menzala is as bad an obstacle as the Suez–Mokattam desert.

(3) North-east of the Great Bitter Lake to Serapeum, and at Ferry Post, fresh water is available immediately the ship canal has been crossed. Ismailia railway junction and other resources are at hand; fresh water exists all the way to the Delta, and the sweet-water canal is navigable by Nile boats and launches. This section is specially attractive at Serapeum and Tussum, where the eastern canal bank is not in full view from the west bank.

(4) Between Ferry Post and Kantara the latter place offers the only attraction; elsewhere the fresh water is too far away. But the stretch of desert beyond rather rules out this section as a crossing-place. The conclusion is that the portion of the canal between the Bitter Lakes and Lake Timsah offers the best sites for crossing. Ferry Post is a second choice, Kantara a poor third.

Broadly, the British intention was to let the Turks first overcome the desert obstacle and to use the Suez Canal itself as a second obstacle. The plan was to strike at the enemy only when he arrived at the Suez Canal, where the defenders would have the benefit of ships' guns and armed launches—a purely passive defence.

At first, rather wild figures appeared as to the enemy's numbers. When Turkey declared war, Cairo noted that about four corps were on the Hedjaz railway, and the Turks had 40,000 armed Bedouin auxiliaries. But ten days later a former military attaché in Constantinople had estimated that not more than 70,000 Turks could be brought against Sinai.

General Sir John Maxwell, commanding the force in Egypt, formed the Suez Canal defences into a separate command under Major-General A. Wilson. The latter had the 10th and 11th Indian Divisions (six infantry brigades), Imperial Service Cavalry Brigade, and Bikaneer Camel Corps; in all, about 30,000 men. Besides, as previously mentioned, in Egypt, about Cairo, were the 42nd Division, some Yeomanry and the Australian and New Zealand formations training and equipping. Altogether, the troops in Egypt amounted to about 70,000 men. The force was short in artillery, and so relied on the Royal Navy and French war vessels to supplement its gun-fire from the Canal. Major-General A. Wilson put his headquarters at Ismailia and had an advanced base at Zagazig, whence the single line railway served the Suez Canal.

The Suez Canal Defences were organized into four sections. The principal defended posts on the east bank were :—

1st Section : El Shatt, Kubri, Geneffe ;
2nd Section : Deversoir, Serapeum ;
3rd Section : Ferry Post, Ferdan, Ballah ;
4th Section : Kantara, Port Said Salt Works.

The 10th Indian Division, and part of the 11th, furnished troops for these posts. The remainder of the 11th Division, and the Imperial Service Cavalry Brigade, were retained in reserve at Moascar, near Ismailia. Heavy bridges were provided at Kubri and Kantara. Light foot-bridges and ferries were prepared for most of the other posts. Water transport was in great demand, and steam and motor boats were only too scarce at first. The lack of a road along the Suez Canal was much felt ; and this was not provided until nearly two years later.

Three days after the Turks had declared war 14 transports left India for Suez with the first instalment of the 12 battalions, three cavalry regiments, and Bikaneer Camel Corps, which had been put under orders for Egypt a fortnight earlier.

Egypt immediately evacuated El Arish and Nekl according to plan. The Turks crossed the frontier, and by 15th November they were considered to have 5,000 infantry and 3,000 Arab auxiliaries in El Arish. Four days later they reconnoitred El Abd, and on 20th November attacked and drove back a strong patrol of Egyptian Coastguards at Bir el Nus (half-way between Abd and Kantara). Constantinople announced this skirmish as the occupation of the Suez Canal. Early in December the inundation ordered by General Sir John Maxwell—between Port Said and Kantara had taken effect and greatly reduced the front to be patrolled.

Troops of the Turkish Expedition had entrained at Damascus on 23rd December. They proceeded *via* Afule, whence they marched to Jerusalem, and on through Beersheba, Auja, and El Arish. The British were getting fairly good information of their progress. On 13th January, the Turks were reported at Auja and Kossaima, and said to be increasing at El Arish. (See *Plate* II.).

On 15th January, the R.F.C. located 700 troops at El Abd, and parties on the Bir Murr and Moiya Harab roads.

On 24th January, 200 Turks appeared at Dueidar. Next day the post at Hill 70, eight miles out from Kantara, was attacked.

Jemal Pasha now issued his hortative to his troops :—

> " Warriors ! Behind you lie the vast deserts ; before you is the craven enemy; behind him the rich land of Egypt, which is waiting impatiently for you. If you falter, death will overtake you. Before you Paradise lies."

The Turkish advance was now in full swing. Warships took post on 26th January, and Cairo was asked for an Australian Brigade. The intelligence reports of 26th January showed 5,400 Turks at various wells some 25 miles from the Canal. Next day, these numbers had swelled to 9,400 men, and some had come on closer. On 27th January, Kubri, seven miles off Suez, was raided.

It will be observed, that the raid attacks were made on the left and right while, actually, the main attacking force was assembling against the centre.

On 28th January, Kantara again was attacked; and a new camp appeared at Bir Habeita, eight miles east of Deversoir.

The camps continued to grow; but shipping went on through the Canal by daylight undisturbed.

On 1st February, the British patrols were in touch with the enemy all day from Serapeum to Ferdan, about 20 miles of front.

The situation on 2nd February was:—

5,000 Turkish infantry and guns east of Serapeum;
5,000 Turkish infantry and guns outside Ferry Post;
2,000 Turkish infantry and guns close to Kantara.

General Wilson reinforced behind Ferry Post with a battalion, and Cairo was asked for two more battalions and some Yeomanry, and also sent up a mountain battery from the Egyptian Army.

The Turks moved to the attack on the night of 2nd–3rd February. They sniped at Kubri and Ferdan, and made a feeble attack on Kantara defences. But, under cover of artillery and infantry fire, they brought their pontoons to the Suez Canal between Serapeum and Tussum. (See *Plate* III.).

Their attempt to cross was broken up by fire action, and by the armed launches on the canal. Actually, three pontoons got across, but all the Turks in them were killed or captured. At 0930 hours on 3rd February, the Turks brought up fresh troops against Serapeum, and again tried to force a crossing. Traffic in the canal was suspended. The shipping anchored in Lake Timsah came under artillery fire. The battleships *Ocean* and *Swiftsure* were moved to Deversoir and Tussum respectively.

At 1330 hours, the Turks drew off, leaving about 60 dead and 300 prisoners with the defenders. Covered by weak rearguards, the enemy began to retreat by the routes over which he had come.

On 4th February the Imperial Service Cavalry Brigade were crossed over at Ferry Post, and reconnoitred the enemy; they captured a small convoy, but did not engage the enemy closely. The night 4th–5th February was quiet: the whole canal was clear of Turks. On 5th February, the R.F.C. reported enemy columns retiring along all roads. The Suez Canal was re-opened by day for ship traffic; and night traffic was resumed a week later.

The Turkish advance was boldly conceived, and well executed. Although it did not achieve its prime object of raising revolt in Egypt and blocking the Canal, it had a great effect. The demonstration of the possibility of bringing so large a force as 12,000 men of all arms across the Sinai Desert so impressed the authorities that the next time the canal was threatened nearly 400,000 troops were massed in Egypt. Moreover, the event showed that defending Egypt, and defending the Suez Canal, are not synonymous. The shipping in the canal is obstructed, unless the canal is defended from further east than its own banks.

The Turkish effort deserves admiration. To bring 12,000 or 15,000 men, artillery and pontoon train across 140 miles of desert was creditable; to assault a front defended potentially by 70,000 men, and the heavy metal of ships' armament, was audacious; to depart again with artillery and baggage intact, and a loss of not 10 per cent. of infantry was clear gain and left the defenders little to boast of. The Turks gave out that the attack was merely a reconnaissance raid, the precursor of a real descent in force. A German account published later declared that the Suez Canal was bridged, five battalions got across, and, but for the bulk of the attackers missing their way in a sand storm which enabled a cruiser to come up and sink the bridge, the invasion of Egypt would have been accomplished!

Among the features of these first four months of war in Egypt and Sinai, the most prominent were:—

(*a*) The general unpreparedness for war;
(*b*) Scanty knowledge of the water resources and routes of the Northern and Sinai Deserts;
(*c*) Lack of appreciation of the extent to which a descent on Egypt from east or west was practicable.

The attack on the Suez Canal was met by purely passive defence. There was no intention of or preparation for either counter-attack or pursuit. Although the Imperial Cavalry Brigade crossed the Suez Canal after the Turkish attack had failed, it merely watched the retreating enemy and returned to its camps. The moral effect of this inaction was that the Turk, although he failed, felt unbeaten, and he returned to attack again with greater forces 18 months later. Lack of transport has been urged in excuse for this. But Egypt and the Sudan employed normally—and ultimately furnished the army with—thousands of camels and donkeys. And the Yeomanry and the Overseas troops in Cairo were admirable material at hand for extemporizing Camelry.

(*To be continued.*)

*THE BATHING PROBLEM IN UPPER SILESIA.**

(Communicated by the Chief Engineer, British Army of the Rhine.)

THE British Upper Silesian Force concentrated at Oppeln early in June, 1921. By the end of that month it was extended on a frontage of some twenty-five miles to a depth of twelve miles.

For the most part, the troops found themselves distributed in small posts and detachments occupying villages of a very primitive nature.

The local water supply consisted usually of a few shallow wells; of sanitary arrangements there were practically none. As a result, many types of disease were prevalent; the possibility of an influx of refugees from the Russian famine added to the risk, serious enough in normal times.

The preservation of the health of the Force at once became a matter of prime importance, and the provision of suitable hot bathing accommodation an early essential.

It was apparent from the wide areas to be covered and from the constant changes in the disposition of the troops that some mobile type of bath would be required.

To meet these contingencies, the idea of a bath lorry and a bath train was evolved, the latter to bath units within reach of the railway, the former for the more isolated posts.

By arrangement with the D.A.D.R.T. the construction of both was carried out by the German railway authorities in their workshops at Oppeln.

Since August, both have been in continuous use, and have been of inestimable value.

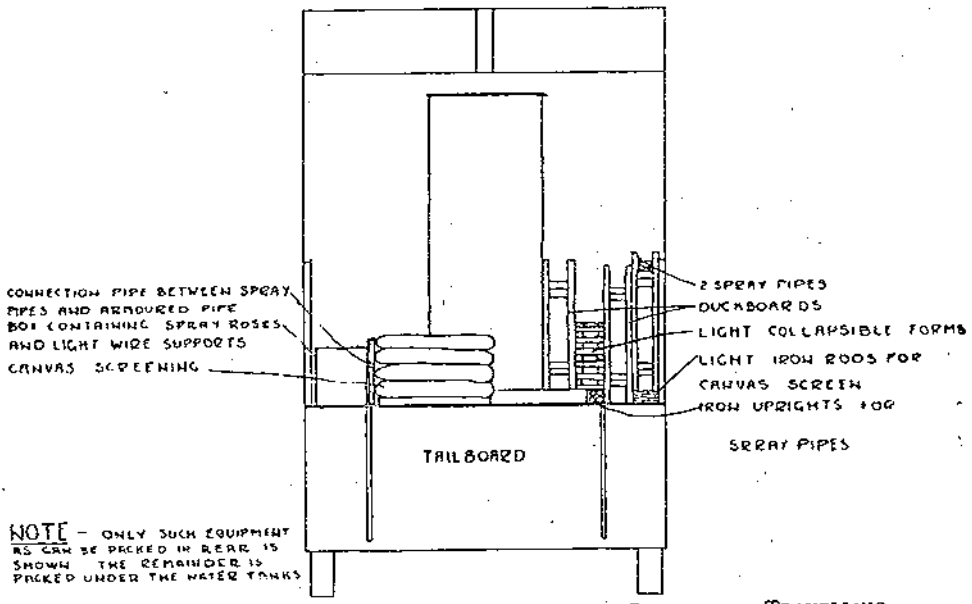
Winter conditions later on restricted the use of the lorry, but the train, fitted with stoves and corridor connections, still carried out its weekly programme.

The accompanying plates need little explanation.

* Several interesting photographs, showing the bath lorry rigged up for bathing in a large building (in the summer months it was rigged in the open), and the interior accommodation of the bathing and dressing vans of the bath train, were also received, but the Editor regrets that they were found unsuitable for reproduction, and had to be omitted.

The following particulars may be of interest :—

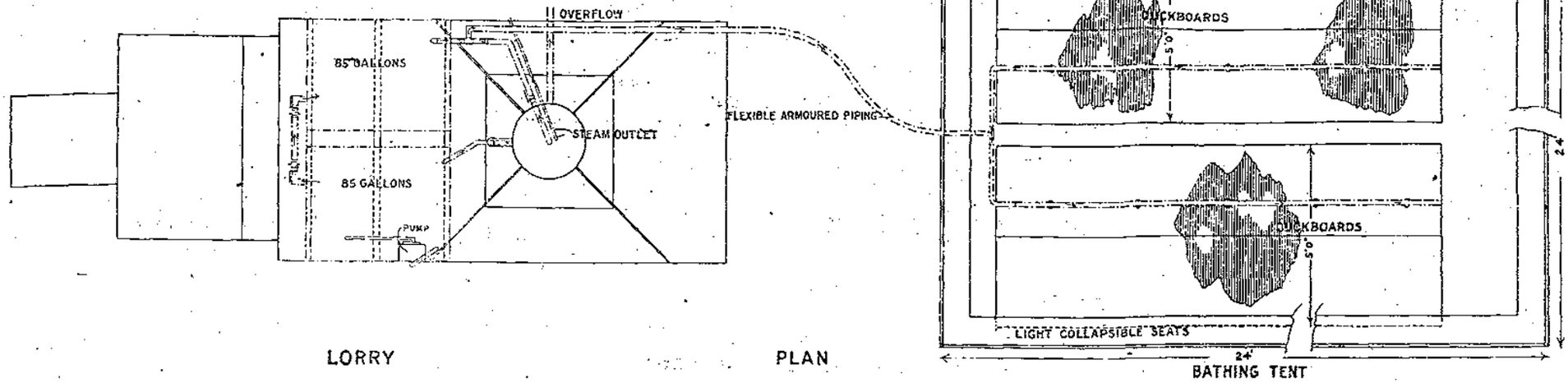
	Bath lorry.	*Bath train.*
Water supply ...	By hand pump or lorry from nearest available service.	From locomotive.
Method of heating water	Central flue boiler.	Hot water from engine.
Bathing capacity ...	40 men per hour.	120 men per hour.
Time required to set up, heat water, and commence bathing	One hour.	10 minutes.
Maintenance personnel	One M.T. Driver, one Sapper	One R.A.M.C., one Sapper, attendants and German railway personnel.



BATH LORRY.—SKETCH ELEVATION SHOWING LORRY PACKED FOR TRAVELLING.

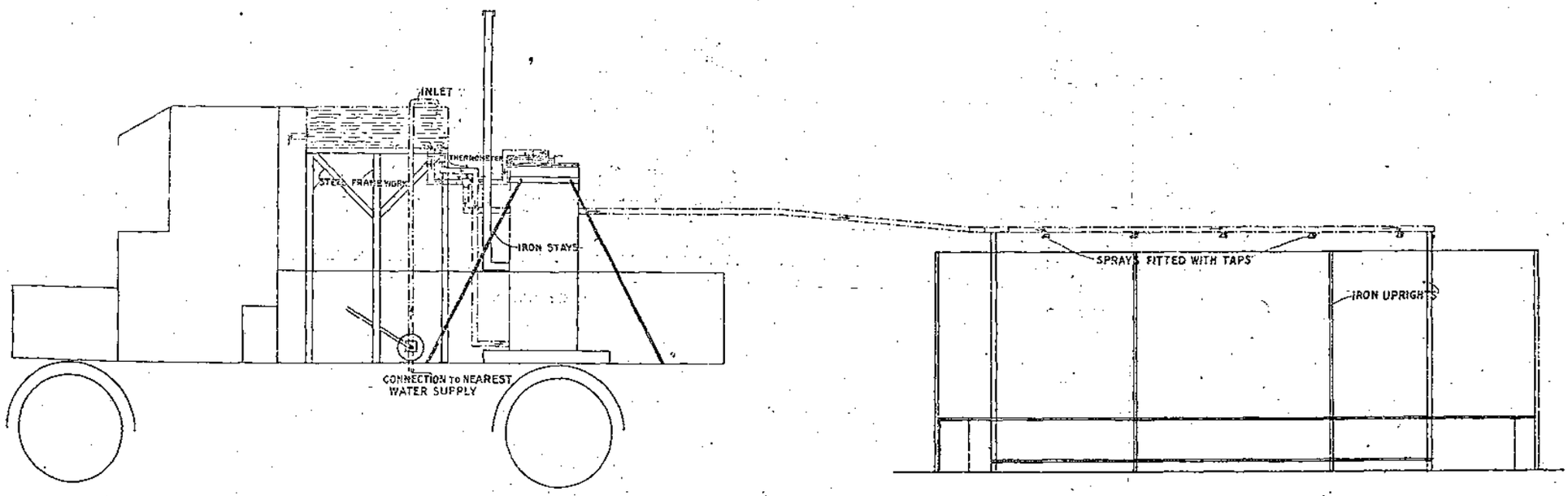
BATH LORRY WATER SUPPLY.

PLATE



LORRY PLAN

BATHING TENT



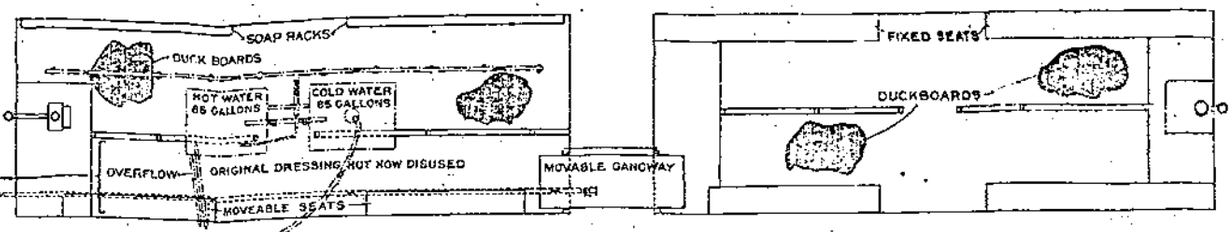
LORRY ELEVATION

BATHING TENT

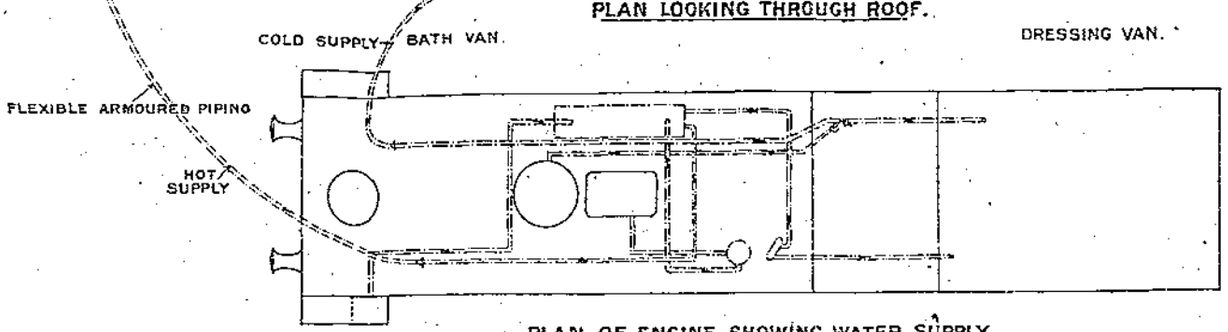
BATH TRAIN WATER SUPPLY.

PLATE

The original idea was that this compartment was to be the dressing accomodation. It was too small and clothes got damp.

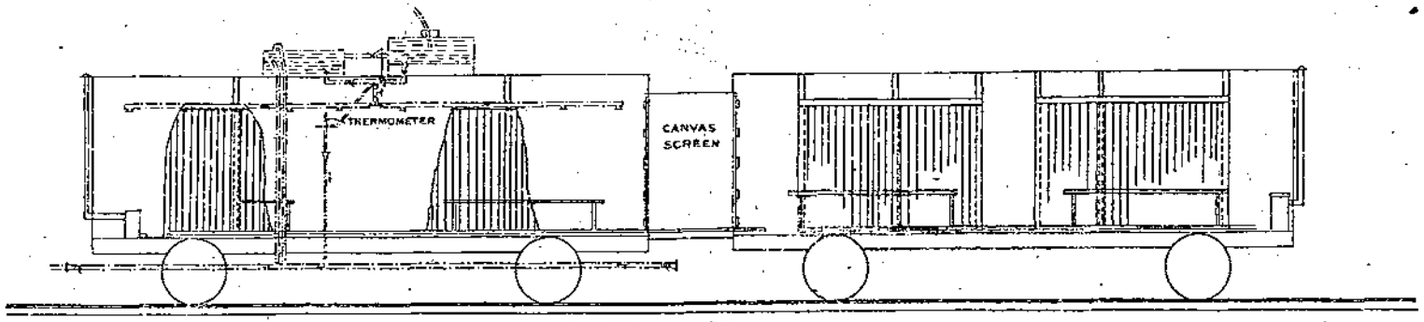


PLAN LOOKING THROUGH ROOF.



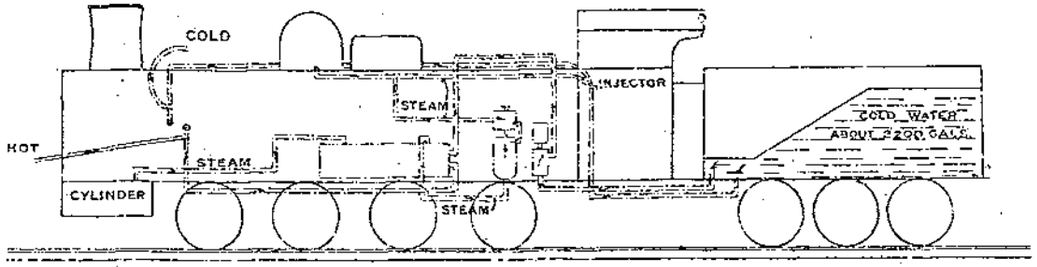
PLAN OF ENGINE SHOWING WATER SUPPLY.

TRAIN CONSISTS OF 2 SUCH UNITS, i.e.
2 BATH VANS.
2 DRESSING VANS.
1 ENGINE.
1 GUARD VAN.



ELEVATION.

BATH VAN. DRESSING VAN.



ELEVATION.

THE SUPPLY OF BULK STORES IN WAR.

By LIEUT.-COLONEL and BT.-COLONEL J. W. S. SEWELL, C.M.G., R.E

INTRODUCTORY.

1. The historian of the work of the R.E. in the War of 1914–1918, in his "Supply of Engineer Stores and Equipment" has produced a successful, if brief, record of the growth of the organization developed at home for the acquisition and shipment of engineer stores to various theatres of war. The last few pages are devoted to a sufficiently accurate record of the work of the organization in one of the theatres of war, *viz.*, France, created to collect, hold and distribute engineer stores.

This history only carried the reader as far as June, 1918, at which period the Store Branch of the Director of Works organization was reformed into a Directorate under the Q.M.G.

The subsequent months included a period of mobile war, which presented different problems from those arising in the supply of stores to armies stabilized in one position.

The historian very truly observes "few subjects need studying with more careful regard to attendant circumstances."

2. The object of this article is to deduce from the cold facts recorded, and from the records of the Stores Service in France, lessons which may serve to guide officers called on at any future date to organize a service for the supply of engineer stores in a theatre of war.

It is fully recognized that the conditions which prevailed in France from 1915 to September, 1918, were those pertaining to one type of war only, *viz.*, siege or trench warfare; that such conditions are not those for which a modern army is normally trained and organized; and that the arrangements requisite for supply of engineer stores during a long period of stabilization are widely diverse from those required to supply stores to an army "on the move."

Nevertheless, the study of the history of the British Army, and of the national organization, or rather of the lack of any such organization for war, may justify the conclusion that in any great continental war in which this country is engaged the British Army will probably again be required to act on the defensive as a covering force behind which the national resources can slowly be mobilized.

There would, therefore, appear to be strong arguments that we should be prepared for a considerable period of "trench-warfare," and that such preparations should include, if not an active organization, at any rate a considered plan for the supply of engineer stores in great bulk to stabilized armies.

Moreover, it will be quite unsound to attempt to base such an organization upon any principles laid down by continental powers for the guidance of their army administrations.

In such countries supply to their armies can be organized in parallel lines of supply, running from areas of the country to the various formations. Supplies, however, for a British Army must inevitably pass through a bottle-neck in crossing the sea and then arrive at one or more bases from which lines of supply will radiate to the various armies. In consequence, the volume of supply is eventually controlled by considerations of transport facilities.

The principal considerations before a supply service are:—

(i) What will the Army require?
(ii) How can it be obtained?
(iii) How can the required quantities be transported to the critical point at the critical moment?

Of these the third will always be that which causes the gravest anxiety.

3. In order to envisage properly the arrangements required, it is necessary first to consider the conditions imposed. In the following four paragraphs are enumerated, in broad outline only, the conditions which prevailed in France, as regards the existing lines of supply. Paragraphs 8 and 9 record a few general statistics of engineering stores supplied in France, gathered from the records of the Stores Branch.

Transport Conditions in France.

4. For an army reaching from north of Ypres to Albert and the Somme, there were in 1915 the following possible lines of supply:—

(i) Dunkirk—Hazebroucq } Lille.
Calais—Hazebroucq }
(With a branch line Hazebroucq—Ypres).
(ii) Calais—Aire—Bethune.
(iii) (Single railway) Etaples—Arras.
(iv) Abancourt—Amiens—Albert; Abancourt being connected to Havre, Rouen and Dieppe.

The principal lateral line connecting these lines of supply was the main line:—

Amiens—Abbeville—Etaples, Boulogne—Calais, with a single-line extension from Calais to Dunkirk. This was the only line available

for the transfer of troops from flank to flank, for the movement of stores obtained in France, and for cross-movements, between northern and southern depôts.

The line Bethune—St. Pol—Amiens was a supply line, rather than a lateral.

The incidence of this remark will be inferred from the following facts :—

(i) The bulk of the timber—constituting more than 50 per cent. of the bulk of engineer stores—was obtained from areas south of the Somme.

(ii) The provision arrangements made in the United Kingdom involved considerable inter-depôt movements in order to carry sets of stores.

(iii) A great offensive necessitated the use of the store reserves from both northern and southern depôts on one sector of the front.

Of the rail lines of supply mentioned above it may be observed that :—

(*a*) The Calais—Dunkirk line was doubled in the winter of 1916–17.

(*b*) The Etaples—Arras line was doubled in the winter of 1916–17, the work being completed only just in time for the battle of Vimy Ridge.

(*c*) A double line direct from Dunkirk to Ypres salient was constructed in 1917.

(*d*) Finally, in the summer of 1918, the Etaples—Abbeville line was quadrupled but not opened, and a new line was opened leading up to the southern flank of the Third Army front.

5. The following elementary transportation statistics may be worthy of note :—

(*a*) For engineer stores, 1,000 tons required three trains.

(*b*) The whole of the above lines, except the Hazebroucq—Ypres line were operated by the French railway company throughout the war.

(*c*) Two hundred trains daily was the maximum number of trains which it was considered feasible to operate for the B.E.F. on the lines concerned, with reasonable efficiency. These included personnel and ambulance trains and any inter-depôt trains. Even quiet periods demanded at least one ambulance train and one leave train per army per diem. For rough calculations the whole army was usually assumed to be equivalent to 60 divisions, each of which required one food train per diem.

The average number of trains of engineer stores required per diem, including supply of L. of C., was twelve.

(*d*) Engineer stores ex-U.K. represented about five to six per cent. of the volume of traffic, but probably not in excess of three per cent. of the value.

(*e*) When estimating transport possibilities, it must be borne in mind that what is required is maximum momentum, which obviously determines the quantity delivered at a given spot in a given period. It is futile to double the number of trains started, if that results in halving the average speed over the line.

During the battle of Passchendaele, supply services, etc., were actually starting at one period about 270 trains daily, but it was found that this reacted deleteriously on the tonnage actually received daily at the front.

(*f*) A single line of rail is only "good for" about 12 trains per diem each way.

6. It is instructive to recall the discovery and elimination throughout the war of the various "transportation limits." Unfortunately a "bottle-neck" is naturally discovered, like a weak link in a chain, by a test load; its elimination usually spells construction with attendant train-loads of heavy material.

The Q.M.G. staffs have then to decide whether to reduce supply trains by *m* daily, in order to obtain an increase of *n* trains daily at a later date, where *n* is, of course, hypothesized as greater than *m*. The answer to this conundrum must normally be "a bird in the hand is worth two in the bush."

Chronologically the limitation was discovered as follows:—

1915–6.—Slow discharge of ships in French ports resulted in the tonnage landed from the available ship tonnage imposing the limit on supply. This was met by development of wharves, and large increases to the number of cranes installed in peace.

This was followed in 1916 by the discovery that narrow rail exits at Havre and Dunkirk had insufficient capacity to clear away stores as fast as they were discharged.

This was met at Havre by the formation of the Soquence Canal Depôt (later to be one of our bugbears) and construction of a new line to Dunkirk Harbour from Coudekerque rail depôt.

1916–7.—The congestion resulting from establishment of store depôts (food and ordnance) on dock wharves was eliminated by the move out of such depôts from the ports. Next, supply lines were doubled and new lines constructed, necessitating lifting and transferring to France whole branch lines from U.K.

Then the limit was imposed by available rolling stock. This was met by importation of rolling stock in large quantities, and construction of repair shops.

These were only some of the major operations which gradually developed transportation efficiency, until about the summer of 1918

transportation had arrived at a stage when in effect as much stores could be carried as the armies really required, until, of course, the advance began.

7. The foregoing remarks are made in no spirit of criticism of the work of transportation officers. Of our relations with them stores officers have only the happiest remembrances of their willing, even self-sacrificing, readiness to co-operate and assist in every manner within their power, and often beyond their authority; of their tireless and incessant struggle to overcome the numerous obstacles; and of the efficiency eventually attained in the development of transportation to the fighting armies. But it does not appear fully to be realized by the fighting arms how intimately supply is interlocked with transportation. This somewhat long digression is intended as an attempt to present, from the aspect of a layman, a bird's-eye view of the transport problem, in order that it may be realized that whatever organization be adopted for a branch to supply engineer stores, it is essential to efficiency that it should take a form which allows for the closest and quickest co-ordination with the transport branches.

I have only dealt with sea and rail transport, but in 1918 it was beginning to appear that a stage had been reached when the limit was the rate at which distribution by road could be effected from railhead, a matter which will subsequently be considered.

Principal Engineer Store Statistics.

8. A study of the tables annexed to the History of *The Supply of Engineer Stores and Equipment* will reveal the following principal statistics for engineer stores:—

	Tons.
Average monthly supply to formations ...	110,000
Maximum ,, ,, ,, ...	140,000

Of this 110,000 tons more than half consisted of raw timber, 90 per cent. of which was supplied by the Directorate of Forestry *ex* French forests; about one-third only of the gross receipts was imported from the U.K. The remaining one-sixth consisted principally of timber articles manufactured in base workshops.

Summarizing, it may be said that trench war requirements involved the supply per division per mensem of:—

	Tons.
Timber	1,000
General R.E. stores	700
Articles manufactured at bases	300
Aggregate ...	2,000

9. To complete the collection of a few principal facts, the following table of rough values in 1918 may be of interest in these days of cost accountancy :—

	Value per ton.
(i) Engineer stores—Timber	... £15
General stores ...	... £25
(ii) Ordnance stores—General	... £50 to £100
Clothing	... £300
Ammunition ...	... £200
(iii) Foodstuffs	... £70

Based on these tonnage values and the known weekly importation of various classes of stores, it has been very roughly estimated that the total average daily consumption by B.E.F. of supplies and stores of all descriptions, including equipment and ammunition, amounted to about £2,500,000, of which engineer stores represented about £80,000.

The aggregate cost of the personnel engaged directly or indirectly in discharging, storing and handling these stores at bases cannot have fallen far short of £250,000 per diem. These figures, which, it is believed, are not exaggerated, are given with a view to emphasizing the necessity for the most efficient supply organization. An economy of only five per cent. on these figures represents £50,000,000 per annum.

Engineer Stores as a Portion of Bulk Stores.

10. The historian has been at some labour, in his introductory remarks, to attempt a definition of engineer stores. A wider view would appear to be justifiable. Thus the stores required for an army may be classified as :—

(i) Food supplies.
(ii) Arms and ammunition—including guns, gun-carriages and "tanks."
(iii) Vehicles of every description (except gun-carriages), including rolling stock.
(iv) Equipment.
(v) Bulk stores.
(vi) Animals.

The fundamental distinction between "bulk stores" and "equipment" is that bulk stores can and must be forwarded in train loads to various "sectors" of the front, or "areas" of L. of C. Equipment comprises those stores which require to be sent to a specific consignee unit on a detailed demand.

It must be realized that these two classes of supply demand entirely different methods of storage, accountancy, and above all, of transportation.

Bulk stores are loaded by the truck-load. A scientifically laid-out depôt of bulk stores will, therefore, allow for loading any category of stores into a truck with the minimum of rail movement on the one hand and of "carry" on the other.

Equipment is loaded by assigning one truck (or covered van) per consignee unit. Long carries in a depôt are unavoidable, but the aggregate weight so carried is not great compared to bulk stores.

Again, as regards accountancy, statistics for equipment are designed to show the average rate of consumption of each specific store per, say, division which the depôt has to feed. This enables a forecast to be made of the next few months' requirements *ex* U.K.

Bulk stores, on the other hand, are in general supplied perforce on a "ration" basis, and statistics must be framed to record the quantity issued up to the ration allowed per, say, Corps.

Supply of equipment then means normally dispatch of one or two trucks to each Division daily. These trucks are normally attached to the Division's food-supply train: for this purpose the equipment depôt must be adjacent to the food depôt.

Supply of bulk stores involves the dispatch of complete train-loads to one or two destinations for each train, normally not the supply railheads, but stations further to the rear.

Bulk supply should, therefore, include the supply of such "vocabulary stores" as barbed wire, sandbags, screwposts, etc. In fact, it smoothed working when the Engineering Stores Directorate took on such stores at the ship's side at French ports. Bulk stores might with advantage also include such bulk supplies as blankets and tents, and should certainly include railway construction material.

A prospective advantage to be obtained during mobile war will be referred to later. Whatever be the reader's opinion, however, on the matter, it must be accepted as a transportation axiom that engineer stores must proceed in *complete train loads*; it will generally be accepted that they should comprise all stores used in bulk by the R.E.

11. It is possibly necessary to enunciate the processes involved in the supply of engineer stores in order that a true perspective may be obtained, before any visualization of the necessary organization can be attempted. These processes are:—

(i) Prevision.
(ii) Provision.
(iii) Sea transport.
(iv) Storeholding and sorting.
(v) Distribution.
(vi) Rail transport.
(vii) Reception and distribution in army zones.

No attempt will be made in this article to view these processes from any other aspect than that of the officer in the theatre of war, but it is now proposed to consider each of these processes *seriatim* and to enunciate the lessons to be inculcated so far as the trench war period in France was concerned. It must be borne in mind that the conditions were of a special nature and that, in consequence, it will not be safe to draw conclusions of too general a nature.

12. *Prevision.*—As regards field stores. This is a function—and no unimportant function—of the E.-in-C. Upon his forecast of the probable requirements of the field engineers, six months ahead, depends the whole efficiency of supply. It was found, even when the manufacturing output of the U.K. was strictly organized, that it took about four months for the first arrival of a new pattern store and quite six months before a steady flow was ensured. In the occasional event of a clamour from armies for some special store which has not been foreseen, or for abnormal quantities of a normal store, it is almost invariably the case that the demand has died before supply has developed. We were left at the Armistice with some considerable stocks which were obtained as a result of army pressure, but often not used at all, or absorbed only to a very limited extent.

The E.-in-C. has to foresee both types and quantities which will be required. He has also to decide on standard patterns, usually a compromise between the different opinions of several armies as to the best type, modified by consideration of the alterations required to obtain maximum supply. This modification is important and very essential: especially in details of such trench stores as "A" frames, trench boards, etc., modifications which did not affect strength but enabled "standard" sizes of timber to be used, resulted in most important increases of the output. Critical study of the country behind the enemy's lines was essential to enable a forecast to be made of the bridges, which would be required, and of the water supply plant essential to certain areas.

The R.E. generally do not sufficiently appreciate the extraordinary foresight which was displayed by the E.-in-C.'s staff in this respect. As one example alone, it may be noted that the bridges used in the advance of 1918 had, under E.-in-C.'s orders, been gradually accumulated for three years; whilst 1,200 steel cubes, manufactured in 1916, were absorbed suddenly in the 100 days' battle of 1918 at a rate which caused grave anxiety for a time; but they lasted out.

The three-year-old prophecy, in fact, was precisely justified by events.

To such prescience the whole stores branch also owes a deep debt of gratitude; for inevitably a shortage must have been blamed to their account.

13. *Provision.*—Once requirements have, however, been predicted, the compilation of indents is *prima facie* easy, but close co-operation with the home authorities is very essential. Doubtless owing to reluctance to worry overworked men in the theatre of war, the provision branches at home did not always confide to us their difficulties. When they did it was often possible to compromise. For example, in 1918 the ration of steel for engineer stores in France was about 20,000 tons, which did not meet the demands of E.-in-C. and D.W. The situation was met by reduction of the army demand for corrugated iron and acceptance of shell-discarded steel for some other stores (*e.g.*, screwposts). Again, the situation demanded minimum use of sea freight; it has already been pointed out that only one-third of the whole tonnage of engineer stores was imported. It will inevitably be necessary in all wars to develop to the uttermost the resources of the theatre of war: it may be hoped that such development will definitely be assigned as a function of a glorified Director of Works—let us say a D.G. Engineer Services. The total supply of timber from French forests attained to a figure of about 100,000 tons per mensem for R.E. and railways.

The maximum quarry output is not known to me. Both these development branches were originated by D.W.

Again, brick and concrete block factories were developed to a considerable extent.

The obvious lesson is to study beforehand the resources of the probable theatre of war, and in due course to take over to it the requisite staff of experts.

14. If a digression may be allowed at this point, it may be observed that peace and small war practice have inculcated on the R.E. the geographical organization by which a C.R.E. takes control of all R.E. services in his area, with the aid of a few junior experts. But in an extensive campaign a time will arrive when it may be advisable to scrap this economic organization for a generic organization in which experts in one branch of engineering are formed into a directorate or sub-directorate controlling, over the whole theatre outside the zone of the armies, the special operations assigned to their branch. Primarily this involves a large increase of officers, but:—Firstly, it will probably result in intensive work;

Secondly, it will, if due control be exercised, result in an economy of "labour," owing to the greater and more specialized supervision;

Thirdly, it is a system by which maximum results can be obtained from Civil Engineers, who are normally specialists in some one branch. This makes no difference in the function allotted to a Director of Works, but means that instead of directing C.R.E.'s he will command Directors of Engineer Services.

15. Under the head of "Provision" must be considered the subject of base factories. As is, no doubt, well known, shipping

tonnage is a matter of cubic feet, not of deadweight tons. My own general impression of engineer stores was that on an average it required about 2½ shipping tons to make up one ton deadweight. It is therefore very necessary to use every endeavour to reduce bulk to a minimum. Great economy can obviously be effected if timber trench stores can be manufactured from raw material in the theatre of war.

The only question is at what site in the theatre of war should this conversion take place. I have no quarrel with Army or Corps Workshops in principle; they are necessary for certain purposes, but I submit that they should be kept mobile, that normally they should be restricted to jobbing repair work and the manufacture of a few special "jims" peculiar to their own locality, and that iron-working tools should be rigidly restricted to those essential for rapid repairs to R.E. machinery. The objection to allowing Army shops to develop into factories is that they tend to immobilize field forces, absorb fighting men of category "A_4" and then, owing to dissipation of effort, do not, with the same amount of plant, produce in the aggregate the results that can be obtained from concentrated factories in the L. of C. in which prisoners of war, unfit men, women, and even children—in fact, the "useless mouths"—can be employed.

As a result of the retreat of 1918 the E.-in-C. decided to concentrate manufacture at the bases Calais and Abancourt. The reader is referred to Table L on page 96 of the History and is invited to consider whether this decision was justified by the result.

Going to the other extreme, personally I remain an unconverted believer in supplying a Divisional C.R.E. with a small circular saw to be driven from a lorry flywheel. But this is a personal heresy.

16. Another source of provision is local purchase in the theatre of war—a subject that requires some control. Obviously C.E.'s must have power to acquire local stores, but if they continue to purchase for several years in a limited area, it is equally obvious that a very undesirable situation will be created. In France, in 1915, local merchants continued to import from Paris or elsewhere to the Army zone in order to sell to the local C.E. or C.R.E. in base areas. This entailed competitive buying with the resultant forcing up of prices, profiteering, by local merchants at the expense of the British public; and finally traffic of civil stores over railways whose last ounce of accommodation was required for the supply to the Armies of troops, ammunition and such necessaries. In effect, it amounts to a circumvention of the orders of the C.-in-C. as to priority of supply.

17. *Sea Transport.*—This concerns the R.E. in several matters. Firstly it is a R.E. service to develop the ports so that maximum duty may be obtained. It may be—often will be—necessary to construct wharves: whilst it may be taken for granted that many

cranes will be required in order to produce maximum discharge. Generally, the best type of crane will be found to be the Port of London type, three or five tons, carried on a travelling gantry which strides the rail sidings. One powerful crane will be essential which can lift 30 or 40 tons. This will be a fixed crane; for the few lifts of this nature required, ships will shift their berth to come under the crane. Extra wharf sidings and cross-overs are sure to be required and, usually, a development of the connections between the wharf sidings and the railway sorting sidings outside the Port. The main objective is to reduce the time of discharge to a minimum.

18. Reference has already been made to the necessity for reducing imports to a minimum by development of the resources of the theatre of war; also to the necessity for reducing bulk by conversion of imported raw material to manufactured articles in the theatre of war.

19. Beyond this there is a distinct necessity for greater consideration than existed in the European War, between stores officers in the theatre of war and provision branches at home in dispatch of cargoes as and when required. In France we were assured that it was not feasible to create in England a receiving depôt to accept stores as manufactured and to dispatch to the theatre of war as indented. That being the case, it was necessary to accept the disadvantages. It may be as well, however, to enumerate these, in order that in future wars the advantages to the home authorities may be fully weighted with the disadvantages to the Expeditionary Force.

The system which prevailed during the War was dispatch direct from factories at home to base depôts in France. At the best this involves holding enormous stocks in the theatre of war, for manufacture must proceed steadily throughout the year, whilst demands are largely seasonal. For example, Nissen huts poured in steadily throughout the year with the result that we would be holding 25,000 or more ready to send up in October, November and December. This involves huge depôts in the theatre of war with attendant risks from enemy aircraft and *saboteurs*; it also necessitates an extensive personnel, which is naturally more costly in the theatre of war than at home depôts.

Directors in France were constantly pressed to reduce "reserves"; we unanimously agreed that we would cut our reserves to little over the amount consumed in the period necessary to fulfil a shipping indent. Nevertheless, I found it impossible to hold, under the prevailing conditions of shipment, less than 350,000 tons or three months' supply measured by tonnage. Nor, from our point of view, was this the worst. Owing to the existence of several base ports and two main base depôts, the home system of shipment, from the port nearest to the factory, and of shipment as manufactured,

it constantly occurred that a whole cargo of, say, Nissen steel work would arrive at Havre, whilst corresponding wood work arrived at Dunkirk. Also " sets " of machinery became separated in a similar manner. The requisite redistribution and resorting in France was not only a great strain on our organization, but involved further traffic on the one congested lateral railway between north and south.

We desired the existence of a central R.E. store depôt in England which would collect all stores from factories, make them up into sets and hold in store until they were required in France. Had this been feasible, far smaller depôts in France would have been possible, fewer personnel and less rail traffic.

20. When the number of ships (and their tonnage) which can be allotted for carrying stores to the theatre of war has been determined by the Admiralty, and when the ports have been developed so as to obtain the quickest possible " turn round " of those ships, it is even then almost axiomatic that the supply of stores may be placed in the following order of decreasing tonnage :—

(i) What the Army desires to receive.
(ii) What the provision branches can obtain.
(iii) What can be transported by sea.
(iv) What can be transported from bases to Armies.

(iii) and (iv) may change places at times, whilst for certain classes of stores (ii) is sometimes the limiting factor.

The C.-in-C. functioning through his Q.M.G. (who may delegate authority in this respect to an I.G.C.) has then to decide the tonnage to be allotted to each category of stores. Some of them must be reduced ; the reduction will only touch food supplies in extreme cases. Similarly equipment can hardly be reduced, nor does it really bulk largely in the tonnage programmes.

For the comfort and morale of the troops, reduction of canteen tonnage will, if possible, be avoided. Consideration of the classes of stores enumerated in para. 10 will show that reductions must almost inevitably fall upon ammunition and bulk stores, with due regard to the relative importance at the moment of destroying the enemy and his morale, and of preserving our own troops and their morale. Reduction in the bulk supply of engineer stores must therefore be accepted by R.E. officers as due to the considered decision of the C.-in-C., and not to negligence or lack of sympathy on the part of supply services.

STOREHOLDING AND SORTING.

21. Upon this subject a volume by itself might well be written ; it is, however, necessary to economize space. I will therefore only attempt to enunciate some of the main principles discovered by experience, and to give a few statistics which may guide officers in

future. We may consider this subject under the following sub-heads :—

(*a*) Size of depôt.
(*b*) Site.
(*c*) Rail lay-out.
(*d*) Depôt lay-out.
(*e*) Operation of a depôt.
(*f*) Shops.
(*g*) Storeholding generally.

22. *Size of Depôt.*—In para. 9 an estimate has been given of the average requirements of engineer stores, including huts, per division per mensem, *viz.*, 2,000 tons, during trench warfare. This figure must be multiplied, of course, by the number of divisions to be supplied from the depôt projected; the resulting figure must again be multiplied by the number of months which is required for the fulfilment of a shipping indent. A shipping indent must not be confused with a provision indent.

A provision indent normally takes the form of an estimate of the stores required in the theatre of war by all services to be supplied (*e.g.*, E.-in-C., D.W., railways, etc.) during the next six months. Upon receipt of this indent the home services proceed to arrange a manufacture programme. A shipping indent is a definite indent for the shipment during a given month of named quantities of named stores, the total (ship) tonnage of which must not exceed the (ship) tonnage allocated by the Q.M.G.

In view of the fact that sudden developments at the front may involve rush demands for trench stores, bridges, or water supply stores, it is further necessary to add to the figure obtained as above a considerable percentage to cover reserves of such stores. Similarly a percentage must be added to allow for the collection throughout the year of huts ready to be rushed up when the Armies "go into winter quarters."

For example, for a depôt like Les Attaques we might proceed as follows :—

2,000 × 30 (divisions) × 2 (months to supply a shipping indent) = 120,000 tons.
Add 50% for reserves, etc. We must arrange to hold 180,000 tons.

Now, under the conditions of siting to be considered in the next paragraph, land is of small value as compared to the importance of reducing labour: it is therefore undesirable to stack too high. A good rule was found to be, "allow for all purposes one acre per 1,000 tons."

The Les Attaques depôt, including about 15 acres occupied by the

factories, covered approximately 220 acres and normally held 160,000 to 180,000 tons. (See *Plan*).

23. *Site of a Depôt.*—It will readily be admitted by all concerned that it was by a dispensation of Providence rather than owing to any realization of the principles, which were later discovered to be involved, that the depôt at Les Attaques (except in one particular) was sited, in the autumn of 1915, exactly where it ought to have been.

The principles are :—

(i) A depôt must not be in a dock area, for free space is necessary to quick discharge of ships.

(ii) It must not be so far from the port that haulage from port to depôt involves the occupation of a main line " marche."

(iii) It must be beyond the rail-sorting station, into which pour a miscellaneous jumble of trucks loaded with every conceivable store; in this sorting station trucks must be marshalled for their appropriate depôts.

(iv) If, as is very desirable, inland waterways are available, the depôt must be sited so as to permit of discharge from ship to barge, transit by barge to barge-discharging point and then allow room for trucks loaded *ex* barge to reach another sorting " triage " where they and trucks arriving by rail from the rail-sorting station may again be marshalled for delivery into the appropriate depôt sidings.

24. Having these principles in mind it may be instructive to note the points in which inexperience led us to make mistakes in the original siting of our depôts.

(i) The original Les Attaques Depôt was that portion between the St. Omer Canal and main railway line—it was too narrow and only permitted the existence of short dead-end railway spurs. The depôt was on top of the barge discharge quays. The principle enumerated in para. 23 (iv) was thus violated —and we suffered from that violation.

(ii) In the south the junction of the Havre—Rouen—Amiens line with the Dieppe—Amiens line gave cause for the siting of the Southern Depôt at Abancourt in violation of the principle enumerated in para. 23 (ii).

In consequence, it was often difficult to obtain transport for stores direct from ship to Abancourt; overflow dumps were formed at Soquence (Havre) and at Querilly (on the south bank of the Seine at Rouen). Owing to railway difficulties it was then difficult to get the stores out of these overflow dumps and impossible to get them out as and when required. With the intensive traffic of 1918 it was, in fact, found necessary to regard the bulk stores in these depôts as " dead " stock.

(iii) Had the work to be done again, it would probably be found better to form a large group of depôts on the Seine in the country between Rouen and Caudebec, to construct wharves on the north bank of the river and to double-track the Caudebec branch line.

25. The danger of air raids must be considered, but need not be exaggerated.

If possible two bases and two base depôts are advisable so that all our eggs may not be in one basket. Again, if feasible, bunching of different store depôts in one confined area should be avoided, as offering too big a target. It is, of course, very desirable to choose a base which is unlikely to fall within hostile shell-fire owing to the ebb and flow of war.

But the danger from aerial bombardment, even of the intensivity experienced by Calais, is almost negligible. Bulk store depôts appear to be practically indestructible. "Hun Dump" at Bapaume changed hands three times during the war without any dislocation of its stocks or even of its accounts, which still exist as a continuous narrative of transactions recorded in German and English. Important sheds of machinery or workshops are always a source of anxiety, but the "probabilities" are so largely against a hit that normal fire risks may be considered as far more serious.

Moreover, whilst opinions will vary, it appears possible that the true antidote to air raids was discovered in the last few months of the war, and may in future wars prove an effective deterrent.

26. *Rail Lay-out of Depôts.*—For a bulk store depôt, the rail lay-out of Les Attaques depôt south of the main railway line (R.E. grids) may be considered almost a type plan.

No scale has been attached to the *Plan*, but for guidance it may be stated that from Vampouille Farm to the branch road S.E. of Dimpre Farm is about one mile; from Vampouille Farm to Pont des Briques about 1,000 yds.

Trains from the Calais and Dunkirk docks arrived from the N.W. angle of the map in No. 4 *triage*; into this *triage* also poured trucks from the barge discharge point about 800 yds. N.W. of the Château de Vendroux.

In No. 4 *triage* the trucks were labelled at night for the appropriate sidings (Nos. 1 to 20) in the R.E. grids.

Railway experts on the Director of Engineer Stores staff considered that these sidings were too long—over 600 yds. effective length—and that a double lateral gathering line should have been constructed N.W. and S.E. across them.

The best distance between double sidings was found to be 150 ft. for general stores; 300 ft. for timber yards.

The sidings to the (timber) workshops should be noticed: one

(on N. side) for receipt of timber from timber yards, one (S. side) for loading up manufactured articles and removal to stores yards.

A base depôt is not laid out in principle for delivery of stores to road convoys, but as such delivery may be required, it is as well to run a siding (*e.g.*, E. siding of international sidings) alongside a neighbouring road.

27. It is inevitable that both the site and the rail lay-out of a depôt will be governed largely by considerations of facility of rail construction. But transportation officers should bear in mind that in the event it is facility of railway operation which will make or mar efficiency of transportation. For example, No. 4 *triage* was for several months far too small (four lines), whilst Nos. 2 and 3 *triages* were unnecessarily large. As a result, until No. 4 was enlarged it was found impossible to work a truck through the depôts in less than five days. As an example of the difficulties of railway operations, which were insufficiently appreciated, it may be noted that it required normally 48 hours for the transit of a certain daily express truck from Fontinettes station (two miles from the depôt) to a named siding at Les Attaques.

28. It will be obvious that facilities of construction will demand for the site of a depôt any fen district which may be available. It is then essential that pipe culverts be laid in any ditches which sidings and *triages* may traverse.

If this is not done it is necessary to fill in the areas between sidings up to rail level—a most expensive and extravagant procedure which a small amount of foresight and delay in construction will render unnecessary.

29. *Depôt Lay-out.*—It must be assumed that officers concerned are gifted with sufficient prophetic insight to foresee the eventual size of the depôt. At any rate the following principles should be adopted; if the depôt increases beyond what has been foreseen, the necessary re-organization must be undertaken to relay-out the depôt in accordance with those principles.

(i) Alternate sidings with inflammable and non-inflammable stores.

(ii) On any given siding of inflammable stores, alternate stacks with wide "fire-breaks."

If space is becoming valuable, fill in the fire-breaks with non-inflammable stores. A chess-board lay-out is theoretically desirable, but it is not always very practicable, in so far as it is not consonant with the measures to be adopted for economy of labour, described in the next section.

(iii) "Store Groups" demand separate "yards" (*e.g.*, one siding for water supply stores.) Each yard will require a small office for tally cards and store accounts. Each group will normally require one or more closed sheds for small stores

(*e.g.*, pipe accessories); and for stores which demand protection from the weather (*e.g.*, cement).

(iv) A 4-in. fire-ring main is very desirable, with hydrants and hoses. One central engine, of internal combustion type for choice, is necessary to force water into this main under pressure.

Fire-engines are of little use for the greater part of a depôt. A liberal supply of chemical extinguishers is essential to enable watchmen to scotch a fire at its inception.

(v) Factories: allow *ample* elbow room; it cannot be foreseen how much will be required. You are sure to underestimate and will not be far wrong if you allow for development to four times the size which you consider ample at first. Better waste land than be cramped later. If possible, choose a site which is open to the country at one end, so that sidings and shops may be extended.

Lay out so as to economize carry. A siding for the reception of selected timber from the timber yards will allow for stacks on the sidings, thence direct carriage to rip-saws; then to cross-cut saws; thence to nailing benches; thence to stacks alongside a removal siding; 400 to 450 ft., approximately, between arrival and departure sidings.

Do not attempt to combine a store yard and a factory—it is false economy; *i.e.*, do not put a factory in the timber yard, nor attempt to store manufactured articles in the factory yard. In this respect it is necessary to be deaf to the blandishments and to the growls of transportation officers.

(vi) As, however, one exception to this rule, it will be necessary to convert much timber to "scantlings." Les Attaques had to produce 1,000,000 F.R. of scantlings in a month at times. It is then economical to lay down some rip-saws (motor-driven and portable if possible) in the timber yards.

(vii) Generally the only rough advice that can be given is "think big and then multiply by four."

30. *Operation of a Depôt.*—The essence of efficient operation is to reduce to a minimum the number of transportation moves and the "carry" of stores, two conditions which are not, *prima facie*, compatible. By co-operation, however, this apparent incompatibility can be overcome.

(i) Loaded trucks *ex* ports (including barge ports), etc., arrive in the night, in a reception *triage*. The port has in the

meantime advised, by telephone, truck numbers and general contents. Armed with these advices and "periscopes," a special staff must rapidly label these trucks for appropriate sidings.

(ii) The railway officers then have trucks shunted to the working sidings, including any empties required for loading. After the hour of commencing depôt work, say seven hours, no rail movement must occur in the working sidings until the dinner-hour; it will probably be necessary then to allow the railway officers 1½ hours for operation.

(iii) Of the trucks thus put into working sidings it will normally be possible to reconsign a fair percentage (10% to 20%) without off-loading. As regards the remainder, it is obviously very desirable to discharge straight to a stack alongside the truck, and similarly to load an empty from a stack alongside the truck—all without further truck movement (*prima facie* impossible). If any system is to be introduced into storage, as is of course essential, this result can only be obtained by "repeat" grouping of stores. This system is difficult to explain.

Essentially it consisted in the adoption of the following measures. Bulk stores were considered under two categories:—

(*a*) Those which required one or more sidings to themselves. For example, timber was classified generally in eight principal groups of sizes. Stacks were then laid out between two sidings, four deep between sidings; two such lines provided the eight groups.

The next group would be reversed.

Thus any group size could be loaded with a maximum of about 60 yds. of carry.

Water-pipes, again, were stocked in four principal sizes, 4 in., 2 in., 1½ in. and 1 in., and stacks of these sizes alternated along one siding.

Corrugated iron and steel shelters similarly required one siding each; cement about half a siding; steel joists, half a siding; bridges, two half sidings, etc. Sand-bags and barbed wire alternate well on one siding.

(*b*) Stores stocked in bulk which demanded only small frontages.

For these stores one of the store branch officers —Major Crossley, R.E.—invented what was subsequently known as the "repeat group system." Stores items, usually about 12 in number, were

selected, *e.g.*, tanks, coir lewing, wire netting, wire weaving, etc.; proportionate quantities of each of these were formed into stacks about 50 ft. on the siding front, 75 ft. deep and 15 ft. to 25 ft. high, each store item forming a vertical column in the stack. One 600-yd. siding would contain about 15 to 18 of such stacks. As a result a truck arriving for discharge could be off-loaded to the stack opposite which it chanced to be placed by R.O.D.

Similarly an empty could be loaded from any stack opposite which it stood.

This system worked well, was obviously economical of labour and is strongly recommended for use under similar conditions.

(iv) During the depôt working hours, from 7 hours to 17 hours, with the exception of the dinner interval, the R.O.D. must avoid any rail movement on the depôt sidings. The dinner hour must be made long enough to enable the R.O.D. to move out loaded trucks, place more empties as required, and put in any trucks for discharge left over at 7 hours in the reception *triage*.

The work of making up and dispatching trains will be performed by R.O.D. from 17 hours to midnight: from that hour until 7 hours they will be receiving trucks from ports and shunting to sidings indicated, also in placing empties.

(v) During the afternoon, information and instructions will have been received as regards:—

(*a*) Number of trains allotted to depôt for dispatch by Q.M.G.

(*b*) Railheads vacant (from A.D.R.T.).

(*c*) Stores to be expected *ex* ports during the night.

The balance of the monthly ration of stores due to each railhead being also known, a conference of the depôt staff must be held after working hours to arrange the next day's programme of loading, reconsignments, and discharges, which in its turn may have to be modified by later information and instructions received up to midnight.

Instructions have to be issued to the labelling parties referred to in sub-para. (i).

(vi) It will be obvious that a flexible organization is essential, which will admit of rapid decisions being taken and the acceptance of considerable responsibility by subordinates on night duty.

During periods when the front line was quiet, that is, when no major operations were in hand, it was found, under the conditions prevailing in France, that by arrangements with armies, the monthly ration "stores" for various Corps could be dispatched in "pack" trains with considerable advantage to all concerned. Acting on the railway principle that a minimum train must consist of 30 trucks and a maximum train of about 40 trucks, it was arranged that 30 trucks in each train should consist of a fixed consignment :—

So many trucks of timber.
So many of huts.
So many of corrugated iron.
So many of steel shelters, etc., etc., up to 30 trucks.

The balance up to 10 trucks consisted of stores specially or urgently required by one Corps.

Thus, if at the last moment, as frequently occurred, the railhead of "X" Corps was not cleared for receipt of a train, the 10 trucks special to "X" Corps could be cut off the train, and the 30 trucks remaining consigned as a minimum train to "Y" Corps.

Normally we could send one such train to each Corps every fourth or fifth day. This system had the advantage that a Corps received its ration in regular consignments, the quantity of each consignment being known beforehand.

31. *Shops.*—These must be considered under the sub-heads of :—

(*a*) Factories.

(*b*) Repair shops.

(i) As regards factories, manufacture in bulk at bases has been considered in para. 15.

The general principles of the lay-out have been dealt with in para. 29 (v).

The base factories for timber trench stores in France were required to convert each about 300 tons of timber daily. The imperative necessity will therefore be apparent of an organization which admits of a continuous flow of operations from raw material to completed article in a straight line, thus involving the minimum amount of carry. The proportion of rip-saws, cross-cut saws, and nailing-benches must also be calculated to avoid "bottle-necks." All cross movements must be avoided and subsidiary stores, such as nails, which will also run to tons per diem, must be fed in with the minimum of labour to the right point at the right moment. Organizing capacity is, in fact, of far greater importance than mechanical engineering science.

Moreover, a change of manufacture will involve alterations in the lay-out of plant which may cause a loss of a fortnight's

output. It is, therefore, essential to foresee the total requirements over a long period (12 months, if possible), and to manufacture a monthly average which must be stocked in the depôt—not in the shop area—ready for heavy issues when the seasonal demand arises.

Any attempt to manufacture to indents is fatal to efficiency in the form of maximum output for a given plant and labour. For prisoners of war, task-work; and for civil labour, piece-work, are very desirable. The output on piece-work will be a good guide to the possibilities of task-work.

(ii) Similar principles control the manufacture of articles of iron work: as a general rule, however, base factories should only manufacture in ironwork new standard patterns required by the E.-in-C. until supply can be developed. The reasons for this limitation are sufficiently obvious.

(iii) Factories for construction of such timber and iron articles will obviously best be sited adjacent to a bulk store depôt which can supply the raw material and receive and store the output.

But the general rule for siting a factory must be to place it where the principal raw material can be obtained with the minimum transport.

(iv) Thus factories for concrete blocks for "pill-boxes" or other constructions, will obviously be sited at a gravel pit.

Brick factories will be sited adjacent to clay pits and, in so far as this may still leave an option, to such clay pits as may permit of coal being obtained with the minimum transport.

(v) It may be necessary to consider the manufacture of cement which will certainly be required in large quantities. As, however, a ton of coal is required for the manufacture of a ton of cement, no advantage will be obtained by manufacture in the theatre of war, unless coal can also be obtained and transported to the factory with less disadvantage to transport than is involved in importing cement from the U.K.

(vi) Before leaving the subject of factories, it may be worth while to consider what at first sight many will regard as a minor point; that is to say, what hours should be worked. On this matter, whilst holding no strong convictions, it appears to me from considerable experience, that the following factors should be given due weight.

(*a*) Engineers are not unanimous, but the weight of opinion appears to hold that machinery, like the animal creation, requires a daily rest.

(*b*) It was a noticeable fact that many men who were certainly indifferent to the danger of the front line, who became further inured to its squalor, found almost unendurable the incessant noise. Now base depôts and factories, except for a few of the superior staff, must be run with prisoners of war and men unfit by reason of age or infirmity (often both). It always appeared to me that I could maintain their efficiency better if they could be ensured a few hours' quiet every day. Railway shunting is surprisingly quiet at anything over 100 yards' distance, provided the drivers can be induced to refrain from using their whistles.

(*c*) A night shift is never so efficient as a day shift, and is very liable to interruption by air raids.

Having in view these considerations, eventually a two-shift arrangement was adopted, which gave peace from the scream of high-speed saws and rest to the plant from 23 hours to 6 hours. I am still of opinion that we obtained maximum results from a given number of men, and probably from the plant installed, by working two shifts instead of three.

32. As regards repair shops—this has always been debatable ground and the matter has not yet been decided.

Metal repair shops are required in a theatre of war, supplementary to Army mobile repair shops, for the repair, *inter alia*, of :—

Armament.
Locos and rolling stock.
Mechanical transport.
Engineer plant.

Each of these operations will involve the occasional use of some heavy plant. It is an open question whether repair shops should not be entrusted to an organization separate from any at present existing in Army Establishments who would organize "groups" of shops on, say, each line of supply. The tonnage of material required is not of such proportions as to render proximity to a store depôt or even to a port essential. Again, facility of transport between armies and shops will be the controlling factor in determining a site.

At any rate, they should be kept quite distinct from "factories."

33. *Storeholding, generally.*—Only the fringe of this subject can here be considered.

(i) Generally engineer stores may be divided into a few definite store groups, as :—

Timber.
Trench stores.
Huts and hutting stores.
Water supply plant and stores.
Electric light plant and stores.
Workshop plant and stores.
Bridges and bridging stores.

It will be found that it is easier to define a store by its eventual use than by such generalizations as "textiles," "hardware," etc. Such definition will also result in better depôt organization. In France we made "machinery" one store group. This resulted in difficulties which need not be specified; but my own experience is against a repetition of what I now consider to have been an error.

(ii) An area of a depôt must then be assigned to each of these "store groups;" with a separate store-holding staff and a yard staff. The function of the store-holding staff is to keep the tally records of the stocks of the group, to check receipt and issues, and to know exactly where every store in the group lies, and to see that their area contains no stores belonging to other groups; in general with the *custody* of the stores. The yard staff are assigned the function of stacking in accordance with instructions, generally in accord with the principles laid down under "Depôt Lay-out" and "Depôt Organization;" with the supervision of labour discharging, sorting, and loading; and with safety precautions against fire and theft: that is to say, generally with yard maintenance.

(iii) These group and yard staffs are controlled respectively by a Chief Storekeeper and a Chief Yard Officer.

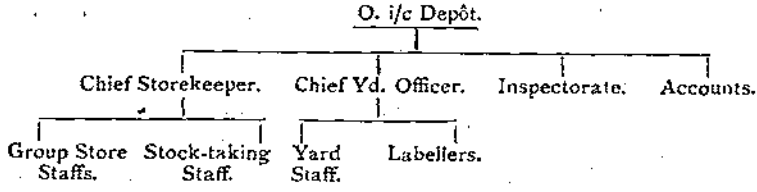
(iv) An inspection staff is essential with plenary powers to pry into everybody's business, with a view to checking correctness of the tally-card stocks, and statistical records, investigating returns, discoveries, stores mislaid in wrong group areas. In addition to such general spy work, they are assigned the duty of obtaining by short circuit methods information required as to the exact position at the moment of any of the multitudinous stocks. Higher authority is apt to expect such information to be telephoned within half an hour of receipt of an enquiry.

In a depôt covering 220 acres this cannot be done by constitutional methods following the normal chain of command.

(v) Finally, an Accounts Branch is, of course, essential.

Unfortunately the Army Accounts System in vogue in 1914–1918 with a view to the prevention of fraud was based on a system which did not lend itself to the recording of the statistical information essential to the E.-in-C's control of the distribution of Engineer Stores. As a result a separate statistical set of records was necessary.

34. The general organization of a depôt of engineer or bulk stores will therefore normally be as indicated in the following table :—



35. An Assistant Director will control the O. i/c Depôt, the various factories, and the port staffs in his area.

36. A Port Officer with a small staff is required at each port, charged with the following duties :—

He will in general watch the interests of his service; report any undue rough-handling of stores; label trucks for his depôt; use his best influence to procure, so far as is reasonable, homogeneous loading of trucks *ex* ship; report to O. i/c Depôt by telephone each evening truck numbers dispatched and approximate contents; and will see that no stores consigned to his Director are mislaid in dock areas.

This is a task which requires considerable tact and energy.

37. Economy of man-power is a most important consideration. In this respect, officers in a theatre of war are apt to lose their sense of proportion and to indulge too much in opportunism. The temptation to do so is very great, for a supply officer is naturally judged rather by his efficiency than by his economy; rightly so, indeed, but nevertheless he must obtain efficiency at the minimum cost.

It is, therefore, only just that he should be given such orders concerning economy of man-power as will take some of the responsibility off his shoulders. He can, if the necessity is brought home to him, so organize work and lay-outs as to reduce the number of "handlings" and the distance of carry to a minimum. He can also curtail the number of "employed" men.

Two orders were, therefore, issued to engineer store depôts in France.

(i) Involved the calculation set forth in the History of the *Supply of Engineer Stores and Equipment*, page 86.
The fundamental idea was that :—

(*a*) On the average no store required to be handled more than three times, once into the depôt, once in the depôt for sorting, once out of the depôt.

(*b*) An efficient lay-out would reduce each handling to an average of 25 yds. carry and 10 ft. lift.

(*c*) That even low-fed prisoners of war could handle under conditions given above 6 tons daily.

Therefore, the allowance of labour could be restricted to one labourer for every two tons received into the depôt in the ayerage day.

(ii) Involved the principle that it is the duty of a C.O. to maintain his men's morale, reduce "casualties" to a minimum, and cut down all "employ" to a minimum; that 5% was about the maximum which could be on leave at a time. Therefore, for every 100 British Military personnel on the strength of his depôt he must produce 75 "on the works." The remaining 25% must include all leave, sick, and all "employed" men. On the whole it was found feasible to work to these two restrictions.

Distribution.

38. It has already been observed that engineer stores have inevitably to be issued on the basis of "rations;" for Armies' demands far exceed the possibilities of supply. It is perhaps doubtful whether Armies could have used all the stores for which they asked; probably demands were framed rather with a view to obtaining, and maintaining, in Army zones a large reserve against any such contingencies as a breakdown of transport or the necessity of constructing an entirely new defence line.

Be that as it may, the demands had to be cut at G.H.Q. to the average of the E.-in-C.'s forecast of six months' requirements.

The ration for the month for each Army having thus been decided by the E.-in-C. on the basis of:—

(*a*) The monthly provision.

(*b*) Special consideration of the operations on the front of the Army concerned.

(*c*) The retention of an adequate E.-in-C. reserve;

The C.E. of each Army communicated to the affiliated depôt, his sub-division of this ration between Corps.

In the spring of 1918 the situation altered with such rapidity that it was found necessary by E.-in-C. to order weekly instead of monthly rations; this fact is worthy of note, inasmuch as the long "settled"

conditions of the western front cannot be regarded as normal; but the general system of distribution was determined by the existing conditions and must not, therefore, be taken too rigidly as a guide to action in future wars.

39. From time to time Corps endeavoured to fix the dates on which trains should arrive, or to fix an order of priority for dispatch. This is frankly unworkable. Depôts must be given a free hand to get up the stores ordered within the period ordered. Bulk stores dispatch cannot be organized on a parcel post system.

40. Moreover, it is necessary that the tonnage to be sent to each named destination should be so divided up as to represent a definite number of train loads. As has several times been observed, it must be accepted as a fundamental axiom that the dispatch of single trucks, or indeed of anything less than a train-load, is prohibited by transport conditions, and, moreover, that one train-load cannot be divided between more than two stations, which must, in addition, be on the same branch line.

41. This condition is somewhat less rigid for distribution in the back zones (L. of C.) but even so the period of transit of isolated trucks is a very uncertain factor.

42. The principal feature to be noted under distribution is that the "ration" is determined by the E.-in-C. and the G.S. based upon information supplied by the supply service as to quantities available in depôt.

RAIL TRANSPORT.

43. Having received from E.-in-C. instructions as to the ration allotted to the various Armies, and the indents of the Director of Works and other branches, the stores branch must now reduce these to tons and train-loads, and then calculate the number of trains required in the month for dispatch of stores.

It will be ascertained from the Q.M.G. staff whether there is a probability of the allocation of the required number of trains. If operations or other considerations render it improbable that a sufficiency of trains can be allocated, it will be necessary to inform the E.-in-C. at once so that he may decide in what respects to reduce his allotment of stores.

44. It did occur that C.E.'s of Armies were on occasions urging the dispatch of stores whilst at the same time the D.Q.M.G. of their Army was allotting all the trains allocated to him for the transport of other stores. The remedy in such event is obviously not in the hands of the supply services.

45. The general principles of rail transportation have been enunciated in foregoing paras. (5, 6 and 7, 10 and 41); the system of dispatch of "pack trains" has been detailed in para. 30 (vi).

46. If the front line be stabilized for any considerable period, it may be possible to relieve rail congestion to some extent by

establishing a line of supply by an inland waterway. In general, however, inland water transport is most efficient when employed for bulk transport between fixed points, and in France was, therefore, of the greatest value in relieving the strain on railways when clearing stores from ports to depôts.

Similarly, in a river war it will normally be employed working between fixed points on a line of supply, and will not be found to be at its maximum efficiency if employed as column transport following up an advancing force.

47. As regards rail transport, the principle to be noted is that the (inevitably) insufficient transport accommodation is allotted by the Q.M.G. and his staff; in consequence the E.-in-C.'s allotment of engineer stores can only be fulfilled if circumstances, or the instructions of the C.-in-C., permit the Q.M.G. to allot sufficient transport.

Decisions giving priority to any special category of store must obviously rest eventually with the General Staff. For example, it is only the General Staff who can decide that engineer stores shall be forwarded at the expense of ammunition, or personnel trains.

48. The vast quantity of engineer stores and, for that matter, ammunition required for a serious attack on entrenched enemy positions, must in effect be got to the required zone, before troop concentration commences. The difficulty of so doing without "giving away" the intended attack to the enemy gives rise to serious reflections which more appropriately belong to the ensuing section.

Reception and Distribution in Army Zones.

49. There was at times some consensus of authoritative opinion that R.E. Corps dumps became of excessive volume during the long period of stabilization from 1915 to March, 1918, on the Western Front. It is not difficult to schedule the arguments both for and against large Corps dumps; it is necessary to do so before attempting a solution.

50. Pre-War regulations and organization envisaged the establishment of an advanced R.E. Park for every two Corps, the park to be an "accounting" unit.

In effect, the R.E. park either formed the nucleus of a Corps dump in some cases, or in others became a "paper organization" accounting for stores which it never handled. In certain cases it was the actual custodian of stores "blacklisted" by the C.E. Army; that is to say, stores which could only be issued on his authority, and were not at the disposal of C.E. Corps.

In the French Army it was apparently a sort of transit store for two annexed Corps dumps. In effect, in the British Army the Corps dump was the recipient of stores *ex* base and was sited on a railway at a safe distance from front line. From it stores were issued

both for Corps use and for the Divisional R.E., involving in the latter case heavy road transport. Divisions were, as a rule, somewhat "independent" in their execution of siege works, and were not compelled to work to an area scheme of works, under control of Corps H.Q. directed by Army H.Q. Under these circumstances C.E. Corps appears to have retained control of trench stores with a view to preventing wasteful use on works not entirely approved by the Corps Headquarters.

51. Reference has already been made in para. 48 to the disadvantages of rushing up large quantities of stores, just before an intended operation. C.E.'s had also an uneasy feeling at all times that rail transportation might be unavailable just at the moment when a forward move of either side rendered necessary the construction of a new trench system requiring heavy consumption of engineer stores. This feeling was, of course, more prevalent when the absolutely front-line trench was considered to be the main fighting line, and was less apparent when this trench began to be recognized as the outpost line.

The result was a heavy accumulation of reserves in the Corps dump, which was again reflected in the accumulation by lower formations of their reserves.

52. Whilst this view must meet with some sympathy, it is essential that the disadvantages inherent in the consequent accumulation of reserves should be more fully realized than was the case.

(i) Such accumulation tends to dissipate and immobilize the E.-in-C.'s reserve of stores. It may well occur, and did in fact occur, that stores urgently required on one sector were not available, because they were locked up in another sector.

(ii) It is very wasteful of stores; one unit has accumulated reserves and is relieved by another unit which regards, and treats, such reserve, as an excellent means of enabling it to execute sundry unauthorized works.

(iii) A Corps dump is not an accounting unit, and although statistics of its stocks were kept, no reliable statistics could be obtained of the stores locked up in minor dumps of lower formations. In any case, not only are the stores immobilized owing to the practical impossibility of moving them back by rail, but they are quite beyond E.-in-C.'s control and are lost to him as a reserve.

(iv) Should the Army make a considerable advance, it must either :—

Abandon its stores dumps; or

Drag them forward, thus encumbering itself with heavy transport; or

Leave men behind to guard the dumps, thus extending its tail at the expense of its fighting head.

(v) If the general organization involves all engineer stores passing through the Corps dump, this spells heavy road transport to the front line, for obviously such large dumps must be kept behind zones liable to heavy shell-fire.

53. The system now to be enunciated is put forward as a suggested solution; it met with the approval of one or two Army C.E.'s, at any rate in principle.

To some extent it presupposes and is contingent upon another suggested general principle, which is that an Army zone should be fixed at a certain depth dependent upon long-range shell-fire. Let us suppose it to be 20 miles deep from the outpost line. This zone would move with the outpost line. Up to the 20-mile limit all administrative operations, such as engineer works of all descriptions, transportation and supply would be conducted by the services of the rear zones (bases and L. of C.), with all the accountancy and other control prescribed for rear zone services. Forward of the 20-mile line, administrative operations would be conducted under orders issued by the Army Command concerned, according to the conditions and circumstances of the moment. For example, as regards rail transport, the line would be treated as a frontier; trains passing across it forwards would be freed from all traffic regulations of the rear zone and would be operated by an Army railhead staff.

54. As regards engineer stores, an advanced depôt would be created just behind the Army zone, into which could be poured such stores as the C.E. Army, subject to the approval of the E.-in-C., might desire to see within his reach as an emergency reserve, which could in emergency be obtained by Army road transport.

The stores would, however, remain on charge of, and be accounted by, the stores branch; and would remain an E.-in-C. reserve.

It is suggested that, with such a reserve within reach, independent of rail transport, issues of stores for current works in progress might be made direct from base to the point on rail nearest to the work, that is to say, to the nearest point on rail which can be operated.

Under such conditions C.E. Army and C.E. Corps would retain control of store expenditure, without actually having to hold and handle stores intended by them for works to be executed by Divisional R.E.

When the Army moves forward it will feel no responsibility then for accumulation in its zone; the advance depôt will be transferred back to base upon the close of the period of stabilization.

Or, if the forward move is only temporary and followed by another period of stabilization, the depôt might be moved forward. In the event of retreat, the loss of stores would at any rate be no greater than under the circumstances which prevailed on the Western Front, and might well be far less.

SUPPLY OF STORES IN MOBILE WAR.

55. It must frankly be admitted that the war on the Western Front afforded little experience which can be used as a guide for the future.

During the final advance in September and October, 1918, the records of the Directorate of Engineer Stores show that considerable quantities of trench stores were still dispatched at the request of Armies. Perhaps we all had a feeling that another period of stabilization might ensue at any moment. For the most part these stores were subsequently found in various dumps staged in the trail of the advance. Conservatism causes the continuance of established habits after such habits have become anachronisms. It can hardly be assumed that an army on the move will normally require train-loads of trench stores. It will require bridges and bridging stores in considerable quantities, and often water pumps, hose and canvas tanks.

56. A bridge may well require the dispatch of a special train to one point, which presents no difficulty. But as regards all other engineer stores, the demands which may be expected require the dispatch of a few trucks at uncertain intervals to various points. It is further obviously very desirable that such trucks should arrive at the front within 24 or 48 hours of dispatch; for an Army on the move will not demand stores before they are actually required.

Unfortunately it is just this class of transportation which appears to be absolutely hopeless; to collect various consignments into a mixed train at all is apt to congest railway sorting stations; and, if an attempt to do so is actually made, the results are usually most unsatisfactory from the aspect of rapid transit.

Try, even now, with slack traffic on the railways, to consign a "parcel" of goods from the Midlands to the South of England by rail and note the number of days or weeks which elapse between dispatch and receipt. In war the difficulties of the railways can but magnify the delays.

57. There is then a difficulty which must be faced, and the solution found.

It was with these difficulties in view that a recommendation was made in para. 10 that all bulk stores should be collected in and dispatched from one depôt. There would then be a reasonable prospect of making up complete trains with stores for various consignees, such as blankets, tents, sandbags, and engineer stores. It was actually found in 1917 that this method had to be adopted to get forward the bulk stores supplied by R.A.O.D. to R.E. parks and Corps dumps. Ordnance depôts were then included in R.E. base depôts. Later we actually took over these stores.

The inclusion further of railway construction materials amongst

bulk stores would render it certain that complete train-loads could be made up. It is absolutely certain that railway materials will be required in the vicinity of any bridge to be constructed.

Design of Field Structures.

58. One subject upon which opinion was fairly unanimous was the necessity of designing any structures, whether bridges, huts, steel shelters or pill-boxes, etc., intended for front-line use, so as to be as nearly fool-proof as possible. They will meet with very rough handling, transport over the barest apologies for roads, may have to be carried down C.T.'s, will be erected often in the dark, and then by semi-skilled men. It is therefore not, merely "very desirable," but almost essential, that they shall be designed to have a minimum of "parts." Steel shelters, for example, should consist merely of 8-gauge or 12-gauge curved corrugated iron sheets with one type of bolt. All the extras which make the shelter look pretty, and incidentally more expensive, when erected as a sample in a manufacturer's yard, are encumbrances and nuisances to the field engineer.

The new type of steel bridge now under trial appears to be exactly what was, and is, required, provided that no fancy trimmings are added at some future date.

59. For all such stores the ideal is a sausage; the field engineer should be able to demand so many feet run of large shelter, small shelter, "M" type hutting, or even of bridge.

With every 100-ft. run supplied of any such article would go automatically a fixed weight of the (one) type of fastener peculiar to it (nails, hooks or bolts).

60. This principle might even be adopted for hutting. The vision before me is of a demand for 1,000 ft. of Nissen hutting.

This would be met by supply of (say):—

1,500 curved corrugated iron sheets.
5,000 ft. run of purlin scantlings.
250 T-iron ribs.
50 doors.
200 windows.
50 stoves,
and so many cwt. of hook fasteners.
Or in lieu of the doors and windows:—
50 "A" type } gable ends might be supplied.
50 "B" type }

This roofing would be erected on walls made of filled sandbags, or over a pit, thus giving more headroom, whilst providing splinter-proof protection against air-bombs.

The floors would be provided either by materials found locally or drawn from timber stocks or by supply, where necessary, of marquee floors.

It may be worthy of note that timber floors amount to half the cost and half the bulk of most types of hut and really impose the limit of supply.

The principles advocated are :—

(i) Provision of roof covering (of the simplest design) from bases.
(ii) Such provision to be on a basis of feet run.
(iii) Provision of either gable ends, or preferably only joinery to be built into sandbag walls from bases; to obviate the field troops requiring skilled artisan labour.
(iv) Construction of walls and floors *in situ*.

This suggestion clearly means the sacrifice of quality to quantity. Climatic conditions and transport facilities will, no doubt, decide on the extent to which such a course is desirable.

ARMY ORGANIZATION.

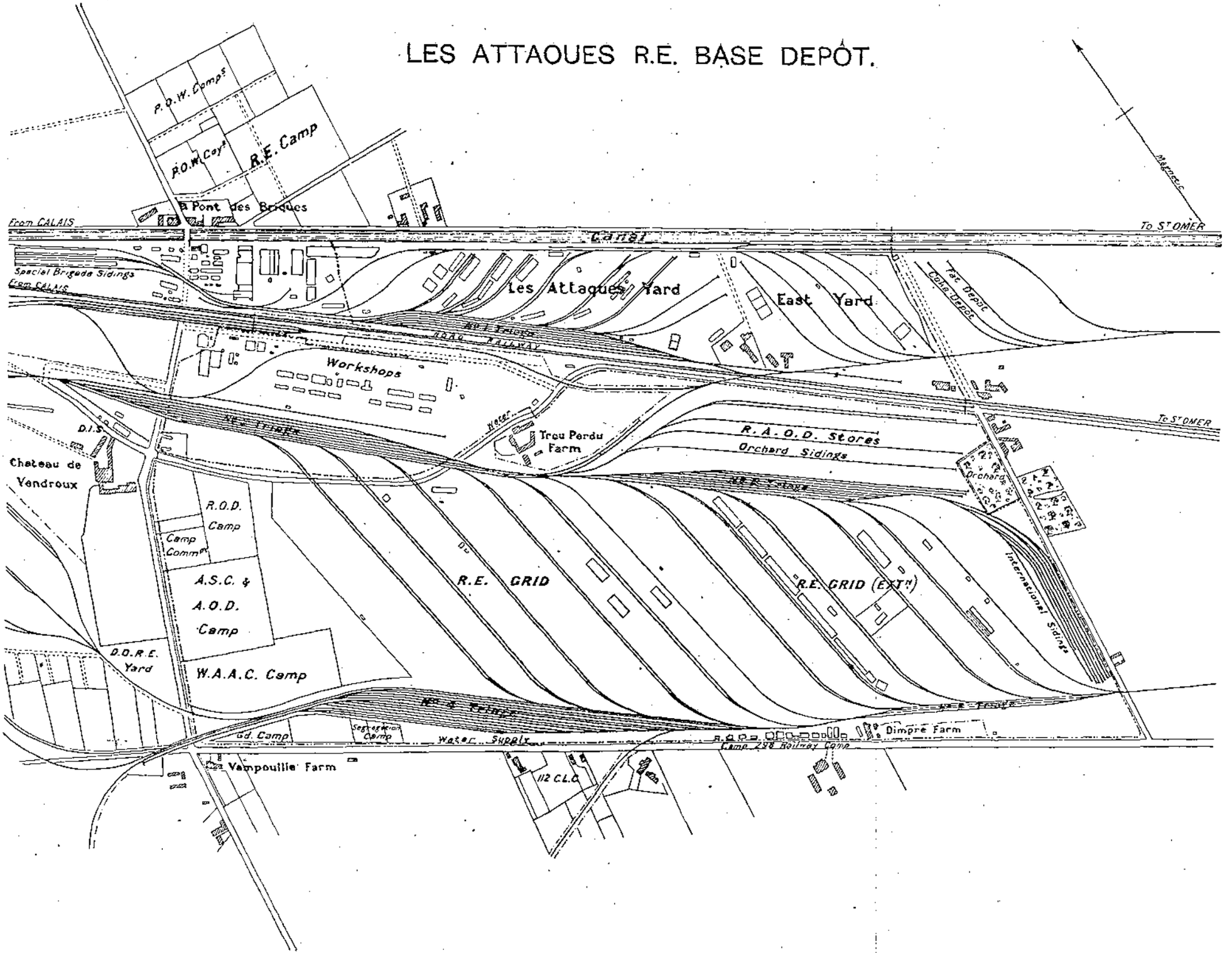
61. During and since 1918 many R.E. officers have appeared to attach great importance to the subject of the relation of the stores branch to the Higher Command.

At the moment the F.S.R. state that "the C.-in-C. will exercise his functions through three principal staff officers." There are no doubt many excellent reasons to be adduced for the alteration of the word "three" to read "one," "two," or "four." Until such alteration has been decided and functions allotted to the x Principal Staff Officers it would appear somewhat futile to attempt to fit the stores branch into any hypothetical new organization of the Field Command.

So far as "co-ordination" is concerned, this word can perhaps be given undue weight; the co-ordination wanted is that which will ensure the maximum supply of the right stores at the right moment at the right place.

Clearly, so far as field engineers are concerned, the E.-in-C.; and so far as rear zone engineers are concerned, the Director of Works, whatever be the organization of the Higher Command, can alone decide upon the class and quantity of stores required and the locality in which they are required. Those problems have their own inherent difficulties, but when these are overcome it must not be forgotten that the real crux of the problem lies on the ability to transport the stores from factory to site, a problem for solution by Q.M.G. branches at home and in the theatre of war. Far too many, not only of R.E. officers, but of civil business men, fail to grasp that bulk stores cannot be got to the site of the work by mere indent for transport on a R.T.O. or the methods of a parcel freight agency.

LES ATTAQUES R.E. BASE DEPÔT.



Stores of the best type and in ample quantities are useless to the R.E. unless they can be got to him; to do so involves the most intimate, constant, and rapid co-operation with all transport services.

Whatever be the higher organization adopted, it must provide for such co-operation as the prime essential. Depôts and depôt organization must similarly be designed in the first place with a view to facility of transport operation.

62. At the same time, the organization must be one which is in sympathy with and "speaking the same language" as the R.E. whom it serves. To this end many, if not most, of its higher staff should be R.E. officers fresh from the command of R.E. units. The ideal staff for a depôt would probably be a triumvirate of a R.E. officer, a "Q" staff officer, and a transportation officer.

PRESERVATION OF COAST LINE.

By LIEUT. G. G. McD. CARR-HARRIS, R.E.

ALONG most shores are to be found large quantities of rip-rap. Although this primary feature is often buried in sand and shingle, yet it was, no doubt, formed by the action of the waves and tidal currents gradually washing away the finer portions of the shore and leaving the rougher. In time the sand and shingle accumulate, if the conditions are favourable, thus forming a secondary feature. It is through the developing of one or both of these two features that a natural protection against the sea is created.

It should be remarked that either natural rip-rap or a shingle beach seem to be the only imperishable protection for an exposed coast line. The success of such an agent is largely due to the perfect foundation which it has, and itself filling in all tendencies to scour. The utility of rip-rap has been generally recognized, but the formation of shingles or bars to a somewhat lesser extent.

The methods by which a beach can be formed may well be examined, and artificial methods for obtaining sand and shingle deposits become of importance. It is, therefore, towards this section of the subject that we shall give our attention.

There are at least two artificial methods for obtaining shingle beaches which have been tried, and which have proved successful :—

(1) The construction of groynes.
(2) The sinking of mattresses or rafts of brushwood.

(1) Groynes are used extensively in England, particularly on the South Coast. These sea fences are built out at an angle to the shore line and collect the drifting shingle. They are usually constructed of planking supported on piles. When the drifting shingle is arrested in them it is heaped up on one side, leaving the leeward side quite bare. For this reason the groyne, if of any height, should be of strong construction. If, however, a low groyne is built, it will not require the same permanence and strength as it will, in all probability, be very soon buried in the shingle. Low temporary groynes of, say, 2 ft. in height, would seem to be best, as they may be raised afterwards another 2 ft. or so.

Mr. E. W. Wheeler's book, *The Sea Coast*, gives a very good description of the system of groyning. In it he says, " After a beach

has been raised to nearly high-water mark, or a little above mean-tide level, the accumulation of shingle will proceed without artificial aid, when there is a continuous supply of drift." It would, therefore, appear uneconomical to construct groynes after high-water mark is reached.

No definite rule can be laid down as to the length and distance apart of the groynes, but as a rule the length can be assumed to be that distance between high-water mark and low-water mark of spring tide; the distance apart being the same as the length, but not usually under 100 yds.

Finally, the movement of drifting material is governed by the carrying power of the water and that carrying power is governed by the speed with which the water moves. This, of course, varies with wind and tidal currents in each locality. Hence, it may be wise, before siting your system of groynes, to make certain by experiment the actual length, type, and position you require for that locality.

(2) The sinking of mattresses or rafts of brushwood. Some time back the U.S. Government undertook extensive reclamation and coast-line protection work along the coast of Florida. The work was carried out by the U.S. Army Engineers on rather a gigantic scale. One of the engineers in charge is reported to have said that, as an ocean barrier, every other method failed except the formation of artificial shingles and bars. The expedient that was used for obtaining these differed somewhat from the groyne.

Saplings and brushwood were roughly interwoven in rafts, say, 200 ft. long, 10 ft. wide, and 3 ft. deep, and the whole secured by chains or strong wire. These rafts, or mattresses, were towed out to position, piles driven through them to fix them, and sunk. This allowed the work of construction to be concentrated in one place where the necessary facilities existed.

In using this expedient for collecting shingle, the direction in which the mattresses lie must be settled. As this location will vary somewhat with the different tides and currents, experiment, again, is the surest way to settle it. In general they would be transverse to the prevailing winds and currents. In this connection it might be well to experiment with several different mattresses over a period of, say, twelve months, before finally carrying out the scheme of defence. In the case of reversing currents, as on tidal seas, the mattresses might be sited to utilize both currents, one system of mattresses for currents right to left, another system for currents left to right.

It may happen that the formation of shingles or bars cannot be effected by either of the two means described, and to show that nevertheless the possibility of doing so still exists, the following instance is given.

The main line of S.E. & C. Railway running between Dover and

Folkestone, follows the sea-front. It is an interesting bit of coast-line; and perhaps the best known landmark is The Warren. However, that particular bit from The Warren to Abbots Cliff, in the direction of Dover, concerns us. Here the sea had seriously threatened the railway at one of its most vulnerable points, *viz.*, where the line entered a tunnel. Every effort had been made to maintain the original coast-line. Groynes had been built, but failed to collect either sand, or shingle. An expert who was called, considered it was impossible to save the line, and as a possible solution recommended the building of a strong sea wall at once. This was done at considerable expense, the wall being little under a mile long, but after a time it was found that scour was occurring at different points under the wall, and it would soon be useless.

However, a suggestion was made to bring a few truck-loads of shingle and dump it where scour had occurred. This was acted upon. The shingle showed signs of remaining, and more of it was dumped. Scour was checked and the wall preserved intact. What is, however, of more interest to us, 102,000 cubic yards of shingle have since been transported and dumped here, forming a broad and expansive beach. This appears to be permanent, and no anxiety is now felt in regard to the safety of the line at this point.

It is curious that groynes built previously failed to collect the drifting shingle, but once the artificial beach had been formed, the shingle, not only remained in the groynes, but accumulated there.

CORRESPONDENCE.

THE LATE MAJOR-GENERAL SIR REGINALD S. CURTIS, K.C.M.G., C.B., D.S.O.

To the Editor, R.E. JOURNAL.

SIR,

May I be allowed to add to the memoir of Major-General Sir Reginald Curtis, which appeared in the June number, a few words of appreciation from one who was very closely associated with him in the later years of his career? He came to Aldershot as O.C. Troops and Companies in the early part of 1910. At that time I was Chief Engineer of the Command, and under a Commander-in-Chief who very thoroughly realized the importance and relative value of R.E. in field operations. Many were the schemes which Curtis and I worked out together, and many were the interesting staff tours and manœuvres in which we had the chance of practising our proposed developments of R.E. work. For Curtis was, by nature and training, one who took wide views. He realized the great value of parade efficiency, but he knew it was only a step to greater usefulness, and must take its due place in the co-operation between R.E. units, with their varied characteristics, and other arms of the Service. There were many opportunities of developing all this, in the annual courses of instruction, in brigade and divisional training, and at manœuvres, and our association in all this is a most charming memory. There were also some great State functions—the funeral of King Edward, the Coronation and visits to Aldershot of His present Majesty—and there are some sad memories, such as the fatal accident to Capt. Beresford, a few minutes after Curtis and I had inspected his troop on a lovely summer morning. Throughout it all there were episodes of a very kind and benevolent character, he was always doing some kind action to some "lame dog," and never saying anything about it. We were associated together in starting the R.E. Old Comrades' Association.

Later on we were both sent to the War Office, sorely against our desires. There we were in different departments, but for all that, in the closest co-operation. During the strenuous years 1914–1916 I do not think there were many days in which we were not in one another's rooms. We knew that the work and the personnel of the Corps had to be in absolute harmony in the great struggle. More than this, we knew that the policy which was followed, often in the teeth of much opposition, might be of very far-reaching influence, so it was not merely a matter of temporarily gaining one's point, but of the future of the Corps in peace and war. Often I sent to him for his criticism the draft of some of my minutes and often I had from him the soundest and most prudent counsel. A more charming and capable colleague one could not have.

But the poisonous atmosphere of Whitehall was too much for him.

He had to work in a dark, stuffy office day after day, while others were able (as I was) to spend a good deal of time on inspections. I do not know whether it laid the seeds of the painful disease of which he died, but I do not think he was ever quite the same again.

During this last year he wrote to me often—brave, cheery letters, full of fun, but with full recognition that he would never recover.

"English in heart and in limb,
Strong with the strength of the race to command, to obey, to endure."

Yours faithfully,

GEORGE K. SCOTT-MONCRIEFF, *Major-General.*

REVIEWS.

ENGINEER TRAINING, 1922.

THIS little book is excellent, and the officer responsible for compiling it deserves congratulations, not only for the soundness of the principles inculcated, but for the clear and terse expression of them. Past experience has shown the gradual development of engineer training, from the days prior to the South African War when it was carried out on a rigid principle, entirely apart from other troops, and with little higher supervision (from C.R.E.'s or Generals Commanding), to the early years of the present century, when co-operation and tactical combination of all arms began to be established and Divisional C.R.E.'S were appointed. Now, at last, the lessons of the Great War have shown that "throughout their training all ranks of *engineers* must be taught to realize the close relationship between their own rôle and that of the other arms in battle" (pp. 2 and 3). This is a great step gained, and a further advance is to be found in the new departure that "higher commanders will arrange for the temporary attachment of engineer officers and N.C.O.'s to branches of the service other than their own. Similarly, officers and N.C.O.'s of other branches will be temporarily attached to engineer units. Higher commanders will create opportunities for training the various arms together by means of combined exercises and operations" (p. 3).

This is a sound and admirable foundation, and in reading it one cannot but regret that it was not realized long ago.

The application of sound principles to the details of training is equally good. It is pointed out (p. 4) that, while an officer cannot possess the manual dexterity at a trade which any of his men may have, he has knowledge of the application of that trade, and that knowledge enables him to use the dexterity of the other to the general advantage. He must be as zealous of his men's trade proficiency as he is of their smartness and skill at arms (pp. 34, 35), for the efficiency of his unit or section is dependent on both military and civil qualifications, and the combined value of these may be incalculable in many operations of war.

The broad principles of command and training, the delegation of authority, the power to impart knowledge, the influence of personality, which are common to all branches of the service are reiterated with special reference to the organization of engineers—an organization which

owing to the size of the units and the trade occupations of the men, lends itself well to the exercise of discipline, mutual working between all ranks and delegated command.

Chapter II. gives a short summary of the training of R.E. officers. This is a valuable departure from previous publications, for it defines the aims and scope of the S.M.E. training to an extent which is not only valuable to engineer officers themselves, but is useful to other arms also, leading them to know—what otherwise they could not possibly know—how much to expect from any R.E. officer. The programme is a very extensive one, but at all events it is definite and precise. That in itself is of value, for at one time, not very long ago, it was largely left to the instructors at the S.M.E. what subjects they should follow in their special branch. Another useful innovation is the announcement that certain officers should be attached to representative engineering firms in Britain or the Dominions.

Recruit training, which forms the subject of Chapter III., deals with the military training common to all arms and also to the special training for sappers, recognizing that the diversity of employment of different engineer units must admit of certain elasticity in progressive instruction. The annual training dealt with in Chapter IV. defines, among other matters, the relations of the chief engineer of a command, and the C.R.E.'s of divisions, and of districts, to the engineer units in the matter of annual training. This, too, supplies a want, for, prior to 1914, there was ambiguity on this subject. The relative position of units and the works staff in connection with the employment of men at their trades is also given. Some of the paragraphs dealing with training in conjunction with other arms are specially sound. The work of engineers in war, being either constructive or destructive, cannot readily be imitated in peace, and "from its very nature it involves a considerable expenditure of time and money, both of which factors militate against the production of war conditions on manœvres with sufficient reality. Care must be taken therefore to guard against the formation of erroneous impressions as to the part played by the engineers in battle." This is very sound wisdom, and it is earnestly hoped that all arms will take it to heart.

The collective training of field squadrons and various classes of companies is next dealt with, obviously based on recent war experience. The characteristics of each unit are recognized in their special training. Emphasis, in field units, is laid on engineer reconnaissance, and on *liaison* with other arms, both vitally important matters. In connection with railway companies it is noticeable that the training will be directly under the War Office. The programme for these units is large, and it seems doubtful whether facilities for a large proportion of it are available ordinarily.

Chapter V., dealing with drill, calls for no special criticism, except to say that the excellent principle is laid down that the first-line transport of engineers, being an integral part of the unit, must not be separated from it. This has, of course, been known to R.E. officers for at least 35 years, but other branches of the Army have not always realized the fact. The drills based on this are very simple.

Part II. (Chapters VI. to X.) deals with war, and, while some of the chapters await the publication of F.S. Regulations dealing with specific subjects, others deal with practical matters resulting from war experience of a valuable nature. There are several most important principles enunciated. One of these lays down that, while engineer work must be carried out according to the conditions of the tactical situation and with the plans of the commander, yet, as time is an important factor, the engineers must receive early intimation of a commander's requirements. This is one of the most urgent necessities of successful R.E. work and emphasizes the necessity for close touch between the General Staff and the R.E.

It is hardly possible, in the necessarily limited space of a short review, to do justice to the admirable summary—some fifty pages—of the duties of engineers given in this section of the book. It deals with the nature and control of work, technical approval of designs, responsibility for and methods of execution of work, inspection of work and units, precautions, duties on the march, water supply, passage of rivers, bridging, road-construction, attack, defence, retreat, position warfare, co-operation with other arms, duties of Corps engineers and of Army engineers. Possibly some of the subjects are treated in rather too detailed a manner, and therefore encroach a little on the functions of a manual of field-work instruction. On the other hand, this is a good fault, if indeed it be a fault at all, for it is better to have an important point repeated than to allow it to be omitted on the understanding that it will come up in some other publication.

The book generally is very compact and easily read. It will be invaluable not only to R.E. officers, but to higher commanders, to the General Staff, and to those who are responsible at Headquarters for supplying R.E. needs.

G. K. S.-M.

LA RUÉE VERS CALAIS (15 Octobre–13 Décembre, 1914).
Par le GÉNÉRAL PALAT (Librairie Chapelot, prix 12 *fr.*).

THIS book of nearly 400 pages forms the eighth volume of General Palat's work, *La Grande Guerre sur le Front Occidental*, but is complete in itself, giving the story of Battle of the Yser and the First Battle of Ypres. The progress of the fighting each day in the various sections is described in detail, working from north to south, the account of the action of the British Army being taken from Lord French's dispatches and from his book, "1914." Needless to say, the action of the French troops is given in greater detail than that of their Allies, and it is well that the magnitude of their effort during this momentous period of the War should be fully recognized, and that the debt of gratitude owed to Foch, Grossetti, D'Urbal and Dubois should be acknowledged. Their incorrigible love of the attack, even in the most desperate conditions, is very striking, "le parti le plus audacieux est souvent le plus prudent," but did not increase the popularity of some of the junior staff officers, who had to carry their orders among the fighting troops, as in the case

of the officer who was nick-named "en honneur de son nez, 'le Tapir de Flandres.'" "A entendre ces jeunes sots, tout devait tombre devant nous et l'ennemi n'existait pas," was the remark of one exasperated general. The narrative is illustrated by five small sections of the 1/40,000 map, which is probably the most suitable method that could have been devised to meet conditions which changed daily, and often many times a day, but a key plan would have been helpful to the reader who is not already well acquainted with the ground.

F.E.G.S.

NOTICES OF MAGAZINES.

MILITÄR WOCHENBLATT.

No. 39.—In an article by General von Zwehl the percentage loss in officers in the various branches of the German Army during the War is given as 75·3 per cent. for Infantry, 7·4 per cent. for Cavalry, 8·5 per cent. for Field Artillery, 3 per cent. for Garrison Artillery, 3·3 per cent. for Engineers and 2·5 per cent. for the remaining branches.

General von Kuhl defends Ludendorff against Dr. Delbrück's attack in his recent book entitled *Ludendorff's Selbstporträt*, according to which Tirpitz and Ludendorff are responsible for the destruction of the German Empire.

A paragraph is devoted to the equipment carried by the infantry soldier. It quotes 25-30 kg. as being the standard weight usual in Europe before the war. It describes how the conditions of the late war made for a material increase, but points out that science has proved that this increase cannot be made without destroying the efficiency of the infantry soldier. This, under modern fighting requirements, is declared to be truer now than ever before. A satisfactory solution to the problem has yet to be found.

No. 40.—Lieut.-General von Altrock, in *Geschichtliche Betrachtung zum Bismarcktage*, pleads for a united front among all political factions in all that concerns German Foreign Policy.

No. 41.—Little of special interest.

No. 42.—The new *Berufspflichten des deutschen Soldaten* $L2\frac{4}{5}$ supersedes the former *Kriegsartikel für das Heer und für die Marine.* It consists of fifteen articles which have to be read out to each recruit and repeated annually.

It lays stress on the virtue of honour, obedience, duty, courage, patriotism, fidelity, comradeship and clean living, and points out that the private soldier can attain even to the highest positions.

No. 43.—A favourable review of Volumes I. and VIII. of General

von Freytag-Loringhoven's book on the Great War 1914–1918 appears. These are the first two volumes published. They are sub-divided into sections written by various military experts, the whole being edited by Freytag-Loringhoven.

The first volume contains seven sections dealing with the war from the beginning till the Spring of 1915. The first section deals with the political reasons for decisions taken at the beginning of the campaign; the second with armaments on land; the third gives a summary of operations; the fourth deals with the campaign on the Western Front till the middle of September, 1914; the fifth with the rescue of E. Prussia; the sixth continues with the war on the Western Front till the middle of April, 1915, and the last describes the war on the Eastern Front during the Autumn and the Winter, 1914–1915.

The first section in Volume VIII. deals with the expansion of and the recruiting for the Army during the war; other sections with the provision of horses, arms and munitions. Later sections describe the work of the Engineers, Signal Service, Army Service Corps, etc.

The *Militär Wochenblatt* quotes the following progress report on the work of the disarmament commission from the latest information supplied by the *Reichstreuhand Gesellschaft* :—

	Number.	*Destroyed.*	*Remaining undestroyed in Store.*	*to the Govt. or to the Allied Powers.*
Rifles and Carbines ...	5,879,256	5,855,979	8,588	14,699
Machine-guns	104,477	104,084	14	379
Mine-throwers and Barrels	28,440	28,440	——	——
Guns and Barrels	54,415	54,415	——	——
Gun-carriages	27,869	27,869	——	——
Loaded Shells and Bombs ...	38,770,000	35,400,000	3,300,000	70,000
Rifle and Hand-grenades ...	16,500,000	14,400,000	2,100,000	——
Detonators	60,100,000	59,300,000	800,000	——
Rifle Ammunition	468,000,000	425,000,000	35,000,000	8,000,000
Aeroplanes	14,014	13,381	4	629
Motors for Aeroplanes ...	27,711	24,045	15	3,651 (delivered up without destruction)

No. 44.—Major Saring tells us that the reorganization of the Russian Red Army can be regarded as complete. It consists of approximately 1,500,000 men. Various courses of instruction up to three years' duration have been started for leaders.

Trotzky is the Chief of the Army, with Skylzansky as his deputy. Particulars concerning the higher command with names of those holding office are given.

H. de C. TOOGOOD, *Capt.*, *R.E.*

REVUE MILITAIRE GÉNÉRALE.

February, 1922.

The Czecho-Slovak Mobilization.—The arrival of Karl of Hapsburg at Odenberg on 21st October, 1921, to assume the Hungarian crown raised a difficult situation for the states of the Little Entente; at first the Hungarian government seemed little inclined to oppose him. Czecho-Slovakia was the first to realize the danger of this violation of the peace treaty, and determining to act energetically for the general good ordered the mobilization of the five classes 1895–99. The Army, constituted after the Declaration of Independence from Czecho-Slovak formations which had fought with the Allies, and of national units incorporated during the war, was increased later by units repatriated from Siberia, but the formations lacked homogeneity, and material was incomplete. In March, 1920, every citizen of Czecho-Slovakia without distinction of nationality had been made subject to compulsory military service. Owing to the numerous nationalities represented in the Republic, Czechs and Slovaks, Germans, Magyars, etc., it had been ordained, in spite of the technical difficulties, in order to ensure consistency, that recruiting was to be national and not regional, and that not more than 30 to 50 per cent. of other nationalities were to be incorporated in each Czecho-Slovak unit. The work of organizing the Army on a war footing had been in hand during the three years 1919–21 under the direction of a French Military Mission; 12 Divisions, each of two brigades of two infantry regiments, had been completely constituted, with divisional artillery consisting of two groups of field batteries, a mountain battery and a heavy battery, two companies of engineers, a squadron of cavalry, and necessary services. Besides these there were two mixed mountain brigades, each consisting of two infantry regiments, a regiment of two groups of mountain artillery, a company of engineers, a squadron of cavalry and services; also three brigades of cavalry of three or four regiments, and an artillery reserve of a certain number of regiments of field and heavy artillery. This organization was far enough advanced to allow of the Army responding to the effort demanded from it on mobilization. The various operations—calling up the reservists, completion of formations and commands to a war footing, dispatch of reinforcements to formations already in the field, and creation of new formations—were completed in good order and in the time prescribed. Seventy-six per cent. of the 300,000 men affected by the order presented themselves within the regulation period, which for various reasons may be considered very satisfactory, and constituted a direct denial to the propaganda of Magyar irridentism. Both Slovaks and Ruthenes responded to the call, thus testifying their attachment to the new state and their intention to withdraw from Magyar influences. Germans of Bohemia and Magyars of Slovakia were equally ready. The material mobilization was equally satisfactory, only 45,000 men were incompletely clothed at the depôts, and this could have been remedied in less than a month. Czecho-Slovakia possesses more than half the industries and nearly all the war industries of the old Austro-Hungarian Empire, and

the War Ministry had ascertained that the mobilized industries, besides satisfying the demands of the Army, could lend effective aid to the states of the Little Entente, and their faith was justified. By the light of the industrial mobilization Prague appears as the industrial centre of the Little Entente in case of war, and representatives of the latter have discovered this for themselves.

The capture of Karl and submission of Hungary did not permit of testing the Czecho-Slovak army in the field, but the discipline and smartness of all units are proof of their real military value. No untoward incident marred the mobilization; transport, even from Moravia and Bohemia to the Hungarian frontier, worked without a hitch and without interfering with the normal traffic of the railways, and the deployment of the covering troops took place according to plan. It was in conjunction with the Little Entente that Czecho-Slovakia undertook the conduct of the war against the Hapsburg dynasty, and during the whole crisis the various general staffs were in close touch, and the states of the former have learnt the valuable services which the army and industries of the latter can render. A confidence has been produced which will bear fruit in the future. At home the experience of the civil and military authorities in working together for a patriotic end has created an atmosphere of mutual trust from which the army will be the first to profit. The insight gained by the G.S. will enable them to perfect their machinery for mobilization.

With Regard to the Offensive of March, 1918.—By Major Toussan.—The writer considers that when Ludendorf decided on his huge offensive of March, 1918, he can hardly have expected it to be a success. With so many factors in his favour he was yet short of draught horses, cavalry and tanks, and, realizing as he did the depth of the thrust he must make to secure a strategic success, it is hardly likely that he can have hoped to gain full advantage from the effort. At any rate, after seven days of fighting, on the evening of 27th, he realized that the German infantry had shot its bolt and could advance no further, while his objective, Amiens, had not been taken. Discussing this with his staff he regretted that he had no cavalry to exploit the success, and sketched for them the part cavalry could take in holding open the breach in the line between the British and French to allow his infantry to deploy beyond it. Even if the cavalry had been there, their training and equipment had been so neglected that they would have been incapable of effecting what would be required of them, and he thereby acknowledged that it would have been worth while to have retained properly trained cavalry. An interesting article.

March, 1922.

The Revision of the Regulations.—A continuation of the article by "Lucius," 5th period continued. (1) Those operations which appear most successful at first may lead to ulterior difficulties, and before engaging in them it is necessary to have considered the means by which continual superiority may be maintained. (2) A success may more often be exploited than is generally supposed, and such an occasion should always be thought of as possible, even in operations with limited

objectives. (3) The enemy artillery need not be destroyed, it can be neutralized, and by this means the length of the artillery preparation reduced, and surprise obtained. (4) The use of masses of tanks allows of surprises being realized. Finally, the success of offensives with limited objectives depends on the mass of material means employed, which cannot be utilized in like proportion in wider operations. Their advantages are the achievement of easy successes, the elimination of risks, and a sensible decrease in casualties.

IV. The Instruction of 31. 10. 17 *on the Offensive Action of the Larger Units in Battle. The Triumph of Method. A New Conception of Continuity.*—The compilers of the new Instructions did not embody all the deductions made from the operations of the second half of 1917, but the conception of offensive operations was profoundly modified. The defensive system was considered to be too deep to admit of being breached by a single thrust widely enough to bring about dislocation of the whole, and as a result offensive action was to be characterized by successive attacks on strictly limited objectives (normal, intermediate and eventual) determined by the possibilities of artillery action. Conducted methodically on as wide a front as possible the offensive would aim at piercing the enemy's successive positions by successive attacks on limited objectives, the system advocated in the Instruction of January, 1916, but the conduct of the attacks very different. In a word, if the first attacks should be simultaneous, along the whole front selected, to effect surprise, the later ones would be separated by intervals of space to be attacked alternately but in such a way that the enemy is everywhere threatened. The preparation of the attack on each interjacent space is governed by the change of position of the artillery, the preparation of communications, the collection of materials and food, alterations in the infantry dispositions and by the artillery preparation or assembly of tanks, and each attack would aim only at the occupation of a single enemy position. Strategic surprise must be sought for by manœuvre, *i.e.*, by opening attacks on several points of the front in order to puzzle the enemy as to where to employ his reserves; tactical surprise by deceiving him as to the exact time and place of the attack, and submerging him by the rapidity of the advance. If tanks are available the artillery preparation might be entirely omitted, if not, the latter must be shortened by neutralizing the enemy's artillery, his concentrations and observation posts, with gas-shell, at the moment fixed for the attack. Still, even now the artillery preparation is estimated to last for three or four days, and neutralization during the artillery preparation, which proved so useful at Malmaison, is not advocated. Preparations of every sort must be carefully camouflaged, and to ensure secrecy the diffusion of orders must be strictly limited.

The *exploitation*, now termed the *development* of the success, though proved possible by the events of 1917, is so hedged about with restrictions as entirely to change the character given to it in the Instruction of 16. 12. 16. In a first phase "development of progress through the fortified position," it is laid down that the advance, gradual and methodical, is not to extend beyond the eventual objective

except by order of the Army Commander. Its object is to widen the breach, and as this is widened cavalry can be employed to preserve contact with the enemy. The artillery will not be able to ensure barrages, the protection for the advance will consist in the enemy's disorganization and the capture of his batteries. In a second phase, "development of the advance into open ground" progress, still regulated by the higher command, will be characterized by greater rapidity, and it is in this phase that the larger cavalry formations will be employed in advance of the other troops. Still the result will be delay, and the almost total extinction of initiative in subordinates, whose activities are limited to reporting to the higher authorities chances of success, and of preparing to take advantage of them should an order to do so be received, but if favourable opportunities are to be seized the command should be decentralized. Method is also insisted upon in the preparations for the attack by the elaboration of innumerable plans, revised and corrected in each higher formation, involving great inconvenience and serious loss of time.

The Instruction of 31st October lays down as a principle that the larger formations will be formed by temporary groupings having sufficient offensive capacity in depth to carry an attack through to its conclusion (2,000 to 3,500 metres). The Army Corps will normally comprise two to four infantry Divisions. The Division becomes the unit of attack, the useful width of an assaulting battalion being 300 to 400 metres, and its depth of advance 800 to 1,200 metres; the Division of three regiments will occupy about 1,200 metres of front and penetrate 2,000 to 3,000 metres. The employment of each arm in the different phases of the battle is carefully regulated, that of air-craft in particular, and stress is laid on the importance of mastery in the air. The employment of tanks is also precisely set out. Attention is drawn to the necessity for good *liaison* and communications, and the conditions for success, omitting surprise, which has already been dealt with, are stated to be superiority in equipment of all kinds, complete preparation by conditioning command and troops, by the preparation of plans, by the execution of works of offence and by collaboration between all arms. In short, the Instruction evinces the triumph of method over rapidity; offensive procedure becomes more rigid than ever, and except for its insistence on surprise is a retrograde step in the domain of tactics. It codified the results of long experience of a war of position, but did not educate for the exigencies of open warfare although the disintegration of the enemy's position was provided for, and this, if realized, must lead to fighting in the open until a new organized position is met. The Instruction erected into a system what should have been considered only as a temporary expedient. The infantry were now persuaded that they could do nothing without the support of a powerful artillery, but it should have sufficed, as true at the time, to bring this to the notice of the higher commanders, and not to have sown the idea broadcast through the Army, of which the resources of the infantry arm had lately been largely augmented.

V. The Defence of Positions.—(1) From the German side. The

results of the battles in April and May, 1917, were satisfactory on the whole to the Germans, except that the battering-ram tactics led them to distrust any work of fortification as a shell-trap. Ludendorf set to work to counteract this impression, and argued that if the strongest works could be destroyed the greater the necessity for making them more numerous and complicated, employing camouflage to deceive the attackers as to the principal line of resistance, and induce him to waste his ammunition. The front trenches need not be remade, but the craters joined up to form a line of advanced posts after the battle; (2) since the enemy tried from the first to capture the artillery, the guns, minenwerfer and machine-guns must be distributed in depth; (3) to diminish casualties the infantry must be disposed in greater depth, with fewer men in the front line, which was to be considered as an advanced position, while reserves were at hand without crowding the advanced lines. More mobility of both infantry and artillery should be attempted, especially by advancing into the less bombarded or more sheltered sectors. Finally, no ground was worth holding at all costs; an opportune and voluntary retirement would have no demoralizing effect, while the stubborn defence of unfavourable localities would destroy confidence in the commanders. It must be understood, however, that without the decision of superior authority the soldier's duty is always to preserve intact the ground entrusted to his defence. Under these circumstances the fight for the first line resolved itself into a fight for the first position. As to the employment of the reserves, he considered that too many infantry were often employed in counter-attacks; it was not necessary to engage the whole formation when part would suffice, and a counter-offensive should never be ordered unless the expected results would justify the anticipated losses. The artillery should economize ammunition by well regulated fire intended for destruction, instead of mechanical barrages which produced little result. In fact, the German doctrine had evolved very little since the end of 1916, the most important advance being that not the first line alone, but the first position as a whole was the object to fight for.

(To be continued).

A. R. REYNOLDS.

THE MILITARY ENGINEER.

IN the May–June, 1922, number of *The Military Engineer*, under the heading "With the Rank and Pay of a Sapper," a letter is quoted which had appeared in *The Infantry Journal* of March, 1922, from an officer who took part in the St. Mihiel offensive on 12th September, 1918. In front of the attack, in No Man's Land, ran the Rupt-de-Madt, a little stream of unknown depth and width, for which Division Orders required the engineers to build bridges in parts, carry them up to the jumping-off line the night before the attack, and go over the top with the first wave of infantry and place the bridges across the stream. In the attack the writer found only a small stream about thigh-deep, and that no bridges were necessary. After he had arrived at the first objective, in fog and smoke screen, he saw one of the sappers carrying his heavy load of

bridging material, and enquiring where the river was to be found. He had carried his piece of the bridge through the stream and beyond it. Commenting on this incident, *The Military Engineer* writes :—

While it magnificently illustrates the spirit of the American soldier, it does more than that—it illustrates the need for an efficient distribution of Engineering Intelligence as distinguished from psychological, strategical, tactical, industrial and economical intelligence of the enemy, which are the particular spheres of the Military Intelligence Division of the General Staff.

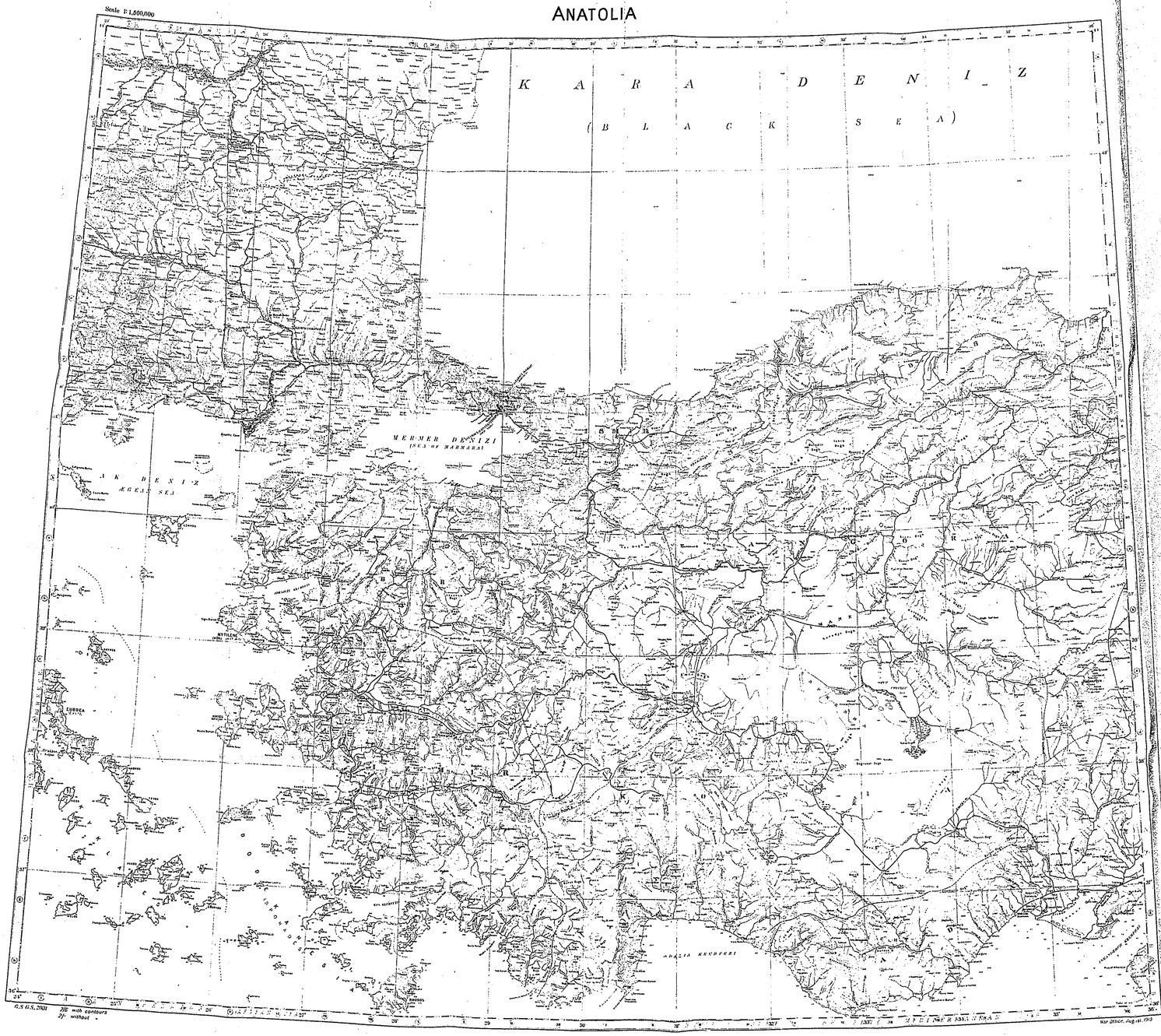
Major Emery states that the Rupt-de-Madt was "a little stream of unknown depth and width—*unknown because the Germans had been in there for four years.*" As a matter of fact, a group of Engineer officers, working in the offices of the M.I.D., began in the fall of 1917 to compile data concerning streams, roads and bridges in enemy territory, giving dimensions, clearances and other data pertinent to transport operations. Another group working in the office of the Chief Engineer, but in close *liaison* with the M.I.D., made a series of studies on water supply. From both of these sources information concerning the Rupt-de-Madt was available at the time of which Major Emery writes. The water supply studies contained data as to volume of stream-flow and clearly indicated that the Rupt-de-Madt was a rather insignificant stream, particularly during the summer low-water stages. The other studies listed every bridge upon it and gave dimensions indicating the width of the stream.

All this data was printed and released for distribution as "Intelligence Documents," but for some reason they failed to reach the officers of G-4 and the Engineers whose duty it was to prepare engineer annexes to the Operations' plans.

Keen and able as they were on the "Order of Battle," the morale and similar information concerning the enemy, there were very few officers in the M.I.D. service who appreciated the significance of hydrologic and geologic reports or the possible effect on military operations of insufficient or faulty engineering reconnaissances. Then, too, secrecy and caution in collecting and distributing intelligence were often carried to such excesses as to defeat the very object of compiling the data. This appears to have been the case in the instance mentioned by Major Emery, for the necessary information was actually in the hands of the American forces, but unfortunately was locked up somewhere in idle storage.

F.E.G.S.

ANATOLIA



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