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THE INSTITUTION OF ROYAL ENGINEERS.

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MOUNT EVEREST.

By MAJOR H. T. MORSHEAD, D.S.O., R.E.

THE following notes by one who had the privilege of serving as a member of the Expeditions of 1921 and 1922, have been written in response to a request from the Editor of the *R.E. Journal* for an article on Mt. Everest. It is hoped that the subject, though devoid of any technical or military importance, may yet, perhaps, prove of sufficient general interest to appeal to readers of the *Journal.*

Permission to use the accompanying maps and the illustration "Mount Everest at Sunset" has been kindly given by Mr. A. R. Hinks, C.B.E., F.R.S., on behalf of the Mt. Everest Committee, the owners of the copyright. It will be noticed that the spelling of place-names on the maps differs in certain cases from that used in the text—the latter being the form accepted by the Survey of India.

INTRODUCTION.

Mt. Everest is situated in latitude N.27°:59′ and longitude E. 86°:56′, on the main axis of the Great Himalaya Range which here forms the Indo-Tibetan frontier. A glance at the map of India will show that here, in the neighbourhood of Sikkim and Eastern Nepal, the Himalaya undergoes a marked change of direction; after trending for 1,000 miles in a general east-south-easterly direction, the mountains in this region turn due eastward, or slightly north of east, for a further 500 miles, towards the Chinese frontier. It is a significant fact that four out of the world's five highest summits* occur in the immediate neighbourhood of this bend in the axis of the range.

Mt. Everest, or rather its giant satellite Makalu, overlooking the gorge of the Arun river, provides an example of the curious law which has often been noted in the Himalaya, regarding the occurrence of high peaks in close association with deep gorges. The Arun river is an important tributary of the Kosi, itself a feeder of the Ganges; it carries the drainage of the Kampa and Tingri plains southwards through the Himalaya range, yet, with an available length of 200 miles along the range out of which to choose its passage, it has elected to pierce its gorge (at a height of 7,500 feet) within 18 miles of the summit of Makalu (27,790 feet.)

* Everest, 29,002 ft.; Kangchenjunga, 28,150 ft.; Everest S. Peak (Lhotse) 27,890 ft.; Makalu, 27,790 ft.

On a clear day, Everest is visible from the plains of northern India at a distance of over 100 miles. It may also be seen, at a slightly closer range, from the neighbourhood of the hill-station of Darjeeling; but, owing to its great distance, it appears a comparatively inconspicuous object, and has consequently never been deemed worthy of a name by the natives of India.* Among the Tibetans, the mountain is known by the name of "Chomo Longma" or "Chhama Lungmo"—a phrase which has been variously interpreted as: "the liberal-minded fairy," "the goddess-mother of the country," "the place of the female eagle," and "the mountain which is so high that a bird is blinded by flying over it!" Personally, I prefer the first of these renderings!

Up to the middle of the last century, Kangchenjunga was believed to hold the supreme place among the mountains of the world. The discovery of Everest as the world's highest summit was made by an Indian computer when working out the results of some observations taken by the Great Trigonometrical Survey of India three years previously. About the year 1850, the field-work of the principal triangulation of India had been extended northwards over the whole peninsula, and was being brought to a close by a series of long rays to numerous "intersected points" along the snowy ranges of the Himalaya. The computation of the results of these observations entailed several years of work in the survey offices at Dehra Dun, and the story is on record in the office archives of how one morning the excited Bengali assistant rushed into the room of his chief, waving a sheet of paper and exclaiming: "Sir, I have discovered the highest mountain in the world!" The height, as then deduced from the mean of six rays averaging 111 miles in length, came to the now familiar figure of 29,002 feet. As the result of subsequent additional observations, combined with an improved knowledge of the laws of terrestrial refraction and of the deflection of the plumb-line at the stations of observation, this figure is now believed to be too low by approximately 150 feet.

In the absence of any native Indian name, the Surveyor-General, Sir A. Waugh, decided to christen the mountain after his distinguished predecessor, Colonel Sir George Everest, under whose direction the triangulation had been carried out which resulted *inter alia* in the discovery of the mountain. Mt. Everest thus forms the only exception to the accepted rule forbidding the use of European proper names for Himalayan peaks. The title has now been so long firmly established throughout the English-speaking world as to preclude

* On the expedition of 1922, General Bruce's Gurkha orderlies usually referred to the mountain as "Himal chuli" which may be translated as "the rocky snow-peak," but this cannot be regarded as a proper name.

the possibility of any change. It is noteworthy, however, that the name Mt. Everest has not hitherto been accepted by Continental geographers, who, relying on an erroneous observation made by the Schlagintweit brothers 75 years ago, still persist in calling the mountain Gaurisankar. Gaurisankar (called by the Tibetans "Chomo Tshering") has long been known to be an entirely distinct mountain, 35 miles west of, and 5,560 feet lower than Everest. It is regrettable that the publishers of a modern standard British work such as the new *Times Survey Atlas* should see fit in the year 1920, to perpetuate this confusion by labelling the world's highest summit "Mt. Everest, or Gaurisankar."

For a period of 60 years after its discovery, access within 75 miles of Everest was barred by its position on the frontier between Tibet and the Native State of Nepal, both of which territories have for the last century and a half been normally closed to European travellers.* About the year 1912, however, consequent on the decline of Chinese influence in Tibet, an expedition to Mt. Everest through Tibetan territory first began to appear as a practical possibility. Major Rawling of the Somerset Light Infantry, a well-known traveller on the Tibetan borderland and in New Guinea, was planning an expedition of reconnaissance for the summer of 1915, to be followed by

* It is worthy of record that in the 17th and early 18th centuries, both Nepal and Tibet appear to have been freely open to European travel. In both countries, Capuchin and other mission stations maintained a precarious existence for many years. The earliest recorded European travellers in the neighbourhood of Mt. Everest are the German Jesuit, Johannes Grueber, and his Belgian companion Albert de Dorville, in 1661–62. Grueber, who occupied the position of mathematician to the Court of Peking, received a summons to Rome early in 1661. The sea route being closed owing to war with Holland, Grueber was instructed to discover a route to Europe overland. Travelling by way of Sining Fu and Lhasa, he thence proceeded south-west to Katmandu and India *via* Kuti (Nyenam) and the valley of the Bhotia Kosi river—finally reaching Italy through Makran, Persia and Asia Minor. Grueber made sketches of his route, and also carried an astrolabe with which he took occasional observations for latitude. His results exhibit a general mean error of about half a degree.

During the first half of the 18th century there appears to have been frequent traffic across the Himalayan passes between the Capuchin mission then existing at Katmandu and the various branch establishments in southern Tibet. The only journey, however, of which a record exists is that of Cassiano Beligatti de Macerata, one of a party of ten Capuchin monks returning from Europe to re-establish the mission at Lhasa. Leaving Patna in December, 1739, the party remained at Katmandu (then only a provincial town) until after the rainy season of 1740. Their route led through Kuti and the Tingri plain to Sakya and Gyantse; Beligatti's description of the country and people might well have been written to-day.

It was while the Capuchin missions were still in existence, between

a serious climbing effort the next year. The war, however, intervened, in the course of which Rawling was killed as a Brigadier-General in France, and the project was, of course, temporarily abandoned.

Interest in Mt. Everest revived as soon as the war was over. During the summer of 1920, Lt.-Col. Howard Bury visited India at his own expense in order to enlist the sympathy of the Government of India towards an expedition. He also visited Darjeeling, and reconnoitred the routes through Sikkim as far as the Tibetan frontier. At the same time Dr. A. M. Kellas and myself undertook some investigations into the use and effects of oxygen at high altitudes on Mt. Kamet, in the Garhwal Himalaya.*

THE EXPEDITION OF 1921.

As the result of Howard Bury's mission, Mr. (now Sir C. A.) Bell, the Political Officer in Sikkim, who happened to be in Lhasa at the time, was instructed to ask the Dalai Lama for permission for a small party to enter Tibet for the purpose of exploring and climbing Mt. Everest. Mr. Bell being on the most friendly terms with His Holiness, the necessary permission was granted towards the close of the year, 1920, and thus the one great obstacle in the way of an approach to Mt. Everest was at last removed. The Mt. Everest Committee was at once formed, consisting of three representatives each from the Royal Geographical Society and the Alpine Club, under the able and enthusiastic chairmanship of Sir F. E. Younghusband. Funds were raised by means of initial grants from the two societies supplemented by public subscriptions, and the organization and equipment of an expedition were hastily put in hand.

The Mt. Everest Committee rightly decided that the whole of the first season must be devoted to a thorough reconnaissance of the mountain with a view to finding not only a feasible route to the summit, but what was without doubt the *most* feasible route. This was considered ample work for the first year's expedition, while the season of 1922 would be devoted to an all-out effort to reach the

the years, 1723 and 1736, that the adventurous Dutchman, Samuel Van de Putte, visited Tibet in the course of a remarkable 20 years' tour from Aleppo to Peking. He appears to have been an excellent Tibetan scholar as well as a skilled and competent observer, but on his death (in Batavia on his way home in 1745), his papers were all burnt under the terms of his will. His sketch map of southern Tibet, which is, however, still extant, gives the positions of Kuti, Tingri and the Phung Chu.

From the final closing of the missions in 1745, there is no further record of travel in this portion of southern Tibet until the period of the Survey of India trained native explorers, a century and a quarter later.

*An account of this trip appeared in the *R.E. Journal* for April, 1921.

summit along such route as the first year's reconnaissance should indicate as the best.

The members selected to form the first season's party were as follows :—

Lt.-Col. C. K. Howard-Bury, D.S.O., Leader of the Expedition.
Dr. A. M. Kellas
C. Raeburn
G. H. L. Mallory
G. H. Bullock } Mountaineers.
A. F. R. Wollaston, Doctor and Naturalist.

On arrival in Darjeeling early in May, the party was joined by Dr. A. M. Heron, of the Geological Survey of India, and by a small survey detachment consisting of the writer and Bt. Major E. O. Wheeler, M.C., together with three Indian surveyors. Wheeler, who is a member of the British and Canadian Alpine Clubs, had been entrusted with the task of making a photographic survey of the immediate environs of the mountain on the 1-inch scale, while the remainder of the detachment were to be employed on a general ½-inch plane-table survey of the whole area covered by the expedition.

The main body of the expedition, together with 100 mule-loads of stores, left Darjeeling in two parties on 18th and 19th May. A week's marching brought the party across the Sikkim frontier *via* the Jelep pass into the Chumbi valley of Tibet. At the head of the Chumbi valley is the village and *dzong* (fort) of Phari, the residence of the *dzongpen* or governor of the district. Phari is a bleak, dirty village, situated at a height of 14,300 feet above sea-level, and well above the tree-line. Transport arrangements here necessitated a halt of some days while the *dzongpen* was collecting fresh pack animals and supplies for the six days' journey to his colleague at Kampa, which was reached on the 5th June. Here I joined the expedition, having travelled from Darjeeling *via* Thango and the Serpo pass in order to superintend the revision of the map of northern Sikkim.

The arrival of the expedition at Kampa was saddened by the death of Dr. Kellas, from heart-failure consequent on severe gastritis. He had been unwell from the start, but with characteristic determination had refused to give in or to turn back. He was buried the following day on a spur below the *dzong*, in sight of the three great peaks of Chomiomo, Pauhunri, and Kangchenjau, which he alone had climbed. Raeburn, who was also unwell, was at this point compelled to return temporarily to Sikkim under Dr. Wollaston's care.

Resuming our march on 8th June, Tengkye *dzong* was reached in two stages, and here we first came into unsurveyed country. At Kampa I had started a chain of triangulation based on Colonel

Ryder's old stations made at the time of the Lhasa Mission in 1903-4. I realized, however, that with daily marches averaging 15 to 20 miles it would no longer be possible to keep this up, and that it was necessary to decide at once whether to delay the surveyors sufficiently long to enable a triangulation to be carried forward, or, alternatively, to allow them to keep pace with the expedition while merely utilizing the previously existing triangulated points, of which a fair number were visible. In view of the obvious signs of a rapidly approaching monsoon, I decided in favour of the latter alternative.

From Tengkye we marched in six stages to the next *dzong*, Shekar—crossing the broad, sandy bed of the Shiling river a mile above its junction with the Phung Chu. Owing to the prevalence of rinderpest in the Phung valley, the transport yaks and bullocks provided by the *dzongpen* of Tengkye had to be replaced by donkeys for the last two marches before reaching Shekar.

The Phung river is remarkable for the amount of mud which it carries in suspension; below Shekar it flows through a wide, open valley with occasional stretches of fertile marsh-land, and scattered clumps of a stunted species of *salix*, resembling sea-buckthorn, known in Tibetan as "lamdse." Flowering clematis is common, and a sweet-smelling valerian or candytuft—the latter is said by the Tibetans to be very poisonous, and is carefully avoided by cattle.

The town of Shekar is situated 5 miles north of the Phung Chu, on the edge of a level plain containing numerous irrigated fertile barley-fields, and scattered hamlets. The large monastery of Shekar Chote is finely situated on a commanding hill behind the town to which it gives its name—Shekar being an abbreviation of "Shel karpo" (white glass), in allusion to the numerous windows and conspicuous white-washed walls of the monastery, which glisten in the morning sun.

Resuming our journey up the Phung valley, Tingri was reached in two long marches. The village is built on the slopes of a low, isolated hill in the middle of an extensive alluvial plain. The hill is crowned by the remains of an old Chinese fort, now abandoned; just below is the former residence of the Chinese commandant—a building now used as a "circuit house" for Tibetan officials when on tour. This was destined to be the headquarters of the expedition for the next six weeks, and formed a convenient centre for various scientific excursions into the surrounding districts; a dark-room was installed in which were developed the photographs taken by the several members of the expedition.

After a few busy days spent in sorting and arranging stores, Howard Bury and Heron started on a hasty reconnaissance of the tracts of country known as Pharuk and Kharta, lying to the north and east of Mt. Everest, with the object of selecting a suitable site for the next headquarters when a further move should become neces-

sary. Mallory and Bullock set off to examine the north-west approaches of Everest, and to train the coolies in ice, snow and rock technique. Wheeler commenced his photo-survey in the neighbourhood of Kyetrak, two marches to the south. I spent a week with one of the surveyors exploring and mapping the western headwaters of the Phung Chu.

Early in July in response to an invitation from the *dzongpen* of Nyenam, Wollaston and I, with Surveyor Gujjar Singh and an interpreter, started on a visit to the district of Nyenam which lies four marches to the south-west of Tingri. Our first camp was at Lungkor, a small village on the western edge of the Tingri plain. Crossing the Thung La (17,980 feet) in a driving snow-storm, a long march of 22 miles brought us next day to the bleak village of Tulung, in the upper valley of the Bhotia Kosi river. Two days later we reached Nyenam, a large and very insanitary village which is known under the name of Kuti by the Nepalese, who constitute the majority of its inhabitants. These Nepalese traders (*newars*) have their own Hindu temple in the village; there is also a Nepalese magistrate, having summary powers of jurisdiction over Nepalese subjects.

I spent three days in exploring the neighbourhood of Nyenam, while Wollaston was engaged in his botanical and zoological pursuits. Below Nyenam the river enters a very narrow gorge, while pines and other forest trees begin to appear; the road, which here becomes impassable for animals, crosses the river four times in eight miles before reaching the village of Choksum, but owing to the vile state of the weather which rendered even the roughest attempts at surveying impossible, I abandoned any idea of further progress down the valley.

Returning up the valley to Trashigang, we next followed a rough track leading in a south-easterly direction over the Lapche range to the village of the same name in the valley of the Kang Chu. We were unable to reach the village by dusk, and spent a somewhat miserable night camping on boulders in drenching rain at 14,600 ft., with no fuel except a few green twigs of dwarf rhododendron.

Lapche is sacred as the home and birthplace of Mila Repa, a wandering lama and saint who lived in southern Tibet in the eleventh century, and whose collections of songs and parables are still among the most popular books in the country. His hermit-cell still remains under a rock on the hillside, and his memory is preserved by an ancient temple, the resort of numerous pilgrims, alongside which we pitched our tents.

From Lapche we crossed the Kangchen pass into the Rongshar valley. As we descended the hill into Trintang village, the clouds lifted momentarily, disclosing an amazing view of the superb summit of Gaurisankar towering magnificently above us just across the valley. Owing to the sacred nature of the Rongshar valley, the

slaughtering of animals is forbidden, and the large flocks and herds are only kept for sale in Tingri and Nepal. We were only able to buy a sheep on promising not to kill it until after quitting the valley.

On 27th July we marched 20 miles up the Rongshar valley to the village of Tasam (Takpa-Santsam="limit of birchtrees") which, as its name implies, is situated at the extreme upper limit of the forest zone. The headman of Tasam was too drunk on the evening of our arrival to send out the necessary messages summoning the village baggage yaks from their grazing grounds. In consequence, our baggage next day only got started at 11 a.m., and we were compelled to pitch our tents at a grazing camp after covering only nine miles. The weather showed signs of improvement in proportion as we receded from the Himalayan gorges, but dense banks of cloud still obscured all the hill-tops. An easy march over the Phuse pass brought us on 29th July to the bleak village of Kyetrak at the extreme southern edge of the Tingri plain. Four days later we rejoined the expedition headquarters which Col. Bury had just transferred to Kharta, in the lower valley of the Phung Chu or Arun river.

It is now time to turn to the doings of the mountaineers. Leaving Tingri on 23rd June, Mallory and Bullock—the only two now left out of the four climbers from England—turned southwards into the unknown, to explore the western and northern fastnesses of Everest. Approach was soon found to be barred from the west and north-west by the great peaks of Cho Uyo and Gyachungkang, and the climbers turned their attention without further delay to the Rongbuk valley which drains the northern slopes of the mountain. The great Rongbuk glacier, terminating five miles above the village and monastery of that name, was at once seen to be divided, higher up, into at least two important branches—the western branch swinging round from the southern slopes of Gyachungkang, and the main or central branch ending in a great coombe or cirque under the north face of Everest itself. These two branches were explored in turn, in the face of the most adverse conditions of weather, due to the monsoon season which had now become firmly set in; enough of the landscape was, however, visible to establish the following facts:—(1) That the key to the mountain appeared to be an important saddle—subsequently known as the North Col (Chang La), 23,000 ft.—situated at the head of the main Rongbuk glacier, about $1\frac{3}{4}$ miles north of the summit of Everest; and (2) that only in the very last resort could the main Rongbuk glacier be made use of as a means of access to this North Col, and that an examination of its further (*i.e.*, eastern) flank was the next essential requirement. Towards the end of July, therefore, the two climbers struck their tents, turned their backs on the Rongbuk valley, and hastened to rejoin Howard Bury in the newly-established base camp at Teng on the bank of the Arun river in the district of Kharta.

A broad glacier stream, the Kharta Chu, coming down from the west, and therefore, as it appeared, from Everest, joins the Arun river at Kharta. To follow this stream to its source seemed the next obvious plan, after a few days for rest and re-organization in the pleasant surroundings of Kharta.

Accompanied by a local Tibetan guide, Mallory and Bullock accordingly set out once again on 2nd August; following the upward course of the Kharta stream, past scattered hamlets and waving fields of barley, they camped for the night at a spot where a small tributary joined the main stream from the south. To their surprise the guide led them next day up this side stream, over a pass which he called Langma La, 4,000 ft. above their camp of the previous night. A long descent followed, leading them eventually, baffled and bewildered by continual cloud and mist, to the foot of an enormous glacier* draining in a south-easterly direction. Not until the third day did the clouds lift sufficiently to disclose for a few moments the gigantic precipices of Makalu towering above them to the south.

Altogether, a week was spent in exploring this Karma valley—a valley which is directly overlooked by three out of the five highest peaks in the world. At the broad head of the Karma valley were the two summits of Everest, and Everest South Peak (Lhotse); 10,000 feet below these lay a great basin of tumbled ice, fed by frozen tributaries pouring down between the almost perpendicular buttresses which support the mountain faces in this enormous cirque. Obviously no route to the summit was to be found here, but on climbing a peak on the northern side of the valley, the explorers fancied they recognized in the distance, away to the north-west and almost masked by cloud and intervening ridges, the outline of the elusive North Col, situated apparently beyond the head of the Kharta valley. Retracing their steps over the Langma pass, they succeeded on 18th August in reaching the Col at the head of the Kharta valley which we subsequently christened Hlakpa La, or Windy Gap (22,200 ft.). I was able to join the climbers on this last piece of reconnaissance. Looking westward from the summit of the Windy Gap, the lower slopes of Everest were dimly discernible through the clouds away on our left about 2½ miles distant; directly in front of us, at a slightly greater distance, were the eastern slopes of what we judged to be the North Col; everything above our own level was concealed in a dense bank of cloud. Between us and the North Col, we looked down on a broad, smooth bay of ice and snow 1,000 feet below, draining towards the north—whether this represented a hitherto unsuspected eastern branch of the Rongbuk glacier, or whether it drained into the Rephu branch of the Dzakar stream, we were at the moment unable

* The Kangshung glacier.

to ascertain. Anyway, a possible route to the North Col had been discovered and we were now justified in returning to Kharta for ten days' rest and re-organization, prior to a final assault in which all were to take part as soon as the monsoon should begin to abate.

Howard Bury and Wollaston were already at the base, Heron arrived the following day, followed shortly afterwards by Wheeler, whose photographic survey of the Rongbuk glaciers had been greatly delayed by the appalling weather. Wheeler was able to confirm the important fact that the glacier* on to which we had looked down from the Hlakpa La, drained into the Rongbuk valley, through a narrow gorge which had been overlooked by the mountaineers in the mists and cloud during their first reconnaissance of the Rongbuk glaciers. It was now, however, too late to transfer our line of communications back again to the Rongbuk valley; for this season we were committed to carrying out our assault on the North Col *via* the Windy Gap.

After three weeks of tedious waiting in the upper Kharta valley, the weather improved sufficiently by 22nd September to enable us to establish a camp of six Europeans and 18 coolies on the summit of the Windy Gap. Mallory, Bullock and Wheeler, with ten selected porters, next day pushed forward a light camp to the foot of the North Col. On the 24th they succeeded in reaching the summit of the Col (22,990 feet) in the face of a terrific blizzard which rendered further progress impossible. Beyond the Col, an easy succession of rock and snow slopes could be seen leading to the north-east shoulder of Everest (27,390 feet.)

This closed the season of 1921. The results of the season's work may be briefly summarized as follows :—

(1) The north, east and west flanks of the mountain had been thoroughly explored, and a practicable route of ascent discovered, the key to which was the North Col, which had actually been reached *via* the Kharta valley and Windy Gap, but which would, doubtless, be more easily accessible *via* the East Rongbuk glacier. From the time when we first viewed the mountain early in June until the end of the season it had presented an unbroken white surface of ice and snow; rock was scarcely anywhere visible.

(2) High climbing between 15th June and 15th September had been proved an impossibility owing to the prevalence of monsoon conditions, while from the middle of September the monsoon was found to be succeeded by a series of terrific equinoctial gales from the north. The only hopeful season for climbing at extreme altitudes in the Himalaya thus appeared to be the months of May and early June.

* Since known as the East Rongbuk glacier.

(3) 12,000 square miles of new territory were surveyed on the ½-inch scale, and 4,000 square miles of old ¼-inch survey were revised. 600 square miles of the immediate environs of Mt. Everest were mapped photographically on the 1-inch scale.

(4) The geology and natural history of the area were worked out with considerable thoroughness. Interesting collections were made of mammals, birds, butterflies and plants, all of which were found to include new specimens.

The Expedition of 1922.

Howard Bury having become a candidate for election to Parliament, the charge of the 1922 expedition was given to Brig.-General the Hon. C. G. Bruce, C.B., M.V.O. (now President of the Alpine Club), with Colonel E. L. Strutt, C.B.E., D.S.O., as his second-in-command. The remaining members selected in England were :—

G. H. L. Mallory
T. H. Somervell
A. W. Wakefield
G. I. Finch
Major E. F. Norton
} Climbers.

Dr. T. G. Longstaff, Doctor and Naturalist.
J. B. L. Noel, Photo and Cinema Expert.

The party were joined in India by C. G. Crawford of the Indian Civil Service and the writer, together with Captains Morris and G. Bruce, of the Indian Army.

An important addition to this year's equipment was a number of sets of oxygen apparatus, under Finch's special charge. Each set comprised a light carrier supported on one's back by a system of web belts and straps, and carrying four cylinders of compressed gas, which was delivered to the face mask by a system of flexible piping with a pressure-reducing valve and adjustable flowmeter. The weight of the apparatus was about 35 pounds, and each cylinder was reckoned to last about 1¼ hours at a normal flow of three litres per minute. Empty cylinders could be disconnected and replaced as required.

Leaving Darjeeling on 26th March, the expedition followed the route of 1921, in bitter weather, as far as Shekar, whence they turned southward over the Pang La pass to Tashidzom and Chobuk. The base camp was pitched at a height of 16,500 feet in the Rongbuk valley, just below the snout of the glacier and twelve miles distant in a direct line from the summit of Everest. In contrast to our experience of the previous year, the northern slopes of the mountain now, before the onset of the monsoon, proved, to our joy and surprise,

to be almost devoid of snow and ice, displaying a not too formidable-looking surface of black slabby rock.

The base camp was established by the end of April, and the next three weeks were occupied in reconnoitring the East Rongbuk glacier (the only portion of the route not fully explored in 1921), laying out the advanced camps, and stocking them with supplies and equipment. By 20th May, camps had been established as follows :—

No. 1 Camp—18,000 feet, just above junction of E. Rongbuk valley with main Rongbuk valley.
,, 2 ,, 19,000 feet, half way up E. Rongbuk glacier, on moraine.
,, 3 ,, 21,000 feet, at foot of North Col, on moraine.
,, 4 ,, 23,000 feet, at summit of North Col, on snow.

The time now appeared ripe for a serious attack on the mountain, so while Finch was still busy assembling his gas apparatus, Mallory, Somervell, Norton and myself with ten porters, left Camp III for the North Col (where, as just mentioned, we had already established a camp). Sleeping at the North Col on 20th May, we continued next morning the ascent of the northern face of the mountain over fairly easy going until the onset of a blizzard at midday compelled us hurriedly to camp at 25,000 feet (Camp V), and send the coolies back to the North Col. The hillside was composed of flat slabs of rock of varying sizes, the strata having an outward (northerly) dip ; and it was a matter of some difficulty to scarp out with our ice axes a couple of level terraces sufficient to hold our two small mountain tents. We finally succeeded after a fashion, and spent a tolerably comfortable night, the temperature dropping to minus 20° F.

Next day broke fine, with a powdering of freshly fallen snow on the ground, and after hastily warming up a light breakfast over the spirit stove we were roped up ready to start by 7.30 a.m. The first hundred yards sufficed to assure me that for some reason I had not that day the pace of my three companions, so rather than keep them back, I felt my duty was to unrope, leaving them to carry out their climb untrammelled. In the result, while I remained smoking my pipe in camp, they succeeded in attaining a height of 26,850 feet, just below the north-east shoulder of Everest*, before the lateness of the hour compelled them to turn back. They had reached a point within one mile of the summit, and there appeared to be no serious obstacle in this last remaining lap—only, it was more than could be accomplished in one day from the camp at 25,000 feet. One more intervening camp would be necessary, at about 27,000 feet, and this we had not the immediate means of achieving.

* The N.E. shoulder is marked 27,390 feet on the sketch-map.

It was about 4 p.m. when Mallory and his two companions rejoined me at Camp V, and after hastily melting down sufficient ice to give us each a mouthful of drink, we decided to make at once for the North Col. Instead of benefiting by my day of idleness in camp, my physical incapacity had now become almost complete; and, leaning on my companions' arms, I could scarcely find the energy to descend the easy slopes up which I had gaily led on the rope less than thirty-six hours previously. It was 10 or 11 p.m. and pitch dark before we finally reached the shelter of the North Col camp, too tired even to hunt out some supper.

Next morning, as we wearily made our way down towards Camp III, we met Finch, Geoffrey Bruce and a Gurkha N.C.O., Tejbir, starting on their high climb, with oxygen masks already adjusted and in use. They were being accompanied for the first few miles by Dr. Wakefield who carried a thermos flask filled with hot tea and brandy which remains one of the happiest recollections of my life. Shortly afterwards, on nearing Camp III, we came to the first spot at which a little trickle of water had been melted by the midday sun. Lying prone, I lapped and lapped until I had absorbed, perhaps, a quart of this icy beverage. Instantaneously my strength returned, and I then realized that my whole trouble had been simply due to the impossibility of obtaining sufficient liquid at the high altitudes. All four of us proved to have been more or less frost-bitten during our descent to the North Col the previous night; in the case of Mallory and Somervell the damage was limited to a few skin blisters on the extremities. Norton's beauty has been permanently impaired by the loss of the top of one of his ears, and I had to undergo, five months afterwards, the amputation of the top joint of three fingers of my right hand.

Finch, G. Bruce and Tejbir, with their string of coolies, after sleeping at the North Col, carried a camp to 25,500 feet, at which point the onset of a blizzard compelled them as it had us, to pitch their tent and send back their coolies. For thirty-six hours the storm raged with unremitting violence; the ceaseless flapping of the little tent was afterwards compared to the noise of a machine-gun in one's ear, while the three occupants dared not stir outside for a moment lest the whole frail outfit should be carried bodily away by the force of the wind. On the third day, still supported by their remaining supply of oxygen, they reached a height of 27,250 feet before being compelled to return—being then about half a mile in horizontal distance from the summit of the mountain.

By the end of May, all the climbers were back at the base camp, and all of us were to a greater or less degree *hors de combat* as the result of our experiences. A universal symptom was the loss of one or two stone in weight during our sojourn above the snow line, combined with a strong feeling of disinclination for further exertion.

Early in June, Mallory, Somervell and Crawford gallantly organized a third assault, but the monsoon had meanwhile set in and the mountain sides had become dangerous. An unfortunate avalanche occurred on the steep ascent to the North Col, carrying away one whole rope of coolies, all seven of whom were killed instantaneously. This disaster closed the climbing season of 1922.

The results of the 1922 expedition were :—

(1) Heights of 27,250 feet and 26,850 feet were attained, with and without oxygen respectively, and it was ascertained that no serious physical obstacles exist between the highest points reached and the final cliff of 100 or 200 feet which marks the actual summit. Camps were made at 25,500 feet and 25,000 feet, but from these heights it was found impossible to reach the summit and return in one day.

(2) The months of May and early June (before the arrival of the monsoon) were definitely proved to be the only possible season of the year for the climb—thus confirming the deductions made from the experiences of 1921. Further, at this time of year the whole northern face of the mountain was found to consist of bare rock.

(3) Oxygen was tried for the first time in actual use at extreme heights, and gave proof of its value.

(4) Further collections were made of the natural history and geology of the regions traversed.

CONCLUSION.

The question is sometimes asked : why steps have not been taken to explore the southern (Nepal) faces of Mt. Everest before definitely accepting the North Col route as being the best : and, in any case, why do successive expeditions follow the long roundabout road to the base camp through the Chumbi valley and the plains of Tibet, instead of taking a direct route northwards from the plains of India through Nepal, and thus reducing the distance of the outward and homeward marches from 350 miles to one-third of that distance. These points demand a few observations. Firstly, the Nepal Government do not favour European travel in their territory, and, although their attitude towards the enterprise may be inferred from their generous and spontaneous contribution of 3,000 rupees (£200) towards the funds of the first year's expedition, yet it is uncertain whether or not they would give the necessary permission to traverse their country if such were asked for.

More cogent is the consideration that the routes leading northwards through Nepal are known to be mere coolie tracks swarming with leeches during the monsoon, and where any form of pack transport is an impossibility ; whereas in Tibet, and more particularly on the

Sikkim-Chumbi Valley trade route, unlimited yak and mule transport is obtainable at cheap rates of hire.

Thirdly, arguing from the analogy of other known portions of the Himalaya, it may be stated with some confidence that the unknown southern slopes of Everest, exposed as they are to the full brunt of the monsoon precipitation, will be found far more deeply eroded, rugged and inaccessible than those on the northern face of the mountain. Further, the summer snow line on the sheltered northern slopes of the Himalaya is roughly 2,000 feet higher than that on the south.* Mention has already been made of the fact that the whole northern face of Everest was found to consist of almost bare rock in May, 1922. The reflected glare, always an important consideration at extreme altitudes, is also less on a northern than on a south-facing slope.

The next attempt on Mt. Everest is to be made in 1924. The third expedition will probably be a climbing affair pure and simple, but among the scientific problems whose solution is still desirable it must suffice to mention that the whole southern slopes of the mountain await an opportunity for survey, while a small area of country still requires elucidation at the head of the West Rongbuk glacier; further research is also desirable into the glaciology of the area (advance and retreat of glaciers), and into the problems of mountain physiology, with particular reference to the phenomena of acclimatization to altitude.

A very desirable addition to the next expedition would be the presence of a competent artist who might portray in oil or water colours a few of the many striking and gorgeous effects of sun, snow, cloud and rock which even the most efficient camera or cinema in the world cannot wholly reproduce.

A fifth high camp will be necessary somewhere about 27,000 feet. In 1922, it was found possible to camp and sleep in comparative comfort (barring blizzards) at 25,000 feet, where the barometric pressure is 10 inches; there should not be any further appreciable discomfort in camping at 27,000 feet, where the barometric pressure has only dropped another half-inch. The real difficulty is one of organization, and of the carrying capacity of human beings at these extreme altitudes.

Another great difficulty lies in the incalculable and uncertain nature of the weather from day to day, and it is here that the importance of oxygen comes in. Starting from No. III Camp, without oxygen, it would take three days to establish a camp at 27,000 feet; one day would then be required to reach the summit, and two days for the return to Camp III. Total six days. The

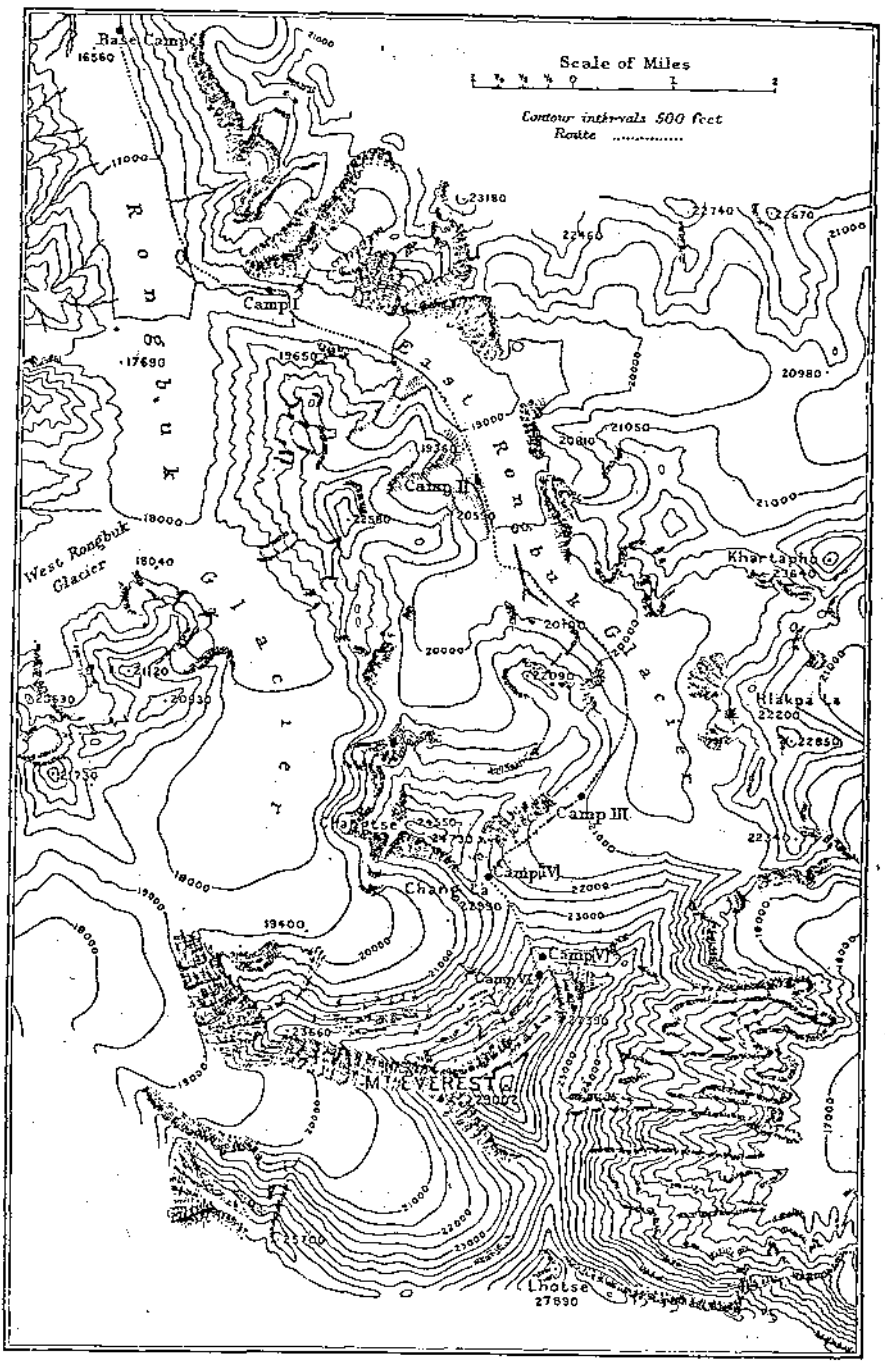
* Approximately 20,000 instead of 18,000 feet in the latitude of Everest.

use of oxygen may, however, enable a party to accomplish in three days what would otherwise take six, and three days is possibly the longest interval which may ever occur between successive blizzards. The problem of establishing a depôt of spare oxygen cylinders at a height of 27,000 feet is, however, one of immense difficulty.

One hopeful element in the problem, on which these notes may be fittingly brought to a close, is the wonderful keenness and endurance displayed by the coolie porters of the expedition, to whom is due a very large measure of such success as has hitherto been attained. These hardy hillmen—known in their own language as *Sharpas* (or "Easterners")—born and bred under the shadow of Everest itself, showed a spirit which was beyond all praise. On the return to Darjeeling, after the death of their seven comrades, every single remaining man asked to have his name registered as a volunteer for the next expedition. With such splendid and willing assistance on the side of the attackers, it will, indeed, be a matter of surprise if Mt. Everest remains much longer unconquered.

MOUNT EVEREST AT SUNSET, from 20,000 ft. Camp, Kharta Valley.

(Reproduced by permission of the Royal Geographical Society, from a photograph by Mr. A. F. R. Wollaston).



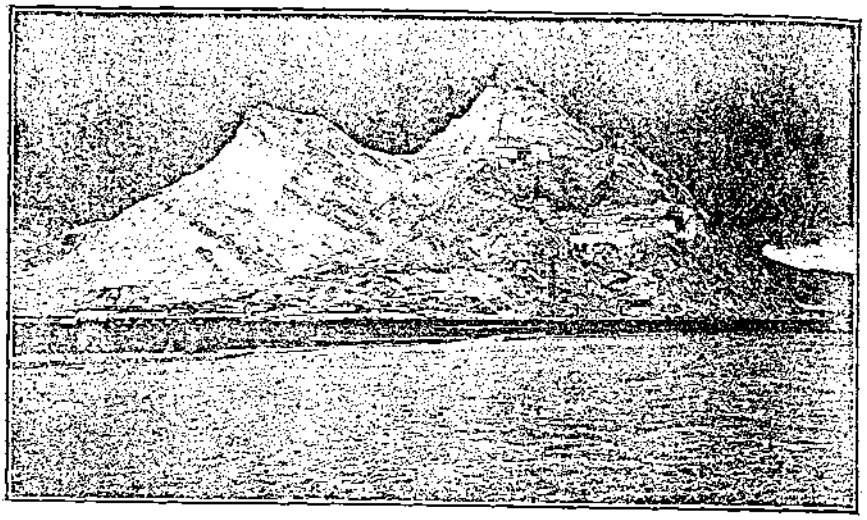
SKETCH-MAP OF MT. EVEREST AND THE RONGBUK GLACIERS.

(By kind permission of the Royal Geographical Society).

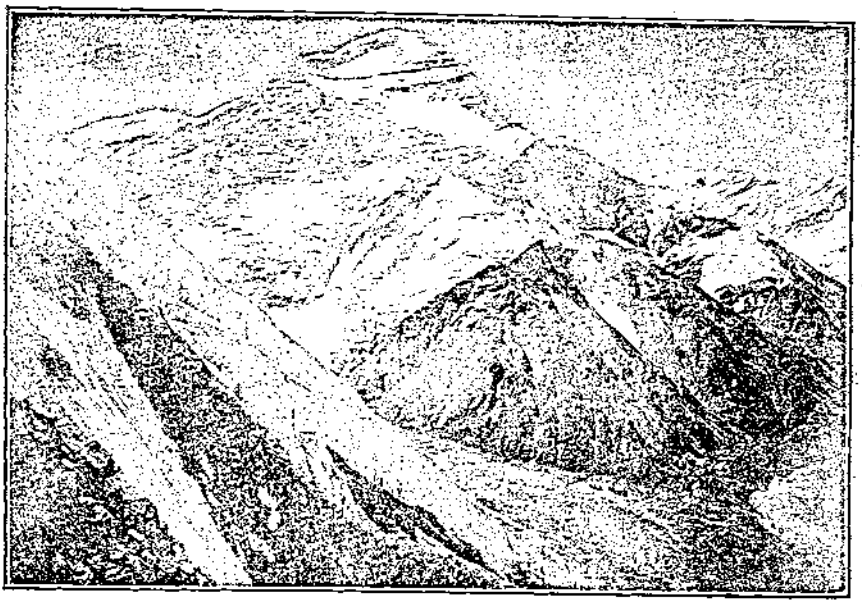
MOUNT EVEREST.

North Col and North Peak, from Hlakpa La.

Survey photograph by Major E. O. WHEELER, M.C



Shèkar Village and Monastery.



Cho Oyu from above Kyetrak.

Photographs by Major E. O. Wheeler, M.C.

SHAFT SINKING BY REFRIGERATION.

By LIEUT. P. J. AHERN, R.E.

THE effective sinking of a shaft through water-bearing strata, containing, as is usual in this country, loose quicksands, is often a matter of considerable difficulty. One of the most convenient ways of doing it, and one which was performed with conspicuous success as far back as 1885, by Captain Lindmark, of the Swedish Royal Engineers, in the construction of a tunnel at Stockholm, is to refrigerate the circumference of the shaft, and thus keep out the water, by maintaining a hard frozen shell round the portion which is being excavated.

Until recently, and especially in this country, progress in this system of shaft sinking has been slow, due primarily to the high cost of its operation, and to the effective rivalry of the cementation processes. In certain extreme cases, however, it is becoming increasingly employed in Germany and in Belgium, and, within the last few years, two important sinkings by this system have been carried out in this country, at Washington and Dawdon collieries, near Seaham harbour, Durham.

The principle of the process consists in freezing the ground, for a sufficient distance round the bore of the shaft, into an ice retaining-wall, capable of withstanding the pressure exerted by the unfrozen part, and so enabling treacherous layers to be worked in safety. Thus, the ice-wall consists of a hollow cylinder, completely enclosing the space in which the shaft is to be sunk, and at such a distance, that the process of sinking can be carried on without damage to it.

In practice, the wall is formed by sinking to the requisite depth a ring of vertical pipes, from 2 feet to 4 feet spacing, concentric to the proposed shaft, the number varying with the diameter of the cylinder to be formed.

The actual freezing apparatus consists of two concentric tubes through which cold brine circulates. (*Fig.* 1). The tubes are usually 1¼-in. and 4-in. diameter respectively, though for deep sinkings a 5-in. outer is sometimes used to give increased surface, and hence, increased cooling action, to the brine. The bottom end of the outer tube is sealed, while that of the inner tube, which can be easily removed for cleaning when necessary, is fitted with a strainer to prevent the passage of grit, etc. (*Fig.* 2). Where a considerable depth of solid strata is met which it is not desired to freeze, it is common practice to fix a third set of tubes between the inner and

outer ones, for the depth that is not required to be frozen. (*Fig.* 3). The tubes of this third set are so connected to the outers that the return flow of the brine is between the inner and middle tubes, leaving an air-space between the middle and outer tubes, which acts, to a certain extent, as a heat insulator. The advantages claimed for this arrangement are that it lessens the work which the brine, and therefore the compressor, has to perform, and it avoids the exposure of the shaft work that is not to be frozen to the very low temperature

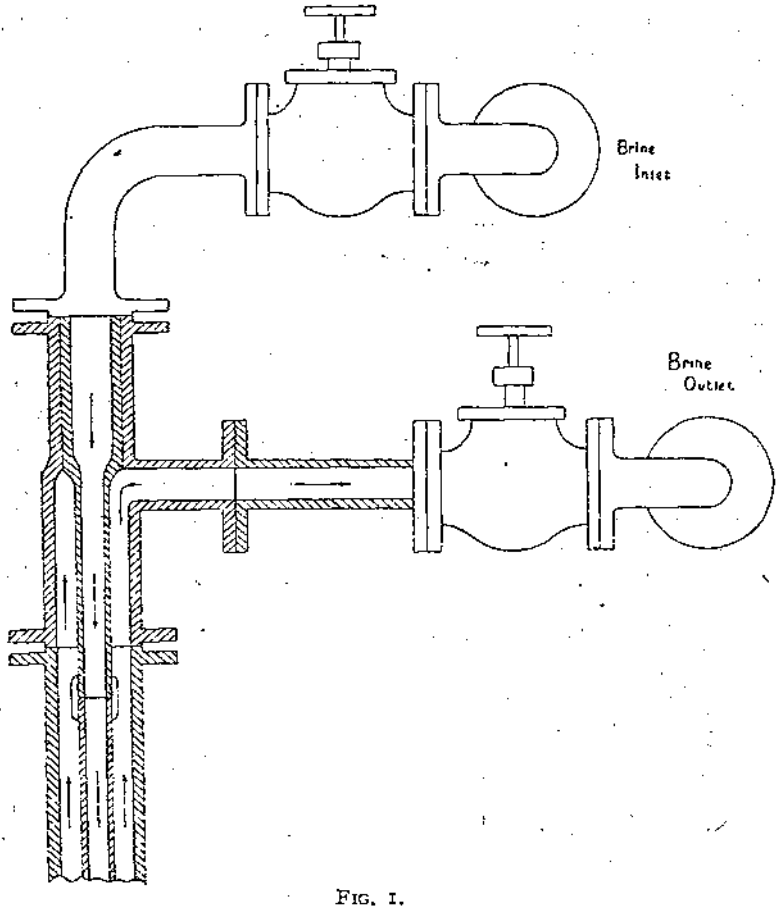


FIG. 1.

attained in the other strata. These advantages, however, are very much open to question. The convection currents set up in the air space rob it of a great deal of its insulative property, and the extra cost of the third set of pipes will often more than compensate for the increase of work required from the compressor.

Success in this method of shaft sinking is dependent upon two considerations. In the first place, the ice-wall must be carried down to a sound, substantial, substratum. A case of failure is reported in Saxony, where the freezing pipes were only carried down to a

thick clay bed between two water-bearing strata, instead of to the stone stratum beneath the lower one. Secondly, the wells for the freezing pipes must be drilled absolutely vertically. This presents by far the greatest difficulty of the process, since the drill frequently encounters an oblique stratum of rock, which deflects it one way or the other, and the only remedy then is to fill the partially drilled hole and make another attempt.

When dealing with sand and softer strata, the wells may be bored, either with a sharp-edged tube and a sand pump, or alternatively, by capping the end of the larger tube and, forcing water out of a small hole in the end of another tube placed on one side of it, driving it through the soft stratum, by washing the sand before it.

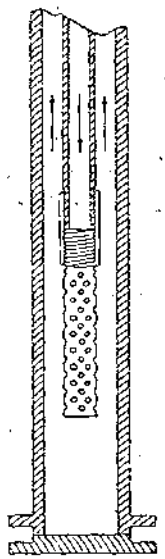


FIG. 2.

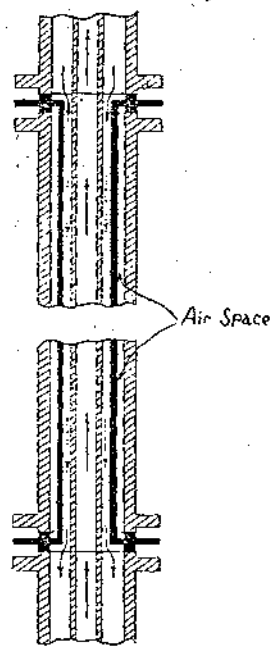


FIG. 3.

Calculations for this process offer no great difficulties, but most of the work is empirical. The ice cylinder when formed must be sufficiently strong to withstand the strains and stresses brought on it by the processes of sinking the shaft, as well as the outside forces due to ground and water movements, and the constant attrition, by the water surrounding the wall, due to convection currents set up in the water. In connection with this last effect, it will be seen that not only has the wall to be formed, but that it is imperative to maintain it at its required thickness, by continuing the brine circulation to such an extent, while the shaft is being completed, that the heat, which leaks into the wall from outside sources, is entirely absorbed.

The requisite thickness of the ice-wall will vary according to the conditions present. It will necessarily be thicker with a deep sinking, than with a shallow one, and with a shaft of larger diameter, than with one of smaller diameter.

Owing to the large number of indeterminate variables that have to be dealt with—the varying water content, and the different degrees of freezing at various points in the wall, to mention only two—it is impossible to ascertain the tensile and compressive strengths of the material forming the wall; hence, to attempt to compute mathematically the minimum safe thickness of the wall, for any given set of conditions, would be useless. Certain figures have been found requisite in practice and these can be modified to suit requirements.

With 0° F. brine, the cylinder of ice formed usually extends about 3 feet inwards and 1 foot 6 inches outwards from the freezing-pipe ring. This wall will usually be found of sufficient strength for shafts up to 200 feet deep and 15 feet diameter. As however, modern tendency is to carry a brine temperature from −15° F. to −20° F., with the ice-wall at or near 0° F., when sea-water strata may be frozen, the ice-wall is proportionally thickened and strengthened, and the shaft figures given above may be increased to 350 feet deep and 30 feet diameter. For larger and deeper shafts a double ring of freezing-pipes should be employed.

Cooling will, of course, extend beyond the actual ice-wall itself for a distance of some 5 or 6 feet (*Fig.* 4). This cooled layer repre-

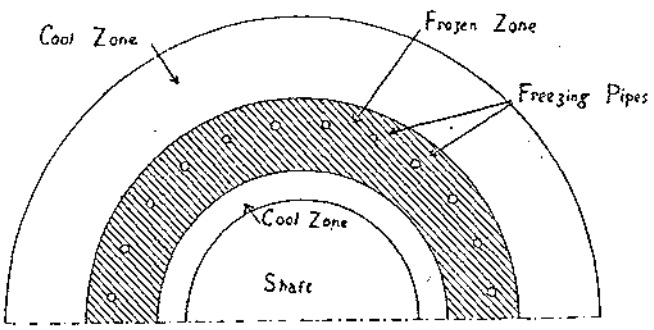


FIG. 4.

sents the heat insulator, and the heat carried across this area represents the heat which must be extracted by the brine to keep the wall frozen. In calculating the diameter of the freezing-pipe ring, from 1 ft. 6 in. to 2 ft. 6 in. of this cooling area should be allowed on the shaft side, so that the processes of sinking the shaft will not damage the ice-wall.

The formation of the wall is a very slow process, taking, in some cases, as long as three and four months. This is, however, all to the good, since ice that is formed slowly is the more durable, and the less likely to go "soft." The reason for this length of time is

that the heat transmission to the brine from the earth surrounding the pipes, though quite high at first, falls rapidly away in value, until at the end of the freezing process it becomes nearly zero. Lorenz (Neuere Kühlmaschinen) suggests as an average value of the heat transmission, 85 B.Th. U.s per square foot of exposed pipe-surface per hour.

The calculation for the size of machine requisite for any given conditions is quite straightforward, and can be demonstrated far more clearly by the following example taken from an actually operated scheme, than by words.

Data :—

Shaft measurements	16′ 0″×6′ 6″
Depth to sound stratum	28′
Average sp. gr. of ground	1·8
Average sp. ht. of solids (dry)	0·2
Average water content	30 lb./cub. ft.
Average ground temperature	50° F.
Data added from nature of problem :—	
Ice-line, inside, from pipe-line	3′ 0″
,, outside, ,, ,,	1′ 6″
Cooling-line, inside, from ice-line	1′ 6″
,, outside, ,, ,,	5′ 0″
Depth of freeze	30′ 0″
Brine temperature	−15° F.
Minimum ice-wall temperature	0° F.
Average ice-wall temperature	16° F.
Average cooling-area temperature	41° F.
Freezing tubes, inner	$1\frac{1}{4}$″
,, outer	4″
The pipe-line dimensions will be—	
[16′+2(3′+1′ 6″)]×[6′ 6″+2(3′+1′ 6″)]	25′ 0″×15′ 6″
Total length of pitch-line of pipes—	
2×25′+2×15′ 6″	81′ 0″
With tubes at 3′ centres, the number of tubes required—81÷3	27
Total length of tubing—	
27×30	810′
Surface of 4″ pipe exposed for cooling—	
$810\times\frac{3\cdot14\times4}{12}$	850 sq. ft.

A.—*Volume of ground to be frozen.*		cub. ft.
Volume enclosed by outer edge of ice-wall—		
28′×18′ 6″×30′	15540	
Less volume enclosed by inner edge of ice-wall—		
19′×9′ 6″×30′	5415	
		10125

B.—*Volume of ground to be cooled.*

Volume enclosed by outer cooling-edge—	
38′ × 28′ 6″ × 30′	32490
Less volume of frozen ground—	
	10125
Less volume of shaft—	
16′ × 6′ 6″ × 30′	3120
	19245

	B.Th. U.s
A.—(1) To cool water from 50° F. to 32° F.—	
10125 × 30 × 18	5,467,500
(2) To freeze water—	
10125 × 30 × 144	43,740,000
(3) To cool ice to average temperature 16° F.—	
10125 × 30 × 0·5 × 16	2,430,000
(4) To cool solids in the ice zone from 50° to 16° F.—	
10125 × 62·5 × 1·8 × 0·2 × 34	7,745,625
B.—(1) To cool water to average temperature of 41° F.—	
19245 × 30 × 9	5,196,250
(2) To cool solids to average temperature of 41° F.—	
19245 × 62·5 × 1·8 × 0·2 × 9	3,897,125
Total heat to be extracted	68,476,500
Add about 33 per cent. to insure against losses	21,525,500
Actual working total heat—	90,000,000

Time to be taken to form wall—

$$\frac{90,000,000}{85 \times 850 \times 24} = 52 \text{ days}$$

Capacity of plant in tons of refrigeration*—

$$\frac{90,000,000}{52 \times 288,000} = 6 \text{ tons}$$

This is, however, the capacity required at an evaporative temperature of −15° F., *i.e.*, a suction pressure using an ammonia compressor of 5 lbs. per square inch gauge. Machines are normally rated at 27 lbs. per square inch suction-pressure and the capacity of any machine varies directly as the absolute pressure; hence a standard machine for this job would have to be capable of—

$$\frac{6 \times 42}{20} \text{ tons} = 12{\cdot}6 \text{ tons of refrigeration per day.}$$

It will easily be seen that a plant capable of forming an ice-wall will have ample capacity for maintaining it once formed, provided the outside conditions remain the same.

Further calculations for the size of condenser, cooling plant, brine pump, etc., are, of course, necessary. As examples of these may be found in any manual of refrigeration, no useful purpose would be served in inserting them here.

* 1 ton of refrigation = 288,000 B. Th. U.s per day.

*ENGINEER STORES IN THE GREAT WAR AND AFTER.**

UNDER pre-war conditions, technical equipment of R.E. units specified in "Mobilization Store" Tables, various tools, pontoon equipment, telegraph stores, those for printing, photographic and lithographical sections, with many others, were classed "Ordnance Stores." Their patterns were fixed and sealed, they were included in the "Vocabulary of Stores," and the duty of supplying them fell on the Royal Army Ordnance Corps, whose business it was to establish convenient depôts in England and in the field for first equipment and to meet wastage.

Building and engineering stores for peace-time works were included in items of Army estimates. They formed part of special contracts which, with some exceptions, were dealt with by the R.E. officer responsible for making the contract. The principal exceptions were electrical and mechanical plant and building stores for foreign stations, which were dealt with by the Director of Fortifications and Works through three sub-branches, viz. :—

F.W.4(a) *Electric Lights*, who designed, inspected and provided all articles of authorized R.E. equipment, and carried out special electrical duties.

F.W.4(b) *R.E. Committee*, who dealt with changes and improvements in equipment, and carried out trials and experiments.

F.W.4(c) *Iron Structures*, who carried out mechanical duties and arranged for contracts for the supply in bulk of building stores for foreign stations.

The placing of all War Office contracts, whether for engineering or otherwise, was the business of the Director of Army Contracts, a civil administrator with no technical engineering knowledge. Any changes found necessary after the contract had been placed entailed considerable delay in supply; so that procedure was slow and unsuited to the needs of an Army in the field.

The Ordnance Corps was fully occupied immediately war broke

* This article is a reproduction of two lectures delivered by Colonel S. L. Cra'ster, C.B., C.I.E., to the engineer students of the Bristol University. Through the courtesy of the Dean of the Faculty of Engineering, a lecture hall at the Merchant Venturers Technical College was placed at Colonel Cra'ster's disposal, and the lectures were illustrated by slides showing plant and machinery typical of the vast number of orders dealt with during the war.

out and, finding itself unable to deal with demands from the front for articles not in the "vocabulary," the work of providing everything which was not authorized equipment fell on the Director of Fortifications and Works, and the present article deals in particular with F.W.4(c), the head of which was known as Inspector of Iron Structures (I.I.S.).

In August, 1914, the Army had no reserves of special engineering plant or machinery, nor were any contemplated, yet by the end of 1914 I.I.S., now on a war footing of 8 officers and 24 other ranks, were providing the multifarious demands for troops in the sphere of combat, for railways, roads, canals and docks in France, as well as for the Royal Flying Corps. Three of these officers were Civil Engineers and, as the war progressed, their numbers rapidly increased, and proved to the full the necessity for maintaining close touch between the Corps and the whole body of Civil Engineers. This close comradeship existed in all theatres of strife, and the interdependence of the Corps and the Civil Engineering profession was one of the great lessons of the war.

It was at once evident that peace procedure was too leisurely for war contracts and D.F.W. was authorized to handle his own, keeping the Director of Army contracts and the Finance branches of the War Office informed of action taken. At the end of a year the Director delegated his powers to Capt. R. Oakes, R.E., his Inspector of Iron Structures. The latter discussed demands with manufacturers on the telephone, decided what was suitable and immediately placed his orders. These, when the Director had concurred, were confirmed in writing.

Capt. Oakes' guiding principles were: (i) rapidity of supply; (ii) economy in price; (iii) efficiency of inspection; (iv) economy in cost of administration.

The continual extension of the world-war opened up fresh theatres in rapid succession, whilst varieties of climate and of natural resources and the kaleidoscope of military operations and events caused a flood of requisitions on the War Office. Many demands were novel, all were reported most urgent, and Capt. Oakes, in touch with his superiors, was obliged to differentiate. He therefore created a relative order of urgency in accordance with the special "inside" information he possessed, and brought to bear his invaluable practical experience, gained during the war in South Africa, and later as Locomotive Superintendent of a large South African Railway. Applying his four principles, and realizing that time in war is everything, he increased his staff of inspectors (from their peace footing of three military mechanists) by a few additional men, military and civil. He immediately ascertained the stocks of engineering and railway plant and machinery available in England, and during the first few weeks of the war he provided a reserve which

was invaluable. Thus he utilized the breathing space which fell to the engineers; for at the outset no one could predict what would be the course of the campaign which opened in France and Flanders in 1914.

1914.—Oakes was a member of a War Office Committee which studied the requirements of *matériel* for the artillery and engineers for a great siege and accordingly provided for R.E. siege parks and workshops, for everything for 2 ft. 6 in. gauge railways, and for workshops and their equipment for the Royal Flying Corps. The siege did not occur, but the *matériel* was most useful for trench warfare.

Shortly after the war broke out, Oakes, already working at the highest pressure, was called on to act as Engineer Shipping Officer, and Qrmr. and Hon. Lieut. (later Lieut.-Colonel) A. N. Tucker, R.E., was selected as his representative at Southampton. Tucker and his small staff were indefatigable, but the port proved unsatisfactory, as it was so congested, and too far from Oakes' headquarters. On 1st January, 1915, Oakes' shipping organization was established at S.W. India Docks (Port of London) and steadily developed as need arose. Both as a store depôt and port of embarkation Abbey Mills and the Docks continually increased in importance and added to the efficiency of the Branch commonly known in the war as F.W.8.

Other ports, such as Liverpool, Newport, Southampton, Rochester, Grimsby and Immingham, were also freely made use of, as circumstances dictated, but the intense submarine campaign eventually forced I.I.S. to abandon the West coast ports, and Richborough was called on to take its share by means of barges and the train ferry.

To meet the difficulty of ensuring prompt shipment, a fleet of small vessels was allotted to Oakes, their numbers varying from 10 to 22, and by this means regular supplies were maintained between England and France. That this was appreciated by Field-Marshal Haig the following extract from his Dispatch of 25th December, 1917, will show:—

> "The supply of engineer stores and materials, now required in vast quantities, has throughout been efficiently maintained. . . ."

The scale of shipments is instructive, and may be studied in detail on the Graphs (*Plates* IV and V), but it is of interest to note, in passing, that, whilst 20,000 tons represented the monthly average of all military supplies of every kind delivered in South Africa during the last year of that war, for the last two years of the Great War the average monthly shipments of engineer stores (apart from anything else) was 40,000 tons, and this in face of difficulties of manufacture due to lack of raw materials of all kinds, to shortage and inferiority of labour employed, to congestion on the railways of the United Kingdom, and the ever-present submarine menace, which barred several important and conveniently-placed ports.

Hitherto we have had in mind the demands of the Western front alone, but it must be remembered that Italy, Egypt, Gallipoli, Greece and Macedonia, Sinai and Palestine, Mesopotamia, East Africa, and the N.W. Frontier of India were all theatres of war whence demands were made, and prompt and regular shipments had to be arranged for all of them. What this meant can best be seen by reference to *Plate* I.

The vicissitudes of a campaign may cause a sudden call for stores at the shortest notice, and the gravest issues may depend on prompt supply. Therefore, intelligently to follow the story told in the Graphs, the principal military events should be borne in mind, *e.g.*, if *Plate* V be enlarged and at top or bottom be added the chief battles and events in chronological order, their domination of the demands on F.W.8 will be clearly seen some three to six months later, *i.e.*, the time required to design, manufacture and ship.

Wherever possible, forecasts of operations were obtained by the D.F.W. from the General Staff, and orders placed accordingly, but there were obvious difficulties in this procedure, and liberal allowance had to be made for variation.

1915.—Instead of an advance to the Rhine, the Allied Armies were committed to winter warfare in October, 1914, and found it necessary to develop communications by rail, road and water, so that in place of 2 ft. 6 in. gauge railways and mobile Army workshops the call was for girder bridges and permanent-way for the French Chemin de Fer de l'Est, and for French lines of railway serving our troops, for many thousand tons of road metal, and many hundred thousand gallons of tar, for road bridges and steam-rollers, for all kinds of shell-proof shelters, trench pumps, hand- and power-driven, trench diggers, loophole plates, sap shields, mining machinery, survey and life-saving apparatus for mining companies, newly raised; for petrol- and electrically-driven air pumps for mines, and for thousands of canaries and white mice to test the air of the mines. All these demands came on Major Oakes' branch and were duly provided.

As the warfare of positions dragged on, and miles of water-logged trenches required dewatering, pumps and more pumps were demanded, and in December, 1915, 15,000 pumps and 250 miles of hose were under manufacture, with 150 miles to follow. Demands for steel screw-posts for entanglements, roofing felt, corrugated sheeting, structural steelwork, cement, stoves, and laundry machinery showed clearly that the winter struggle in 1915 would be prolonged and bitter.

In September, 1915, Major-General Scott-Moncrieff (D.F.W.) visited the armies on the Western front to study the engineering needs of the whole theatre, and took Major Oakes with him. This visit bore ample fruit: the military situation from the ports to the foremost trenches had been grasped, a close mutual understanding

between the military engineering chiefs at the Front and the War Office Suppliers was established, procedure in regard to demands was co-ordinated and simplified, and the good relations then established were continually maintained by periodical visits of Oakes' officers to France, and by visits (to Oakes and his successor) of Engineer Officers on leave in England from all the various theatres of war.

When the campaign in the Dardanelles opened, defence stores were required, and supplies were at once diverted from France, recoupment taking place later. Egypt became a base for Engineer Stores for Egypt itself and all other Mediterranean forces, and the bulk of the contents of the Engineer Siege Parks for France, as well as the complete outfit of 2 ft. 6 in. gauge railways provided for the Western Front (but refused at first by the railway branch), were promptly shipped to Alexandria and were of incalculable value in the subsequent operations against the Turks in the Suez Canal zone.

The endless demands from the various theatres of war entailed many modifications in accepted designs of machines and plant, whilst many novelties were also called for. It was essential that these should be quite efficient under service conditions before dispatch, and to attain this end, an experimental trial ground was established at Claygate, Surrey, under Major Oakes' general supervision. Here, exhaustive trials of tunnelling machines, pipe-pushers, trench-diggers and light and heavy ropeways were carried out. There were many setbacks, but no one acknowledged defeat, and the general consensus of opinion in the field was that the machines thus tried out came up to expectations, and justified the time and trouble entailed in evolving their final and varied forms.

1916.—As the war progressed, one by one the Royal Flying Corps, Military roads and railways and the Inland waterways and docks developed into distinct organizations and took over their own supply problems, thus relieving F.W.8; but, in the meanwhile, fresh problems had arisen on the Western front in connection with water supply, the provision of electric power and light, and the supply of corrugated sheeting and other materials for revetments and temporary shelters for men, animals and stores. It may be noted that the Ministry of Munitions did nothing to relieve the D.F.W. in respect of engineer stores.

East Africa took £51,000 worth of cement, hutting stores and machinery during 1916—a mere bagatelle compared with France, but entailing appreciable additional labour on F.W.8.

Mesopotamia in that year demanded bridges up to 60-ft. span, hot-water apparatus and ice plants for hospitals and camps, and a 1,000-kw. power-station for Basra port to drive 7,000 hospital fans and to manufacture 20 tons of ice daily. To meet this demand, power plant under private order for India was commandeered, and

dispatched with boilers and all accessories. The boilers were sunk by the enemy, but the Branch managed to ship a fresh outfit in eight weeks, and the power station was at work in April 1917.

The Mediterranean base took a million pounds' worth of engineer stores in 1916, of which internal-combustion locomotives and aerial ropeways were notable items.

1917.—England began to suffer from German air raids in 1917, which called for anti-aircraft guns and lights, and these latter, with small sets to work them, were provided by F.W.8 with difficulty, as manufacturers' hands were at this time very full, and steel was scarce.

On the Western front, as a result of the battles of 1917, the British Armies were established in country where roads, railways, villages and towns, water and lighting supplies had been systematically destroyed. The use of tractor-drawn guns and the advent of tanks demanded complete reconsideration of bridge girder designs. The Channel ports were systematically and continuously bombed, whilst Labour Corps swarmed on all Lines of Communication and required immediate shelter to preserve health. Timber could no longer be supplied in vast quantities from England, and the French Government allotted forests to the English armies for their needs. Lastly, the policy of cultivating the devastated areas in rear of our armies was initiated, to provide green food and fodder.

Another spell of trench warfare was indicated and, to meet these various needs, vast quantities of cement, entanglements and posts, corrugated sheets, roofing felt, steel shelters, piping, tanks, rolled joists, and expanded metal sheets were dispatched monthly, in addition to agricultural machinery, large log-saws and sawmill plant, to say nothing of special plant and machinery for water supplies and electric power. Twenty-seven thousand "Nissen" huts were demanded in March, 1917, and 20,000 more a few months later. The first order was completed by the autumn, but steel and other difficulties threatened serious delay to the second 20,000. For the same reasons, 53,000 stoves under manufacture seemed at one time impossible to obtain, but the officers of F.W.8 strained every nerve, and 43,000 had been shipped to France by 31st December, 1917.

Deep well-boring plants, pumps and air lifts, centrifugal, reciprocating, ram and turbine pumps solved the problem of water supply under very varying conditions, whilst in one case, a 22-in. Gwynne centrifugal and 6-cylinder 90 B.H.P. engine, delivering 600,000 gallons per hour, successfully drowned out certain German trenches which it was necessary to suppress. Risk of disease, too, had to be met and countered by water-purifying plants. In the smaller of these, crude water was treated with sulphate of alumina and soda, the water passing to sand filters before use. In larger installations water was chlorinated and dechlorinated, and portable chlorinating plants were manufactured and sent out.

The *Official Medical History of the War* states that, whereas in S. Africa of 530,000 troops employed 58,000 had typhoid and of these 8,000 died, in the Great War 5,000,000 men entered the war areas, and amongst them were 7,500 cases of typhoid and 266 deaths from this disease, thus attesting in a remarkable way the efficacy of water-purification as a preventive.

Mention may also be made of plants for X-ray sets at Forward Clearing Stations, the supply of which fell to F.W.8.

The tale of special plant included laundry and wood-working machinery, machine tools, fire engines, destructors, disinfectors, cranes and concrete mixers for the construction of blocks for " pill-boxes "—small strong points in the front line capable of withstanding the heaviest bombardment.

Supplies for American Armies. 1917–1918.—In April, 1917, the United States declared war on Germany, and it was agreed that the Armies of our Ally should be supplied, as far as possible, from England, notwithstanding the increasingly serious position of the markets for steel and all raw materials, and the shortage of skilled labour in England. The American Engineer Purchasing Officer in London (Colonel R. G. Powell, C.M.G., U.S. Engineers) got in touch with the Chief Mechanical Engineer, and the cordial relations then established increased under the stress of war. The various demands of the British Army already enumerated now came in, in an increasing flood, from the American Base Depôt in London, and taxed the hard-worked staff of F.W.8 to the utmost. But the best of good fellowship prevailed, and the demand for units of baking plant to supply a total of 1½ million bread rations per day was met with a smile and a laugh, and the plant was, in the main, supplied in due course. On taking leave of England in 1919, Colonel Powell expressed, in cordial and graceful terms, the boundless appreciation of the American Expeditionary Force and the U.S. Engineers and their debt to the Chief Mechanical Engineer's branch. Between August, 1917, and December, 1918, the American Armies had been supplied with engineer stores to the value of £1,500,000.

In Mesopotamia the Turks had retreated 30 miles north of Baghdad by 18th March, 1917, and Sir Stanley Maude decided to cultivate cereals and fodder in the Tigris and Euphrates valleys to relieve the strain on India and on shipping from Indian ports. Pending the construction of canals, water reached the land by means of powerful pumps and engines sent by F.W.8, and he also managed, after much difficulty and labour, to fill demands for numbers of " spares " for hundreds of pumps and engines of English manufacture, seized as prize of war. Little beyond the names of makers and very meagre descriptions of the machines were cabled, but these, with the makers' help, proved sufficient in the majority of cases. An exactly similar experience occurred in 1918, when General Allenby seized Palestine.

1918.—Mesopotamia, in pursuance of the agricultural policy, also demanded hay-balers, corn-crushers, ploughs and harrows, all of which were on the sea by May, 1918. In this last year of the war, General Marshall's forces also received a 9-unit milling plant, and several dairy plants, whilst former orders for oil-driven pumps (6 in. to 20 in.) and agricultural instruments were repeated.

The port of Basra was being rapidly developed, whilst large railway shops were to be located at Baghdad. In June, 1918, the power available at Basra (1,700 kw.) was to be replaced by a large turbine set to meet the increasing requirements of docks and wharves, the bulk of the three existing installations being earmarked for transfer to the Baghdad railway shops. With the signing of the Armistice by the Turks, the scheme was abandoned, though much of the necessary plant had reached F.W.8's stores at Abbey Mills.

A small British detachment ("Dunster Force"), operating in the direction of Enzeli and the Caspian, was dependent on a precarious Line of Communication over mountainous country between Mesopotamia and Hamadan. To aid in passing in supplies, F.W.8, after long and patient experiment, had evolved a satisfactory monocable "general utility" ropeway capable of handling at least 360 tons *per diem* in 5 cwt. loads, 30 per mile. In August, 1918, 50 miles were under manufacture for the benefit of Dunster Force, but it was not required, owing to the sudden termination of hostilities in Mesopotamia in November, 1918, and was stored in England for future eventualities. Similar units were manufactured for use in the Balkans, and these, too, became surplus in November, 1918. But in the following year the Indian Government were in difficulties regarding transport in the Khyber, and gladly took 70 miles, which proved very useful. Everything in the outfit had been standardized, and spans of 1,000 ft. could be negotiated, with standards 64 ft. high if required. The engines were of 40 h.p. and required 30 gallons of petrol and 3 gallons of oil per hour. The outfit required for average country, delivered at F.W.8's store, cost £2,000 per mile in 1918.

The course of events in Palestine during 1917 and 1918—from the first attack on Gaza to the brilliant capture of Damascus and Aleppo—cannot be followed in detail, but the consequent reinstatement of roads, ports and water supplies and the varied needs of camps and hospitals created an unending series of difficulties for the Engineers, who relied on F.W.8 for all machinery and stores, and no call was made in vain. The story of the Allenby bridge over the Jordan may be taken as a fair illustration of the demands and how they were met.

An Inglis heavy rectangular bridge, 240 ft. over all, was demanded by cable on 7th April, 1918, and was landed on 1st July at Alexandria, complete with all erecting gear, by an R.E. Territorial Subaltern who had been selected to take charge of the consignment

so as to ensure delivery of the thousand packages intact. This officer was attached to the Army in Palestine and took charge of the bridge, and in August and September erected it just north of the Dead Sea, 1,200 ft. below the level of the Mediterranean, in the very hottest season of the year—a fine piece of work.

During 1917 and the greater part of 1918 General Milne's forces in Greece and the Balkans could make but little headway, notwithstanding strenuous exertions and unremitting toil, until at last their chance came, was seized and ended on 30th September in complete victory. During those 20 months the forced inaction, the mountainous, and in many places marshy, nature of the theatre created special difficulties, and necessitated the supply of quarrying machinery for road metal, hutting and building materials for improved camps and hospitals, water supplies, lighting sets and multifarious machinery, destructors, disinfectors, and water-purification plants, to combat disease.

In 1917 it was clear that supplies of French charcoal for the British Armies could not be depended on, so the Chief Mechanical Engineer was directed to build and equip with special machinery a peat-fuel factory at Dumfries, and the first consignments of fuel were ready when the Armistice was declared. As France no longer required it the fuel found its way to garrisons in England and Ireland.

The great German attack in March and April, 1918, caused heavy losses of huts, water supplies, machinery and tools of all kinds. Whilst it was necessary to replace these losses, though F.W.8 were working at very high pressure already, the highest authorities contemplated that 1919 would also be a year of war, and called on F.W.8 to maintain in full the tale of monthly "maintenance" stores, and added demands for 20,000 fresh huts and 15,000 steel circular tents, for over 1,000 bridges of spans from 21½ to 120 ft., and in addition for a special equipment of bridges for tanks which were themselves to carry and lay them. Large electric power plants for Boulogne, Calais and Yvetot were urgently required to supplement the French installations, now heavily overworked, and four bakery units, each with a capacity of half a million rations daily, were under manufacture for British Armies in France.

During the struggle on the Western front, camouflage was used more and more extensively, and F.W.8 provided hundreds of thousands of fish-nets, miles of canvas and coir screening, calico and hessian, all of which were required to be made fireproof. This problem presented many difficulties and entailed much experiment and research and repeated failures. In November, 1918, success had just been achieved when the Armistice caused demands instantly to cease, but the records of trials and results remain for future use and should prove of value if the need arises.

Plates I and II show comprehensively the value of engineer stores

ordered and inspected, and *Plates* IV and V the tonnage shipped through the fateful years 1914-16, but owing to circumstances which Oakes could not control his office accommodation was miserably inadequate; *e.g.*, the nine officers of the branch, dealing with masses of orders, contracts and bills were working in one room at the War Office with four telephones in use—and the strain under such conditions may be imagined. On 1st April, 1917, Oakes installed his branch at Adastral House, Blackfriars, and in the Army Order sanctioning a larger staff for the Chief Mechanical Engineer his duties were thus defined: "The purchase, inspection, shipping, store accounting, and in some cases, design, of machinery, mechanical engineering plant and engineering stores for Expeditionary Forces and Colonial Stations, and any special machinery, mechanical plant and structural steel work for Home Stations."

The framework of the new organization was in two parts: (*a*) design, purchase and inspection; (*b*) shipping, store accounting, finance and general correspondence. The backbone of the structure were the "section officers," of whom there were six on the design and purchase side and four on the shipping side. To each were allotted specific duties, *e.g.*, on the design side, Section 1 dealt with hutting and building stores; Section 3 with special machinery; Section 5 with electrical and pumping machinery, and so on.

At the S.W. India Docks was Quartermaster and Hon. Lieut.-Colonel Tucker, Assistant Director of R.E. Stores, with section officers dealing with (i) shipping, (ii) store depôts, (iii) accounting; the whole under the general control of the head of the Shipping and Accounting side of the Chief Mechanical Engineer's office—Quartermaster and Hon. Capt. (afterwards Major) A. Walker, R.E.

On the design side the section officer received the original demand from overseas and kept a grip of it through all the stages of design, tender (when this had been accepted by the C.M.E.), contract, inspection and completion of manufacture. Then the section officer handed on the documents to the shipping side to be dealt with. All documents and correspondence were carefully filed together, and the section officer knew not only the life history of any order, but could assess the value of the contractor. The latter also learnt to know and appreciate his section officer, and this mutual knowledge and respect bore ample fruit after the Armistice, when the branch proceeded to liquidation of outstanding contracts.

The Section officers were all experienced Civil Engineers; some were specialists, and some had been wounded and were unfit for futher service in the field. They thus had both military and civil knowledge, and were able to gauge the essentials of plant and machinery required by the armies in the field, and boldly adapted or altered accepted commercial designs to suit individual cases as they arose. Section officers were ably assisted by younger Civil

GRAPH—SHOWING QUARTERLY DEAD-WEIGHT TONNAGE SHIPPED OVERSEAS.

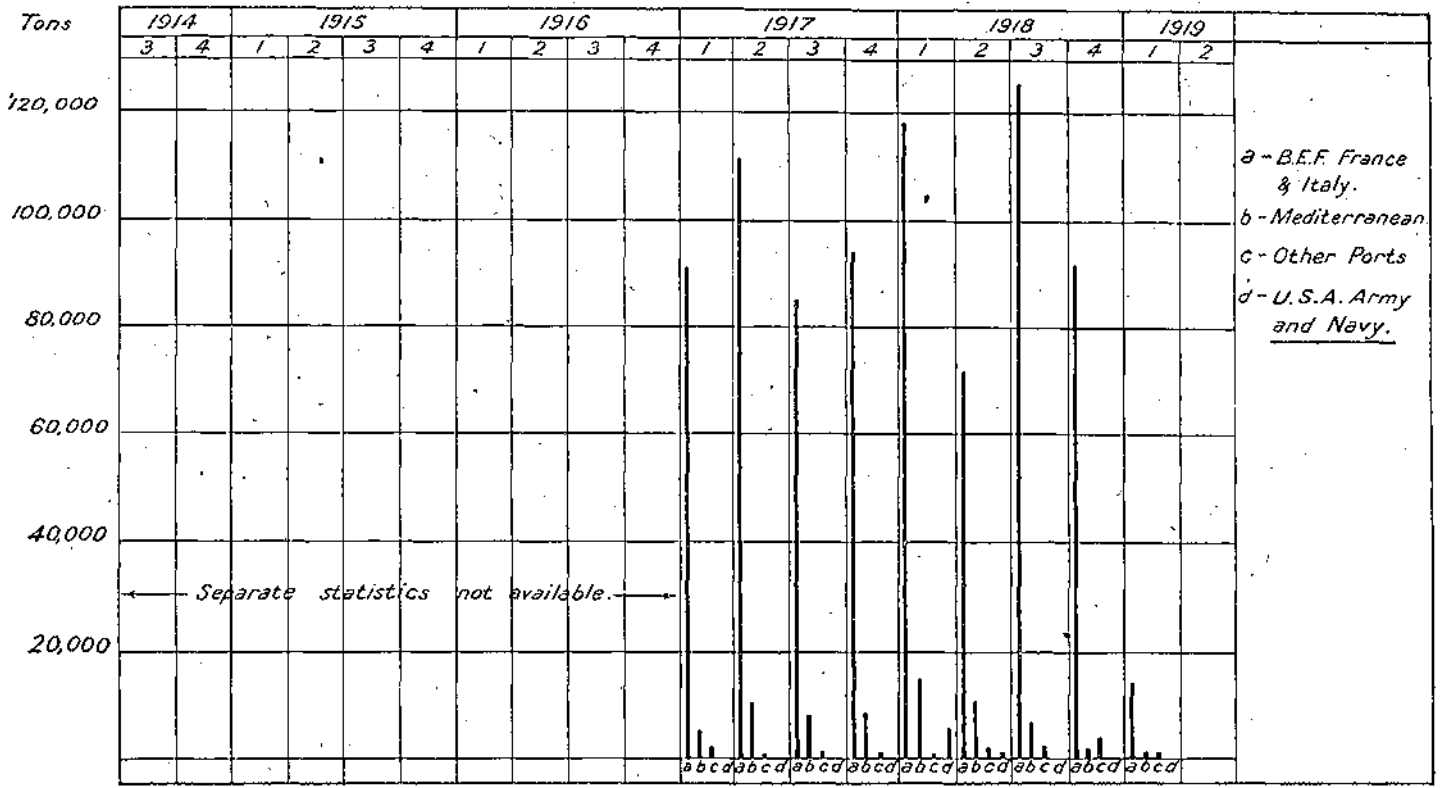
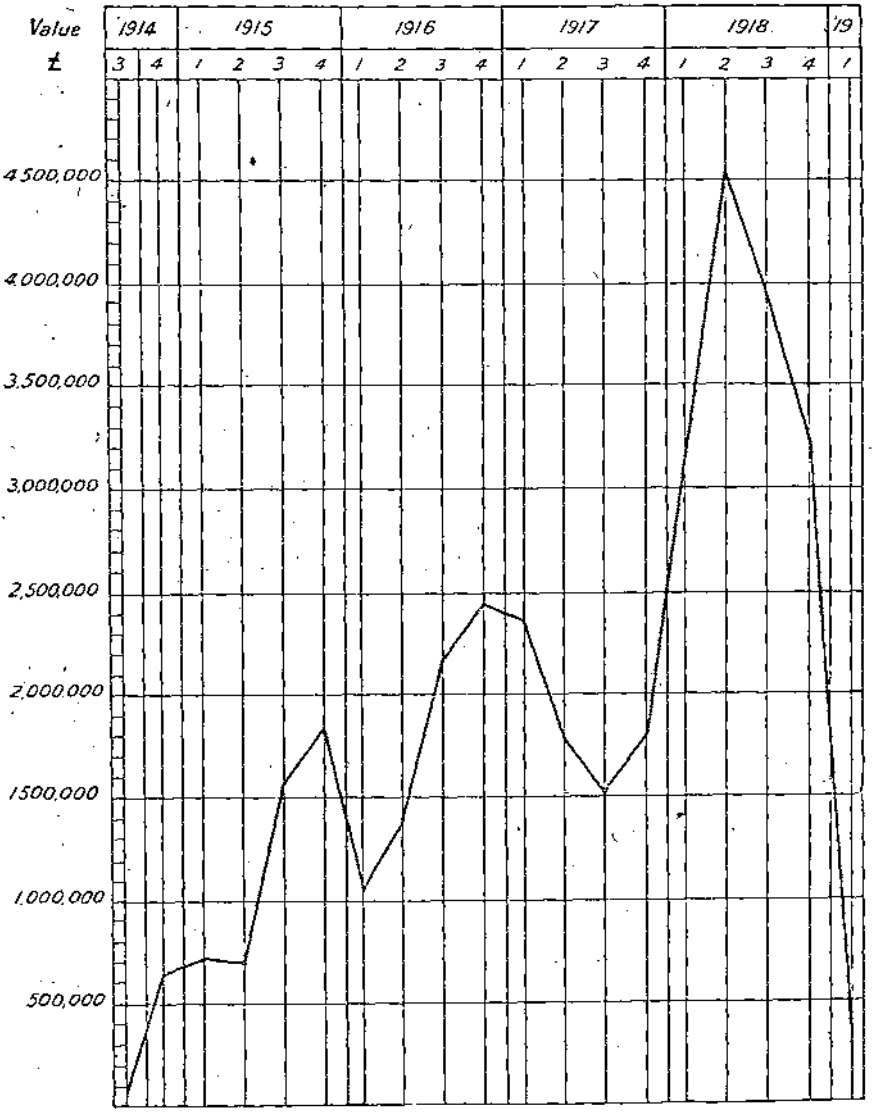


PLATE I.

GRAPH—SHOWING TOTAL QUARTERLY VALUE OF STORES ORDERED AND INSPECTED.



GRAPH—SHOWING QUARTERLY SHIPPING TONNAGE OF ENGINEER STORES.

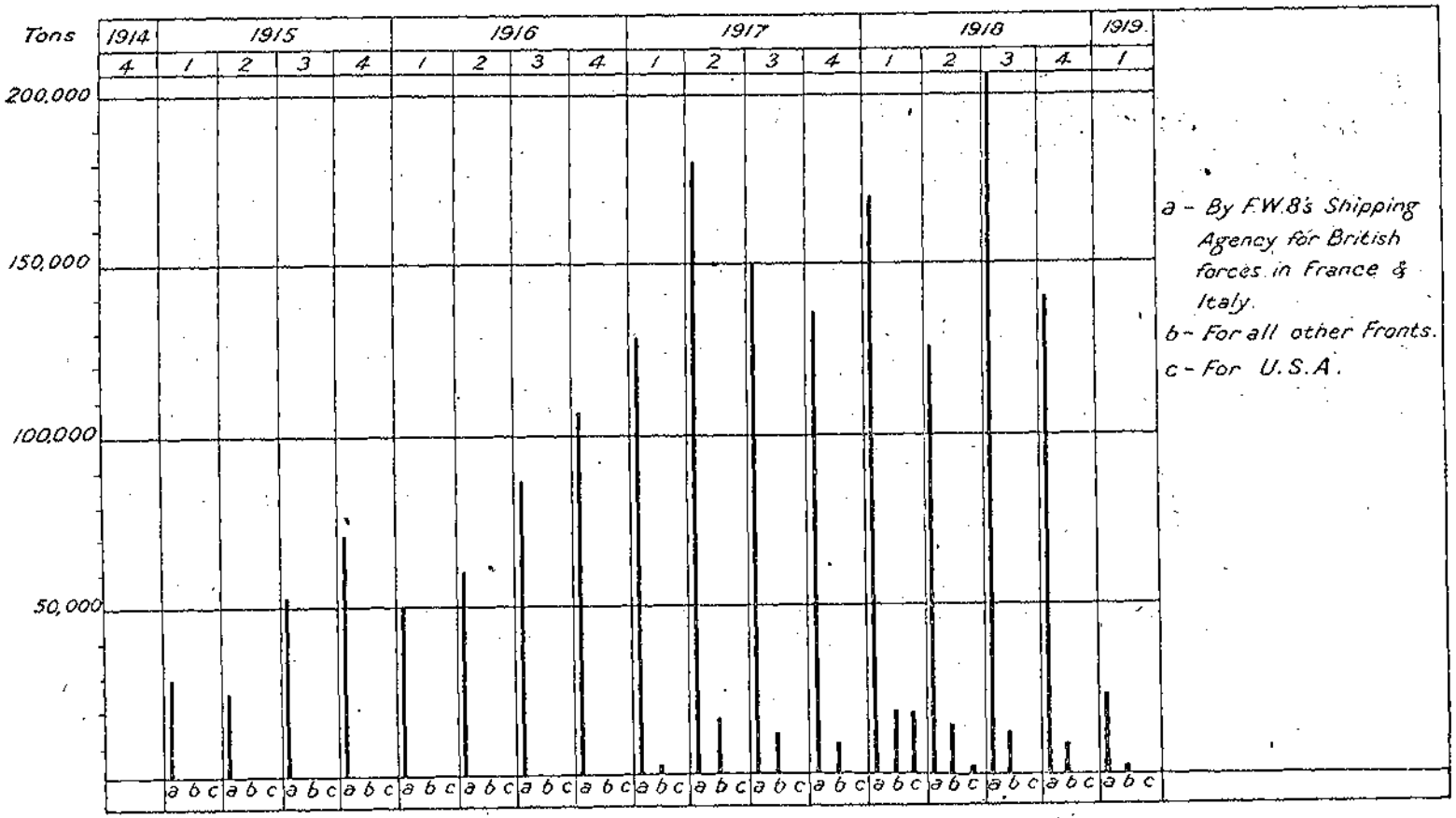


PLATE III.

GRAPH—SHOWING QUARTERLY VALUE OF ENGINEER STORES ORDERED AND INSPECTED.

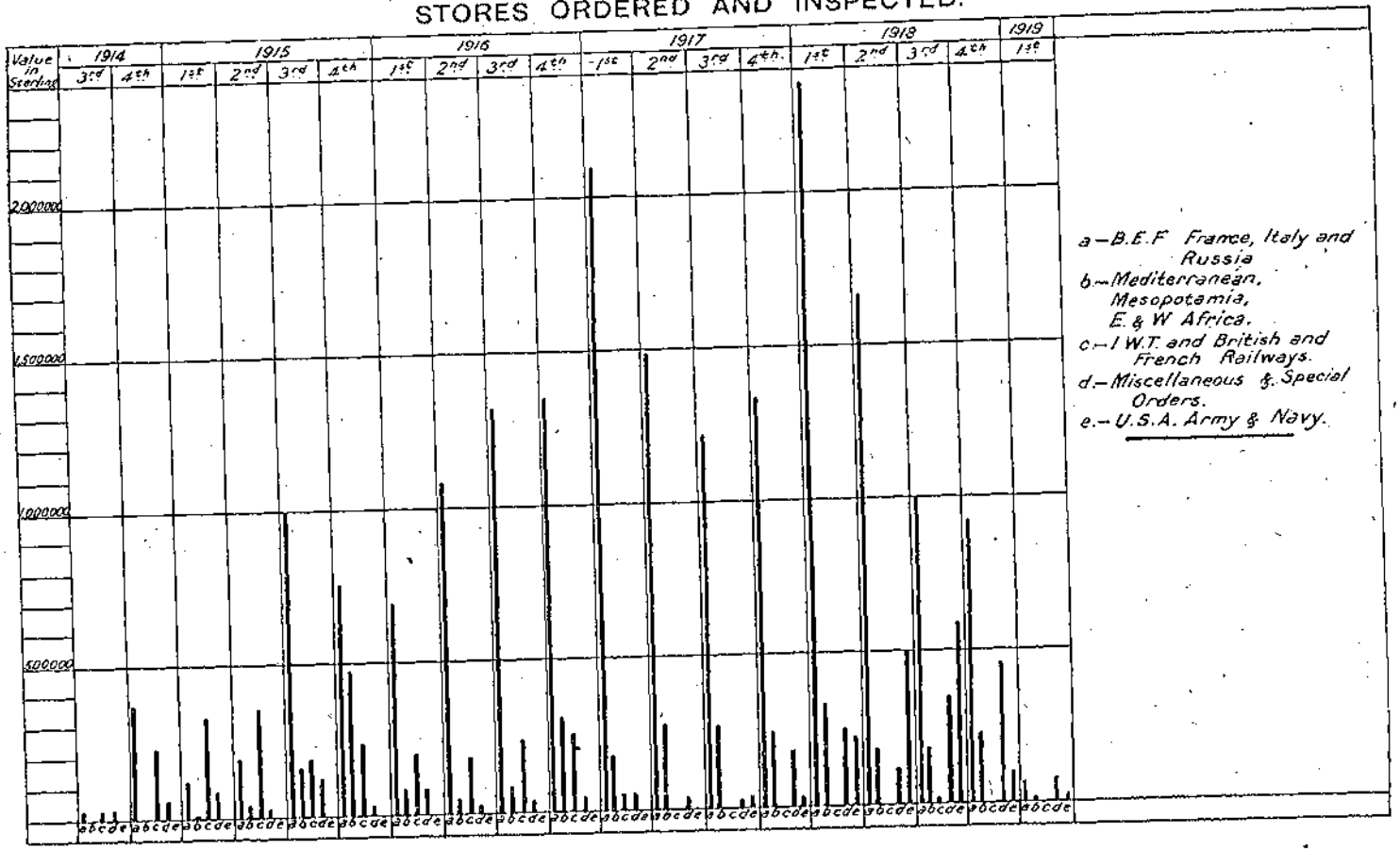
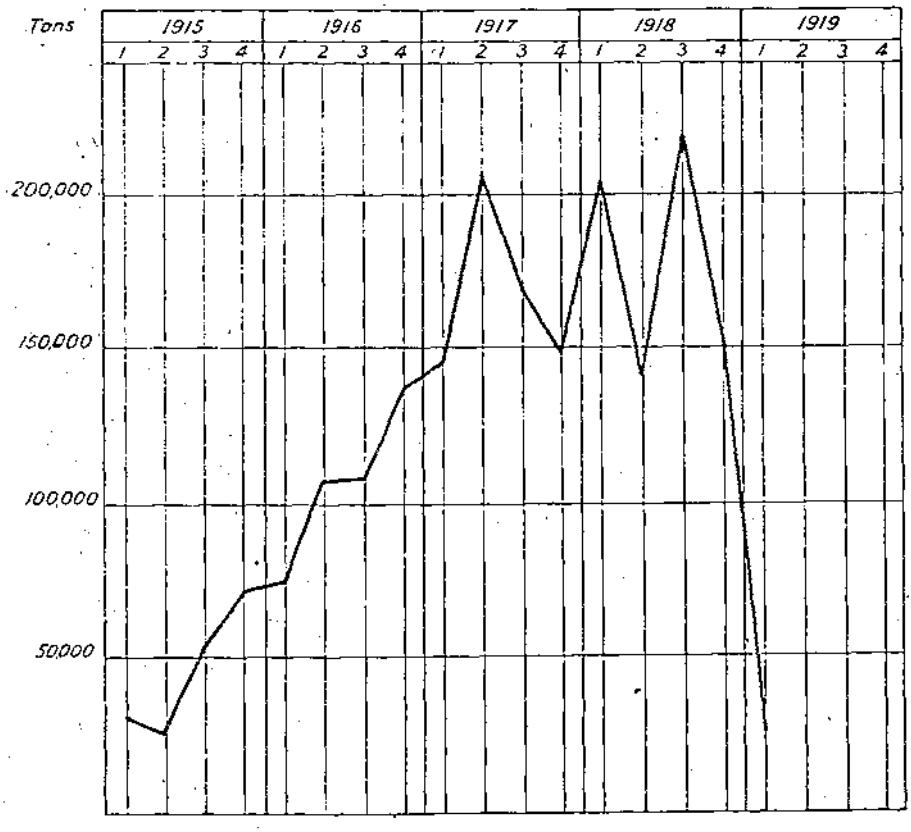


PLATE IV.

GRAPH—SHOWING TOTAL QUARTERLY SHIPPING TONNAGE OF ENGINEER STORES TO ALL FRONTS.



Engineers whose enthusiasm compensated for any lack of experience and enabled those who were unfit for further field service to triumph over physical disability.

The shipping and finance sections were similarly organized, based on the section officer, and thus the foundation was laid to ensure the attainment of the first two principles enunciated, *viz.*, (i) rapidity of supply, (ii) economy in price.

There still remained the third principle, *viz.*, efficiency of inspection. In peace three military mechanists, R.E., sufficed to carry out these duties, but under stress of war many contractors undertook work they had never contemplated in peace. They required constant advice, improved processes, special tools and jigs, and the inspectors were their mainstay. Their circles were large, entailing continuous work and travelling, and the staff of three had swelled to 11 military and 17 civilians in January, 1917; and in November, 1918, 46 commissioned and 28 civilian inspectors and examiners were watching, testing, encouraging and hastening manufacture in the face of continually increasing difficulties in markets, material and labour.

The new organization which Colonel Oakes had created had been working five months, when he was selected, in September, 1917, to occupy an important railway post in Mesopotamia, and Colonel Cra'ster succeeded him at Adastral House.

During the war a weekly conference of senior officers of the General Staff was held in the War Office, to give all branches an insight into the true military situation. The Chief Mechanical Engineer attended whenever possible, and, fortified with the information thus obtained, guided the policy of the branch to meet the most pressing needs of the Armies; whilst in the interests of economy, he exercised supervision over tenders, and inspection during manufacture in contractors' works scattered all over the kingdom.

The course of events in 1917 and 1918 tested the soundness and flexibility of F.W.8, essentially a War Organization, and it stood the test. As difficulties cropped up in connection with supply of steel, labour problems, and priority of supply of raw materials to manufacturers, sections threw off sub-sections, and still the organization grew and functioned efficiently and smoothly. When the Armistice was signed the Headquarters of F.W.8 at Adastral House numbered 49 officers and 143 clerks and draftsmen, as compared with a total strength of 29 of all ranks on the first day of the war.

The average monthly expenditure during 1918 (*see Plates* I and II), was £1,242,000, and the total from August, 1914, to March, 1919, £32,250,000. The cost of administration on the other hand, worked out to less than 0·66 of a penny per pound sterling of stores delivered, and when it is remembered what were the duties laid on the Chief Mechanical Engineer, it is fair to claim that the fourth

guiding principle, *viz.*, economy of administration, was acted up to. The Civil Engineers in the branch had borne their full share in attaining victory. They displayed efficiency and tact, grit and superlative loyalty, and all ranks, without exception, were fired with a grim determination to win the war.

Subsequent to November, 1918, demands still continued (though on a rapidly decreasing scale) for the armies in the field, now cantoned in the late theatres of war, and for troops operating in North Russia, on the shores of the Black Sea, and in Mesopotamia.

The demand for a reduction of staff immediately the Armistice should be signed had been foreseen, and proposals had been submitted in October, 1918. In consultation with the Finance Branch, War Office, the principles which should govern the liquidation of F.W.8 commitments were laid down.

These were (i) to ascertain the legal position in respect of every contract then current; (ii) to effect cancellations at the least cost, compatible with real economy to the State; (iii) to leave with contractors part-finished goods only of use to those particular firms—*e.g.*, engine cranks—and to take into store, for issue or sale, only raw materials at full invoice value, or completed articles at full contract value.

The Section officers were evidently those best fitted to open negotiations with contractors, and this was done. After full discussion with the contractor, section officers' proposals were put up to their seniors, and after consideration the complete case, with the Chief Mechanical Engineers' recommendations, was passed to the Finance Branch, War Office, for disposal. The final decisions arrived at were communicated to all concerned, and an early settlement effected. The advantage of recording the history of each separate demand in full detail was soon apparent, for, although section officers were demobilized one after another, the officer selected to carry through liquidation was never at a loss for information, with the records before him, and in the end in only three cases did contractors threaten legal proceedings, and of these, two cases were withdrawn. The following liquidation figures for F.W.8 are of interest:—

Value of contracts settled *without any compensation*	... £795,000
,, ,, ,, with compensation *under* 15%	... 543,000
,, ,, ,, *exceeding* 15%	... 225,000
	£1,563,000

The compensation paid was £87,593, or 5·60 per cent. of F.W.8's commitments. The Select Committee on national expenditure, criticizing the operations of another Government department, states that the figures as at 31st March, 1920 were 42·3 per cent. for contracts

liquidated in England and 60 per cent. for contracts closed in the United States.

With the advent of the Armistice it had been agreed by the U.S. Army Authorities that F.W.8's contracts made on their behalf should be liquidated by him, on a basis some 50 per cent. higher than the compensation on English Army Orders. Those contracts were duly closed to the complete satisfaction of Colonel Powell, C.M.G., U.S. Engineers, and the figures are not included in the total above.

On July 1st, 1919, the duties of supply were transferred to the Ministry of Munitions, but during the seven months ending 30th June, 1919, the Chief Mechanical Engineer placed orders valued at £936,000, and from existing stocks complied with demands from Home and Colonial Stations to the value of £595,000. The Shipping and Store Accounting Sections were busy dealing with all stores delivered. By 1st August, 1919, they had shipped 50,000 tons overseas, had arranged for war reserves, and had listed and passed the remainder to the Disposals Board. The Finance Branch of F.W.8, meanwhile, examined and passed for payment over 16,000 bills, aggregating £4,795,000, including arrears at the Armistice. Reductions in staff began early in December, 1918, and on 1st August, 1919, when the Chief Mechanical and Chief Electrical Engineers' branches were amalgamated under the latter, F.W.8's staff numbered 24 officers and 55 other ranks. By May, 1920, the numbers had been further reduced to five officers and 11 other ranks, and by 31st March, 1921, these had been gradually extinguished and F.W.8 had become a memory.

Major-General Sir George K. Scott-Moncrieff, K.C.B., K.C.M.G., C.I.E., and Sir William A. Liddell, K.C.M.G., C.B., who were present at Bristol, addressed the University authorities and the Engineer students on the conclusion of the lecture.

Sir George Scott-Moncrieff reminded his audience that the Engineers' object was to "deliver the goods" as quickly and economically as possible: his reward lay mainly in the joy of achievement. He pointed out that engineering in war embraced not only mechanical work to produce munitions, but an immense amount of work in the field, corresponding closely to that of a Municipal Engineer in time of peace, with this difference—that in war such work must depend on local circumstances and the military situation at any given moment. Thus, at the outbreak of war in 1914 the Engineers at the War Office could not become really busy till the campaign developed. Then they took the matter in hand, and the branch whose history they had heard was one of twelve which were evolved under him (as Director of Fortifications and Works) as War Organizations. The splendid staff of officers, military and civil engineers who did the

work, were not those who advertised their exploits, but were typical of the bull-dog breed that has built the British Empire.

Sir William Liddell defined the leading characteristics of the Military Engineer thus: Ability to adopt expedients, and ability to realize the value of time, to obtain tangible results consistent with efficiency. Referring to the University students who would go abroad as "Pioneers of Empire," he advised them to study the history of the work of the Engineers in the Great War, as the engineering problems they would meet in the course of their employment bore a strong family resemblance to those in war, chiefly owing to paucity of means and lack of machinery.

Thus the Military Engineer could help his Civilian brother and each should foster and keep fresh the comradeship engendered by a common participation in the trials of the Great War.

RECENT DEVELOPMENTS IN WATER ELEVATORS.

By MAJOR G. C. GOWLLAND, R.E., A.M. I. MECH. E.

THE inventor of the Persian water wheel would be gratified could he read the new *Water Supply Manual*, for on *Plate* XLVII of this publication he would find a drawing of his ancient patent elevator, together with the following description :—

"The Persian water-wheel (or *sakia*) elevator is a hand- or animal-driven water-lift of extreme antiquity. It is suited for low lifts where continuous delivery is required, as for irrigation purposes."

Early forms of other types of machinery are not honoured with full-plate illustrations in other volumes of the *Manual of Military Engineering*, and it therefore appears that there must be something fundamentally sound in the age-old *sakia*, or it would not be mentioned or illustrated in a modern military publication.

The *sakia* consists of a wheel suitably mounted in a vertical plane directly over the water supply, and there caused to rotate. On this wheel are slung a pair of endless ropes to which are attached at intervals a number of earthenware vessels, small tins or other water receptacles. The ropes are made long enough to reach the water.

As the wheel revolves, the rope goes round the wheel, and a continuous stream of water-filled receptacles is brought up and discharged into a suitable receiver as they top the vertical wheel. A simple invention, yet it has lived, and all modern elevators work more or less on the *sakia* principle ; the more successful being close copies of the original.

The chief good points about the *sakia* are :—

(1) No fixed parts down the well ; therefore, the whole installation can be done at the well-head without going below ground. There being no rigid fixtures down the well means that shaky steining can be ignored.
(2) Positive action. However slow the belt speed, some water is bound to come up.
(3) The lift is not limited to some 25 ft. as in a suction pump.
(4) No skilled supervision is required.
(5) Spare parts can be easily improvised.
(6) It works well with animal power as its prime mover.

A most excellent appliance for getting water out of roughly steined wells that are too deep for a suction pump to work from ground

level. The writer was, in fact, asked in 1916, to design a portable *sakia* capable of raising water from 200 feet depth for use with a desert column. Some such elevator obviously is wanted, but the *sakia* is no good for military purposes, for the following reasons :—

(1) It is not portable, and cannot, in its ancient form, be made so.
(2) It cannot be speeded up. Any attempt to get high belt speeds causes the efficiency of the water receptacles to drop to zero, owing to air displacement difficulties.
(3) It is incapable, owing to mechanical weakness, of raising water from much above 50 feet.

With the innumerable well-designed pumps that are now being produced, it may be asked why water elevators come into the picture at all. The chief reason why these elevators are being produced is on account of the ease with which they can be fixed, and the fact that they have no fixtures below ground level. This renders them particularly useful for military work, or for situations where quick installation is necessary and where skilled supervision may be at a reduced minimum ; *e.g.*, for farm, colonial or country house use.

In order to make the *sakia* of use for military and other purposes, inventors have tried to cut out its three main faults.

Two such improved designs, the Canvas Belt and Chaîne-Hélice, are described in the *Water Supply Manual*, whilst a third, the Caruelle, is mentioned, but misnamed the Carnalle elevator.

In the Canvas Belt elevator the positively acting water lifting cups on the endless ropes used in the *sakia* are replaced by a broad canvas belt, in which the water is partially absorbed and partially retained by capillary action on the hairs of the belt. By this method belt speed can be increased, in fact the higher the belt speed the better, since there must be always a certain amount of " slip " in the water on the rising side of the belt. The higher the speed of the belt, therefore, the greater will be the difference of speed between the ascending side of the belt and that of the water that is tending to slip down the belt under gravity, and in consequence the greater will be the output. In other words, the action of the belt is not positive, and if the belt moves slowly, the output of water will be very small, firstly because the slip will be great, and secondly because there will not be sufficient centrifugal force to throw the water off the belt as it reaches the top of the pulley.

The belt elevator answered well in many respects for military purposes, as it was light, fairly portable, and very rapidly installed, but it had several bad faults.

(1) It was not positive in action, and therefore had to be run at speed. This entailed the use of some type of engine, usually internal combustion, not always very portable, but ever hungry for spare parts and skilled supervision.

(2) The lack of positive action cut out the useful employment of men or animals as prime movers, firstly, because in order to get belt speed from a slow moving beast it is necessary to use a lot of heavy, not over-portable, gearing at well-head, and, secondly, because if the prime mover, a mule or ox for instance, stops or slows down for any reason, the belt speed drops and down goes most of the water on the rising side of the belt, and the efficiency drops enormously.

(3) The belts wore out quickly if run at economical output speed. This entailed the cartage of spare parts and reduction in portability.

(4) Finally, the efficiency was low. When run at high speeds, so high that the belts quickly wore out, the overall efficiency of the belt outfit is about 35 per cent. Thus the actual belt efficiency would be about 65 per cent.

Water can be raised by means of the canvas belt from depths up to 200 feet, the output being from 1,500 to 2,000 gallons per hour for a single belt. This elevator, in eliminating the three main faults of the *sakia* has eradicated all its good points. There is no demand for the Canvas Belt elevator in civil life; it is, in fact, a makeshift, and was used in war time because nothing better had been thought out. It would probably not be much good for watering desert columns on the move, owing to its non-positive action.

The Chaîne-Hélice is another form of elevator. In this case water is brought up on an endless chain surrounded by coils of wire that move with the chain, and are fixed to it at frequent intervals. The water is held between the spiral and the chain by surface tension, and as the chain goes over the upper pulley, the water is thrown off by centrifugal force.

The action of the Chaîne-Hélice is, therefore, non-positive. The chain speed is about 850 feet per minute as against the 1,600 f.p.m. necessary in the canvas belt. The overall efficiency is between 30 per cent. and 40 per cent., giving an efficiency of the chain itself of between 65 and 75 per cent.

Water can be raised from a depth of 300 feet, and with suitable gear at well-head the elevator can be worked by man or animal power, but being non-positive in action its efficiency will drop off rapidly as the speed of the chain slacks off.

This elevator was much used during the late war, some 400,000 yards of chain being supplied for water supply services. It was found, however, that under service conditions chains were liable to frequent breakage. The outfit is portable, but probably not portable enough for use with camel, mule, or other pack transport.

The weights of complete Chaîne-Hélice outfits are shown later, where they are compared with the weights of the Carruelle outfits of similar capacity.

The third type, known as the Boulton Water Elevator is made by Messrs. Boulton & Paul, of Norwich, and in it is incorporated the Caruelle patent water elevating belt.

The inventor of this has taken the *sakia* as his model. He has incorporated in his invention all the good points of the old water-wheel, and has cut out most of its faults, producing what appears to be a most excellent elevator from the military point of view.

The action of the Boulton elevator band is positive. The band itself consists of a series of open-ended cells attached to an endless belt. The form of these cells, and their method of attachment to the belt, are shown in *Fig.* 1. The cells being open-ended are capable of being filled even if they are passed rapidly through water, but they are so designed that when held in a vertical position the water is retained in them, even though the belt be stationary. The moment, however, that the belt is inclined, the water flows out of the cells. This effect is shown in *Figs.* 2 and 3, and is somewhat remarkable.

The result of the use of this cellular belt is that water will be elevated no matter what speed the belt is run at. Therefore man power or animal power can be usefully employed, as no matter how slowly the belt moves, or how often it stops, the supply of water in the rising side of the belt will not be entirely lost. On the other hand, if it is convenient to drive the belt at speed by means of an engine, it still remains efficient. The Boulton band is designed so that various units can be placed side by side and so increase the water-lifting capacity in direct proportion to the number of units used.

Fig. 1 shows the single unit. This is mounted on a special metal strap (A), while the multicellular bands, as shown in *Fig.* 4, are made up of a number of single units as in *Fig.* 1, mounted close together on a Balata belt. Tests on a single element band (as *Fig.* 1) show that at a speed of 400 feet per minute the efficiency of the band is 95 per cent., the overall efficiency of an elevator run at this speed being 57 per cent. The single element band lifts at this speed 355 gallons per hour from a depth of 152 feet.

Fig. 5 shows a section of a Boulton elevator fixed in a well. From this it is seen that there are no fixtures down the well, and that the whole apparatus can be quickly erected at the well-head.

This elevator appears to be the solution of the portable *sakia* problem.

Desert columns will, as a rule, have camel transport, supplemented in favourable places by motors.

For the moment, consider the problem of a column with no motor transport, operating across desert country, the only water supply being from deep wells usually a long day's march apart. These are the normal conditions in many parts of Africa and Arabia.

The column of tired men and camels arrives at its halting place; both men and camels are thirsty. The wells are, perhaps, 200 feet

RECENT DEVELOPMENTS IN WATER ELEVATORS.

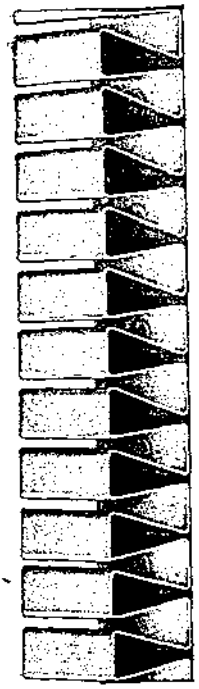


Fig. 1.

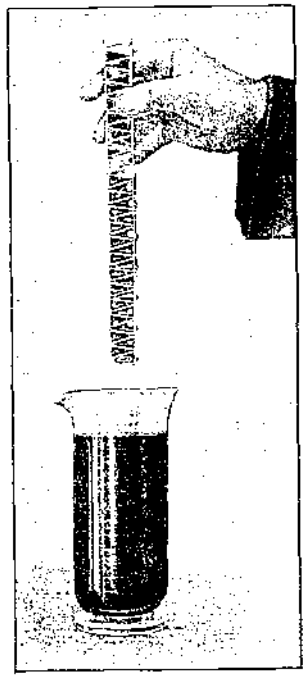


Fig. 2.

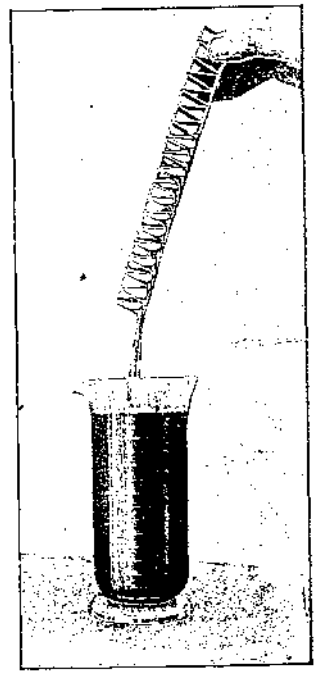


Fig. 3.

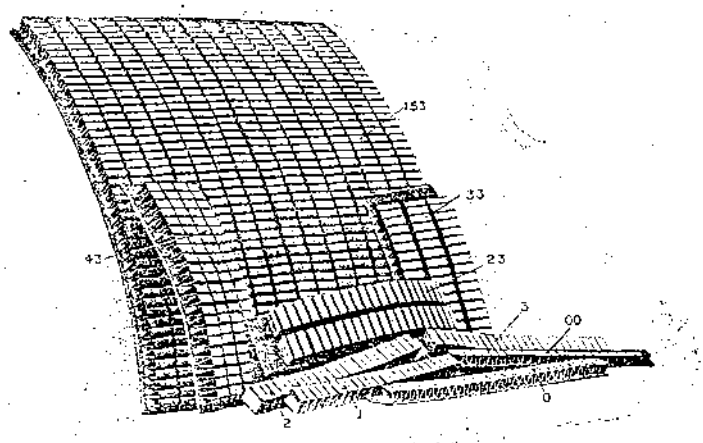


Fig. 4.

deep; water has to be got up. The usual method employed is, in the case of irregular troops, for each man to carry a small *dilwa* or leather bucket with a long rope. With this he laboriously pulls water up from the bottom of the well, getting up, perhaps, half a gallon at each lift. With regular troops special water lifting parties will probably be told off, but their method of getting water, and the amount raised per man will be the same.

Watering men and beasts under these conditions is a long business, and often goes on far into the night. It is uneconomical in time as well as in transport, for each man carries his own bucket and rope; but at present no other method exists.

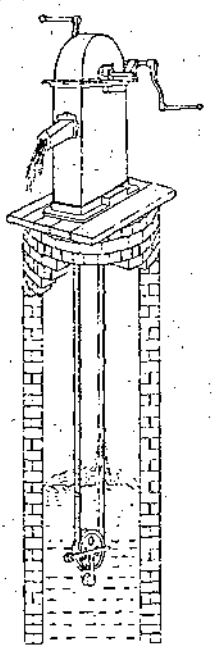


FIG. 5.

Suppose 500 camels have to be watered from one well 150 feet deep by rope and *dilwa*. Each camel wants, say, 10 gallons; therefore, 5,000 gallons are required. Given that each man draws up half a gallon at the time, this means 10,000 lifts. Suppose one man can lift, lower and empty his *dilwa* in one and a half minutes, it would take him 15,000 minutes to water all the camels. Suppose 5 men could work at well-head at once, they would have to work some 50 hours continuously in order to get the work done. Conditions, of course, vary, size of *dilwas*, energy of the men, depth of wells, thirst of camels, etc., but it is fairly clear that by the rope and *dilwa* method the watering of 500 camels is a long business. Given that each camel carries its own rope and *dilwa*, the weight carried by the column will be something like 17,000 lbs., or the useful load of some

40 camels. Probably one camel in five only would carry rope, so the wasted useful load would be that of eight camels.

It seems that something better could be evolved; and the Boulton elevator, or something of the kind, appears to fill the bill.

Assuming that man power only is available for getting up the water from the well previously considered. A suitable single hand gear elevator weighs 305 lbs., and works with a belt that weighs 30 lbs. per 100 feet. Three hundred feet of such belt will be required. Say the whole outfit weighs 400 lbs. A single baggage camel will carry this, or it can be loaded on two trotting camels. By making a special elevator gear for the belt to work on, the weight could be reduced by one half; *e.g.*, aluminium could be used in place of cast iron for the greater part of the well-head fittings.

The elevator could be quickly mounted over the well, and with one man working the handle will bring up 4·4 gallons per minute. By putting 4 men on the elevator, and putting on 3 extra belts, the weight of the outfit will not be more than two camels can carry. The water output will be 17·6 gallons per minute, say, 1,000 gallons per hour, or the whole water could be raised in 5 hours; the net gain in time being some 45 hours, and in weight the useful load of some 6 camels.

A Chaîne-Hélice elevator, to do the same work as the Boulton elevator, would have to be heavier, the weight of 300 feet of chain being 177 lbs., while 300 feet of the Boulton belt weighs 70 lbs. —the weight of the well-head apparatus being the same in each case. However, the weight is not the most important consideration. The Chaîne-Hélice must have speed, or its output drops; working with a long, rising chain, heavy with water, men will not keep up chain speed and water will not come up properly.

Suppose motor transport is available, the water supply problem is simplified. A complete power-driven Caruelle plant giving 5,000 gallons per hour from 300 feet is supplied, weighing 1,180 lbs. This is a good load for a Ford van, and could be quickly mounted over any well. The Caruelle belt and the well-head gear that works it has not been designed for military use. It appears, however, to be worth investigation. It is probable that the weight of the whole outfit could be considerably reduced without impairing its efficiency. The jointing of belts is an easy matter, but for military needs some special form of joint might be required.

A further development would be the design of some portable animal-driven well-head gear, to which spare transport animals could be harnessed, and so speed up the rate of raising water without the use of an engine.

ENGINEER WORK IN CONNECTION WITH THE LANDINGS AT LUDERITZBUCHT AND WALVIS BAY, IN 1914.

(Extracts from "Railway Construction during the campaign of 1914–15, in German South-West Africa," by A. J. Beaton, M. Inst. C.E., C.M.G., V.D., Major, South African Engineer Corps).

Contributed by the Royal Engineer Board.

An advance expeditionary force from the Union of South Africa, under the command of Colonel Beves, landed without opposition at Luderitzbucht on the 19th day of September, 1914, and the main "Southern Force," under the command of General Sir Duncan Mackenzie, C.B., K.C.M.G., V.D., landed on the 4th October, 1914.

Investigations were at once made by the officers of the Engineer Corps to ascertain what plant, materials and appliances were available for the landing of stores, supplies, etc. The main timber pier was found to be intact, but the steam cranes thereon had some of the essential parts missing; these were, however, discovered, and the cranes were put into operation at once. Unfortunately the capacity of the cranes was not sufficient to deal with weights heavier than three tons, consequently other means had to be devised for handling locomotive engines, heavy artillery pieces, condensing plants, boilers, boring machines, etc. Some of the engine packages weighed as much as sixteen tons.

It will, therefore, be seen that the most difficult problem which had to be solved was the best and quickest method of landing the rolling stock and other heavy material which the cranes on the pier were incapable of handling, for on active service quick decision and rapid movement are as essential in engineering problems as in combative actions.

"Military engineering in contrast to civil practice is characterized by makeshifts and temporary expedients," and as there was, therefore, no time nor suitable material available to construct even a semi-permanent landing-stage, a makeshift arrangement had to be contrived out of the best material at hand. It was of vital importance that the heavy artillery and the railway rolling stock should be landed with all possible speed—the one for the coast defence of Luderitzbucht, and the other to permit of an early advance of the railway inland, for the enemy removed the whole of his rolling

stock to the interior. Furthermore, the early release of the transport ships was important, not alone on account of their costly hire charges, but they were urgently wanted at Cape Town to convey further supplies of ammunition, stores and men from the Union.

After a rapid but careful inspection of the foreshore, it was decided to experiment with a simple inclined plane running into the sea, with a railway connection thence to the station emplacement. The inclined plane or temporary landing-stage which was designated "The Jetty," consisted of piers of loose baulks of timber picked up near the site of the work. The baulks were laid on top of each other to suit the grade, and roughly dogged together, the piers being at about 4-ft. spans.

On top of the transverse baulks or "piers," 10-metre lengths of 3 ft.-6 in. gauge track, consisting of steel sleepers and 40¼-lb. rails, were laid, and packed up with wood wedges to secure a uniform grade of 1 in 25. The natural slope of the foreshore was about 1 in 15. "The Jetty" and siding were completed in one day. *Photograph* No. 2 conveys a good idea of the structure.

A pontoon 43 ft. by 25 ft., capable of carrying a 45-ton load, was built by the Engineer Corps in three days from a design prepared by Major Beaton. *Plates* A and B show the plan and elevation of this pontoon. *Photograph* No. 1 shows the launching of this pontoon.

The pontoon had a 3 ft.-6 in. gauge track laid on its deck on which an empty bogie truck was carried from the shore to the ship's side, and heavy cases loaded thereon by the ship's cranes. The pontoon was then towed by a steam tug to the end of "The Jetty," where several closure lengths of track were in readiness to suit different stages of the tide, to bridge any space between the track on the incline with that on the pontoon. After the pontoon was securely fastened to mooring posts, the bogie truck was hauled ashore by a steel wire rope operated by a steam winch at the top of the incline. *Photograph* No. 2 shows the pontoon approaching "The Jetty."

Considerable difficulties, however, were experienced with this scheme, owing to the variation in the levels due to the rise and fall of the tide and from heavy land swells in windy weather, which prevented the fixing of the fish bolts on the "bridging closures."

The first obstacle was overcome by adding to, or reducing, the number of the baulk piers of the incline, dependent on the level of the tide. This was a simple operation, as the timber baulks were floated to or from their position as required.

The second difficulty was obviated by making a longitudinal slot in the web of the junction or closure rail instead of the usual bolt holes. This arrangement not only facilitated the fishing up of the joints, but permitted a certain amount of play to the movements of the pontoon, and relieved the strain on the fish-bolts.

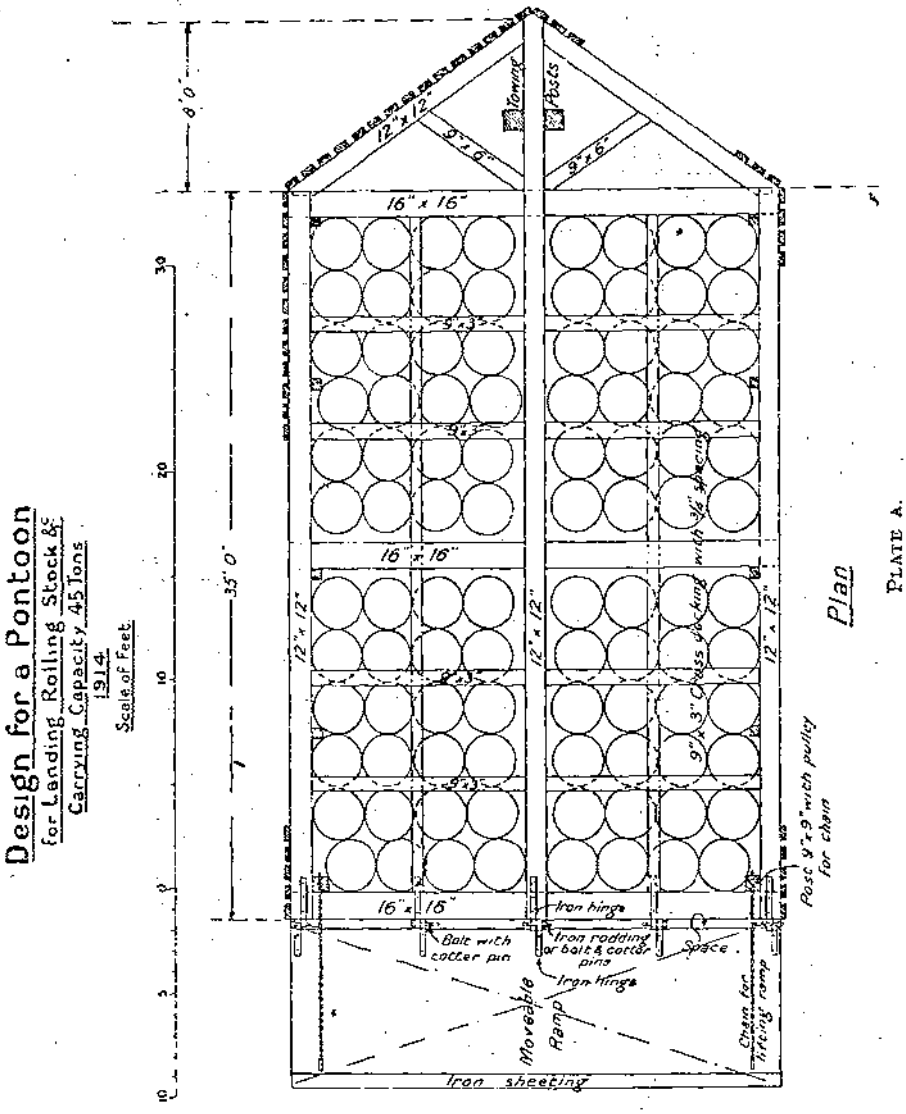
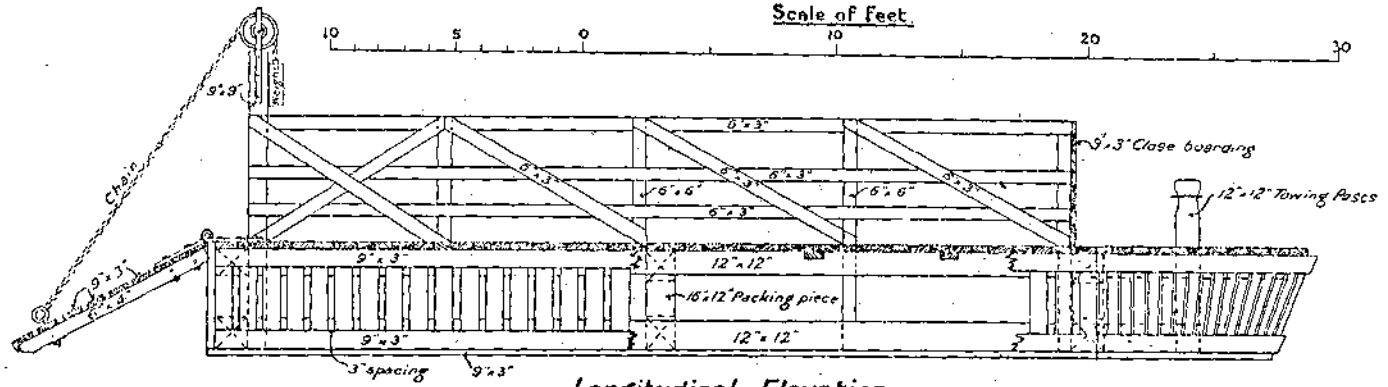
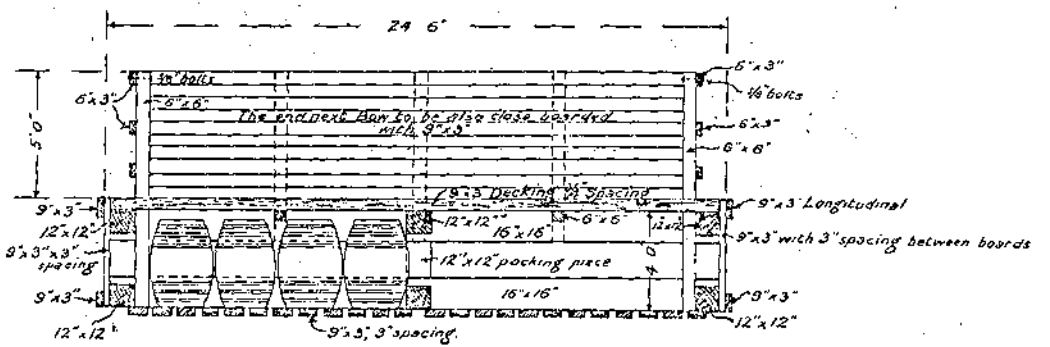

Design for a Pontoon
for Landing Rolling Stock &c
Carrying Capacity 45 Tons
1914
Scale of Feet
0 3 10
8' 0"
35' 0"
Towing Posts
12" x 12"
9" x 6"
16" x 16"
12" x 12"
9" x 3" Cross yoking with 9" spacing
9" x 3"
Iron hinge
Bolt with cotter pin
Iron rodding or bolt & cotter pins
Space
Iron hinge
Moveable Ramp
Chain for hoisting ramp
Iron sheeting
Post 9" x 9" with pulley for chain
Plan

PLATE A.



Longitudinal Elevation.



End View.

PLATE B.

By these simple and somewhat crude means the following rolling stock, etc. were landed during the first ten days of operations, viz. :—

2 Seventh-class engines.
10 Bogie trucks.
3 Ballast trucks.
2 Water tank trucks.
3 Foreshore boilers for condensers.
Several heavy pieces of artillery.

Within fourteen days from the date of the military occupation the engines were landed, erected and in steam, and all the trucks were in running order. There were no railway erecting shops at Luderitzbucht, so that all engine fitting-up had to be done with a makeshift erecting appliance.

At Walvis Bay a similar contrivance for landing rolling stock was adopted, but, instead of a movable jetty as at Luderitzbucht, a semi-permanent pier built of timber piles was used. This method prevented the landing of vehicles at any stage of the tide, as the pontoon had to moor against the end of the pier and discharge its load while the level of the rails on the pier was practically on the same level as the pontoon. *Photograph* No. 3 shows the pier and pontoon at Walvis Bay. The pontoons used here were made at Cape Town and launched from ships.

At Luderitzbucht all rails and sleepers were landed at the main jetty by the steam cranes, but at Walvis Bay, where there were no such appliances, great difficulty was experienced and various schemes tried, but the most successful method was a steam winch and wire rope contrivance erected at high water level, whereby 6 to 8 rails at a time were hauled ashore off the pontoon. Owing to the steep incline of the beach, a timber gallows with a pulley to raise the inclination of the wire rope prevented the nose of the rails ploughing into the sandy, sloping beach.

Steel sleepers were pulled ashore in a similar manner, but all the wood sleepers were thrown overboard from lighters as close to the shore as the craft could float. When the backwash was strong, the sleepers drifted seawards, and natives had often to swim into deep water to recover them. Owing to the variety of sections of rails landed, all the permanent way material had to be classified and sorted on the foreshore before being loaded up on trucks for railhead.

Various other works at the Luderitzbucht harbour were carried out by the Engineer Corps in connection with landing stages for animals and reconstructing the west jetty and gantry whereby weights of ten tons were dealt with from the lighters. The 2-ft. gauge lines on the main pier and traversing the streets and suburbs of Ludentzbucht were of immense value in distributing supplies to the different stores and camps in the town and vicinity.

Two small locomotives left behind by the enemy in a derelict condition were repaired and did useful work, but the bulk of the traffic was operated by animal traction. Some of the narrow-gauge rolling-stock carried as much as 10,000 lb.

The above extracts give a short account of how the South African Engineer Corps dealt with a contingency which may, perhaps, have to be faced by a future generation.

The works carried out are, in accordance with the dictum of an eminent military engineer :—

"That the fundamental economic principle of military engineering is that time is of essence, and cost and durability of works are ordinarily matters of minor importance. The quickest makeshift is usually the best solution.

"Simplicity must characterize all designs. Materials which are available at or near the site must be utilized to the fullest possible extent. The works resulting from these conditions are of a very simple nature. The highest expression of the skill of the military engineer is this very simplicity and the rapid adaptation of his designs to the tactical requirements of the situation and to the resources in men, tools, materials and time at his disposal."

ENGINEER WORK IN CONNECTION WITH THE LANDINGS AT LUDERITZBUCHT AND WALVIS BAY, IN 1914.

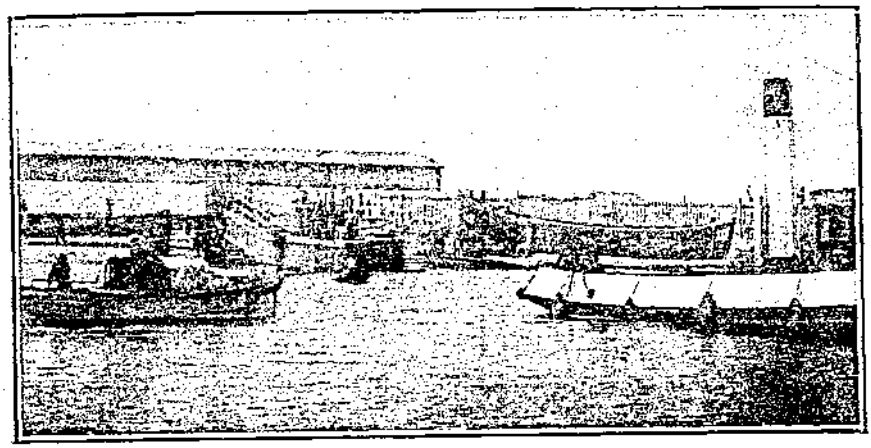


Photo 1.—Launching Pontoon at Luderitzbucht, September, 1914.

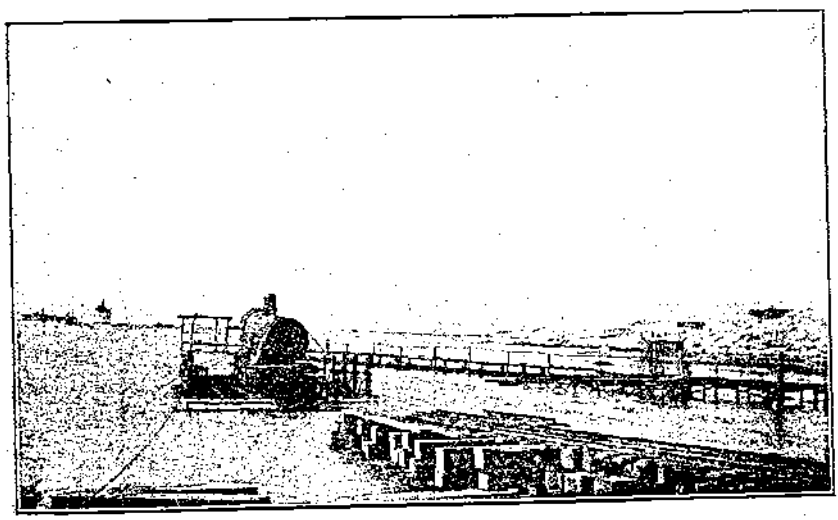


Photo 2.—Pontoon approaching "The Jetty" at Luderitzbucht.

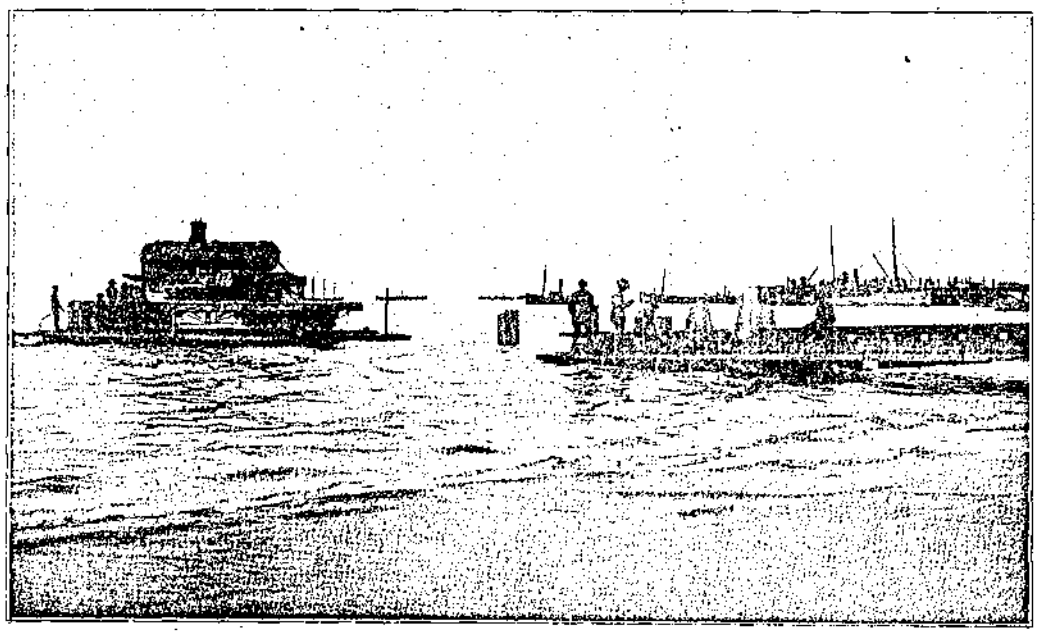


Photo 3.—Pier and Pontoon at Walvis Bay.

THE TRAINING OF A TERRITORIAL FIELD COMPANY.

By MAJOR H. W. T. PALMER, D.S.O., R.E.

IT is very difficult for a regular soldier, if he has not had practical experience with the Territorial Army, to visualize the circumstances under which a Territorial unit carries out its training. The circumstances are so very different from those which govern a Regular unit that questions of training and administration have often to be approached from a point of view which is entirely new; and many matters, which in a Regular unit are merely routine, present very real difficulties under Territorial conditions. Like all other difficulties, these exist in order that they may be overcome. But a point which needs emphasis is that, at the present time, the value of any instruction which a Regular soldier may give to members of the Territorial Army will be very greatly enhanced if it be accompanied by sound advice as to how the instruction given can be applied under Territorial conditions. In fact, without this additional information, the instruction given will sometimes fail to reach its objective.

As a result of the late war, the Territorial Army has earned for itself the position which it now holds, and there is now a bond between the Regular and the Territorial Armies which did not exist in pre-war days. It is therefore desirable that the Regular soldier should have an understanding of the Territorial Army, and, when in contact with a Territorial unit in peace time, that he should be able to approach subjects from the Territorial point of view.

This article is written with two purposes in view. Firstly, in the hope that, by dealing with some of the everyday matters which present themselves in a T.A. unit, it may be of use to Regular soldiers who may at any time be called upon to take part in the training of members of the T.A. Secondly, in the hope that some of the methods suggested for overcoming certain difficulties, which methods have all stood the test of practical trial, may be of assistance to Territorial officers in the training of their units.

The conditions affecting Territorial units differ, to a certain extent, according to local considerations. Consequently, in writing an article of this nature, there is always the possibility that experience gained with the engineers of one division on any matter may be based on conditions which do not exist elsewhere. Recently the

writer had the opportunity of taking part in discussions which were held during a course for senior R.E. officers of the Territorial Army, and in this article he has confined himself to points which were shown to be of general application, and not dependent on a particular set of local circumstances.

I. General Description of Territorial Organization.

The largest formation in the T.A. is the division, and this for training and administration is directly under the Headquarters of the Command in which it is located.

A division is distributed over an area which may vary from a portion of a county to one of several counties. The division is organized on the same lines as a Regular division, but the peace-time staffs of divisional and brigade headquarters are smaller.

With the exception of certain administrative matters, mentioned below, which are dealt with by the County Territorial Association, the unit is both trained and administered by divisional headquarters, working through the usual chain of command.

The Territorial Association of the county in which a unit is located carries out certain administrative duties in connection with all T.A. units in the county. Of these duties the most important are :—

(*a*) Recruiting.
(*b*) Provision of accommodation.
(*c*) Provision of horses.
(*d*) Provision and maintenance of uniform and personal equipment for the men.
(*e*) Provision and maintenance of rifle ranges.
(*f*) Administration of War Office grants in connection with the above as well as furniture, lighting, heating, storemen office expenses, travelling for musketry and annual camp, etc.

The County T.A. Association communicates direct with the War Office, and is not under the Territorial Divisional Commander Consequently, there are two channels of communication between the War Office and the Territorial unit, each dealing with its own class of subjects.

A Territorial unit obtains its arms, unit equipment and training stores from Army sources in the same manner as does a Regular unit.

Funds in connection with the emoluments of the officers and men, as well as allotments from the Training Grant, are obtained from Army sources : the imprest holder being the adjutant.

The location of a Territorial unit varies from the case in which

two or more units, possibly of different arms of the Service, are accommodated together and share the same drill hall, to that in which the unit is distributed over several stations, and is provided with accommodation at each. Owing to changes, as, for example, the formation of new units and the redistribution of others, that have taken place since the various premises were built, hired, etc., the facilities that are provided at each vary considerably. But the majority of units are well provided with accommodation, which includes drill hall, canteen, recreation room, N.C.O.s' room, officers' room, offices, and stores for clothing, equipment, harness, vehicles, etc., and a miniature range.

Some very fortunate units also possess a drill field, attached to their drill hall.

Officers and other ranks of the T.A. draw pay, rations, or allowances only when at annual camp and courses of instruction, and when taking part in staff rides, regimental exercises or week-end camps.

Out-of-pocket expenses in connection with travelling to drills may be refunded at the discretion of the County Association.

A recruit is eligible to earn a bounty of £2 10s. in the first year of his service by either (*a*) performing 40 drills, firing the musketry course and attending annual training in camp for 15 days, or (*b*) performing 50 drills, firing the musketry course and attending annual training in camp for 8 days.

A trained man can earn a bounty of £3 by either (*a*) performing 20 drills, firing the musketry course and attending annual training in camp for 15 days, or (*b*) performing 30 drills, firing the musketry course and attending annual training in camp for 8 days.

The C.Q.M.S. of a company is paid £50 a year for the performance of his duties, in addition to pay, bounty, etc., mentioned above.

The Territorial officer on the Active List is at all times subject to Military Law. But other ranks are only so subject when actually on parade, when at camp, and when the T.A. is embodied. One important result of the latter provision is that the Territorial N.C.O. or man cannot be compelled to attend a parade. A notification of the parade is given, but it rests entirely with the N.C.O. or man as to whether he attends the parade or not, the one exception to this being the notification to attend annual camp.

The Permanent Staff for Divisional Engineers consists of an adjutant and four (or in the case of wide distribution of units, five) Regular N.C.O.'s, of whom one is from the Mounted Roster. Of these the adjutant and one N.C.O., appointed as R.S.M., alone fill executive posts within the establishment of the Divisional Engineers. In addition to carrying out the normal duties of an adjutant of a unit, the adjutant's chief duty is to assist the C.R.E. with the training of his officers. The R.S.M., in addition to his duties as such, carries out Orderly Room clerical duties, and instructional

duties as laid down for the remaining N.C.O.'s of the Permanent Staff.

The remaining N.C.O.'s of the Permanent Staff are attached to companies. The details of the attachments vary with the distribution of the companies. These N.C.O.'s do not fill any executive posts within the establishment of the unit to which they are attached. They are placed there as instructors, and their chief duties are :—

(*a*) Instruction of recruits.

(*b*) Instruction of N.C.O.'s in all subjects, and this includes the instruction of the C.Q.M.S., pay-serjeant, etc., in their duties as such.

(*c*) Clerical duties for the O.C. Field Company. The Regulations permit this, provided that it does not interfere with their instructional duties. In actual practice the cases in which the clerical duties have not got to be carried out by the N.C.O. of the P.S., except at annual camp, must be very rare. The duty of pay-serjeant is the one and only duty in a Territorial unit which it is impracticable for the Territorial Army N.C.O. to carry out for himself; except during annual camp, when he can carry it out.

(*d*) The Mounted N.C.O. of the Permanent Staff must carry out all training in equitation, unless the unit is fortunate enough to possess a Territorial N.C.O. who is a qualified equitation instructor.

(*e*) Keeping of AB 220—the book in which attendances at drill, camp, etc., are recorded.

II. Amount of Training Undergone by Members of the T.A.

The amount of training carried out by the Territorial officer is governed by the results which he has got to achieve, and not by the number of periods of attendance at "drills." He has his command to run entirely, both as regards training and administration, and in addition he has to improve his own efficiency. To assist him in the latter respect regimental exercises, staff rides, and lectures are held : and courses are available at the various Army training centres.

As regards other ranks. Recruits are required to attend 40 drills,* and the annual camp, and fire a musketry course during their first year. They are then classified as trained men and as such they are obliged to attend 10 drills in the year and the annual camp and fire a musketry course.

Like the officer, the attendances carried out by a N.C.O. cannot be based on the number of obligatory drills laid down for a trained

* A "drill" consists of one hour's instruction. When larger periods are given, a soldier may count up to a maximum of three drills on any one day.

man, because he also has his command to run, and to improve his own efficiency by attending special lectures. So, in practice, regular attendance becomes a *sine qua non* for the holding of rank as a N.C.O.

A musketry course is fired annually by all ranks, and attendance at the annual camp for at least eight days is obligatory. The total duration of the annual camp is 15 days, and the majority attend for the whole period.

III. Organization and Administration of the Unit.

This subject is dealt with before consideration is given to the question of training, because it is a branch in which some Territorial units are undoubtedly weak; and if the organization is not sound, the best-intentioned efforts at training will bear little fruit.

The principles governing the organization of the unit are the same as those which apply to a Regular unit, or, for that matter, to any business concern. Three of the chief ones may be summarized as follows:—

(*a*) The number of individuals whom one commander can directly supervise and control is strictly limited.
(*b*) Control must be exercised through a definite chain of command.
(*c*) It is necessary for the commander to direct the policy to be followed by those immediately under him in the chain of command; but, he should leave them scope and initiative as to the methods by which they carry out his policy.

Previous to the late war, many Territorial units were almost entirely run by the Adjutant and the Permanent Staff. The results of this system—or lack of system—were obvious on embodiment.

The object of the commanding officer is to build up a unit, the members of which will all be capable of carrying out their duties on embodiment of the Territorial Army. Now, unless each responsible member carries out his duties in times of peace, he cannot be expected to be able to carry them out when the unit is embodied. This statement may appear to be so obvious as to be superfluous. Nevertheless, the fact remains that it takes continual perseverance on the part of the commanding officer to enforce it because it is difficult to overcome some of the obstacles, and a strong tendency to leave matters to the members of the Permanent Staff is always present. Further, the members of the Permanent Staff are liable themselves, from keenness or other reasons, to carry out duties which belong to members of the Territorial unit. For example, the member of the Permanent Staff finds it much quicker to check a consignment of stores and enter them in the company ledger, than to go and find the Territorial C.Q.M.S. and get him to carry out this duty. But by doing the C.Q.M.S.'s duty for him, the member of the P.S. is defeating his own object in the long run.

The foundation on which the efficiency of the unit can alone be built is an organization in which each of its members carries out personally the duties which belong to the post which he holds.

The point now to be decided is, what are the duties of the various officers and N.C.O.'s? A suggested distribution of responsibilities and duties as affecting the principal members of company headquarters is given in Appendix A. On the basis that a second-in-command relieves his commander of a considerable amount of the administrative duties, the various duties within a section can similarly be distributed.

In order to be in a position to carry out his duties, an officer or N.C.O. must realize exactly what they are. In order that he may be able to fill his post in the chain, he must have an understanding of the organization of the unit; and in order that he may be in a position to act for his immediate superior, when occasions necessitate, he must have a knowledge of the duties of his immediate superior. It is therefore recommended that the distribution of duties and responsibilities throughout the unit be not only fully explained, but also be put down in black and white, and be kept available for all concerned to have access thereto.

To go a step further, each N.C.O. may with advantage be furnished with a card detailing his duties and responsibilities. This method will convey the lesson much more clearly than the somewhat vague statement that "a N.C.O. is responsible for everything concerning the men under him."

The first stumbling block which a unit commander encounters on attempting to carry out the organization of his unit on the above lines is the absence of persons qualified to carry out the duties of some of the posts in the chain of command. The temptation is to leave the post vacant, in the hope that somebody who has had experience in that nature of capacity will turn up; and, in the meantime, to allow the member of the P.S., or the T.A. C.S.M., or somebody else to carry out these duties, which are not his own. In the writer's experience this is a wrong policy to pursue; and, if the member who is available does not know his job, well, he will never learn younger, and the sooner he starts to learn it the better. He will need very close supervision and guidance for some time to come; but, provided he is keen he will learn; and, when given a show to run, and allowed to run it under *supervision* (which does not mean continual *interference*) it is surprising how quickly improvement comes in what, at first, appeared to be somewhat unpromising material.

With regard to the above, it is not intended to recommend that any N.C.O. be granted rank, above that of unpaid lance-corporal, if he is not qualified for it. The subject of qualification is dealt with later. But it is recommended that each of the necessary posts in

the Chain of Command be filled by somebody, though the rank of that post cannot be obtained until full qualifications for it are possessed.

The fact remains that the unit has got to be organized as a unit, and the only practical method of facing that proposition is to make the best of the material that is to hand.

Another difficulty in the way of getting the organization into operation is the paucity of occasions on which anything like a full company is on parade. One section may be well represented, whilst another may consist of three or four men, with or without a N.C.O. The error that is liable to be made is to tell these few men to fall in with the section that is fairly strong.

Infantry Training, Vol. I, Section 2, para. 4, lays down very clearly that "To maintain the organization, in and out of battle, no matter what the difficulty, is one of the first duties of every commander," and later, in the same paragraph, states, "So long as one member of a section remains effective, it will retain its identity."

Engineer Training, Section 4 (9) commences with the statement: "Strict and unvarying maintenance of unit *organization* in all circumstances is the surest guarantee of *esprit de corps*."

Every opportunity must be taken for instilling this principle, and the following few examples will illustrate the nature of procedure that is contrary to this principle, but liable to occur unless rigidly prevented:—

(*a*) Member of P.S. ordering the unit to fall in, and generally performing the duties of the C.S.M., instead of the senior T.A. N.C.O. present performing his duty as such, regardless of his rank.

(*b*) If no N.C.O. is present with a section, the roll-call, etc., being carried out by a N.C.O. from another section, instead of the senior sapper present in the section carrying on.

(*c*) Men going direct to the C.Q.M.S. about equipment, etc., without the section or sub-section N.C.O. having any responsibility in the matter.

(*d*) If a man is at fault as regards punctuality, attendance at drills, turn-out, etc., the person in authority, who deals with the case, omitting to take the opportunity of rubbing into the section or sub-section N.C.O. concerned the lesson on his responsibility in the matter.

The above may seem very small points; but in the T.A. it is only by taking advantage of these small points, and especially of small points of administration, that the organization of the unit can be built up.

As regards the senior and experienced N.C.O.'s, a large proportion of whom may have carried out their duties as N.C.O.'s on Active

Service. It is sometimes noticeable, particularly in the case of those with pre-war service in the T.A., that, though fully competent to carry out their duties, they are prepared to stand by and allow the member of the P.S. to act for them. This is a relic of the days when it was quite the recognized order of things that the P.S should run everything. This reluctance to assert themselves is not due to any lack of keenness or of self-confidence on the part of the T.A. N.C.O.'s. It may usually be traced to a desire not to intrude on what had come to be considered the functions of the P.S. In the writer's experience the only way to overcome this reluctance was occasionally to prevent the attendance of the member of the P.S., so that the T.A. N.C.O.'s had to carry on. They then did so, and in most cases did so efficiently; thus a start was made in getting those concerned to realize what was expected of them, and that each had an interesting job of his own for which he was entirely responsible. This practice of temporarily removing the member of the P.S. is a valuable method of improving the organization, and consequently the efficiency, of a unit.

An experiment was tried, with noticeably successful results, of removing the members of the P.S. from all companies immediately on arrival at the annual camp. The P.S. were retained at Regimental Headquarters under the Adjutant. If a unit commander required the services of a member of the P.S. for a particular piece of instruction he could obtain his services from the adjutant; but, like a R.E. unit attached to a lower formation than a division, the P.S. instructor returned to the command of the C.R.E. on completion of the particular task.

IV. Training of the Unit.

(*a*). *General.*

The salient points governing training in a Territorial unit are the shortness of the time available for instruction during the year, and the impossibility of getting regular attendance of all the members of a class throughout the sequence of any course arranged.

As regards the first, the Territorial soldier has to be taught in minutes what the Regular is taught in hours. Therefore, the Territorial officer must think in minutes when supervising the training of his command. Every minute is of importance. It is necessary to prevent even the shortest delays during parade hours. Five minutes spent in drawing stores, which with foresight might have been laid out in advance, is valuable time wasted. Men left standing about and learning nothing, whilst awaiting their turn to shoot on the miniature range, is another example of time being thrown away. Further, as the time is so short the instruction has got to be carefully prepared in advance so that the man is only taught just what is essential for the object in view. A case which comes to mind, as an

example of time being wasted, was an occasion on which the writer heard a squad being taught about the weight of the rifle, number of grooves in the barrel, and a number of other facts, which were interesting but of no practical use for attaining the object in view; the latter being to teach the men to be able to hit a target, with only a very few "drills" available in which to teach them. The importance is obvious of a squad or class working "all out" throughout the whole of a period of instruction. But it must be realized that every instructor is not blessed with the ability to keep a class interested and working at pressure for a whole hour at a stretch. Consequently, it is recommended that, as a rule, instruction should be given in two or more different subjects during each "drill."

As regards the loss of the sequence of instruction during a course, owing to members of the class missing lectures or parades, in a unit in which soldiering is not its members' primary occupation, unavoidable cases of absence must occur, and must be accepted as a necessary evil. If, however, avoidable cases of absence are frequent, the cause will lie in the nature of the instruction given. the recreational facilities provided or the state of the organization of the unit. It is recommended that the remedy be applied in the direction of improving these, rather than on the lines that the absentees are solely to blame.

The subjects that have to be taught in a field company are laid down by the Army Council. They cannot all be even touched upon during any one year; but the selection of the subjects for the year, and the ground to be covered in each, will have been decided upon by the C.R.E. and so this question need not be discussed in this article.

(*b*). *Training of Officers.*

The time which the officers can devote to military duty is strictly limited in a R.E. unit, where it is the exception to find an officer who is not a busy professional man. Of this time, a very considerable portion is occupied in the administering and training of their commands. Although an officer undoubtedly "learns by teaching those under him," still, what he learns in this manner only covers a very small portion of the ground which he must cover to keep himself up to the standard demanded by his rank. In addition to the subjects that have to be taught to those under him, he must possess knowledge which will enable him to adapt his professional knowledge to military requirements: and, in order that he may have a knowledge of what the military requirements are in any situation, he must have a knowledge of the functions and methods of employment of all arms. The contents of *Field Service Regulations* is therefore necessary, in addition to that of *Engineer Training* and the engineering manuals.

How to acquire this knowledge with limited time is a problem, for which a solution has to be found.

There are practical considerations, of which human nature is one, which will render unsuccessful the solution of merely relying on all the officers of a unit devoting their hours of recreation to a frequent study of these manuals. Regimental staff rides, and courses at the S.M.E., or with Regular units, for those who can give the time for them, are valuable aids. Courses of lectures by the adjutant will only partially solve the problem, owing to difficulty in the way of all officers being able to attend on the same night. In the case of divisional engineers, the units of which are distributed over several stations, it becomes all the more unlikely that it will be practicable to achieve anything approaching the result desired by means of lectures.

The solution would appear to lie in supplementing lectures and staff rides by some means whereby all officers will carry out an organized course of instruction in their own homes and at times convenient to themselves. But some form of test or proof of action taken is a necessity to keep the system working: for good resolutions are apt sometimes to fail in the carrying out.

A system on these lines, which was adopted by the Engineers of one division, was a weekly correspondence course carried out by the adjutant with each officer. It did not entail a heavy task upon anyone, and its results were satisfactory. All the officers agreed that one hour in the week was the period which they could undertake to devote to this course; and the weekly programmes of study were adapted accordingly. The system was that, at the end of the week, each officer was notified of the pages of *F.S.R., Engineer Training*, or of an engineering manual for study during the ensuing week, and he was given a short series of questions bringing out the application of the contents of these pages. During the ensuing week he posted his solutions to these questions to the adjutant. At the end of this week the adjutant sent to him a copy of the suggested solutions to the last questions, and a notification of the subject for the next week, together with the questions thereon. Criticism and comments on officers' solutions were only sent in special cases. Even on those occasions when it was impracticable for an officer to devote the time necessary for that week's subject, it was agreed that useful instruction was obtained by noting the adjutant's suggested solutions to the problems.

(c). *Training of N.C.O.'s.*

Training presents little difficulty in the case of the efficient and experienced N.C.O.'s. They can keep themselves efficient by teaching those under them, and in addition special lectures can be arranged. But the training of N C.O.'s who have had no previous

experience in the Corps, or who have had very little training of any nature, is a very different matter. By being given practice in taking command of, and in carrying out administrative duties in connection with their own men, their ability to take charge and to accept responsibility will develop. But when it is a question of these N.C.O.'s teaching drill, musketry or fieldworks, the difficulty is to teach them sufficient to enable them to carry on tolerably well on the next parade, without even attempting to look further ahead.

Special classes for these N.C.O.'s must be held, and the instruction of these classes must take place at a time when the sappers and drivers are not parading. The practice, on a parade night, of the bulk of the N.C.O.'s being taken away for lecture, whilst the sappers or drivers are collected together for instruction under a member of the P.S. or some senior N.C.O. is fundamentally wrong: for it is detrimental to the building up of the organization of the unit.

It is usually necessary that the instruction of the N.C.O.'s class on any one evening should be based on what they will have to teach their men on the next parade. It must also be remembered that not only has subject matter to be taught, but also instruction must be given as to how to teach it to their own men.

The preparation of the lecture or other form of instruction to be given to a N.C.O.'s class has therefore got to be made with care and thoroughness, for the instructor is very liable to neglect the second object in view.

Although keenness and interesting instruction will in most cases produce regular attendance at the N.C.O.'s classes, an incentive is added by the provision of a definite object at which they can aim. The system of holding oral and practical examinations for promotion, say half-yearly, and a rigid adherence to the principle of never considering a N.C.O. for promotion unless he has passed the examination held for his rank, will provide an object.

Another point in favour of these periodical promotion examinations is that they provide a means whereby merit can be rewarded. A soldier of previous experience as a N.C.O. may enlist at any time. His capacity may be such that he would be valuable to the unit as a senior N.C.O. forthwith. But it is liable to dishearten those who have been serving in the unit for the past three years if a new arrival is immediately promoted over their heads, on his past record in some other unit. But the institution of the periodical promotion examination introduces a means whereby each can definitely establish his merits in competition with the other candidates; and nobody can then cavil at the reward going to the best.

It is particularly trying for a senior, whether officer or N.C.O., to stand by whilst an inexperienced junior is making a well-intentioned but somewhat feeble effort at instructing his men. The knowledge that he could carry out the instruction so much more

efficiently himself, affords a strong temptation to the senior to take the job out of the junior's hands. But the fact remains that the training of the officers and N.C.O.'s is of first importance: and, unless the junior is given his chance, he will never learn. Therefore, if the senior is forced to intervene, his action should be in the direction of assisting the junior to carry on; and not on the lines of doing his job for him.

Regimental exercises for N.C.O.'s form a valuable means of instruction. But, in the writer's experience, any attempt at carrying out instruction of both officers and N.C.O.'s at the same exercise on the same day is not a success. In theory it would appear sound that first the officer should carry out his portion and then he should allot tasks to his N.C.O.'s; but in practice various circumstances affect the case, with the result that neither class gets sufficient value in instruction for the time available.

(d) Training of Sappers.

The salient difficulties here are the unevenness of the standard within the section, and the difficulty in giving practical instruction in fieldworks at the drill shed.

The unevenness of standard will not apply to a great extent as regards fieldworks, for the percentage of men with previous service in the Corps, who will not have attained to non-commissioned rank, will be small. But for instruction in drill and musketry, the standard will vary from the man who has had several years of previous service in the infantry, to the man whose experience of soldiering is limited to his recently completed recruit drills.

It is in the interests of the unit that the attendances of those men who are at least moderately proficient at drill and musketry, should be concentrated on those parades at which instruction in fieldworks is being given. But it means a very persevering effort, on the part of all in authority, to procure attendance at just those parades which are most beneficial to the sapper concerned. Unless this effort is made and maintained, the attendance at "drill" will be haphazard, and individuals will be left to turn up at the drill hall and "find out what is on when they get there." The effect on the keenness of a man with years of service in the infantry, who finds out four or five times running that it is "squad drill and rifle exercises" is obvious.

In order to procure attendance on anything approaching a system, the responsibility for the attendance of his men should be placed upon the Territorial section—or better still, sub-section—N.C.O. Apart from the question of organization, which has already been discussed, his persuasive efforts will probably be more successful than postcards or other notification sent direct from company headquarters to the individual sapper. As soon as a N.C.O. has

really begun to " get hold of " his command, his efforts will certainly be the more successful method.

Another necessity in this connection is the early publication of the training programme. One thing which cannot be done in the T.A. is to make arrangements for *anything* at short notice : and the publication of the details of periods of instruction a week or a fortnight in advance does not give sufficient notice to enable those in subordinate positions of authority to act. A system, which in one unit has provided a means towards arranging attendances on a system, and gives sufficiently early notification to all concerned, is the issue to each member of the unit, at the beginning of each quarter, of a linen-backed folding card, on which are printed the details of all parades for the ensuing quarter, the names of the instructors in special cases, and the paragraphs of the manuals that will be dealt with on each parade. These cards have the advantage over the publication of parades in local newspapers, in that they are convenient for a man to retain in his pocket ; the parades at which his attendance is particularly required can be marked for him, and he will have the information definitely written down and in his possession, instead of reliance having to be placed on his remembering what he was told or what he saw in the evening paper, if he read it.

Further advantages of this card system are : (*a*) that keen N.C.O.'s have a means of knowing beforehand the exact details of what they will be called upon to teach, and (*b*) that the cost in the case quoted was less than that of the system of newspaper publication.

As regards the difficulty of giving practical instruction in certain branches of fieldworks at a drill hall, to which no ground out of doors is attached : The chief cases in point are entrenching, obstacles and bridging. Useful instruction in pontoon drill and the construction of footbridges of petrol-cans, cork-floats, etc., is possible. But beyond that, it would appear that the difficulty must be overcome by the use of fairly large scale models. Valuable instruction can be given with models in preparation for the carrying out of actual work at camp : and the possession of adequate models would appear to be a necessity for the instruction of a unit.

It is obviously desirable to obtain attendances at drills in excess of the number which has a bearing on the amount of bounty earned. In a certain unit a stimulus was given to this by the formation of a class for those sappers who wished to compete at the next examination for appointment as lance-corporal. The attendance at this class was very satisfactory.

(*e*) *Training of Drivers.*

Training in actual driving has mainly to be carried out at the annual camp : but the facilities for teaching riding and all preliminary

work are good in most towns. Although external courses do not exist for the sappers (and it is doubtful if the expenditure on their institution would sufficiently benefit the unit), great benefit can be obtained by the attendance of drivers for a short course at the R.E. Mounted Depôt, Aldershot.

V. CERTAIN DIRECTIONS IN WHICH THE ADJUTANT CAN ASSIST.

(*a*) Owing to the limited amount of time available for their military duties, it becomes of the greatest importance that the unit commander and his officers should be able to devote every possible minute of their time spent at the drill hall to actions which will assist directly to further the efficiency of themselves or their commands. In exercising the command of a unit there is bound to be an amount of correspondence. But, if a means can be devised whereby the adjutant can reduce the time spent by officers on office work, the unit will benefit. The sort of actions which consume time without furthering efficiency are the reading through of a monthly book of Army Orders or Army Council Instructions, only to find that there is nothing contained in them which affects the unit; the reading through of a very lengthy A.C.I., when the only portion which can affect the unit is contained in a small paragraph hidden away in the middle; the necessity of having to read through a lengthy instruction several times to make sure that the meaning is grasped correctly, and then having to write to the C.R.E. to ascertain whether it applies or not. To the Regular soldier these would appear to be trivial matters, and all in the day's work. But to the Territorial unit commander, who rarely possesses a fully-qualified orderly room clerk, it is a very different matter, and constitutes a drag on the training of the unit.

The Regimental orders issued by the C.R.E. can be utilized in such a way as to provide a labour-saving device for the company commanders, with regard to such matters as those cited above. It is a simple matter for the adjutant to incorporate in orders a very brief *précis* conveying the gist of *all* instructions and information received from Higher Authority, which can in any way affect any members of the companies. By mention being included of the reference of the source of information, the unit commander is enabled to refer at any time to the more detailed instructions, if necessity arises; and, by having the matter mentioned in his file of C.R.E.'s orders, he has a ready means to hand of tracing the source of information he requires, if the need occurs at some later date.

A considerable amount of time spent in registering, filing, and in office routine generally can be saved in the company offices by adherence at Regimental Headquarters to the principle of never writing about anything if it can possibly be communicated by means of the Regimental Orders

It is difficult for a unit commander to read through all A.O.'s, A.C.I.'s, etc., but it is quite impracticable for junior officers to do so. But another advantage of the system of publishing everything through Regimental Orders in *précis* form is that the perusal of the file of C.R.E.'s orders furnishes a rapid means whereby all officers can keep themselves acquainted with any information, changes, etc., which may affect themselves or their commands, either as regards training or administration. The simple rule that this file has to be initialled up to date by officers will save the unit commander many written communications.

In order to save the clerical work involved in repetition in company orders, each unit should receive sufficient copies of C.R.E.'s orders to enable a copy to be posted up in every drill hall.

Any additional labour involved in the C.R.E.'s office by the above procedure is amply repaid.

(*b*) There are certain stock lectures which a Territorial subaltern is called upon to deliver from time to time, such as lectures on discipline, map-reading, reconnaissance and report writing, etc. The material for these is laid down in various manuals, but all Territorial officers will be able to remember occasions when they have arrived at the drill hall to give a lecture, to the preparation of which they have been quite unable to devote time beforehand. As regards fieldworks and co-operation with other arms, this is not of so much importance, as the course which they themselves are undergoing with the adjutant covers these subjects. But as regards subjects such as map-reading, etc., there may be no recent experience on which they can frame their lecture; and the result is that the lecture given is not as instructive as it otherwise might have been. Cases also occur when a substitute has to be detailed at very short notice to give a lecture.

The adjutant can be of great assistance to all concerned, and incidentally he can facilitate a uniform standard of instruction in the subjects throughout the units, by writing out these stock lectures, either in full or in the form of headings and notes, and by issuing a copy for each drill hall. These can then be kept filed together ready for reference if required.

(*c*) Every unit is not fortunate enough to possess a fully-trained and experienced C.Q.M.S., and it must be the exception at present for a unit to be furnished with a Permanent Staff instructor whose experience in these duties extends beyond what he has managed to learn during his present employment. The result of such a combination is additional correspondence, and possibly a deficiency of stores. The correct procedure for all branches of the C.Q.M.S.'s duties is no doubt laid down explicitly somewhere; but it is sometimes a matter of much time and labour to find just the information required. Further, there are various necessary steps to be taken

which an efficient C.Q.M.S. always knows from experience, and the neglect of which may involve his commanding officer in financial liability, *e.g.*, the danger of giving a clear receipt to the railway company previous to checking contents, and suchlike. The adjutant can be of material help to a unit by preparing, in conjunction with a quartermaster of experience, very clear and definite notes on the procedure in connection with the various duties of a C.Q.M.S. Suggested headings under which these notes might be compiled are :

1. Public Equipment.
2. T.A. Association Equipment.
3. Clothing.
4. Transport of Stores.
5. Ammunition and Explosives.
6. Supplies.
7. Camp Equipment.
8. T.A. Association Property.

(*d*) The case of the pay-corporal is analogous to that of the C.Q.M.S., except that in all probability he will only be able to carry out his duties at the annual camp. The chances are very remote that the member of the P.S., who normally has to carry out the clerical work, is fully trained in pay duties. A short cut to knowledge of office routine is therefore almost a necessity. The following headings are suggested for guiding notes :—

1. System of filing, and dealing with correspondence.
2. Method of obtaining books, stationery, etc.
3. Stock of books, forms, etc.
4. Books, registers, etc., to be kept posted up to date.
5. Part II orders.
6. List of files of orders, etc., to be kept up to date.
7. Payments from Army funds.
8. Cost accounting.
9. Training grant.
10. Hire of horses.
11. Association funds, and dealings with the T.A.A.
12. O. i/c R.E. Records.

In conclusion, mention must be made of one outstanding feature which, if it be possible, holds increased importance in a Territorial unit. That is, that Energy and Enthusiasm on the part of anyone in authority are very infectious : and in a Territorial unit furnish the sole means whereby the best results can be obtained from any arrangements made for organization or training.

APPENDIX A.

Suggested distribution of duties amongst the principal personnel of Company Headquarters.

1. UNIT COMMANDER.

(*a*) Dictates general policy and supervises the work of his immediate juniors.
(*b*) Training of officers.
(*c*) Issues Training programme.
(*d*) Such cash accounts as he retains under his own hand.
(*e*) President of Sports and Entertainment Committee.
(*f*) Secret and confidential files.
(*g*) Confidential Reports.
(*h*) Promotions.
(*i*) Sees all correspondence arriving at his unit and signs all correspondence leaving his unit.

2. SECOND-IN-COMMAND.

All administrative duties. These fall under the following headings :—
(*a*) Discipline.
(*b*) Training of officers in administrative duties : and responsibility for seeing that administrative duties are carried out efficiently in each section.
(*c*) Travelling arrangements and warrants.
(*d*) Such cash accounts as the O.C. allots.
(*e*) A.B. 220 (which is kept by the member of the Permanent Staff).
(*f*) Men's documents and Part II Orders.
(*g*) Publication of administrative orders in company orders.
(*h*) Trade testing.
(*i*) Accounting for maps, books, etc.
(*j*) Addresses of personnel.
(*k*) Efficiency of wheelers, saddlers, shoeing smiths, cooks, sanitary squad.
(*l*) Medical arrangements, including reports under T.A. Regs. para. 659 A.
(*m*) Veterinary and shoeing.
(*n*) Supply of horses.
(*o*) Equipment.
(*p*) Supplies.
(*q*) Clothing.
(*r*) Bedding.
(*s*) Accommodation.
(*t*) Camp equipment.
(*u*) Ammunition and explosives.
(*v*) Custody of arms.
(*w*) Repair of arms.
(*x*) Vehicles.
(*y*) Provision of Transport.
(*z*) Engineering stores.
(*aa*) All T.A. property.

In addition to his administrative duties he commands the personnel of company headquarters, and his duties in this respect are as laid down for a Section Commander.

3. COMPANY SERJEANT-MAJOR.

For any duties in connection with Training, he works directly under the O.C. Company, for whom he prepares Company Orders for signature, and for the publication of which to all concerned he is responsible to the O.C.

The bulk of his duties, however, are administrative, and for these he is responsible to the Second-in-Command. These all come under the headings (*a*), (*c*), (*g*), (*j*), (*k*) and (*l*) as laid down for the Second-in-Command. In dealings with N.C.O.'s and men he will, to the utmost extent practicable, do so through their Section Commander or Section Serjeant. In addition to his duties as C.S.M. to the Company, he carries out for the personnel of Company Headquarters the duties as laid down for a Section Serjeant.

4. COMPANY QUARTERMASTER-SERJEANT.

He is directly responsible to the Second-in-Command for duties (*o*) to (*aa*) as laid down for the Second-in-Command.

He will keep a table showing all returns due from his department and is responsible that these are rendered punctually.

In dealings with sections, his military knowledge will decide him as to whether to deal direct with the Section Serjeant or with the Section Commander on any point; but whenever the acceptance of financial responsibility by the Section Commander is involved in the transaction, he will deal with the Section Commander.

CIMENT FONDU.

By CAPT. J. C. P. TOSH, M.C., R.E.

"*CIMENT FONDU*" or Fuzed Cement, was originally invented in 1905 by M. Bied, then engineer to the firm of Pavin de Lafarge at Tiel, which has since developed its manufacture on a commercial scale.

The new material possesses many advantages over Portland cement and represents an entirely new departure in cement manufacture. Briefly, *Ciment Fondu* develops in 48 hours a strength approximating to that of Portland cement at the end of 28 days, while at the same time its rate of setting is considerably slower. It is further claimed that the strength of *Ciment Fondu* concrete at three months is double that of Portland cement concrete. At the outset, therefore, it will be seen that the use of *Ciment Fondu* should effect considerable economies both in shuttering and in the size of concrete members, and that concrete structures made with it can be taken into use much sooner than is possible where Portland cement is employed. *Ciment Fondu* has the further advantage that it will resist the action of sulphates; it has been tested with sand containing up to 50 per cent. of crushed sulphuric anhydrite, and found to be practically unaffected.

Ciment Fondu is an alumina cement, that is to say, it depends for its cementitious properties on aluminates of calcium. Portland cement, on the other hand, is principally a silicate cement. The following table shows the approximate composition of the two cements:—

Constituents.	Ciment Fondu.	Portland Cement.
Silica (SiO_2)	10—12	20—24
Alumina (Al_2O_3)	40—45	6—8
Iron	10	2—4
Lime (CaO)	35—40	60—65

Now, the combination of alumina and calcium takes place at a much higher temperature than the combination of silica and calcium. Hence a much higher temperature is required for the production

of *Ciment Fondu* than for Portland cement. The former is liquified at a temperature of 2732° Fahr., while the latter is clinkered at 1832° Fahr.

A high alumina content in Portland cement produces a very rapid rate of setting; it might, therefore, be expected that *Ciment Fondu* would be extremely quick setting. This, however, is not the case, because the high rate of setting only occurs when the aluminates and silicates of calcium are both present. It is, therefore, essential that only a very small proportion of silica be present in the furnace, otherwise Portland cement will be formed as an impurity and the product will be too quick setting to be of any practical use. The raw materials must accordingly be most carefully selected; at Tiel only limestone and bauxite are used, the latter being an ore of aluminium containing chiefly aluminium hydroxide and iron hydroxide. Setting time is regulated by hydration during manufacture so that the time of initial set is about two hours, after which the cement sets very rapidly. No free lime is formed in setting.

Owing to the high temperature required in manufacture and the special raw materials used, the price of *Ciment Fondu* in France is twice that of Portland cement, but despite this handicap it is making its way in civil engineering owing to its special qualities.

Some interesting statements regarding *Ciment Fondu* were made at the International Railway Congress held at Rome in April, 1922, by various French Railway Engineers. M. Séjourner, Algerian Section of the P.L.M. Railway, after some experiments made in 1916, purchased the whole output of the Tiel Works for some time. It was stated that *Ciment Fondu* had been successfully used on the Nice–Coni line in situations where, owing to the presence of water containing sulphates, ordinary Portland cement had disintegrated.

In the case of a tunnel under repair on the line from Mantes to Caen, all the exposed portions of the mortar had been attacked by locomotive smoke; *Ciment Fondu* was applied and so far has been quite resistant.

Piles made with *Ciment Fondu* in reinforced concrete have been driven when three days old. It was found that the adhesion of steel in *Ciment Fondu* concrete was greater than in Portland cement concrete.

The final summary made by the President of the Railway Congress with regard to *Ciment Fondu* ran as follows:—

"It would be interesting to follow the result of the use of *Ciment Fondu*, which should prove of distinct value in several classes of work, and which appears to offer exceptional resistance to the deleterious effect of salt-water consequent on the presence of sulphate of magnesia."

It has also been used extensively in France for marine work, bridges, roads, and so on. Two balconies at the newly-constructed

Mathurins Theatre in Paris were made in *Ciment Fondu* and all shuttering and supports were removed in 48 hours. Towards the end of the war, *Ciment Fondu* was used for gun positions during the pursuit, platforms for the heaviest field pieces being used three days after laying.

In view of these interesting reports which had appeared from time to time in the technical Press, it was decided to try to obtain some of this material in order to carry out tests at the S.M.E., and correspondence was opened with the firm of Lafarge at Marseilles. The latter very generously supplied a barrel of *Ciment Fondu* for the purpose, and experiments were started early this year.

First of all, the series of tests laid down in the British Standard Specifications for Portland cement were applied, in order to get some comparison between the two. The tests were carried out in very cold weather and the correct temperature for curing specimens could not be maintained. The early results of tensile tests may, therefore, be considered as erring on the low side.

The tests carried out were as follows :—

(*a*) *Fineness.*—Standard sieves were employed and the residues obtained were as follows :

on 76×76 sieve ... ·5%
,, 180×180 ,, ... 8·9%

For comparison, the figures laid down in British Standard Specifications are 1 per cent. and 14 per cent.

(*b*) *Tensile Tests.*—The results obtained are shown by curves on diagram "A," the values given being the mean of five briquettes broken at each age.

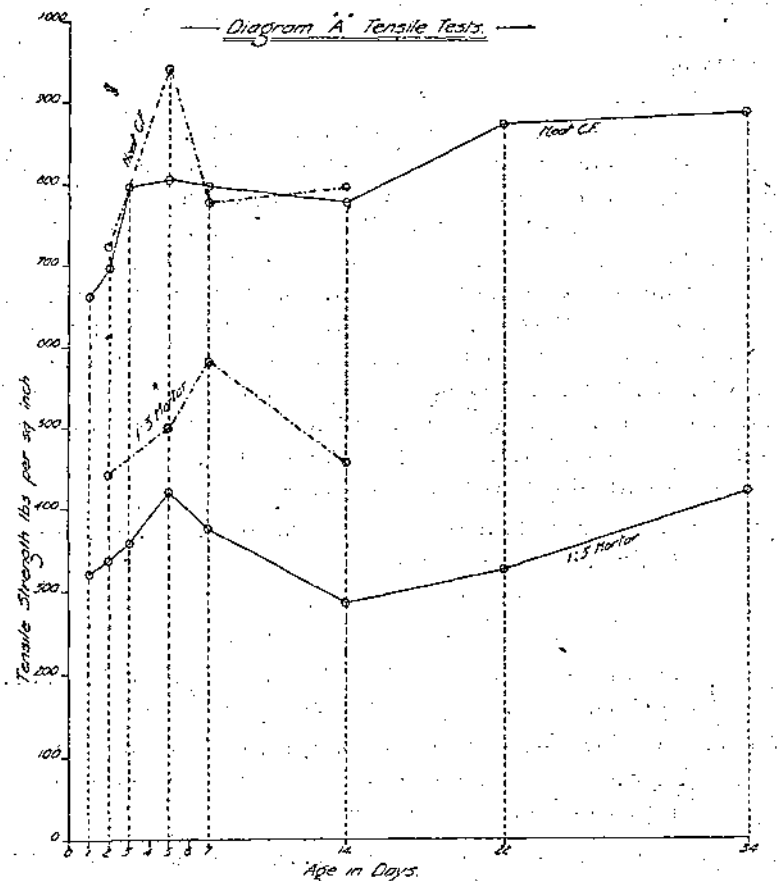
Another small series of tests was made, starting on May 12th, in order to determine the effect of storage. The cement had been stored in a somewhat damp shed in its original barrel, open at the top, for about two months. The values given are the average for three briquettes of each age; the curves for these are shown chain dotted. The inference is that, allowing for the expected earlier gain in strength due to warmer weather, no deterioration had taken place.

The strengths laid down in B.S.S. are as follows :—

	7-day.	28-day
Neat cement	450	540 lbs. per sq. in.
1 : 3 mortar	200	250 ,, ,, ,, ,,

But all good brands of Portland cement give much greater strengths than these, and a fairer average strength for comparison may be taken as :—

	7-day	28-day
Neat cement	580	800
1 : 3 mortar	290	340



Age in Days	Neat C.F. lbs per sq. inch		C.F. Mortar 1:3 lbs per sq. inch	
	March Tests	May Tests	March Tests	May Tests
1	662		320	
2	696	721	358	442
3	758		350	
5	805	940	420	500
7	758	776	375	581
14	776	795	285	455
28	672		325	
34	895		420	

Curves representing tests carried out in May are shown - - - - - -

The drop in strength at an age of 7–14 days need not be regarded very seriously, since it is a common phenomenon in the testing of all small tensile briquettes and does not indicate a corresponding drop in crushing strength.

The tests carried out in warm weather show much greater strengths, especially in the case of the mortar briquettes ; this is to be expected since the neat cement, in setting, gives a considerable rise in temperature, which would, to a certain extent, counterbalance the coldness of the atmosphere.

A curious phenomenon observed during these tests was the formation of an insoluble powdery scum on the specimens during setting. It was particularly noticeable on the neat *Ciment Fondu* briquettes. On inquiry, the manufacturers stated that this scum or film consists of alumina released during setting, and it is for this reason that they emphasize the necessity for carefully cleaning the surface of old concrete before adding new.

Diagram "B" shows the results of tensile tests carried out by Mr. Herbert J. Davey, M.INST.STRUCL.E., who kindly consented to their inclusion in this article. The high strengths obtained at the age of one or two days should be particularly noted, illustrating, as they do, the unique advantage of the new cement.

Setting Time.—The following average setting times were obtained, using the Standard Vicat Needle :—

Initial setting time	...	2 hrs. 50 mins.
Final setting time	...	4 hrs. 25 mins.

Setting time tests were also made in the middle of May to see what effect any storage, under the conditions mentioned before, had made. The results were :—

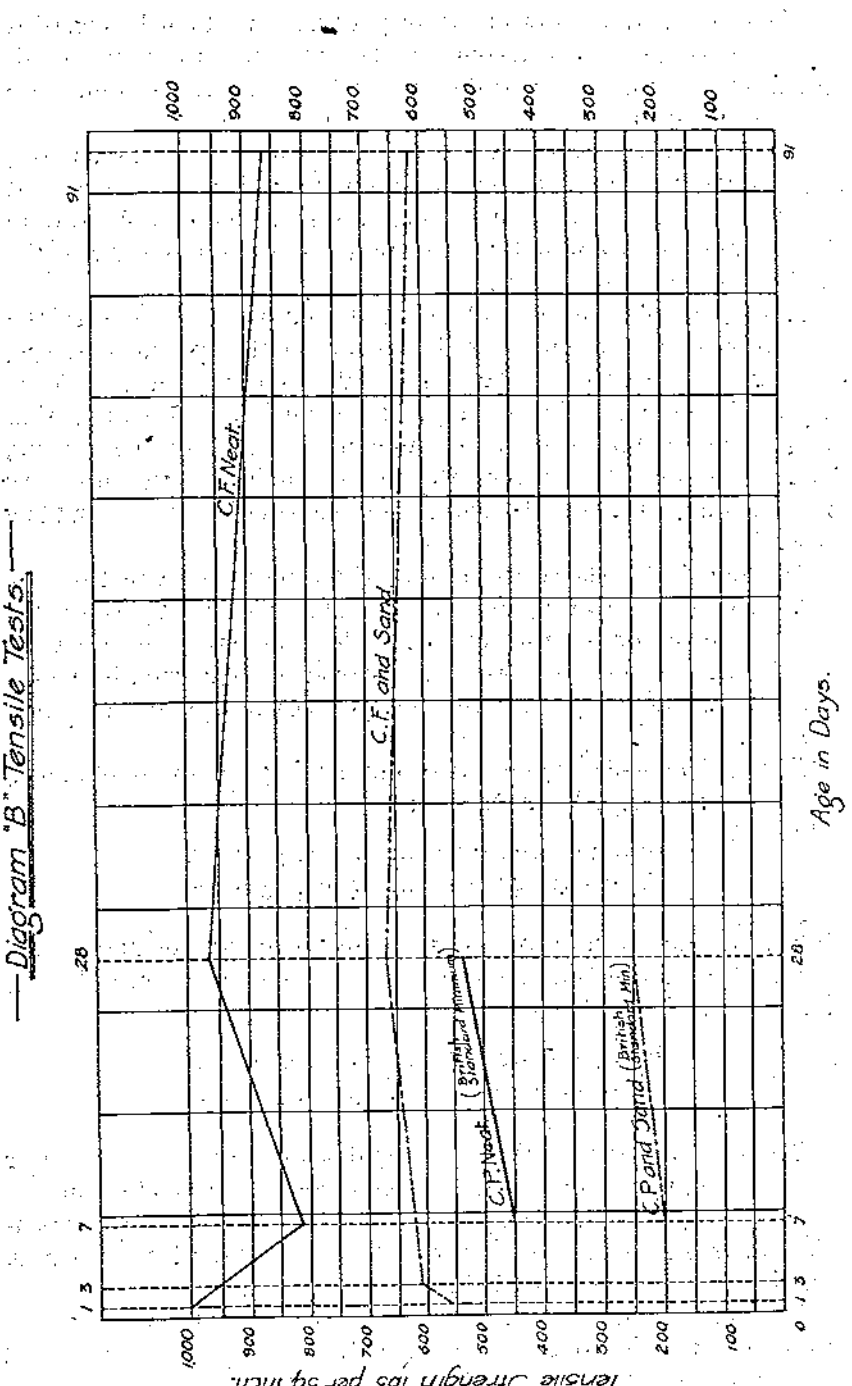
Initial setting time	...	1 hr. 55 mins.
Final setting time	...	3 hrs. 5 mins.

The inference is that the more rapid set was due to the warmer weather and that storage had not slowed down the rate of setting.

Soundness.—The Le Chatelier Test showed no measurable expansion after six hours' boiling, the British Standard Specification allows an expansion of 10 mm.

In addition, the "Hot Pat" test was carried out, which is probably more exacting than the Le Chatelier test. The pat showed no signs of cracking or warping after boiling for three hours.

N.B.—In all tests, the standard proportion of water was used in gauging, *i.e.*, 22·5 per cent. by weight for neat *Ciment Fondu* and 8 per cent. for 1 : 3 mortar, using standard sand.


—Diagram "B" Tensile Tests.—
Tensile Strength lbs per sq inch.
Age in Days.
C.F. Neat.
C.F. and Sand
C.P. Neat
C.P and Sand (British Standard Min)
(British Standard Minimum)
1000
900
800
700
600
500
400
300
200
100
0
1
3
7
28
91

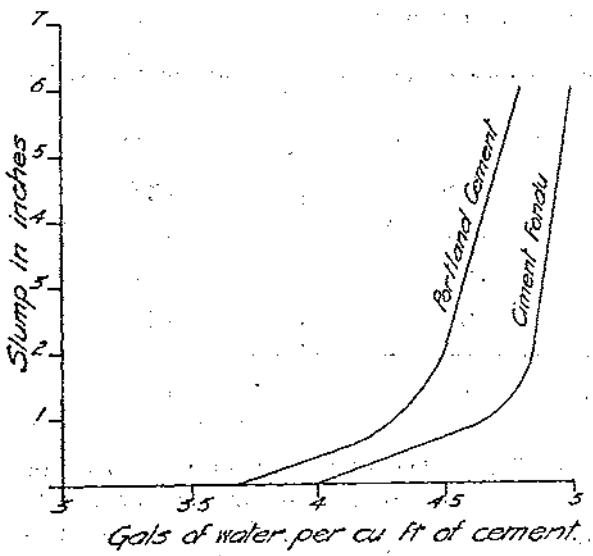
Tests on Concrete.

Slump Tests for Consistency.—Comparative tests on 1 : 2 : 4 concrete mixtures of Portland cement and *Ciment Fondu* were made, the results being given on Diagram "C."

The curves show that the *Ciment Fondu* concrete mixture behaved in exactly the same way as Portland cement concrete, but required slightly more water to produce the same consistencies.

Strength and Hardness Test.—A rough field test for comparing the resistance to explosive force of Portland cement and *Ciment Fondu* concrete was devised and carried out. Blocks of 1 : 2 : 4 concrete, measuring 1 ft. × 1 ft. × 6 in., and reinforced with one layer of X.P.M. at the middle, were made and tested at various ages by firing,

Diagram "C" Slump Tests.



in the centre of the upper surface, a charge of two 1-oz. primers of dry guncotton tamped with sandbags.

It is not claimed that any very accurate comparison could thus be made, nor that any definite inferences as to the resistance of *Ciment Fondu* concrete to explosives could be drawn, as it was impossible to secure uniform conditions of bedding, contact and tamping.

The *Ciment Fondu* blocks were tested at ages of 3, 5 and 7 days, the result being a small crater in the centre, a few radiating cracks and spalling round the upper edges. The five-day blocks were slightly less damaged than the three-day ones. The seven-day blocks showed no visible improvement on the five-day blocks.

The Portland cement blocks were first tested at seven days and collapsed completely. After a fortnight, results corresponding roughly to *Ciment Fondu* at three days were produced.

Blocks tested at three weeks and one month gave practically identical results, similar to *Ciment Fondu* at five days, except that the whole upper surface became slightly concave.

The general inference drawn is that *Ciment Fondu* concrete is slightly superior in resistance to Portland cement concrete, and develops almost its final strength in about five days as opposed to about three weeks in the case of Portland cement concrete.

Absorption Test.—The object of this test was to compare the absorption of water of *Ciment Fondu* concrete with that of Portland cement concrete. Four blocks of concrete made of a 1 : 2 : 4 mixture were made with each cement and carefully cured. They were then allowed to dry out thoroughly and were weighed dry. They were immersed in water for 24 hours and then taken out and reweighed. The results were as follows :—

Absorption after 24 hours, expressed as percentage of dry weight.	
Ciment Fondu.	Portland Cement.
·88	1·75
1·01	1·97
1·56	1·92
·74	1·79
Av. ... 1·05	1·86

Compression Tests.—Owing to lack of necessary apparatus, no compression tests have been done at Chatham. The following figures, published about a year ago in the technical press, are of interest :—

COMPRESSION TEST (LBS. PER SQ. INCH).

Age.	Neat Cement.		Cement and Sand 1 : 3.	
	Portland Cement.	Ciment Fondu.	Portland Cement.	Ciment Fondu.
24 hrs.	1000	6800	260	5000
48 ,,	2000	9800	780	5500
72 ,,	3750	10600	1020	5700
7 days	6350	11600	2350	6150
28 ,,	8700	12600	4100	6800

Summarizing the results of the tests, we may say that *Ciment Fondu* is a cement giving a very high strength after 48 hours and ultimately yielding a concrete superior to that made with Portland cement. Its rate of setting, on the other hand, is about six times as slow as that of Portland cement, so that *Ciment Fondu* concrete mixes may be handled for a correspondingly longer time before placing, without loss of strength, and finally, that *Ciment Fondu* is a sound cement entirely free from expansion.

We have already seen how *Ciment Fondu* is making its way in French Civil Engineering. Considerable interest is also being taken in it in England. A paper was recently read before the Institution of Engineering Inspection by Mr. H. J. Davey on the subject of *Ciment Fondu*. The Building Research Board have also tested the material and issued a report.

It remains to examine its military possibilities, in the light of our experiences during the late war. The value of concrete for military purposes was clearly demonstrated, on account of its adaptability, the ease of transport of the raw materials, and the saving of steel in place of which it could often be used. Its use on active service may be roughly considered under three heads :—

(*a*) *Fortifications.*—Gun positions, pill-boxes, dug-outs.
(*b*) *Structural.*—Machinery and other foundations, concrete structures at Bases and on L. of C., roads.
(*c*) *Sanitation.*—Impermeable floors in cookhouses, latrines, hospitals, stables, etc.

It may be safely predicted that *Ciment Fondu* will give much better results wherever Portland cement has been used, and will extend the utility of concrete in other directions in which it was formerly impracticable to use it.

Fortifications in the field may be of two classes, the rear lines of defence, deliberately prepared under almost peace-time conditions, and defences prepared under continued enemy interference. As regards the former, Portland cement concrete will meet the case, provided that the dispositions are decided on in plenty of time ; or, if the time is short, some provision of cover may be effected with the aid of precast concrete blocks, provided that a large stock of matured blocks exists. But the fact remains that, if an unexpected situation arises, it is impossible to provide good cover for men and machine-guns in less than three weeks. The use of *Ciment Fondu* in such cases would supply a very urgent need ; it should be quite possible, with its aid, to make dug-outs for men and M.G. emplacements which would give good protection in four days from the start of the excavation ; while the advantages of the new material to an army in retreat are hard to over-estimate.

The use of concrete in close trench warfare has several limitations ;

the time of curing, the weakness of the structure for the first few days, which renders it liable to be destroyed by a small chance shell, and the difficulty of mixing the concrete under good conditions and with adequate supervision. There is no room in the trenches to mix concrete properly; the water supply is usually bad, all kinds of mud and dirt find their way into the mixture, and enemy disturbances may lead to some of the concrete being placed long after the initial set has taken place. Here, again, *Ciment Fondu* bids fair to provide a solution to the difficulty. In addition to its rapid hardening qualities it has the very slow initial set of about two hours; this means that the mix may safely be handled and placed after a much longer period than is permissible in the case of Portland cement mixes. It would be useful and interesting to discover by experiment what the maximum safe period is, but, in the absence of the apparatus for crushing tests, the experiments cannot be done at the S.M.E. Probably the safe period is about 1½–2 hours. In consequence of this slow rate of setting it would be unnecessary to mix the concrete on the site of the work, a more suitable and accessible spot further back could be used and the mixed concrete sent up in bags and placed. This method would have the further advantage of reducing the amount of work going on at the site and so lessening the risk of detection by the enemy. A further development which suggests itself would be the formation of several central mixing places, possibly using machine mixers, in each divisional area, from which units could drawr eady-mixed concrete for any particular job. The advantages from the point of view of R.E. supervision would be enormous and the scheme would help to make other arms of the service more self-supporting in their defence work.

The application of *Ciment Fondu* to concrete for structural and sanitary purposes' work requires little explanation. Time is again the ruling factor; hasty foundations have often to be improvised from unsatisfactory substitutes for concrete, such as timber baulks and steel joists, when they could be much more efficiently done with *Ciment Fondu* concrete in only a slightly longer time.

Concrete floors are very necessary in field hospitals and standing camps, to prevent the pollution of the ground and the spread of infection. Portland cement concrete is unsatisfactory for this purpose, owing to the difficulty of preventing the troops from using the floors before they are properly set. Many concrete floors were ruined in this way during the war, representing a serious waste of material and skilled labour. At best there is a vexatious delay before the floor can be used. The only satisfactory solution to the floor problem is the use of *Ciment Fondu*, which will enable the floor to be used for light traffic the day after it has been laid.

Perhaps the greatest possibilities of the new material lie in its application to road-making. The advantages of reinforced concrete

for forward roads have probably never been seriously considered, owing to the prohibitive length of time required for hardening the road itself and also any repairs in case of damage by shell-fire. Such roads present two very great advantages for active service work, the elimination of soling with the large expenditure of time, labour and material involved, and the large reduction in maintenance. *Ciment Fondu* will reduce the time of hardening to a fraction of that required for Portland cement and will give a harder-wearing surface. What the actual time required is can only be determined by large-scale experiments, but a period of five days is probably an outside estimate for the heaviest classes of traffic. The French have carried out successful experiments with a road for tanks, but details are not, so far, available. In view of the vital importance of road-work in war, it is most desirable that experiments be carried out in this country, both to explore the possibilities of such roads and to accustom R.E. personnel to the work.

At present the progress of *Ciment Fondu* in England is severely handicapped by the difficulty and expense of obtaining it. It is only manufactured in France, where the cost of production is about double that of Portland cement, and its price, delivered in London, is about £9 per ton. Though its composition is somewhat similar to that of Portland cement, it cannot be made from the same raw materials, for the clay used in the latter contains too great a proportion of silica; according to a report published by the Imperial Mineral Resources Bureau, deposits of bauxite in the British Empire exist in Ireland, India and British Guiana. The future of *Ciment Fondu*, therefore, depends upon the creation of such a demand as will justify research to cheapen and extend production. It remains, therefore, for us to demonstrate its military possibilities and assist in creating this demand, so that in the next war we may be able to satisfy the urgent need of every arm of the service for a rapid hardening concrete.

STAFF WORK.

By D.B.

I WAS never a Staff Officer till the war. Then I became one by accident. My views are probably very unorthodox, but they may be useful to any would-be administrative Staff Officer.

A General Staff Officer has to depend on information, only a part of which he can verify: some of it may be false through the honest stupidity of those who get it for him, some may be intentionally false, and much must be intelligent guesswork about the secret intentions of other people. You, as an administrative Staff Officer, have access to every sort of knowledge you can want to arrive at a correct decision. What you cannot find out for yourself you can, and must, get from the General Staff. For example: How many sandbags will be required next month? The General Staff will give you, if you ask for it, enough information about probable operations to enable you to calculate. The information is secret, the very next day may falsify it, you must use it intelligently and revise it frequently. Just as you would use a reasonable factor of safety in building a bridge, you allow a reasonable margin in your provision of sandbags. If you are reckless, factors of safety and margins will be too small; if you are stupid, you will waste money, transport, and time, building extravagant bridges, or accumulating useless sandbags.

Though it is very easy to be a good administrative Staff Officer, it is easier still to be a bad one. A few hints may help.

In banking and in business generally, experience has shown that the overwhelming majority of men are honest. The very first thing any Staff Officer must learn is that the overwhelming majority of other officers are honest. If you think that X has made an unreasonable request just to annoy you, you are almost certainly wrong. X may not know what a lot of important things you have to do; he may be neither unreasonable nor lacking a sense of proportion; it is not his fault that his outlook is restricted by the duties he has to do. A civil explanation can do no harm; there may be more in X's request than you think; and even if X is stupid and unreasonable he cannot be annoyed at being treated as neither.

The next thing you must learn is to avoid making heavy weather of your work. To begin with, you are not conferring any favour by doing it, no matter how well you do it. You must never, never, never explain how difficult your work is. Nobody wants to know, nobody cares. What's more, they will think you a fool quite unfit for your job if you insist on talking of your difficulties. If one must descend to low motives, isn't it obvious that no one would think of

giving any better job to a man who makes heavy weather of his present one? There are a lot of ways of making heavy weather, and they must all be avoided. Here are a few.

Consulting others about things you can decide yourself. For example, some simple thing is proposed that would add to the comfort of troops without in the least impairing their efficiency. You know that you should consult the General Staff about anything that might affect the efficiency of troops. If you are an advertising ass you seize the excuse and tell the General Staff that if they concur in "this excellent proposal" it will be carried out. The General Staff say "all right." If you repeat this sort of thing the General Staff (and everyone else) will think: "this fellow is trying to advertise, and he's wasting our time and delaying his work to do it." A similar reference to some other officer will make him think: "this fellow funks responsibility, he's trying to make me responsible." Result: useless correspondence while the proposal is delayed.

Much worse than needless consultation is the pernicious habit of answering questions that are not asked. For example, some appointment has to be made and the necessary correspondence comes near its end with this:—

"The appointment is approved, please submit the name of a suitable officer."

You, as a good Staff Officer, will answer thus:—

"Lieutenant X. Y. Zones."

You have given the name you were asked for; you were asked for nothing else; so you stop. A bad Staff Officer cannot stop: he proceeds to explain why Lieut. X. Y. Zones is suitable. The reasons so gratuitously given may not strike other people as convincing. So a new correspondence is started. Or they may appear to be an attempt to evade responsibility for the nomination. The result is the same: more correspondence. By the time it is done Lieut. X. Y. Zones has got another job, or has gone abroad, or died. All because a garrulous Staff Officer cannot answer a question about the pen of the uncle without dragging in some yarn about the cat of the grandmother. That sort of thing may be good for learning languages, but it is no use for business. Yet it is painfully common. About three-quarters of the official correspondence during the war was a history of the cat of the grandmother.

Another vicious habit is writing to the man next door. It may take a day getting to him. He may refer it to someone who never heard of it, takes no interest in it, and puts it away to be read later on when he is less busy. If some further bits of the history of the cat of the grandmother haven't got into it before you get the paper back, your luck is too good to last. Don't write to the man next door. Write the shortest and clearest possible statement and bring it to

him yourself. Talk to him if you must, watch him well, and the moment you see he agrees, stop talking. Get his signature and vanish. He might change his mind if you waited, he might even think you wanted him to. Don't think he is too busy to see you, the busier he is the more you save his time by coming to see him. You save him from having to read irrelevant bits; you answer his questions at once; you give him no superfluous information; and in three or four minutes he has saved himself half an hour's work. You have saved yourself even more.

You gain something else by going to see people. You get to know them and they get to know you. Some—they are few—you may find stupid or obstructive. Avoid them if an enterprising junior in their office will do their job. If that is impossible, try blarney. Even a clever man can be made to think a proposal he never dreamt of was originally his own. Make a few objections that just, but only just, betray their foolishness. That will draw him unless he is more than clever. He'll think you a fool and argue for the proposal. Get his signature quick and clear out. There is a last resort that I can describe only by giving an example. A is the head of a branch, B his trusty henchman. They are strongly opposed to a scheme that X and Y are quite certain is a good one. A and B have more than once defeated X and Y when the scheme was proposed. It is time to try again. Y suggests a conference. Agreed. He tells A that B is chock-full of arguments against the scheme and will certainly trot them out at the conference. He tells B that A is sure to blow the scheme to bits if he can. At the conference A waited for B, B waited for A. Neither spoke, each thought the other had sold him. The scheme went through. Fortunately for Y the scheme was a success, and A and B got much credit for it. But it was a risky, low-down trick. Always talk things over and settle on a spokesman *before* a conference.

If you have much work to do you must have some organization in your office, but let the organization grow, don't force it. In a bygone war—a thing that could not have happened in the war against Germany—there was a beautifully organized ministry of inventions. Only C3 professors and senior wranglers could be in it. The first branch of the ministry dealt with inventions that could not work: impossible inventions. The second with inventions that were not inventions: someone else had invented them first. The third branch was to have the tranquillity that is absolutely necessary for dealing with really good inventions. Very few inventors got beyond the first branch, none got beyond the second. The organization was too good.

If, in spite of all these useful tips you find you are not a success as a Staff Officer, don't worry. You are well out of it: it's a dog's life, anyhow.

NOTES ON PLATE-LAYING IN INDIA.

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MY Company being at present employed by the Bengal Nagpur Railway on the construction of a 5 ft. 6 in. gauge branch line in Chota Nagpur, it is thought that a few notes on the methods of plate-laying may be of interest to some officers.

The line is some 65 miles long and takes off the main Calcutta–Nagpur line about 170 miles west of Calcutta, from a small station called Amda. The line is being constructed to open up large iron and other deposits in the Singhbum District and Keonjhar Native State. It is being laid with 90-lb. F.F. rails on wooden sleepers, the normal length of rail being 36 ft. Stations, sidings, etc., are, however, of 75-lb. F.F. rails on plain steel trough sleepers.

Linking is carried out by means of special rail-carrying trollies designed by A. Anderson, Esq., one of the Assistant Engineers of the construction, to whom I am indebted for permission to describe his methods. The use of these trollies obviates practically all heavy manual labour as far as bringing up and laying rails is concerned. Besides the usual outfit for linking the following extras are used :—

(1) One or more " feeder " rail trollies, each carrying 4 rails.
(2) One light " linking " trolley, carrying 2 rails.
(3) A pair of light angle irons or " I " beams on which the linking trolley runs in extension of railhead.

To describe these in detail, taking No. 2 first :—

Linking Trolley.—This consists of 6 parts—2 axles and 4 wooden levers. The axles are of the ordinary light trolley type about 1½-in. diameter, having 24-in. wheels. On the axle, 3 in. inside the boss of the wheel, is a fixed ring which acts as an inner bearing guide. The levers are 3 in. × 2½ in., 12 ft. long. One foot from one end of each lever is bolted a simple " U " bearing of strap steel. This runs on the axle and forms not only the trolley-bearing, but also the fulcrum point of the lever. At each end of all the levers is affixed a self-gripping clip of the usual " tongs " pattern. To assemble the trolley, no fastenings are used, so that it is instantly demountable, any one of the 6 parts is capable of being carried by one man.

Feeder Trolley (see *Plates* 1 and 2).—This is an amplification of the linking trolley, and consists of the following parts :—

2 heavy material trolley axles and wheels.
4 master levers.
2 yokes.
4 ordinary levers.

One foot from one end of each master lever is bolted an ordinary cast-iron material trolley-bearing, which acts as the trolley-bearing and the fulcrum point of the lever. On the upper side of each master lever, immediately over the bearing, is a pair of chocks, spaced to receive the yoke, which lies over and parallel to the axle.

The yoke in its turn is chocked on its underside to keep it in position on the pair of master levers and again on its upper side for the ordinary levers. It will be seen that the fulcrum point of the master levers is the axle and that of the ordinary levers the yoke. All levers are provided at their ends with rail clips. The trolley, like the linking trolley, takes to pieces down to one man loads, with the exception of the axles which are unnecessarily heavy. However, they are the only suitable articles of store available.

Railhead Extensions.—

(1) For straight line or level joint curve linking, a pair of 4 in. × 4 in. angle irons, 27 ft. long, are used. At the rear end the "flange" of the angle iron is cut away for 9 in. and the top of the "web" is cut down to 1½ in. for the same distance. A single fish-bolt hole is drilled in this tongue so as to register with the outer fish hole in the rail. The flange at the front end of the angle iron is cut and turned up so as to act as a trolley stop.

The angle irons are laid on the sleepers with their "webs" vertical and the flanges turned away from each other, the trolley running on the edge of the "web." Gauge is kept at the rear end by placing the tongue of the angle iron against the inner side of the rail web and passing a slotted pin through the outer fish hole of the rail, the pin being held in place by a loose key. At the forward end a loose bar clips over the flanges from underneath.

Each angle iron is carried by 4 men. Bamboo and chain slings are permanently attached to ring bolts bolted to the flange.

(2) It is the practice on this construction to lay all curves of 3 degrees and over with staggered joints, *i.e.*, with one rail leading the other by ½ a rail length. In this case one of the extensions has to be 45 ft. long. At present 4 in. × 3 in. "I" beams are used, junction with the rail being effected by a double plate, bolted to the web of the beam, which is

slipped over the rail web. A pin is not found necessary. An 18-ft. length of the 45-ft. extension is detachable so that the pair of "I" beams can be used for straight or level joint curve linking. Four men carry the 27-ft. length and 6 men the 45-ft., light rail slings being used.

Linking Procedure.

(*a*) There are two methods of placing rails in the track so that they can be picked up by the rail-trolleys.

(1) The rails are thrown off the rail truck in the usual fashion and are then placed in the track either by men with crowbars or by direct lifting with slings. This method is very slow if the rails become at all locked in unloading.

(2) An 80-ft. wire rope is attached to a sleeper (in the track) by means of a "U" hook. The other end splits out into 4–6ft. chains, each provided with a hook. The hooks are placed in the fish holes of the rails and by setting back the train the 4 rails fall in the centre of the track. This method is very quick, saves one operation and is very good when the formation is narrow. It does not work well on very sharp curves, as the rails are apt to slew sideways and fall outside the track. It is dangerous to put men up on the truck to guide the rails as they are falling.

(*b*) The train is then set back clear of the rails lying in the track. The feeder trolley picks up 4 rails and drops them about 6 joints in rear of railhead.

(*c*) The linking-trolley picks up the outer pair of rails dropped by the feeder-trolley. The rear pair of levers picks the rail up by the fish-bolt holes and the front levers clip on as far back as they can without fouling the rear levers. In the travelling position there is, therefore, about 10 ft. of rail cantilevered out in front. The trolley is then run up to railhead and along the extensions until the rear ends of the rails are level with their final positions. The rails are dropped and the two halves of the trolley taken away at the double. The new rails now lie about 8 in. inside their final position.

(*d*) The angle iron parties unkey the angle iron and carry it ahead.

(*e*) Two men bar each rail outwards into the adzed seats on the sleepers.

(*f*) The joint is fished with 2 bolts and spikes are driven at the 3rd, 8th and 13th sleepers (assuming 15 sleepers to the rail). The extension is then fished to the newly laid rail.

(*g*) The linking-trolley comes up with a fresh pair of rails and the process is repeated.

Note.—(1) Only those operations peculiar to the method of linking have been described.

(2) On curves with staggered joints the 27-ft. extension is fished to the leading rail. The trolley is thus enabled to drop each rail as it comes into position. The trolley can pick up and move one rail at a time without difficulty. Care should, however, be taken not to push the axles out of square with the track.

GENERAL REMARKS ON THE METHOD OF LINKING.

(1) There is a very considerable saving in manual labour.

(2) The possibility of accidents through the rail falling are reduced to a minimum. In the travelling position the foot of the rail is about 2 in. above the heads of the rails in the track, *i.e.*, $7\frac{1}{2}$ in. above sleeper level. This is sufficient to clear points and crossings, level crossings and normal obstructions in the track.

(3) The supply of rails is not hindered by a narrow formation in the bank or cutting. In the case of carrying rails by hand this is an important consideration. It is no easy matter carrying a heavy rail over sleepers.

(4) Very small parties can carry out linking. Recently a platoon of my company, 30 strong, spread all sleepers and linked 19 pairs of 90-lb. 36-ft. rails in 3 hours. All sleepers were spiked. To take an extreme case, it is actually possible for a party of 4 men to link ! In this connection it may be mentioned that when the trolleys are closed up so that the levers of one axle rest on the other axle they form very handy trollies for carrying sleepers.

It is not possible to give any satisfactory figures regarding the speed of linking. We have always laboured under difficulties owing to lack of labour, material, etc. Our chief trouble is the formation, which the contractors only think about finishing off as the rails arrive. Given a decent formation, 2 minutes per joint is a good average when everything is running smoothly.

(5) This method is essentially designed for F.F. rails on wooden sleepers, but there is no reason why it should not be used on plain trough sleepers. It is most economical when heavy rail sections are used.

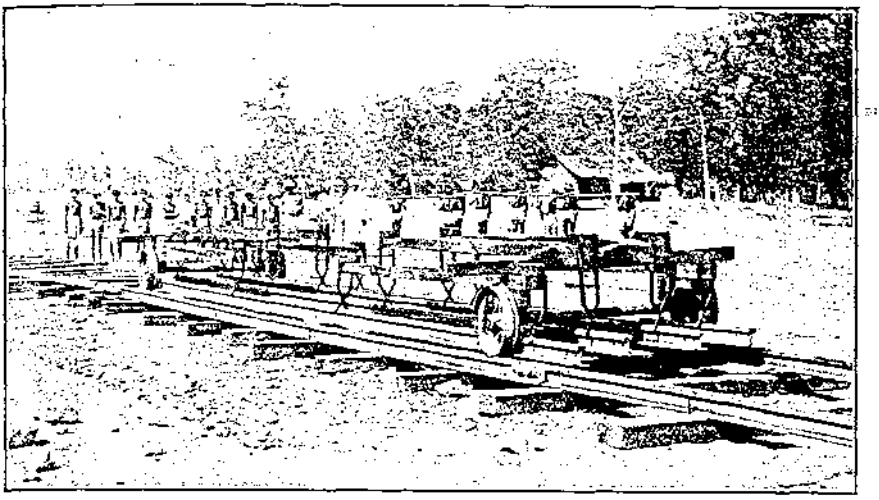
(6) If the N.C.O. i/c angle party does his job the line requires practically no preliminary straightening to pass the train.

(7) The local " jungly " learns very quickly how to use the levers of the trolley. A weak cooly can operate the rear levers of the linking-trolley by himself, but requires assistance on the front levers.

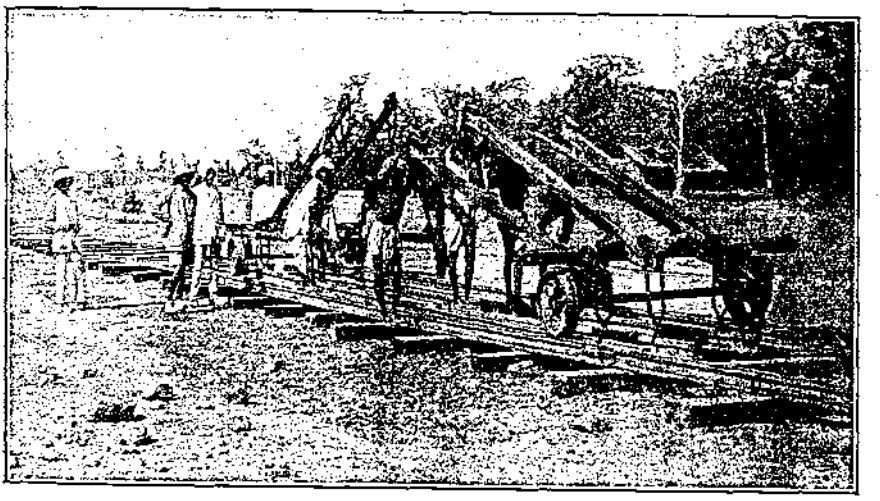
(8) On down grades either trolley can be braked by releasing the front clip of a rear lever, thus allowing one rail to drag over the sleepers.

The following is a distribution and strength of parties Table. In many cases we have to economise owing to lack of coolie labour.

NOTES ON PLATE-LAYING IN INDIA.



(1). The "Feeder" Trolley in the Travelling Position.



(2). The "Feeder" Trolley about to Lift its Four Rails.

Detail of Parties.

	N.C.O.'s	*Sappers*	*Coolies*
1. Sleeper Carriers and Spacers	2	—	as available
2. Material Spreaders	—	2	12
3. Angle Iron Party	1	8 (*a*)	—
4. First Fishing Party. (Also help party, No. 3)	2	6	—
5. Barring rails into adzed seats and holding up rails for fishing party ...	—	4	—
6. First Spiking Party (sleepers 1, 8 and 13)	1	12	—
7. Rail Square	1	—	—
8. Linking-Trolley Party	1	8	—
9. Second Spiking Party (sleepers 1, 6, 11, 15)	1	16	—
10. Preliminary Straightening Party ...	1	6	—
11. Second Fishing Party ... ... N.B.—The 3rd and 4th bolts are not put in till the line is being packed. These men only tighten the work of 4.	—	2	—
12. Placing rails for the rail carriers ...	—	4	—
13. Marking rails for spacing	1	—	—
14. Feeder-Trolley Party	1	—	16
15. Placing rails in the track, using crowbars	1(*b*)	8	—
16. Final spiking, straightening, fishing and packing	Labour is usually insufficient to carry these on at the same time. Spare time or special days are allotted for this work.		
17. Spare men on 15, usually about ...	2	16	—
Totals	15	92	28

Notes.—(*a*) Staggered joints, 10.

(*b*) Using rail slings, 1 N.C.O. and 10 men.
Using wire rope, 2 N.C.O.'s and 8 men.

(General) Parties for unloading material have to be found from linking parties, on account of lack of labour.

Jamda.
25*th February*, 1923.

ROADS CONGRESS, SEVILLE.

By MAJOR H. E. COAD, A.M.INST.C.E., S.R.E.S.

THE Fourth Meeting of the Permanent International Association of Road Congresses held in Seville in May, 1923, was useful in the fact that civil engineers from all parts of the world were brought into contact for the exchange of views, but the almost entire absence of public discussion was a grave drawback to the success of the Congress. This was unavoidable. The time at the disposal of the Congress was limited to one week. The work of interpreting discussions into two or more languages would have made free debate an endless and impossible task.

Six subjects were chosen for consideration, *viz.* :—

1. Surfacing of roads with concrete.
2. Use of bitumen and asphalt for surfacing.
3. Laying tramway rails.*
4. The development of motor traffic.
5. General traffic regulations.
6. The problem of traffic on congested roads and streets of towns.

Fifty-nine papers on these subjects, condensed from contributions from 158 leading engineers of all countries, were received. These were summarized and reported upon by Committees chosen from the representatives of Spain, France and the English-speaking nations. Both papers and reports were printed in the three languages and circulated to all delegates. The few hours at the disposal of the Congress were utilized in reading the conclusions arrived at by the committees. These conclusions were necessarily of an elementary description, upon which there could be little disagreement, for, had much of a debatable character been expressed, no agreement could have been arrived at in the allotted time.

The following gleanings from the papers may be found useful :—

1. CONCRETE ROADS.

Materials.—Any hard stone or gravel may be used for the aggregates, provided the material is tough enough to resist stresses of traffic without crushing. This eliminates any soft limestone. All material must be perfectly clean. Grading to eliminate voids as far as possible is important. The sand should contain only a small percentage of fine grains, as these produce a weak film on

* Further mention of this subject is omitted as being of insufficient interest.

the surface of the concrete. Various types of reinforcement have been used with no apparent important difference in result, whether placed near the surface or towards the bottom of the slab.

Plant.—A mechanical plant is most desirable, since it ensures regularity of mixing and rapidity in laying. The mechanical tamper and finishing machine allows of comparatively dry concrete being used. Mechanical devices riding on the side forms and designed to cut the subgrade to true elevation are increasing in favour. Side forms of specially-rolled steel shape are in almost universal use in the United States.

Proportions.—For one-coat work the proportions 4/2/1 should not be exceeded. For two-coat work, the base may be 6/1/1 and the surface of finer aggregate of 3/1/1. One-coat work is preferable, since it ensures greater homogeneity for expansion and contraction and admits of greater speed in laying. With regard to this somewhat rich mixture of cement, the delegates from the United States expressed an opinion that a weaker mixture might be equally efficacious. They were in the habit of using 3/2/1 and 4/2/1, but thought the reason of so doing might be traced to the influence of the cement manufacturers in that country.

Reinforcing versus Ordinary Concrete.—Ten-inch thickness of ordinary concrete appears to be approximately equal in strength to 6 in. of reinforced concrete. On firm road-beds there is no apparent advantage in reinforcing, other than the saving in the cost of materials. Beds are, however, rarely firm all over and therefore reinforcement is desirable.

Formation of Carriage-way.—It is desirable that the foundation bed should have the same camber (about 1/48) as the surface, and it should be thoroughly consolidated. Where the subsoil is wet, it must be drained, and, if the subsoil is clay, a separating medium such as ashes, clinker, sand or ballast, rolled to a consolidated thickness of 2 in. is desirable.

Thickness.—A thickness of 6 in. is an absolute minimum and 8 in. reinforced or 10 in. unreinforced are desirable minima for heavy traffic.

Construction.—Wherever possible, full-width construction of new roads should be adopted, as failures have occurred in cases where the whole of the traffic has been diverted to one-half of a new road. The concrete should be kept damp for two weeks and free from traffic for four weeks.

Cracks are considered to be inevitable, whether expansion joints are used or not. The difficulty found in making an expansion joint, without, at the same time, causing an inequality of surface, counteracts any advantage which might be gained by lessening the number of transverse cracks.

Advantage of a Concrete Road.—The main advantage lies in the

stability. It is free from deformation, corrugations, tracking and waving. A concrete road offers less resistance to traction than one which is pliable. A new concrete road can be laid at a cost not greatly exceeding that of other methods. It can be resurfaced with either new concrete or with asphalt.

Disadvantages.—The length of time required to allow concrete to be laid and cured, and similarly the time required for hardening patches necessitated by trenching, are undoubted disadvantages.

2. USE OF BITUMEN AND ASPHALT FOR SURFACING.

Compressed Rock Asphalt Process.—This process consists in heating and depositing, raking and rolling a 2-in. surfacing of the compressed powder (Val de Travers, Seyssel, Limmer or Ragusa) on a prepared bed of Portland Cement Concrete, 6 in. to 12 in. in depth, according to the degree of traffic. The qualities of the powder for road-making seem to depend more upon the fine grain of the limestone than upon the character of the impregnating bitumen. The percentage of bitumen varies from 6 per cent. to 16 per cent., the best percentage for work in Great Britain being between 10 per cent. and 11 per cent. This type of asphalt is suitable for roads carrying very heavy traffic, but on account of its high initial cost would appear to have no great future.

Mastic Asphalt Process.—In this process similar ingredients to those used in the compressed rock asphalt process are employed, with the addition of a sufficient percentage of bitumen to bring the mixture to such a consistency that it can be floated by hand with wooden trowels. Usually the mastic is first made into blocks, which are melted upon the site of the work; the final addition of bitumen and chippings is then made before depositing the mixture on the prepared foundation. The latter may be either prepared water-bound macadam or a concrete foundation. When prepared from natural rock asphalt, the rock is pulverized to such a degree that not less than 60 per cent. passes the 200 mesh. This powder is digested in bitumen at a temperature of 350° F., bitumen being added until it forms not less than 15 per cent. of the whole. The mixture is then moulded into 60-lb. blocks. These are remelted on the site of the work and clean $\frac{1}{4}$-in. to $\frac{3}{8}$-in. granite or limestone chippings are added up to 40 per cent. by weight. This process is now being extensively employed on ordinary water-bound macadam surfaces, a consolidated depth of 2 in. to 3 in. of asphalt being laid. It is suitable for a lighter traffic and is a cheaper process than the preceding one.

The Two-Coat Asphalt Macadam Process consists of a binder-course or base-coat of asphaltic concrete, with a wearing-surface composed of mineral aggregate bound together with asphalt, cement or

bitumen. The existing road-bed is reformed and consolidated with steam-rolling and 2 in. to 3 in. of asphaltic concrete or "binder," and 1 in. to 1½ in. of fine asphalt wearing-surface laid on it. The asphaltic concrete consists of, approximately,

65 per cent. of concrete, granite, whinstone, slag clinker or gravel, broken to 1½-in. to ¼-in. gauge.
28 per cent. of fine sand as a filler.
7 per cent. of bitumen.

The wearing-surface consists of a sand aggregate combined with a predetermined proportion of filler and bitumen. In modern practice the sand selected for the aggregate carries about 12 per cent. by weight of soluble bitumen and contains little or no 200-mesh grains and not more than 12 per cent. of 50-mesh grains. Between the 100 and 50-mesh, the sand should be as evenly graded as possible. The filler consists of Portland cement, ground chalk, limestone or slate dust. A minimum of 10 per cent. by weight is used, its function being to add density to the bituminous coating of the sand-grains and to close the finer voids. A well-graded wearing-surface should have approximately the following analysis :—

Bitumen soluble in CS_2				...	...	12	per cent
Sand passing		200	mesh	...	...	16	,,
,,	,,	100	,,	...	...	14	,,
,,	,,	80	,,	...	...	10	,,
,,	,,	50	,,	...	...	36	,,
,,	,,	40	,,	...	...	5	,,
,,	,,	30	,,	...	...	3	,,
,,	,,	20	,,	...	...	3	,,
,,	,,	10	,,	...	...	1	,,

This two-coat asphaltic macadam is used in secondary city streets and also in surfacing country roads, in fact, wherever the traffic is not excessively heavy.

Single-Coat Asphalt Macadam Process.—This process is similar to the mastic asphalt process, except that sand is used for the aggregate instead of the crushed impregnated limestone. The mixture also is applied to the road by means of raking and steam-rolling (thickness 2 in. after consolidation) instead of being hand-floated.

The ordinary surface mixture with sand aggregate as described in the two-coat work is taken as a base, and to this is added from 10 per cent. to 40 per cent. of granite or limestone chippings broken to less than 1-in. gauge.

The formula for this process may be taken as :—

Bitumen	... 12 per cent.	(a)	Stone	... 95 per cent.	(b)
Sand	... 72 per cent.		Bitumen	... 5 per cent.	
Filler	... 16 per cent.		(for coating this stone)		

The mixture consists of 60 per cent. of (*a*) in proportion to 40 per cent. of (*b*).

This process is useful where the traffic is not heavy and where a firmly consolidated road-surface is available without radical reconstruction. It is thus a cheaper process than the preceding one and has been extensively used for resurfacing stable water-bound roads and worn tar-macadam roads.

Sheet Asphalt Process.—This process is used extensively in the United States for heavy street traffic, the asphalt being laid on a Portland cement foundation 6 in. to 8 in. thick. It generally consists of two courses, the binder course and the wearing-surface, both 1½ in. thick. The process is similar to the two-coat asphalt macadam previously described. The stone in the binder course is of 1-in. gauge and a typical formula is as follows :—

	Binder	*Surface*
Stone ...	840 lbs.	—
Sand ...	210 lbs.	814 lbs.
Filler ...	—	165 lbs.
Bitumen ...	50 lbs.	121 lbs.

The hot mixture is deposited in place with heated shovels, thoroughly "fluffed up" with rakes and raked to a true grade. It is then rolled with a 10-ton roller at a speed not exceeding 2½ miles per hour, first parallel to the curb and finished with cross or diagonal rolling to eliminate ridges. The binder mixture should reach the work at a temperature of about 250° F., and the surface mixture at about 300° F.

Asphalt Block Pavements.—The blocks are composed of hard, crushed stone of less than ⅜ in. gauge, filler and bitumen, to the following formula, *viz.* :—

Crushed stone ...	70–75 per cent.
Filler	15–20 per cent.
Bitumen	6–8·5 per cent.

The ingredients are heated and thoroughly mechanically mixed. The resulting material is then pressed under high pressure into blocks of size 12 in. × 5 in. × 2 in.

The blocks are usually laid on a mortar bed ½ in. thick, spread over the concrete foundation of the road. They are laid with close joints. Sand is then swept into the joints and as the blocks are malleable, they soon weld together into a smooth, durable pavement.

Grouting or Penetration Process.—Hard rock is broken to 2-in gauge and is uniformly spread over the road and lightly rolled to a consolidated thickness of 3 in. Pure bitumen grout or a mixture of sand and bitumen is poured over the surface to fill the interstices, clean chippings are spread, and the whole consolidated by rolling.

Finally the surface is swept and a sealing coat of bitumen applied. This type of construction is cheap and easily carried out, but it is essential that the surface should be dry. The process cannot, therefore, be successfully performed in wet weather.

Bitumen Surface Sealing Process.—The essential factors to success are :—

1. Complete stability of the surface to be treated and the removal of all dust.
2. Fine weather.
3. An adhesive elastic and stable quality of bitumen.
4. Dry *cubical* chippings, free from dust.

Sealing water-bound surfaces with bitumen is unsatisfactory for the following reasons :—

1. Periodical alteration in contour. Owing to the variation in subsoil water-level in the summer and winter the height of a water-bound road increases during the winter months.
2. Under heavy traffic, moisture is forced through the thin sealing coat; in fact, this thin coat, laid on a partially unstable foundation of macadam, is insufficient to carry heavy traffic.

On the other hand, good results have been shown in the application of bitumen sealing coats to new and old tar-macadam roads, the natural affinity of the tar for the bitumen ensuring a close joint.

4. The Development of Motor Traffic.

Mass production of motor vehicles under Government subsidies in order to make them as cheap and perfect as possible is desirable. Of the whole number of motor vehicles in use in Great Britain, it is estimated that 80,000, or one-eleventh, are Ford cars. This is attributable to the cheap price at which a standardized vehicle, produced in mass quantities, can be sold. The output of the Ford Works in Detroit, U.S.A., is given as 750,000 cars per annum.

In every country investigations are desirable to find the best and cheapest carburant of the country in order to be independent of foreign produce. Similarly with regard to tyres.

Passengers and goods motor-transport companies should be encouraged by Government subsidies.

The situation in Great Britain at present appears to be complicated and unsatisfactory. There are more motor vehicles than there is volume of traffic to keep them employed. Tentative proposals for clearing houses at industrial centres, where loads could be bulked and allotted and back loads could be secured, have mostly broken down. The only remedy would appear to be a slow process of

amalgamation of existing companies and consolidation, the start of which is now in evidence.

As regards the second essential factor in the development of motor traffic, *i.e.*, the road, it is obvious that the most perfect road is that which is the shortest, the cheapest to construct and maintain, possesses the least pronounced gradients, and curves with the greatest radius, offers the fewest obstacles to rapid and free running, has the greatest width, so as to enable all classes of users to utilize it independently, and has the most resistant and durable surface with the lowest cost of construction and maintenance, without dust, moisture, cracks, etc.

Width.—The narrowest road should be not less than 20 ft. wide, *i.e.*, to take two lines of traffic. Every part of a main road system should be at least 40 ft. wide, *i.e.*, for four lines of traffic. Since permissible speeds of cars are likely to increase, widths of 60 or 100 ft. in main arterial roads, to enable overtaking vehicles to move unchecked, should be looked to. Such widths would allow special tracks for horse-drawn vehicles and tramways, as well as for pedestrians, these tracks being separated from the roadway proper by means of kerbs.

Gradients.—It is obvious that gradients restrict both speed and load. The maximum gradient recommended is 6 in 100, and the radii of the curves should not be less than 30 metres in mountainous countries and 100 metres on flat or nearly flat ground. Super-elevation on the outer part of the curve is recommended.

Freedom from Obstruction.—Level crossings over railways should be eliminated and, where this is impossible, visibility over 150 metres on each side of the track should be looked to. Humps over bridges obscuring the forward vision, weak underbridges incapable of supporting ordinary loads, overbridges of insufficient height over the roadway, should all be done away with. At all intersections of roadways there should be a setting back and easing of corners. A clear, continuous forward vision of at least 100 metres should be striven for.

Camber.—The smallest possible camber to ensure road drainage, not exceeding 1 in 30, is desired. Vehicles seek to hold to the crown of a heavily-cambered road, impeding each other and wearing out the centre portion.

Road Surface.—Whether the surface should be resilient or rigid has not yet been agreed upon. A compromise of a rigid substructure, deep and strong enough for heavy fast-moving traffic, with a protective surface-coat of resilient material would appear feasible.

Sign-posts.—Roads should be indexed and numbered. At cross-roads there should be concise information to indicate the direction and places served by each branch road. Wherever possible, such sign posts should be lighted at night. All indications and general

signals on the road should be similar in every country and the direction of movement, either right or left-handed, should be uniform. The former is preferred.

Footpaths.—Adequate provision of kerbed footwalks to ensure the safety and comfort of the pedestrians should be allowed for.

Telephones.—Telephones for public use should be installed wherever possible alongside the road. The creation of good inns for travellers and depôts to serve as receiving or distributing offices for goods should be encouraged.

5. General Traffic Regulations.

Dimensions of Vehicles.—The limiting dimensions of vehicles cannot at present be defined, but it is desirable that the maximum width should not exceed 2·5 metres.

In Great Britain the governing width for motor wagons is 7·5 ft., with a usual length of about 30 ft. The maximum width for public passenger service vehicles used in London is 7·167 ft. Private motor-cars are also limited to this width. The average ratio of useful platform area to the total area of British vehicles is ·75 to 1·00 for goods vehicles driven by steam and ·85 to 1·00 for petrol-driven vehicles.

Weights and Speeds.—The maximum unladen weight for heavy motor-cars in Great Britain is at present 7·25 tons and the speed limit 20 miles per hour. A Government Committee has recommended the removal of the speed limit for motor-cars weighing unladen 2·5 tons or less, and not more than 3·75 tons laden, but this change is not yet in force.

As regards weight and speed, internal-combustion-engined vehicles are lightest and quickest, with steam-engined vehicles next and electric vehicles heaviest and slowest.

Width of Tyres.—Single-rubber tyres are frequently made with a rim width of 7 in., but the tendency is to multiply the number of axles and wheels as a solution of weight distribution rather than to increase the width of the tyre. Six-wheeled construction with an overall length of 33 ft. is on the increase in Great Britain.

Lighting.—An International Conference is recommended by the Congress to make uniform in all countries regulations on Lighting, Licences and Identification Plates. In Great Britain, a Government Committee has made certain recommendations which have been accepted in principle. Generally speaking, all motor vehicles are required to carry two white lights in front and a red light behind on the off-side. No part of the vehicle must project laterally more than 12 in. from the centre of each white light, and no part of the vehicle or its load must project longitudinally more than 6 ft. beyond the red lamp. In addition, headlights may be used and, to reduce

"dazzle," regulations regarding the range and the dispersal of light of the lamps have been made.

Brakes.—Motor vehicles should be fitted with two brakes, sufficiently powerful to stop the vehicle on the steepest gradients. In Great Britain, front-wheel brakes are seldom fitted, but there are indications of developments of this class of brake which will bring them into use.

Average retardations of cars, with brakes in average condition and with drivers possessed of average technical ability and alertness, are found to be, for level ground, approximately :—

Speed in miles per hour.	*Distance required for stopping in feet.*
10	10
20	40
30	90
40	160
50	250

Pressure, hydraulic and vacuum braking have so far failed for road motor vehicles, and it cannot be said that the braking systems commonly in use have reached finality.

Drivers' Licences.—The British Departmental Committee on the Taxation and Regulation of Road Vehicles in March, 1922, found that the institution of tests of mechanical knowledge or of physical fitness, before the issue of motor-drivers' licences, was not justified. The Committee considered that a declaration on the part of an applicant for a licence, of freedom from disease or physical disability which would be likely to make his driving of a car a danger to the public, should be obtained. Apparently the chief control over a careless licence holder, apart from fine or imprisonment, lies in the power of suspension or cancellation of his licence.

Pedestrians.—In Great Britain, the pedestrian has a definite status on the carriage-way, and an exclusive status on the foot-way. "It is equally the duty of foot-passengers crossing a highway to take due caution to avoid vehicles, as it is for the drivers of vehicles to take caution to avoid foot-passengers." However, if a foot-passenger on the carriage-way is injured by pure accident, he has, apparently, no remedy, and, moreover, in an action, the onus is upon the pedestrian to prove negligence on the part of the driver of the vehicle.

Loose Animals.—The fencing of grazing-land cannot in all cases be enforced, nor can the movement by road of herds of animals be prohibited.

In the absence of proof of wilfulness in their destruction, or of gross carelessness on the part of the driver of the car, dogs, cats, or poultry can, apparently, be injured without expectation of redress on the part of the owner.

6. The Problem of Traffic on Congested Roads and Streets of Towns.

The general opinion in the reports is that both drivers and pedestrians disregard regulations for the facilitation of traffic. The existing regulations are for the most part adequate, and it is considered that the authorities should be more stringent in exacting penalties for their infringements.

Prohibition of car-ranks next to foot-walks in busy streets, of central lamp-posts, overhead wire standards or of any other obstruction to traffic is recommended.

At street junctions, rotary circulation is recommended, with pedestrian crossing zones on specially coloured pavement strips. The rotary method, in which each stream of traffic pours into a circular track and each vehicle steers off at a tangent when the required opening is reached, is not very suitable for a great volume of traffic. In the absence of fly-over bridges or tunnels at road crossings, however, it appears to be the best solution. In very narrow but important streets, it is for consideration whether the foot-path cannot be placed in an arcade constructed within the building line. This has been adopted in Philadelphia, U.S.A., in a position where it was absolutely necessary to increase the width of the roadway, irrespective of cost.

Where a street is wide enough, it is desirable to divide each side traffic into two parts—slow traffic near the pavement and faster traffic towards the centre. The method of marking the centre-line (*ligne d'axe*) of the street with a white-painted line is very suitable for separating the traffic.

This central line gives greater confidence to the drivers, who know that there is little danger of collision with vehicles travelling in the opposite direction as long as they do not cross the line. Whilst useful on straight tracks, it is of greater value at curves.

Parallel streets should be used, where available, for slow-moving traffic. The fact that the obstruction of streets is in direct relation to the differences of speeds of vehicles is important; with speeds varying from 3 miles per hour to 35 miles per hour, it has been ascertained that a certain stretch of road reaches its maximum capacity with a traffic of 750 vehicles per hour. With a constant speed of 15 miles per hour, the same area will accommodate 5,000 vehicles.

The education of the public by methods similar to those employed by the British and American "Safety First" and "Children's Essay Competition" organizations, is most useful and these methods should be practised universally.

Systems of mechanical signalling for the regulation of traffic do not appear to be yet entirely satisfactory.

SOME IDEAS ON THE FUTURE OF PERMANENT FORTIFICATION RESULTING FROM EXPERIENCES OF THE GREAT WAR.

By CAPT. AND BT. MAJOR R. P. PAKENHAM-WALSH, M.C., *p.s.c.*, R.E.

THE lessons of the Great War as regards permanent fortification have, naturally, not received the same attention from British military writers as they have from those of continental nations, who possess long land frontiers. It is important, however, that the matter should receive due attention, not only on account of the land frontiers which do exist in the Empire, but also in view of the fact that we may be easily once more embroiled in a continental war, in which the antagonists may have vulnerable land frontiers.

Military mechanical science has advanced a long way since 1914, and improvements in air forces, tanks, and gas are daily changing the material side of war. For this reason it may be argued that the present is not an opportune moment for the discussion of the developments of an art, the products of which must stand for so long a time.

But the same arguments might have been produced all down the ages. Each war has found the design of existing fortifications out-of-date. Nevertheless, these fortifications have, to a greater or less degree, achieved the object for which they were constructed. 1914 was no exception to this rule, and found the fortifications of Europe, almost without exception, out-of-date in view of the enormous advance in weapon power.

The object of this article will be, in the first place, to consider to what extent the fortifications existing at the outbreak of the Great War fulfilled the purpose of their designers and, where they failed, to endeavour to trace the cause of failure. It will then be possible to look forward and get some ideas as to the future of permanent fortification. Lest there be any misunderstanding, let us at once get away from the idea that the fortresses of the future will of necessity bear much resemblance in design to the nineteenth-century European fortress. Principles may remain the same, but the design may vary as much as the Vauban fortifications of Ypres do from the *Feste* system adopted in Metz. For this purpose we must not be tied by the definition of a fortress as given in *Field Service Regulations*, Vol. II, 1920, which reads: "The term fortress implies

a girdle of mutually supporting works designed for the protection of some town or area of importance." This definition may be accurate enough for the moment, but for the student endeavouring to meet future conditions no such narrow limits can be accepted.

Before considering the extent to which the fortresses existing at the outbreak of the War affected the course of operations, it is necessary to understand the purposes for which they were designed. Perhaps the simplest definition is that given in Major-General Bird's *Direction of War*: "Fortification is normally employed to economize force, to free troops for active operations, and to hamper the movements of the enemy." This definition is applicable to all forms of fortification, but perhaps does not stress sufficiently the offensive as well as the defensive use of fortification. On this point Napoleon says: "Fortresses are equally useful in offensive as in defensive warfare. It is true they will not, in themselves, arrest an army, but they are excellent means of retarding, embarrassing, weakening and annoying a victorious enemy." Jomini in an endeavour to be more precise, divides the objects of fortification into two main rôles:—

(i) To cover frontiers (*i.e.*, the defensive rôle).
(ii) To assist the operations of a campaign (*i.e.*, the offensive rôle)

To go into more detail, the following headings summarize the main objects of pre-war fortification:—

(*a*) To cover areas of importance from a political, economic or military point of view.
(*b*) To hinder an enemy's advance by narrowing or breaking up his avenues of advance, by delaying him and compelling him to make large detours, by threatening his communications, or by forcing him to make detachments.
(*c*) To assist the offensive action of the field army by affording jumping-off places and pivots of manœuvre for an attack, by economizing men on inactive parts of the front and on the L. of C., or providing stages or links in an advance.
(*d*) To assist defensive action by immobilizing numerically superior portions of the enemy's forces, by covering the retreat of the field army if driven back, and affording it rallying points or a refuge if seriously defeated.

However, with all these objects in view, as Captain (now Major-General) Thuillier pointed out in *Principles of Land Defence* (1902), the prime object of all permanent fortification is to gain time, and on the relative length of time a fortress can continue to achieve its object depends its value.

To gain time for one or more of the objects given above each of the great continental fortresses had been designed. Some were

successful in gaining their object, others failed, while still another class fulfilled an object for which they were not primarily designed.

The first class to be considered are those great self-sufficient ring fortresses, designed, not so much for playing a part in the plan of operations, as for providing a refuge for the Government or the Army, when the latter, for the time being, could not maintain itself in the open field.

In this class fall Antwerp, Bucharest, and Paris. All three were called upon to carry out the task assigned to them, and not one of them fulfilled it.

Antwerp, on which much money had been expended in recent years, and which might, therefore, be considered by the Belgian nation as up-to-date, was given up by the Field Army and the Government as soon as it became a question of standing a siege or continuing the war in the open. Owing to the action of the Allies, the fortress was held long enough to show that the forts, like those of Liége and Namur, had not been constructed to be proof against the weight of metal brought against it by the Germans. The outer line of forts fell rapidly, smashed by the German heavy artillery. A field position on the line of the Rivers Nethe and Rupel was successfully held far longer by the Belgian Field Army and the British Naval Brigade, and was abandoned rather to avoid isolation from the Allied Armies than by the direct assaults of the enemy.

However, as a pivot of manœuvre for the Belgian Field Army in their threats against the German right wing, it proved effective for a time, and was thus responsible for containing an important detachment of the German Field Army till after the Battle of the Marne.

Bucharest, the fortifications of which were constructed in 1880 to the plans of Brialmont to meet a Russian threat, was evacuated as a result of a linear battle in the foreground, and so proved of no value.

In the Marne crisis, Paris was evacuated by the Government, and, therefore, as a refuge and a protected capital, the fortress failed to fulfil the object for which it was designed. On the other hand, as one of the pillars of the defensive line, Verdun–Rheims–Paris, it fulfilled a purpose for which it was not primarily intended. The fortress itself was badly out-of-date and, if attacked, would have depended chiefly on the field fortifications constructed under the orders of Gen. Gallieni, though the latter also took steps to strengthen and modernize the permanent works then existing. Thus, we see, that no fortress designed to fulfil a rôle independent of other fortresses or the field army successfully achieved such an object. We must, therefore, pass on to consider fortresses, organized for all-round defence, but included in a linear battle system.

The first system to be considered are the defences of the Belgian Meuse, including the fortresses of Liége and Namur. Their object is

explained by Lord Sydenham in his report on the Belgian defences in 1890. "It is not the protection of Belgium against invasion," he says, "which is directly sought, but the closing of a route connecting the territory of two other powers, who, it is assumed, must, sooner or later, be again at war, and either of which might select this route as offering advantages in striking at the other . . . If, however, Belgium possessed an effective field army capable of being rapidly mobilized, the strategic value of the positions of Liége and Namur would assume far greater proportions."

Actually the Belgian official description of the fortresses was that they were "*simples pivots de manœuvre, des places d'arrêt.*"

Lord Sydenham pointed out that the minimum garrison for these two fortresses amounted to 53,000 men out of a total mobilizable strength of 80,000. Therefore, if the fortresses were properly garrisoned an altogether insufficient Field Army would be available to co-operate in the defence of the line of the Meuse. In matter of fact, the active troops were removed from Liége before the attack, leaving only troops of low category, insufficient in numbers to man the perimeter. At the same time the permanent works had only been designed to withstand 21-cm. shells, while it was known that pieces of considerably greater calibre had been used against Port Arthur ten years before, and that the Austrians possessed considerable numbers of 42-cm. howitzers.

In consequence of the weakness of the garrison of Liége the intervals between the forts were penetrated by the German infantry attack on August 6th, and the citadel captured. Even so the forts thus isolated held out till August 16th, and thus, at a low estimate, delayed the German advance for about four days.

The Belgian Field Army thus at an early stage ceased to act in co-operation with the fortresses for the defence of the Meuse, and withdrew on to the line of the river Cette, with their right resting on Namur, and with the great buttress of Antwerp in their left rear. The defences of Namur, before which the Germans arrived on 19th August, were in a similar condition to those of Liége. The Germans opened fire on 21st August with heavy howitzers, and the fortress was abandoned on the night of 23rd–24th August, as five out of the nine forts were reduced to ruins in the first 24 hours' bombardment.

The value of the four days thus gained can, to some extent, be realized when one remembers that on 20th August the French 5th Army had not completed its change of front and had only two corps on the River Sambre, while the B.E.F. had only that day completed its concentration. While the value of the four days' grace cannot be underestimated, the credit for the delay cannot be claimed solely by the permanent defences, though the fact of their existence marked beyond doubt the importance strategically of the position.

The towns of Langres, Dijon, Rheims, Laon, La Fère and Lille were all ring fortresses not joined up by permanent works, but so placed as to become the keystones of a defensive position. The lines Belfort–Epinal and Toul–Verdun were so joined up in peace.

The first of these lines, that from Langres to Lille, was not so up-to-date, nor so well armed as were the latter two. The fortresses in that line had been neglected, and, in fact, the policy of the maintenance of the majority of French fortresses had not been fully co-ordinated with the plans of the Field Army. The line was turned because the fortresses of the Meuse failed to restrict the enemy's turning movement, also because General Joffre did not realize at this time the seriousness of the outflanking movement, and so did not move troops to oppose the German right flank armies in co-operation with the northern fortresses. The four northernmost of the fortresses of this line were, therefore, abandoned without offering any resistance.

It is here of some interest to consider what the effect on the course of the campaign would have been if, with the help of an adequate Field Army, the Belgians had been able to hold the line of the Meuse. The German flanking movement would then have failed or have been limited to routes south of the Belgian Meuse. Would it then have been able to break frontally through the line of French frontier fortresses, which by this time could have been covered by an allied Field Army? This operation would have been rendered especially difficult by confinement of the invading forces in the difficult Ardennes country, and the loss of the more accessible routes closed by the defences on the River Meuse.

Of the more up-to-date lines Belfort–Epinal, and Toul–Verdun, the former was never closely attacked, though it formed the base for the successful First Army defence of the Trouée de Charmes.

The northern line was attacked and, though pierced, never gave way. The left flank of this line rested on the fortress of Verdun, and the operations for the attempted capture of this town form the most important item in the history of fortification in the whole war. The trace and design of the fortress was not absolutely up-to-date, but the works had been strengthened to withstand the fire of the heaviest pieces of artillery then known, and it is claimed by French military writers that no gun turrets or armoured emplacements in this fortress were put out of action permanently by shell fire. To what extent the successful defence of Verdun was due to its permanent works will remain open to question. It can be pointed out that the defence of the field defences of the Mort Homme was as successful as that of sectors which were more closely covered by permanent works. There can, however, be little doubt that the moral effect of the presence of these permanent works assisted considerably in the stubborness of the defence. But more especially

the existence of a properly organized system of field defences contributed to the successful retention of the position.

From the strategic point of view, the retention of Verdun by the French, in conjunction with the active operations of General Sarrail's Army in August and September, 1914, during the Marne crisis, is probably of greater importance than its defence against the concentrated efforts of the Crown Prince's Army in 1916. The salient caused by the defence of Verdun hung up the advance of the German 5th Army, and drew their 3rd and 4th armies far to the east of their allotted axes of manœuvre. To this cause may largely be attributed the gaps on either side of Von Bülow's Army, and the change of direction of Von Kluck.

The defence of the line Toul–Verdun and of the heights of the Meuse at the same time finally put a stop to Von Moltke's plan of double envelopment.

Two other French fortresses must be mentioned, Besançon and Maubeuge. These were ring fortresses in advance of the main lines already referred to. They were designed to draw on themselves a part of the invaders' effort should it be condensed on a wing, and to control certain communications which might otherwise be useful to the enemy if he pushed forward on those flanks. Both these fortresses were badly out-of-date, and the policy of the French Government as to their status had not been clearly defined.

Besançon was never attacked. Maubeuge, the totally inadequate details of whose permanent defences were clearly brought to light in General Fournier's trial, was garrisoned by about 40,000 men of low category, and was provided with few guns. The energy of the commander had produced, when the siege commenced, a ring of field defences between the permanent forts, well provided with means of communication. The fortress thus improved withstood the German assaults for eleven days, and thus during the critical period of the Battle of the Marne closed certain railway communications to the Germans, and also contained two complete army corps of the German Field Army, which might have proved of decisive importance on the Marne. On the German side, Thionville, Metz and Strassburg formed a line of fortresses which were to be joined up by field positions on the outbreak of war. Even without these field positions it was considered that penetration between the fortresses would so constrict a French attacking army as to endanger its safety. As none of these fortresses were ever attacked, their practical value was not tested, but their existence and also that of the French fortresses had undoubtedly a very great limiting effect on the plans of campaign of the respective combatants at the beginning of the War.

The German march through Belgium was, undoubtedly, due in large measure to the natural and artificial strength of the French

Frontier, while the action of the French armies under plan 17 de pended largely on the effect of the Fortress of Metz.

Turning to the Eastern Front, Russia had adopted a different system of frontier defence. A barrier of fortresses was constructed on the general line Grodno, Ossoviets, Ostrolenka, Novo Georgievsk, Kosensi, Ivangorod, Lyublin, Kholm. East of this line the country was fully developed with main roads and strategic railways. West of the line a zone of undeveloped country, with few main roads and practically no railways, was maintained up to the Austro-German frontiers.

The object of this undeveloped zone was purely defensive, and to render any invasion of the Polish Salient a very difficult matter. The result was that, when the Russians wanted to assume the offensive on this front, the attempt broke down owing to the difficulties of an advance over this "desert area." The Germans on the other hand, owing to their superior equipment and organization, succeeded in advancing to Warsaw over this area.

Before the War the Russian fortresses along the Eastern edge of this undeveloped region were quite out-of-date and their armament almost useless. The Russians, therefore, did not rely on them and actually, in the case of Ivangorod, when attacked, they took the guns out of the forts and placed them in new field positions in the foreground. Here they took the Germans by surprise and effectively checked them.

On their Eastern frontier the Germans had fortified the line of the Vistula, from Thorn to Elbing. They intended, if necessary, to surrender the rich country of East Prussia till a decision had been gained in the West. Actually this line was never attacked, for, though Von Prettwitz had commenced the withdrawal of the forces in East Prussia on to this line of fortresses, the plan was countermanded when Hindenburg took command of the German forces in this theatre.

It is open to question, however, whether strategically the original plan of reliance on the fortified river line was not the correct one. The adoption of a forward policy led the Germans to send important reinforcements from West to East before a decision in the Franco-Belgian theatre had been reached. A potent factor leading to the decision to adopt the forward policy was undoubtedly the pressure of public opinion against the voluntary surrender of German soil to the invaders. This is a point of view that may, in the future, press for the protection of strategically unimportant areas and may, therefore, largely affect the siting of fortresses.

Actually a forward line of fortresses did exist about Königsberg, Lotzen and Nikolaiken, through the Masurian Lakes. This line was attacked and pierced by the Russians under Rennenkampf, but the success was limited, as the fortresses of Königsberg and

Lotzen never gave way, though the latter was seriously threatened from 23rd August, 1914, to 4th February, 1915. This was a small fortress relying chiefly on a strong line of field defences flanked by the lakes.

Königsberg succeeded in containing a relatively large detachment, two Russian Army Corps, from the battle of Tannenburg.

The Austrian fortresses of Lemberg, Przemysl and Cracow formed buttresses of a defensive line facing the Russian frontier in Galicia. They were also situated astride the only railway running east and west between the Russian "desert zone" and the Carpathian mountains. They, therefore, formed a barrier line against Russian aggression from the Polish Salient, and also a succession of barriers against a Russian advance from the east.

Cracow was never attacked. Przemysl sustained two important sieges. The fortress in 1914 was hopelessly out-of-date, both in design and strength of works, and in armament. In the first siege, which lasted from the Austrian retreat on 18th September, 1914, till the relief achieved by the Austrian counter-offensive on 9th October, the Austrian garrison consisted of 61½ battalions, the majority of whom were second-class troops, 7 squadrons and 16 field-guns. These contained a Russian force of 150 battalions, 48 squadrons, and over 500 guns of the Russian Field Army, and also effectively blocked the main Line of Communication of the Russian force operating against Cracow. It was due to the offensive spirit of the commander of the fortress that such a large Russian force was contained, and the operations were rather of the nature of field than siege warfare.

The Russians, owing largely to their self-made "desert zone," were unable to get up heavy guns for the reduction of the fortress, and in three attempts to capture it by *coup de main* suffered 70,000 casualties. In the period before the second siege the stores of the fortress had been largely drawn on to supply the Field Army. In the second siege which commenced on 5th November, 1914, the garrison was of approximately the same size as in the first, but contained a force only about half as strong as that used against it before. The defence was again carried out with great vigour, and depended in the earlier stages on a newly-constructed field position well in front of the permanent works. After four-and-a-half months the garrison was forced to capitulate owing to disease and starvation.

When the Austrians advanced again in May, 1915, the fortress fell in four-and-a-half days, though the Russian defenders were told to hold out to the last extremity.

Lemberg was never defended; on each occasion it was evacuated by both Russians and Austrians without its isolation from the Field Army being awaited.

Owing to the static nature of the warfare on the Western Front

the battle-line gradually approximated to permanent fortifications in so far as that much time and material were available for its organization. In the battle-line, however, certain areas were afforded special treatment, where their loss would endanger the rest of the line, or their retention would ensure the safety and inviolability of the front.

Examples of such areas may be given as far as the German defences were concerned in the Paschendaele Ridge, the Wytschaete-Messines Ridge, and the Aubers Ridge. The complicated and permanent nature of the defences built up by Germans in the case of the last-named is clearly shown by the report on those defences prepared by Major B. T. Wilson, D.S.O., R.E.

A similar example on the British side may be mentioned in the area Kemmel-Mont Rouge. Owing to the lack of previous and unimpeded preparation these areas relied more for their defence on troops than on fixed material, and, therefore, could not carry out that essential principle of economy to the extent that might be achieved where time is unrestricted, and enemy action does not interfere with work.

From the above study certain lessons as to the use of permanent fortification from the strategic point of view stand out clearly. The first of these is that fortresses are generally useless, if not actually wasteful, if they are not designed to be mutually supporting, or to be defended in connection with the operations of a Field Army. Hence follows a corollary that the siting of fortresses, if constructed, must be in close relation to the accepted plan of campaign of the national forces.

The value of fortresses can only be judged by their effect on the operations of the field army. If they can still be relied upon to economize men on the defensive front while the decisive blow is struck elsewhere, if they can contain relatively large numbers of the enemy at a moment when the commander of the field army is ready to strike his decisive blow; if fortresses can gain the necessary time or sufficiently restrict the liberty of action of the enemy so as to allow of the development of the plan of the field army commander, then, indeed, permanent fortification must still be practised. Does the experience of the Great War suggest that fortresses can carry out these objects? The above investigation would seem to show that they can. Did not the presence of Metz and Strassburg allow the Germans to economize men in order to add weight to the decisive blow by their right wing, even more than Von Moltke actually attempted to do? Antwerp, Maubeuge, Königsberg and Przemysl, all contained relatively important forces away from what might have been decisive battles on the Marne, at Tannenburg and in Western Galicia. Namur gained time for the Fifth French Army to complete its change of front. Paris and Verdun in 1914, as well as Verdun

and Rheims in 1918, restricted the liberty of action of the German forces advancing between them, and left them vulnerable to counter-strokes. It would seem clear that certain areas, selected in time of peace for defence, did in a great degree fulfil the ideas which prompted their selection, and for one purpose or another gained time for the action of the field armies. It would, therefore, seem to be a fair deduction that, in future wars, certain areas will be selected beforehand for defence, for similar reasons. Whether they will be provided in time of peace with permanent works as at Verdun, or be organized for a defence after the outbreak of hostilities, like Ypres, is a matter which calls for further consideration.

The above investigation of the experiences of fortresses in the Great War would seem to indicate that they relied chiefly for their success on field fortifications rather than on permanent works constructed in time of peace. This does not prove, however, that the existing works were suitable for the type of warfare experienced, and it is possible that other works prepared in time of peace would have been of value in adding to the strength of the defence.

It may be argued that the progress in scientific warfare will tend to neutralize the value of permanent works; and that the increased range and shell-power of artillery and the improvements in aircraft, gas and tanks will make the defence of fortresses more difficult. This is certainly true if the design of the fortress itself does not march with the times, and this has been the difficulty in the past, and is likely to continue to be so in the future. The works of a fortress once built can only, to a limited extent, be altered to meet changes in weapons. But experience in this and other wars has shown that works reasonably up-to-date can be of great value, and in our investigations we must, therefore, endeavour to discover if there are any works which can be best constructed in peace which will be likely to be of value in a war twenty or thirty years hence; otherwise it will not be worth while constructing them.

The increase in power of artillery made very noticeable progress during the war, but, on the whole, the increase in range was more noticeable than any increase in the disruptive effect of the projectiles. From the general point of view of tactics, increase in range of artillery will favour the defender rather than the attacker, and fully-organized defences prepared in good time will enable the defenders to make the best use of their heavy long-range artillery. Defences, including communications, organized beforehand imply permanent fortifications in some form or other. The experiences of Verdun showed that the latest works were proof against the shells fired against them, and, therefore, at the moment no great advance in strength of material would seem to be necessary. The fortifications of immediately pre-war days depended largely on concealment and inconspicuousness for their immunity from enemy destructive fire.

The "*Feste*" system of Metz, as opposed to the closed works of the French Frontier forts, was introduced largely with this object. It has been argued that the advance in air power has rendered the concealment of permanent works impossible, and that, therefore, permanent fortifications will be exposed to a better-directed destructive fire from artillery and air forces. The counter to this air-directed fire, as the static period of the Great War continued, was found in concealment, in tunnelled dug-outs and communications, or concrete works nearly flush with the ground and hidden during construction by carefully arranged camouflage. Tunnelling is always a lengthy operation, and surface works, no matter how much care is expended on their concealment, with difficulty avoid recognition. The other method of avoiding observed enemy fire is improved mobility. Mobility depends on efficient communications, roads, railways, or subterranean passages. All these, in the mobile period of operations which must occur before the decisive moment, can only be available if prepared beforehand. The less passive anti-aircraft defences, including guns, searchlights, and aeroplanes, depend chiefly on carefully co-ordinated action, which demands very efficient communications. A study of the air defences of areas of importance, like London, during the Great War, will clearly indicate that efficient anti-aircraft defences cannot be improvised quickly where no previous preparation has been made. The introduction of gas has been said to make impossible the defence of comparatively confined areas, and it must be foreseen that a previously prepared defended area will form the target of large concentrations of gas delivered by artillery, in clouds, or possibly from the air. On the other hand, previously prepared works permit of the existence of proper gas-tight doors, efficient ventilation, including the supply of fresh air pumped possibly from a distance, and all known means of anti-gas protection. Nor is it very far beyond the realms of reason to foresee the discovery by chemists of neutralizing vapours or gases which, combining with poison gases, will render them innocuous. Such counter-gases could most easily be stored and made use of in works constructed before an immediate call for them arose.

The ideas of the futurist who thinks of war in terms of tanks and their effect on the design of permanent fortifications must not be lost sight of. Measures to resist tanks may be classified under two headings, offensive measures, the chief of which is the gun, whether mounted on another tank or otherwise; and defensive measures, which include obstacles of all kinds and minefields. The use of obstacles and fire weapons must always be closely related. The prime object of the obstacle is to drive the attacker into positions from which he can best be dealt with by the fire weapons of the defence, at the same time obstacles should not interfere with the counter-offensive action of the defenders.

Improvements in tanks, present and future, will enable them to cross considerable obstacles both excavated and erected. In fact, these obstacles must in future be of such dimensions that they must be prepared before they are required. Such obstacles, as well as direct-acting minefields, will interfere considerably with the action of friendly tanks. Where previous preparation is possible, electrically-controlled minefields could be constructed which would allow of the passage of friendly tanks while denying that of enemy tanks. As far as one can see at present, the gun will remain the principle offensive anti-tank weapon. Previously prepared shelters will give immunity from artillery fire and from aeroplane bombs to the gun-bearing tanks of the defence, while concealed and armoured works can be constructed to protect the anti-tank guns not so carried. It will appear evident from the above considerations that, if it is considered advisable to mark down in peace certain areas of strategic importance, whose retention will prove of value in assisting the operations of the Field Army, there are certain works in connection therewith which can best be constructed in time of peace. Some of these works have been suggested by our investigation of measures to be taken to meet certain weapons of the attacker, but the list is by no means exhausted; before considering them in more detail it will be advisable to consider the general design of these fortified areas or fortresses. It has been clearly shown that fortresses must be selected and designed so as to co-operate in the action of the Field Army. While fortresses eventually isolated such as Antwerp, Maubeuge, and Przemysl did produce a distinct effect on operations, the effect would, undoubtedly, have been greater if they had co-operated more closely with the Field Army itself, as in the cases of Verdun and Paris, in 1914. The areas selected as fortresses will then normally be interdependent, so as to form barriers to the advance of hostile armies. The line Verdun–Toul with the fortifications of the Heights of the Meuse was probably the most completely successful example of such a form of defence, but the buttresses of Verdun and Paris to the French line at the beginning of September, 1914, and those of Verdun, Rheims, and the Forest of Compiègne in the summer of 1918, when three and a half years of trench warfare had allowed these areas to be turned into strongly fortified localities, permitted the Allied line to bend without giving way, and by preventing the German Army widening the base of the salients of their advance, restricted its liberty of action and eventually brought it to a standstill and left it open to the counter-strokes of Gallieni and Maugin.

These last examples demonstrate that it is not necessary for the line to be continuous, but that the fortified buttresses should be at sufficiently close intervals to attain this object of restricting the enemy's advance.

Within the limits of achieving this object, the wider the spaces between the fortresses the more will the principle of economy be achieved. The failure to balance the needs of the Field Army with the necessities for the garrisoning of the fortresses is shown by the Belgian defence of the Meuse fortresses in August, 1914.

Examples may still occur of the value of isolated fortresses. Such may be illustrated by the fortress of Adrianople, which, in 1913, blocked the only line of advance of the Bulgarian Army against the Turks, who were reforming their forces behind the Chatalja lines. With the growth of networks of railways, such instances will become fewer, as was foreseen by Moltke when he said "Build no more fortresses, build railways."

The fortresses of the future would, therefore, seem likely to be in the form of buttresses which should not in the first instance be expected to be completely surrounded; though such an eventuality must not be entirely neglected.

The buttresses should be wide at the base so as to avoid the danger of being pinched in the same way that the Field Army, working in conjunction with the fortresses, hopes to pinch the base of the salients formed by the enemy's advance.

We shall, therefore, expect the fortress to be *parabolic* in form with a "gorge" protection across the base in case of isolation.

With regard to the nature of the permanent works within the fortress we have an excellent guide from Lord Sydenham, who, writing in 1892, said, "Organization, capable commanders, efficient armaments, adequate supplies, matured preparations, well-arranged communications, these constitute the essence of defence." It will be noticed Lord Sydenham places "organization" first, and that proved certainly the experience of the Great War. Organization depends in modern warfare chiefly on communications and mobility; without these there can be little co-operation between the various parts of a force, which would otherwise lack flexibility and become a wooden automaton.

The first essential in the modern fortress will, therefore, be invulnerable communications, and rapid and covered means of movement. The framework will, therefore, be protected signal communication, whether buried cable, protected wireless installations, or subterranean passages, added to complete tram and railway systems for moving guns, personnel and munitions. These trams and railways will also, very likely, be all underground, partly for protection and partly for concealment from air observation. These tunnels will be protected from poison gas and will also afford a means of supply of fresh air to shelters and gun stations.

Before the outbreak of war it is unlikely that there will be much in the way of works visible on the surface, save large numbers of shallow concrete "pill boxes" for fighting troops, machine-guns

guns or tanks dotted about on an apparently irregular plan. This would follow the ideas of the German engineers who in the new positions built in front of Metz during the war had as many as 800 concrete pill boxes on a front of two or three kilometres. Anti-tank obstacles and electrically-controlled minefields will also be an important adjunct prepared in peace.

Colonel Lévêque in a series of articles in the *Revue du Génie Militaire*, in the autumn of 1922, gives his ideas of the future design of fortifications, and in them he adds to the works already mentioned above armoured gun positions. It is certainly open to question whether guns are not better protected by concealment and mobility, and it would certainly seem that the larger proportion of the guns should be mobile, either by rail, road, or on cross-country tractors. The experience of the comparative invulnerability of the gun emplacements at Verdun might lead some to consider that a certain proportion of the guns might be mounted in armoured works, especially where these can be concealed. But before including such works in the fortresses of the future, the eternal struggle between gun and armour must be seriously considered. The work that is proof against the shells of 1924, may be useless against the projectiles of 1944. It is probable, therefore, that only in very exceptional circumstances will such works be constructed.

It is essential that all alternative positions for guns should be connected up by protected signal systems to concealed and protected observation posts, without which the value of the guns is very small. The speed of modern aeroplanes and their rate of climbing will make it generally advisable for the aerodromes of machines working in connection with the defence of the fortress to be accommodated outside the fortified zone. Further, as the defence and attack of a position will depend more and more on air action, an enemy determined on the reduction of a fortress will generally first concentrate his attention on the aerial defence of the fortress. The provision of bomb-proof hangars for the defending aeroplanes will, therefore, be necessary, and on a scale quite impossible in field operations. Such may, therefore, in general terms be the nature of fortresses or fortified areas which will be prepared in time of peace in the future. The arrangement of these works, and the details of their construction, are matters which cannot be discussed in one article. The objection may be raised that money will not be available for the construction of such works, and it is certain that it will always be difficult, in time of peace, to get all the money required for military needs. That being the case, the soldier will very rightly argue that all the limited resources should be devoted to the production of a Field Army of the highest efficiency. The soldier must always press for this, but it must be faced that in these days of democratic government it will be more possible to get money

voted for purely defensive purposes, and not for purposes which can be suspected of aiming at "Imperialistic conquest." Possibly also public opinion will demand material measures for the protection of important industrial areas. The French Commission's investigations into the surrender of the Briey coalfields in 1914, are an indication of what may be demanded in the future with regard to the protection of such areas. Even if the areas themselves are not directly fortified, the necessity for forward concentration of the Field Army may demand defensive lines close to the frontier.

Added to this it may be pointed out that the expense of permanent fortification is comparatively small. The total expenditure by France on the defences of Verdun and the heights of the Meuse between the years 1874 and 1914, did not exceed the cost of two battle cruisers—not a great expenditure for blocking one of the main lines of advance into France and for forming a pivot on which the French main plan of campaign could depend. Frontiers may be uncertain and national finances low at present, but it would seem probable that the future will see permanent fortification, somewhat on the lines suggested, reappear. It is important, therefore, that we should follow the trend of European thought on the subject, even though we may only be concerned directly with the construction of coast defences which lie outside the scope of the present article.

HOW TO WRITE A LETTER.

By MAJOR G. E. H. SIM, D.S.O., M.C., R.E.

FIFTY years ago letter-writing was an art. One has only to read some of the collections of "letters" of celebrities (and others) that have been published of recent years to realize the amount of care and thought that must have been expended on their composition Nowadays the writing of a letter is, to most of us at any rate, an uncongenial labour. We take little pride in the composition of a "good" letter, nor are we ashamed of producing a "bad" one. When we die nobody will bother to publish a collection of our letters, and if they were published nobody would bother to read them.

Many are the causes which have gone to produce this state of affairs. The telephone and telegraph, to say nothing of the improved means of locomotion of the twentieth century, render much of the old letter-writing unnecessary. The ubiquity of newspapers and their correspondents has, to some extent, superseded the dissemination of news in letter form. In these hurrying times, moreover, people have little leisure to devote to writing letters: they play bridge instead.

The result is that many people in these days never write a letter if they can avoid doing so. They get no practice in the art of letter-writing and, as a result, are often incapable of expressing themselves intelligently on paper.

But every officer, especially every Engineer officer, should be able to write an intelligent letter. It is surprising how few of them can. All officers have to conduct official correspondence, and at each step in rank they find that a greater proportion of their time than before is spent at an office desk. Many officers affect to despise "paper." To do so is a mistake. Paper at its worst is a necessary evil, and it only becomes an evil when something silly has been written on it. Paper at its best (*i.e.*, intelligently used) may be compared to the nervous system of the body, which conveys the thoughts of the brain to the muscles, and the sensations from the surface of the body to the brain. On the intelligent use of the available means of communication, of which the writing of letters is by far the most important, depends the smooth working of the army machine in all its functions, operations, training, administration, etc.

Our military text books have much to say about the writing of

orders (which really constitute a particular form of letter), but little, if any, help is given to the officer who wants to learn how to set about writing a letter. King's Regulations lay down the *form* in which official correspondence is to be conducted, but one looks in vain for any guidance as to its *substance*. And it is the substance of a letter that really matters.

Every letter, apart from orders, with which it is not proposed to deal, is written with one of two objects :—

Either the addressor gives information to the addressee which will influence the addressee's course of action,

Or the addressor asks the addressee to furnish information which will influence the addressor's course of action.

Letters may, from another point of view, be divided into other categories, namely, original letters and replies.

A third division may also be adopted, namely, letters to superiors, equals and subordinates.

It is not, however, proposed to discuss all these divisions and cross-divisions in detail. They have only been mentioned because the first requirement of a good letter is that the writer should be perfectly clear in his own mind to whom and about what he is writing. The first thing the writer should do, before putting pen to paper, is to " categorize " the letter in his own mind—*e.g.*, " A letter to my subordinate calling for a report regarding the prevalence of rats in his barracks," or " A letter to my superior, in reply to a letter from him, reporting on the state of my mobilization equipment," or " A letter to my superior offering suggestions, unasked, regarding the new system of accelerated promotion of N.C.O.'s."

Having thus indicated the main categories into which official correspondence may fall, we will now proceed to examine certain points which are common to most forms of correspondence and which require the careful attention of the writer if his letter is to fulfil the purpose with which he writes it.

Justification.—When you think of writing a letter, first decide whether it is necessary to write it at all. If it is a letter giving information, ask yourself whether it will be the least use to the addressee when he gets it. If it is asking him for information, make sure that you really want the information, and, if you decide that you do, ask yourself whether the information required is not already in your possession or easy to obtain without bothering him with a letter. Judged by this test the proposed letter may be found to be quite unnecessary, in which case it should be left unwritten. Never write a letter unless it is going to serve some useful purpose. Even if you have nothing better to do than to write useless letters, it is probable that the addressee has something better to do than to read and answer them.

Accuracy.—Having decided that the letter must be written, the

next thing to do is to be sure of your facts. This is especially important in respect of facts of which it is your duty to be cognizant. In this connection it must be remembered that it is your duty to be cognizant of all regulations, more especially of those applicable to your particular duties. A letter based on ignorance of regulations is quite useless. If the addressee is as ignorant as yourself your letter will mislead him. If he knows his regulations he will point out your error and you will look foolish. The same applies to any other kind of fact.

Truth.—Having marshalled your facts, you then have to decide how to use them. The one golden rule is: never, under any circumstances whatsoever, wilfully make a misstatement, or a statement calculated to mislead the addressee, in official correspondence. It is very easy to do and is often done. When one is very keen to persuade someone to do something which he is disinclined to do, one is very apt to suppress facts inimical to one's argument or to exaggerate facts in support of it. One may even be tempted to make a deliberate false statement. This is immoral. Furthermore, it is highly dangerous. The chances are that you will be found out and, apart from the direct consequences to yourself which matter only to you, your argument will be entirely vitiated and spoilt by that one small exaggeration or falsehood. Be honest. Be truthful. If your case is good it needs no *suppressio veri* or *suggestio falsi* to bolster it up. If it is bad it is not worth arguing about.

Relevance and Completeness.—Decide what is relevant to the subject under discussion and put it in. Cut everything else out. Your addressee is probably a busy man who will not appreciate long dissertations on matters which, though interesting in themselves, have little or no bearing on the question under discussion. The inclusion of irrelevant matter in a letter is bound to obscure rather than clarify the argument. Stick to the point.

Completeness is the complement of relevance. Confine your remarks to those that are relevant, but make sure that you do not leave out anything which is really essential to the subject. This point can best be appreciated if we take a concrete example. Suppose you are a Company Commander and the M.O. i/c Troops writes and asks whether Sapper Brown has been inoculated against enteric. You look up his record and find that he was inoculated against enteric at Aldershot on 17th September, 1918, prior to proceeding to Egypt. What should your answer be? It could be one of the following:—

(*a*) Yes.
(*b*) Yes, on 17th September, 1918.
(*c*) Yes, on 17th September, 1918, at Aldershot.
(*d*) Yes, on 17th September, 1918, at Aldershot, prior to proceeding to Egypt.

Answer (*a*), though literally true, is not complete. In fact, it is positively misleading, as the effect of the inoculation has long ago worn off.

Answers (*c*) and (*d*) contain irrelevant matter. It is of no interest to the M.O. to know where he was inoculated, still less is he interested in his subsequent movements.

Answer (*b*) is correct because it contains all the M.O. needs to know and nothing that he does not need to know. It is relevant and complete.

All cases are not as simple as the above. Sometimes it is very difficult to decide whether certain matter is relevant or not, and whether or not it is necessary to include it for the sake of completeness. The best plan is to put yourself in the place of the recipient of your letter and ask yourself whether the inclusion of the matter about which you are in doubt will help him. In doing this it is safest to assume that the recipient is just one degree less intelligent than you really think he is. It is better to include matter which he already knows than to exclude matter of which he is ignorant and about which knowledge on his part is essential. Your grandmother will rightly resent it if you try to teach her to suck eggs, but she will think you are a nicely-brought-up young man if you pass her the salt, even though there be a salt-cellar within her reach.

Courtesy.—Always be courteous. Never be rude. It is sometimes difficult to suffer fools gladly, and when somebody does or writes something which we think particularly stupid we are sorely tempted to write discourteously. It never pays to do so. If you are discourteous to a subordinate who cannot retaliate you are not playing the game. If you are discourteous to a superior you are asking for trouble and will probably get it. Courtesy and politeness cost nothing and you are more likely to attain your ends by these means than by curtness and hectoring. In this connection it is well to remember that sarcasm is usually resented more than any other form of discourtesy.

Promptness.—Closely connected with courtesy is promptness in replying to correspondence. If somebody, whether he be your superior or subordinate, asks you a question it is only common courtesy to answer him at once. If you do not know the answer tell him so. If you do not know the answer, but, given time, can find it out, tell him you are making investigations and will forward a full report by a definite date. All well-conducted business firms make a point of answering all letters within twenty-four hours of receipt. It is a pity that this custom does not obtain in the Army. If it did, the amount of correspondence in most offices would be at least halved. It would be interesting to know how much public money is expended yearly in the Army on the postage of "reminders." If everybody did his job properly there would be no such thing as a reminder.

Humour and Slang.—Official correspondence does not, as a rule, lend itself to humour. One is dealing with serious matters, such as Sapper Jones's dentures or the soot-producing properties of Government coal, and humour is out of place. Furthermore, however proficient you may be as a humorist, it does not follow that the recipient of your letter is blessed with a sense of humour. Slang also is to be avoided as a rule. There are plenty of good English words and phrases with which to express your meaning without having recourse to slang, which is usually American and often vulgar. Both humour and slang may occasionally be used to drive a point home, but they should be used very sparingly and with great care. A definite purpose should always underlie their use. Never be funny for the sake of being funny. Never use slang because you are too lazy to look for an English word or phrase in which to express your thoughts.

Balance.—A letter, to be a good letter, must be well balanced. In this respect a letter may be compared to a picture. The artist decides which parts of the landscape have to be emphasized and which merely suggested: where much detail is required, and where little or none. The result is that the person looking at the finished picture sees just what the artist means him to see. The important points catch the eye; the minor points, though there in the picture, merely serve to amplify the important ones or to make them stand out. So it should be with a letter. The letter, when written, should be a "complete whole," comprising a number of "features," to each of which its correct "value" has been given. The amount of "detail" required will vary with the type of letter, but it must never be allowed to obscure the main points you are trying to make.

Paragraphing.—It is often convenient to divide a letter up into paragraphs. If the letter is a long one on a complicated subject, paragraphing is almost essential. Each paragraph should, where possible, contain one "feature" and one only. Paragraphing will be found a useful method of emphasizing the "features" of a letter. The addition of a heading to each paragraph will add to this emphasis. Numbering your paragraphs, besides adding further emphasis, will facilitate reference. It requires less literary skill to write a letter on a difficult subject in paragraphed form than in the unparagraphed form in which the leading articles of newspapers are usually written.

Style.—One does not have to be an artist to produce a useful and intelligent military panorama sketch. One does not have to be a literary genius to write a useful and intelligent military letter. It is, no doubt, true that a man with a literary gift will usually find it easier to express himself well in a letter than a man with no such gift. But the latter need not despair. The words required are few and simple. The expressions commonly used in official corres-

pondence are more or less stereotyped and standardized. There are certain tricks of phrasing and expression which can be acquired with very little practice. One may even go so far as to say that flights of literary fancy are almost as out of place in official correspondence as are humour and slang. The simpler the style of your writing the easier it will be to understand. Obscure words, recondite phrases, classical quotations, etc., will not help you to persuade the Regimental Paymaster that Sapper Robinson's balance debit is really a credit. A sound argument, clearly expressed in simple English, will serve you best.

Conclusion.—It may appear that the writer has been inclined to lay down the law in no unmeasured terms. His excuse is that he has, for the past seven years, been employed on work entailing a great deal of very varied correspondence. During those seven years he has himself fallen many times into most of the traps against which he warns the reader. He hopes that the conclusions which he has drawn from his own experiences may be of some assistance to others.

THE BIRTH OF A GREAT EXPERIMENT.

SOME OBSERVATIONS ON A TERRITORY THAT FOR THE PAST THREE YEARS HAS BEEN ADMINISTERED BY THE LEAGUE OF NATIONS.

By LIEUT.-COL. E. G. WACE, C.B., D.S.O., R.E.

DOWN in the "left-hand bottom corner" of Germany is a small tract of country to be painted a new colour on modern maps; if you walk the whole way round this tract of country you will only have walked some 300 kilometres, under 200 miles; but you will have walked that distance of the new European frontiers laid down by the Treaty of Versailles.

The country referred to is the "Saargebiet," to give it its local official title; the territory of the Saar Basin is the fuller title to be found in the Protocols laying down those frontiers. Its population is nearly a million, and it contains the famous Saar Basin coalfields, from which its wealth and importance are derived.

When the war ended and France took a look round at all her damaged industries in the north, one of the most grievous sights, as the British Army well knows, was the devastated coalfields of the Pas de Calais. The damage done to the mines themselves was so serious that the most optimistic estimates foretold a period of several years before the pre-war rate of output could be resumed.

As compensation for this disaster, the French naturally turned their eyes to the rich coalfields of the Saar Basin, lying so conveniently close to their restored province of Lorraine. Justice demanded compensation in kind, and here was the coal close to their new eastern frontier.

There are Frenchmen to be met who will claim that the territory where the Saar coalfields lie should have been handed over to France for good and all; the frontiers of Lorraine, a little over 100 years ago, extended well beyond the Saar river, and it was only after Waterloo that Prussia and Bavaria extended their sovereignty to the frontiers of Alsace and Lorraine, as we now know them. If France was to benefit by the coal of the Saar Basin, she required some security and protection for those who were to work the mines or some guarantee for deliveries. What could be simpler, then, than to hand the country back to her?

This solution would not, however, have conformed to the Wilsonian principles of self-determination, and a compromise was found.

While it could be claimed that historically the country had once been French, the fact remains that its great development has taken place during the past century and is due to German enterprise. The insignificant little market town of Saarbrücken of 1814, with its sister-town of St. Johann across the river, have developed into the important industrial and railway centre of 1914, with a population of over 100,000. Here and there, chiefly about Saarlouis, the town to which Louis XIV. sent his British prisoners to work, are to be found families that may be called French Sarrois; but for these, the population is German and, as a result of the great development of Saar industries, to a considerable extent consists of immigrants from Westphalia and other parts of Germany.

The solution, then, for this country, whose coal was to be French, yet whose miners were German, was the practical application of the newest and greatest experiment of Europe: the administration of the country by the League of Nations. The Treaty of Versailles has given to France the absolute possession of all the coalfields of the Saar Basin; to enable them to be exploited by the French without fear of interference or chicanery, the Saar Territory is governed by a Commission of five members, representing and appointed by the Council of the League of Nations.

This *régime* is to hold for fifteen years after the Peace Treaty, when the self-determination principle is to be put into practice, and a plebiscite is to be held. As a result of the plebiscite the League of Nations will decide whether the Saar Territory is to be restored to Germany, or handed over to France, or to remain under the administration of the League of Nations. Which of these three alternatives is the one to bet on is not easy to say; the second seems, at present, to be the least likely; the first is, at first sight, the "favourite," but there may be some hope for the third. The country is rich, and escapes the burden of Reparations; when the customs revenue is at a normal figure the difficulties of the budget must be considerably lightened; in short, the life of the Sarrois, given the continuance of good government, should be a peaceful and happy one. In such circumstances it does not seem to be too great a stretch of the imagination to see a reasonable degree of probability in the third alternative, resulting in a neutral independent State between Lorraine and the Rhineland.

It was evident from the start that the task of the Governing Commission was going to be no light one; agents and propaganda from the "Heimatdienst" in Berlin formed an active opposition. The majority of the most efficient German officials in government services and departments had already been removed by orders from Berlin, while of those that still remained there were few who could be regarded as Sarrois. The unrest that was consequently stirred up in the various government services (railways, posts and

telegraphs and the like) soon came to a head in a strike. The luck, however, was with the Governing Commission, for, before the strike was ordered, a German agent carrying important incriminating papers was discovered, by a fluke, by a French *douanier* at the German–Sarrois frontier, and the cat was out of the bag. A short spell of "state of siege," several deportations, and the issue of a wise and considered statement by the Governing Commission settled matters, and a period of tranquillity was introduced.

The country circumscribed by the frontiers of the Saar Territory corresponds to no single administrative area of pre-Treaty days; it includes portions of both Prussia and the Bavarian Palatinate. To the average German, indeed, living at a distance from this corner of the fatherland, it is doubtful whether "the Saar" connects with his mind anything other than wine; but even the Saar vineyards are not included in the Saar Territory, being situated lower down the Saar river below Mettlach. It is strange, in fact, how little is known even in Germany of the geography of those parts, since it is not a rare event for letters from Germans in Berlin to be addressed to "Saarbrücken, Alsace-Lorraine"!

Saarbrücken, the capital, is an unlovely spot; situated astride the Saar river, and shut in by hills on either side, it has a disagreeable atmosphere, tainted by coal-dust and the fumes from the great steel works on the outskirts north and south of the town. From the hills on the western edge of the town a fine view is obtained across the old German "Exerzierplatz" to the famous Rotheberg and the site of the battle of Spicheren of 1870. North from the Rotheberg, at the point where the frontier crosses the road from Saarbrücken to Metz, stands the inn called "Der Goldene Bremm," round the courtyard of which stand the iron railings still bearing the bullet-marks of 1870. About half-way between this inn and the outskirts of the town lies the new cemetery, in a portion of which are to be seen the graves of the allied soldiers, prisoners of war, buried here by the Germans; this portion of the cemetery is carefully tended by the French troops in Saarbrücken, but to British eyes the wooden crosses, with their misspelt inscriptions erected by the Germans, have a rather tragic air, seeming to emphasize the pathos of the worn-out prisoners of war, far from home and kindred. This feeling is not lessened when, passing from the wooden crosses over the graves of allied soldiers, with the bald "Hier ruht" at their head, followed by the name, rank and regiment, the visitor finds the graves of German soldiers and the inscription on their crosses, "Hier ruht in Gott."

There is, in Saarbrücken, one curiosity to be seen in a broad, much-used street in the centre of the town, which, to our British eyes, seemed to deny to the Germans their boasted characteristic of thoroughness. In spite of their hymn of hate, they had left up

over a piano-shop a large British royal coat-of-arms, with supporters and motto, not a sign being evident on its gold-and-paint of the obloquy the Germans were hurling at our Royal House.

The frontiers of the Saar Territory were defined, on broad lines, in the Treaty of Versailles, their exact location being left to an international commission of five members, whose decision was to be final and binding on all the Powers concerned. The Commission was composed of a Frenchman and a German, as representing the two "interested" States, and three other nationals to be nominated by the League of Nations. The nomination of these three officers constituted the very first decision of the Council of the League.

The frontiers to be laid down were two, that between the Saar Territory and France, and that between the Saar Territory and Germany, or, more strictly, the rest of Germany; for the German claim is that the Saar has not renounced German sovereignty, but has been handed over to the League of Nations as trustee and administrator. The frontier with France is the old frontier between that country and Germany which was fixed after Waterloo and lasted till the War of 1870. The task of the Commission at first, as regards this frontier, appeared simple, but eventually proved to contain many thorns; the frontier Commission of 100 years before had taken some fifteen years over their task, and even then a host of discrepancies was brought to light by the more exact instruments and methods of to-day. In addition to these difficulties, which the Commission, after all, was competent to solve, were others arising from the fact that this old international frontier had, for the past fifty years, formed the boundary only between States of the German Empire. In such circumstances it is only natural that economic conditions on both sides of the boundary tended to merge, and to obliterate the results of the former separation; railways and large industrial concerns developed since 1870 naturally took no notice of the old frontier. In one case a railway station was found astride the old frontier, the main station building being in Lorraine and a certain small but necessary annexe on the Saar side; the great difficulty of such a situation was, of course, the regulation of customs inspections.

The other frontier, that between the Saar and the rest of Germany, was a new one; by the terms of the Treaty it followed in the north mainly along existing administrative boundaries; while in the east the same principle was applied as far as possible.

The Boundary Commission, which had held its first sittings in Paris, as soon as possible after the ratification of the Treaty, moved its headquarters in February, 1920, to Saarbrücken. The country, at that time, was under a French military administration, not very dissimilar to that in the occupied Rhineland. The arrival of the Allied members of the Boundary Commission passed almost

unnoticed, but the arrival of the German Commissioner, resplendent in his military uniform, had a striking effect. By a singularly unfortunate decision of the French officer responsible for billeting, the German headquarters were fixed in an hotel in the main thoroughfare of the town, a street that throughout the day was packed with shoppers; the natural result was the collection of a crowd, anxious to stare again at a uniform so well known and yet banished for over a year! The excitement grew to such a pitch that the French authorities deemed it necessary to clear the street by a force of cavalry with swords drawn. The German Commissioner, whose status was equal with that of the rest of his colleagues, was entitled, like them, to wear uniform, but was prevailed upon to restrict the occasions for wearing it, and the excitement subsided. Later, however, as the result of further incidents, the German delegation appeared only in plain clothes; this change, apart from other reasons, had the advantage of avoiding the friction resulting from the question of saluting; the French soldiers must have felt an extraordinary distaste for saluting German officers, and probably *vice versa*.

The further incidents referred to above included a fracas at Zweibrücken, in the occupied Rhineland just over the Saar border, where the excitement caused by the appearance of the German Commissioner in his military uniform was similar to that caused at Saarbrücken; the crowd that collected round the Commissioner's motor-car was so great that it was some time before he could start, and in the meanwhile "Deutschland über Alles" was sung by the crowd; the singing was started, according to a French soldier's report, by the chauffeur playing this tune on his motor-horn! Germans are wonderful musicians!

Of the difficulties and discussions that arose during the deliberations over the final location of the frontier lines little need be said, especially in view of the fact that they have been solved and the frontier is definite and existing. They arose mainly through the attitude assumed by the Germans towards the German-Sarrois frontier, which they persisted in representing as a mere temporary arrangement to last only for the fifteen years during which the Saar remains under the trusteeship of the League of Nations. In accordance with this view the Germans had even proposed that this frontier should be marked by wooden posts; this, however was negatived by the Commission, and proper stone pillars erected. In the same way minor and insignificant adjustments of what were, in fact, only parish boundaries, were strongly opposed; these boundaries had been adopted as the general line for the frontier in most parts, with the idea of simplifying the administrative changes wrought by the creation of a new territory. But parish boundaries have little in common with a frontier, and offer no particular

obstacles where properties or even houses are traversed by them, or in cases where a village water-supply is derived from the adjoining parish. But immediately these obstacles appear on a frontier the case is altered, and reasonable common sense aims at adjustments which will preclude the possibility of future disputes.

The conclusion is difficult to avoid that, from a political point of view, the Germans would have welcomed the persistence of obstacles and inconveniences resulting from the new frontier, in order, when the plebiscite is taken, to preach the advantages of its removal by the restoration of the territory to Germany. Certain of these difficulties were met by adjustments of the frontier line, and certain are being dealt with by means of *droits d'usage*, but even these measures are unable to reach the greatest difficulty of all. This lies in the fact that the Saar is mainly industrial and carries a large population for which its agricultural area is unable to provide. The farm land within the borders of the Saar is worked with the thoroughness that is to be expected of its people, but, even though to this thoroughness were added the scientific and systematic progressiveness of Canada, it would still be unable to produce the food required. This difficulty would have been sensibly diminished if those responsible for framing the Peace Treaty had taken a larger view of the needs of this small territory, and drawn their blue pencils somewhat more freely northwards and eastwards on the map.

At the office of the President of the Commission was a strangely cosmopolitan collection. The *secrétaire-général* was a French infantry captain, the register clerk was a Frenchman of Lorraine who, in the early part of the war, had perforce to fight on the German side, the typist was a Sarroise who had a smattering of French, and the caretaker a German, who, as ship's steward in pre-war days had acquired a few words of English. The official language of the Commission was French, but the correspondence with the local administrative authorities adjoining the frontier was in German, so that a knowledge of both French and German was essential. The French captain was a professional soldier, who had been severely wounded at Verdun; but, at the same time, Art, musical for choice, and not the military virtues of precision and orderliness, was his particular *forte*. His voice and his 'cello, with both of which he discoursed magnificently, were perhaps his greatest assets, and certainly his pride. To illustrate this, two stories must suffice. After performing one Sunday at Mass, when nearly everyone had left the church, he was approached by a man who introduced himself as an ex-officer of the German army; the latter thanked him profusely for the musical treat he had so enjoyed, and as a token of esteem, though he had never spoken to him before, offered him the Iron Cross which, he said, had been presented him on the field of battle. And the captain not only accepted it, but declared

to all to whom he related the incident that he would treasure it among his most valued possessions! The other story concerns a prominent mole on the captain's forehead; a brother officer, chaffing him about this, said that it foretold pre-éminence, and that some day, doubtless, he would be a marshal of France. "*Tiens!*" replied the captain, "there are six marshals of France, are there not? While there are only five tenors like me!" This reply may well have been made in chaff, too, but as to the former incident—? Certainly music is international, and nothing could have been more enjoyable than a musical evening organized by the Japanese Commissioner in his rooms. Here the charming wife of a French major sang, the chief of the staff of the French troops in the Saar played piano duets with a French civilian of one of the administrative branches of the Saar Governing Commission, the German bass from the State Theatre sang "The Two Grenadiers" magnificently in German, while, to crown all this, the French captain, secretary-general of the Boundary Commission, sang duets from "Carmen" with the German prima donna of the State Theatre, he in French and she in German!

So much for the lighter side of life. What is to be said of its more serious aspect? The Saar Territory is now definitely in being; at a time when labour troubles, such as the great coal strike, were paralysing the trade of Great Britain, and other countries, too, were in the throes of industrial unrest, the situation in the Saar was perfectly calm. The Saar miners, indeed, were invited by their British colleagues to strike in sympathy, but, after a consultation with the French authorities responsible for the mine administration, they contented themselves with a message of sympathy, and continued work; much of their coal, in fact, found its way to England in those difficult days. Now, with trouble in the Ruhr, the Saar miners are on strike, and British coal is finding its way to Germany.

Whether in the Saar mines the French have really got a good bargain is, of course, for them to say. The wages of the miners go into Sarrois pockets, and not into French; the Governing Commission levy their just dues; so that, by the time the coal is delivered to the factories in France, a good deal of money has been disbursed by France to foreigners instead of to Frenchmen. In the event of the plebiscite going in favour of Germany, it is not difficult to suppose that the French will welcome the German claim to buy back the mines—"Ah! Take the cash in hand, and waive the rest"—more especially as by that time the French miners in the Pas de Calais will be well on the way towards their pre-war output.

The various steel works in the Saar have suffered, of course, like all industrial concerns, from lack of orders, but no serious stoppages occurred. While both French and German currencies are legal

tender in the Saar Territory, the result of the payment of the miners in francs and the substitution of French for German currency in the railways and posts and telegraphs must inevitably produce, together with certain other economic tendencies, a general orientation of trade and industry towards France instead of towards Germany. The sudden collapse of the mark, too, has doubtless accentuated this movement. To assume from such changes and developments that political sympathies will follow suit, would be rash indeed. There is, however, plenty of time between now and the date of the plebiscite for a lot to happen; all that one may predict with reasonable certainty is that a continuation of the wise and beneficent rule of the Governing Commission representing the League of Nations will ensure the content and prosperity of the people of the Saar and justify the conception of this great experiment.

(The article was written in the early part of the year, and since then certain events have occurred to bring the Saar Government before the notice of the British public. The extraordinary ordinances of the Governing Commission, to which attention was recently drawn in the House of Commons, have been withdrawn, and the League of Nations Council has enquired into the whole matter. Reports of the enquiry have appeared in the Press. The strike of the Saar miners is over, and things appear to be now practically more normal.)

R.E. WORK AT KILIA AND CHANAK.

PART I.

THE work of the Royal Engineers in connection with the Turkish crises will be published in two Parts. Part I contains an account of the work actually carried out at Kilia and Chanak. Part II, which will be published in the December quarterly *R.E. Journal*, will give an account of the preparations made at home in connection with this work, and enumerate the main lessons which are to be drawn from our experience in connection with the preparations for a small war of this nature.

THE FORMATION OF A BASE AT KILIA, DARDANELLES.

September, 1922 to June, 1923.

INTRODUCTION.

KILIA Bay lies on the European side of the Dardanelles, opposite Nagara Point, some five miles north of Chanak.

The Imperial War Graves Commission has its headquarters here, together with one English contractor, and these were the only British inhabitants.

On September 23rd, 1922, Major E. U. Grimshaw, M.C., R.E.(M.), was sent from Constantinople to reconnoitre Kilia and the valley running due west to Gaba Tepe, with a view to establishing Lines of Communication and an Advanced Base.

At this time the only buildings in Kilia were the huts—officers', workshops and quarters—occupied by the Imperial War Graves Commission. There was also one good central pier which they had constructed, and there were lightly-metalled roads running west to Gaba Tepe, south to Maidos and thence to Krithia and Seddul Bahr, and north to Azmac and Gallipoli, as well as various tracks used by the natives which led to their villages.

The I.W.G.C. had sunk wells of their own and had sufficient water to supply their colony. In September they erected two tanks at the head of the pier, ready to send water by lighter to supply the troops at Chanak, as the pumping station, which supplied most of the water for that town, was already overlooked by the advance guards of Mustapha Kemal's army.

PERSONNEL.

By the end of September the work of forming an advanced base at Kilia was in hand.

The first Royal Engineers to arrive were a detachment of the 24th Fortress Company, from Malta, about 70 strong and one officer, which landed on the 26th September, 1922.

The C.R.E., Lieut.-Col. G. C. E. Elliott, C.M.G., D.S.O., arrived on September 30th, together with the O.C. of the 24th Company, Major J. R. W. Mansfield, who brought about thirty more men of his Company.

By the first week in October, there were six R.E. Officers in Kilia, as well as Captain H. G. MacGeorge, who held the position of Assistant Area Commandant, while the C.R.E. also combined with his R.E. duties the task of commanding the Area for about five weeks.

The 29th Army Troops Company, R.E., under Major K. B. Godsell, D.S.O., M.C., moved from Constantinople to Kilia on the 3rd November.

The 15th Fortress Company from Gibraltar, under Captain B. K. Young, M.C., arrived on the 23rd of the same month.

At the end of January, 1923, there were altogether, besides the three companies, each approximately one hundred strong, eighteen R.E. Officers in Kilia, namely, the C.R.E. and an Adjutant, Officers in charge of R.E. Stores (the R.E. Central Stores had moved from Constantinople to Kilia on the 21st December, 1922) and R.E. Stores in Transit, an Officer i/c Roads, an Officer i/c Railways, with an Officer assisting him, an Officer i/c Water Supply, an Officer i/c Machinery and Electric Light, and nine Company Officers.

LABOUR AND CONTRACTORS.

(*a*) *Direct Labour.*—During October a fair quantity of labour was found at Maidos, a village one mile south of Kilia. This village was overflowing with Greek refugees, who had fled there after the Smyrna debacle. At the beginning, about two hundred applicants for work appeared daily, of whom the R.E. got sixty or seventy, some of them being semi-skilled carpenters. The numbers increased gradually as news of this chance of finding work spread to the more distant villages, so that throughout the month labour was comparatively plentiful. In addition to these local resources, consisting almost entirely of Greeks and Armenians, two hundred Russians—ex-members of General Wrangel's White Army—had been collected from Gallipoli village and billeted at Boghali Fort, one mile and a half north of Kilia.

About the second week of November, the Greek evacuation of the Peninsula took place, and the two hundred Russians were the only labour available for all the units in Kilia. In addition, the carpenters, of whom a large gang of fairly skilled workmen had been formed out of these casual labourers, were lost. This was all the more serious as it occurred just as the first ship-load of Nissen huts was being off-loaded.

A labour battalion for unskilled work was then recruited in Constantinople, and started to supply labour early in the following month. The Chief Engineer sent down gangs of carpenters, also recruited in Constantinople. The first batch, consisting of twenty-

four, was sent down on November 24th, followed by a second party of a hundred and thirty a week later.

These carpenters were retained and increased in numbers up to the end of March, 1923, when the main building works in Kilia had been completed.

The maximum number of civilian labour directly employed by the R.E. was about 250 skilled and 250 unskilled.

(*b*) *Contractors' Labour.*—The chief services carried out by contractors were repair and construction of roads, quarrying of stone and building of the Decauville railway.

Many Nissen huts were put up by petty contracts, made with the foremen of gangs of carpenters already mentioned. The standard price was three pounds sterling for erecting a Nissen hut 30 ft. × 16 ft. and six pounds for a Nissen hut 60 ft. × 20 ft.

The first contract work done was the strengthening of the pier and the repair of certain roads in Kilia. This work was carried out by the I.W.G.C. contractor. A Greek Government contractor from Maidos then offered his services, and carried out a great deal of work up to the time of the Greek evacuation.

Two contractors, who had previously done much work for the British Army in Constantinople, were sent down and employed, one on roads and the other on the Decauville railway, the former for four and the latter for six months.

Water Supply.

(*a*) *Deep-Well Bores.*—Four deep-well bores have been put down. Details are as follows :—

No. 1.—Above Area Headquarters Camp. Depth, 100 ft. Output, 2,000 gallons per hour. 10-h.p. Tangye engine installed driving Duke & Ockenden deep-well pump, which delivers water through 3-in. rising mains, either to I.W.G.C. tanks (increased in number to give 16,000 gallons storage) or to two sail-cloth tanks (capacity, 15,000 gallons) on spur west of bore. Delivery from I.W.G.C. tanks through I.W.G.C. system, with extensions to supply H.Q. camp and water-cart filling point. 4-in. main laid from sail-cloth tanks to supply camps on north side of Gaba Tepe road.

No. 2.—Near 21st Stationary Hospital. Depth, 150 ft. Output, 1,350 gallons per hour. Similar engine and pump to No. 1, delivering through 4-in. rising main to two sail-cloth tanks (15,000 gallons capacity) on hill-side east of bore. Two 4-in. mains laid from tanks, one to supply Hospital, and the other to the R.E. and other camps on north side of Kilia valley.

At the beginning of March, it was found necessary to deepen this bore, as, if more than 500 gallons per hour were taken from it, the quality of sand brought up destroyed the valve leathers. On

removing the pump, the valves and pump barrel were found very much worn, and no leather cups were left on the plunger. If a 750 or 1,000 gallons per hour pump had been available, the bore could have been used without further deepening. The deepening was commenced on March 14th, and the bore was sunk another 50 ft. to a depth of 200 feet, but much difficulty was caused by the quantity of running sand, and because of having to handle two hundred feet of casing in this class of strata. It was then discovered that the Norton-tube well near the Hospital [mentioned in para. (*c*)] if fitted with a Merryweather pump, would yield 1,320 gallons per hour, and, as success in shutting off the running sand had not been attained, it was decided to abandon the bore and supply the Hospital from this Norton-tube well. The bore had been cased off to a depth of 195 ft. It was found possible to jack out the first hundred feet of casing, but no more. The new 8-in. casing spear was tried, but was a failure, as it would not engage in the casing. A charge of gun-cotton was then made up and put down to a depth of 155 ft. This blew and left in the bore the bottom and a portion of the next lengths of casing.

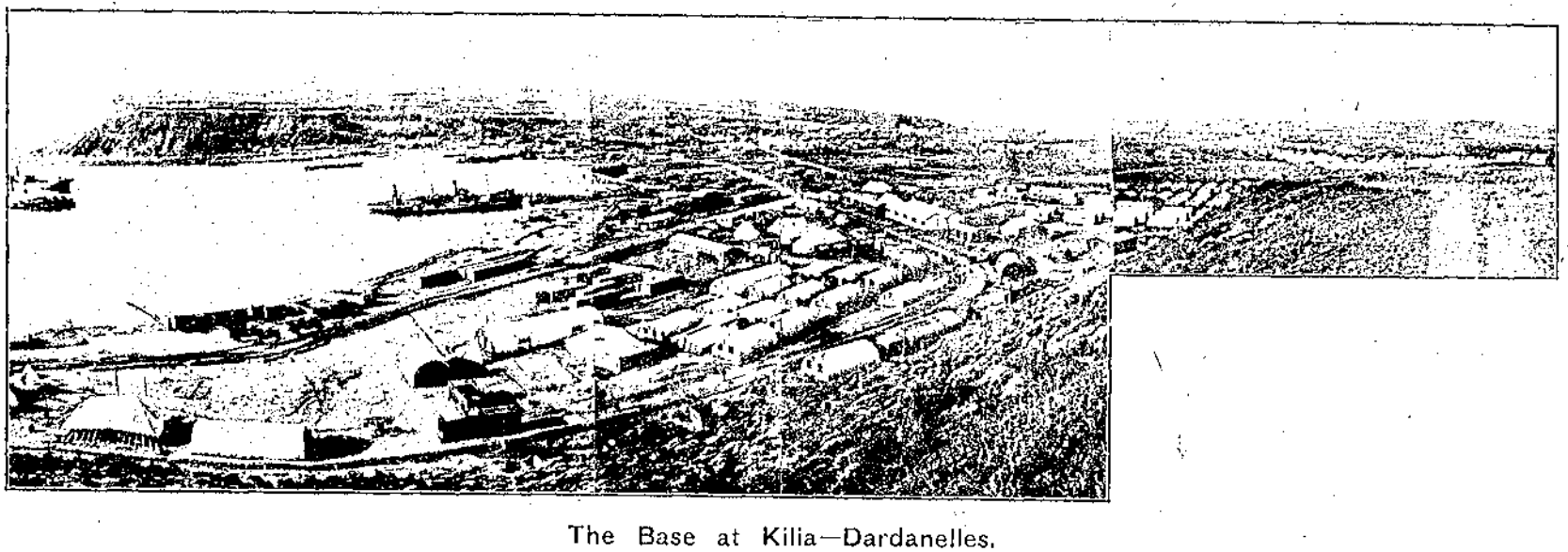
No. 3.—Near 85th Casualty Clearing Station. Depth, 105 ft. Output, 3,000 gallons per hour. Similar engine and pump to No. 1, but delivery through 4-in. rising main to two sail-cloth tanks (15,000 gallons capacity) on spur west of bore. Delivery from the tanks consisted of (i) 2-in. main to 85 C.C.S., which was afterwards turned into a V.D. hospital for 250 patients ; and

(ii) 4-in. main, 1,400 yards long, delivering to the storage tanks of the Infantry Battalion camps, namely, one 7,500-gallon sail-cloth and two 2,300-gallons canvas tanks (total storage capacity, 10,500 gallons). As well as feeding the two Infantry Battalions, this feeds the Ammunition Dump.

No. 4.—Near Royal Fusiliers Transport Lines. Depth, 215 ft Output, 500 gallons per hour. 4-h.p. Lister, driving Duke & Ockenden 1,000-g.p.h. pump, installed. A most unsatisfactory bore, which met with difficulties all the way down and still does not pump satisfactorily. Delivery through 4-in. rising main to two sail-cloth tanks (10,000 gallons capacity) on spur south-east of bore. Delivery from tanks by 4-in. main to Ordnance Depôt and camp, with a direct 4-in. main to a central fire hydrant.

(*b*) *Shallow Wells.*—Fifteen of these have been dug—average depth 15 ft. These are used chiefly for the supply of washing water, the water not being fit for drinking purposes without treatment.

At the Infantry camps a sterilizing plant was installed. This draws water from two shallow wells, and, after sterilization, delivers it into a tank from which it is pumped by a No. 2 Merryweather steam pump to two 2,300-gallon canvas tanks erected at the highest point of the camp. Distribution from these tanks is by 2-in. pipes. As the yield of these wells was hardly sufficient, an attempt was made



The Base at Kilia—Dardanelles.

to improve it as follows :—6-in. perforated casing was driven to a depth of 24 ft. below the level of the bottom of one well, and cleared with a boring tool and bailer, worked by means of a derrick and winch. This increased the yield of the well by 100 per cent., and the same thing was done with the second well, but the result was not quite so good, giving only about 60 per cent. improvement.

Six other shallow wells were also dug in the Gaba Tepe area and lined with rolled galvanized iron sheets—diameter 1·8 metres, depths from 6 to 11 metres. One only at Gaba Tepe has been used. This was 9·3 metres deep. A Chaîne-Hélice pump was fitted, and 200 gallons per hour obtained without exhausting the well.

(*c*) *Norton-Tube Wells.*—A few of these have been tried, but only one was successful for bulk supply. This was at the Hospital and has already been mentioned. Here a 2-in. tube was put down to a depth of 24 ft. In another case a good supply was obtained, but the water was heavily charged with sulphuretted hydrogen and could not be used.

(*d*) Supplies have been laid on to the Ordnance and 86th Field Ambulance camps by tapping aqueducts which formerly supplied Turkish fountains, and piping the water to tanks in the camps. In both cases the overflow from the tanks supplies horse troughs.

(*e*) At various outlying camps (battery positions, etc.) tanks have been fixed and short pipe lines laid, through which water can be pumped to camps by lift and force pumps from shallow wells or springs in the vicinity. A Merryweather steam pump has been installed at Kilid Bahr aerodrome.

Captain A. W. S. Gibson was Officer in charge of Water Supply, and he had Mr. Palmer, ex-Staff-Serjt., R.E., in charge of the deep boring plant.

Hutting.

During October the troops were all under canvas, and corrugated-iron cook-houses and latrines only were built. At the beginning of November five office huts were built for Area Headquarters, the Headquarters Heavy Artillery and the C.R.E. These were made about 28 ft. by 14 ft., of corrugated iron and timber, with an ordinary "A" roof. The office of the I.W.G.C. contractor, which had been generously lent to provide accommodation for the Area Commandant, was handed back.

The first Nissen huts—old pattern and nominally reconditioned—arrived from Constantinople on the 10th November, but the absence of bolts, which had been mislaid in the confusion then existing on the beaches, delayed the work of erection for about ten days. The first Nissen hut was completed at the 21st Stationary Hospital on the 22nd of November.

The scheme was to give each camp one or two Nissens, in which the

occupants of any tent which was wrecked by bad weather could find temporary shelter.

The first consignment of the 1922 pattern Nissen huts arrived from England towards the end of November, consisting of 125 30 ft. and 25 60-ft. huts. Even then the task of hutting proceeded somewhat slowly, as, owing to the hasty packing in the ship, no complete Nissens could be got on shore till practically the whole cargo had been off-loaded. By the end of the year, however, there were sufficient huts erected for all the troops to be able to find somewhat crowded accommodation in case of need.

Altogether 150 large, 700 small 1922-pattern and 365 reconditioned old-pattern Nissen huts arrived from England by the middle of December, as well as about 250 small old-pattern Nissen huts from Constantinople. Over 900 Nissen huts in all have been erected on the Peninsula.

Except in the case of the Infantry Battalions, who erected their own huts under R.E. supervision, the majority of the huts were erected by native carpenters. A gang of ten men could erect a small Nissen hut in one working day and a large Nissen hut in two and a half days.

In addition to Nissen huts, there may be now also seen in Kilia "A" sheds, Malta huts, ruberoid huts, universal shedding, and corrugated-iron buildings of every shape and size—offices, workshops, signal boxes, engine sheds, garages, operating theatres and even a guinea-pig hutch for the pets of the Hospital biologist.

ROADS.

The first piece of road work taken in hand was the making of the road, 4 metres wide and 201 metres in length, which ran alongside what was then the R.A.S.C. Supply Depôt (now Broadway), which was undertaken by the firm of Sir J. F. Payne Gallwey, Ltd., early in October. This was followed by the joining up of the eastern end of this road with the Central Pier, a distance of 80 metres, at 4 metres width, carried out by a Greek contractor, M. Guirdjis.

Meanwhile, minor road repairs were being carried out, chiefly on the Gaba Tepe road, by direct labour. Stone was supplied by contract, unbroken, and stacked alongside the road. A women's gang of about a hundred members was formed from the inhabitants of Maidos, and was employed in breaking this stone. About six to seven hundred metres of stone were used in this way.

M. Guirdjis carried out the following road work up to the middle of November, when he departed for Greece at the time of the Greek evacuation of the Peninsula :—

(*a*) Re-making the road 4 metres wide from the Ordnance Depôt towards the Kilia aerodrome, for a distance of approximately 3 kilometres.

(*b*) Construction of a 4-m. road, from Pontoon Pier to the Coast road, now called Brompton Road, a distance of 77 metres.
(*c*) Widening the road alongside R.A.S.C. Depôt, previously mentioned, to a width of 8 metres.

Other road work done by contract (name of contractor shown in brackets) has been as follows :—

(1) Road through Ordnance Depôt, 6 metres wide by 240 metres in length (M. Papaleo).
(2) Road past R.E. Dump, 7 metres by 133 metres (Payne Gallwey).
(3) Widening of Brompton Road (Payne Gallwey).
(4) Road in front of Ordnance, 5 metres by 263 metres (Papaleo).
(5) Road to Hospital, 5 metres by 295 metres (Kimbulian).
(6) Road through Hospital towards 86th Field Ambulance, 3 metres by 102 metres (Kimbulian).
(7) Road to Maidos, 7 metres by 315 metres (Payne Gallwey).
(8) Road from Maidos-Cham Burnu road to Kilid Bahr aerodrome, 4 metres by 4,000 metres, of which about 400 metres are beech-plank (Farfan).
(9) Road from Area Headquarters towards Ordnance, 5 metres by 600 metres.

Total length of road made or re-made by contract, 9,500 metres lineal.

In addition to these road repairs and constructional works, there has always been a gang of labour employed under direct R.E. supervision. This gang averaged 200 from January to March, 1923.

Two quarries were opened up and worked by contract, the stone supplied being used by the maintenance gang. In addition, about 600 tons of stone were sent down from Constantinople.

Roads to the north of Kilia as far as Azmac and south to Seddul Bahr were kept open through the winter by R.G.A. working parties, the stone used being collected in the neighbourhood.

A beech-plank road was made by a Royal Fusiliers working party from the Hospital Road to Brompton Road, and was continued along in front of the R.E. Dump.

When the weather conditions improved, the maintenance gang was cut down to about twenty, who were used for repairing "pot-holes," and since April the roads have been kept in very fair condition by this gang. Horse transport becoming more plentiful, stone, both broken and unbroken, was collected from the neighbourhood of Yalova and used in repairing the roads in Kilia.

From December, 1922, Major F. A. Ferguson, D.S.O., was in charge of Roads.

KILIA LIGHT RAILWAY.

Early in October it was decided to lay a 60-cm. Decauville line at Kilia, to relieve the congestion on the roads by connecting up the various dumps and piers.

Technical Details.—60-cm. line, to be built of such rail as was available locally or in Constantinople, namely, 12½ lb., 19¼ lb. and 19½ lb. per yard.

Ruling grade 1/50, except at Gaba Tepe end, where a steeper grade of 1/40 was proposed.

Ballast—20 cm. deep, 2 metres wide, on a formation of 3 metres. Gravel, sand or broken stone being used as available. Stone was of poor quality and very soft.

Bridges to take 14 tons.

General Details.—Work was commenced on the line at Kilia from Central Pier to Ordnance on October 18th, by a contractor who was brought down from Constantinople, with 130 men.

The material immediately available was a miscellaneous assortment of rails from Gallipoli, containing rails of three different sections, a small number of fish-plates, and no new bolts. A few parts of points and crossings were also found locally.

By November 26th, 3,667 metres of line had been laid and ballasted, but the bolting-up was only provisional, as proper fish-plates and bolts were not yet available. The line was worked by mule transport up to November 27th, when an engine became available. From November 19th to December 2nd, owing to labour difficulties arising out of the Greek exodus, the contractor was able to provide only ten men per day. This difficulty was overcome by getting as many men as possible from the recently-formed labour corps—varying from 30 to 90. Their work was indifferent and much slower than that done by the contractor's men.

On November, 25th, two German six-wheeled coupled engines and 15 five-ton bogies arrived. They had to be completely dismantled, as they were in very bad order, but by working night and day, Mec.-Q.M.S. Parslow, R.E., managed to get one running by 28th November, and the pair by November 30th—a very excellent piece of work.

On December 14th, two engines, four-wheeled coupled, arrived from Malta. They were in good order and were put into the service right away. Later four 40-h.p. petrol Simplex tractors and two 20-h.p. tractors arrived. They required a lot of adjustment before they would work satisfactorily.

By the middle of February, 9,000 metres of line had been laid, linking up the three piers, providing three lines in the Supply Dump, one in the Ordnance Depôt, two loops in the Infantry camps, and lines to the Stationary Hospital and C.C.S., and loops and sidings to the R.E. dumps and to sand-pits.

Personnel.—The whole of the railway work has been done under the supervision of Major E. U. Grimshaw, M.C.

On December 9th, Lieut. S. Lamplugh joined the Railway staff as traffic manager.

Up to November 22nd, all work, including maintenance, was carried out by six British O.R.'s and a contractor employing from 130 to 300 men. On November 23rd, Mec.-Q.M.S. Parslow arrived, together with 38 railway personnel from the Anatolian Railway, with a good superintendent. This party was increased on December 2nd, by 20 more men. From this date all normal maintenance was carried out by the Railway staff. The upkeep of the line has entailed continuous and extensive work, owing to the bad weather, the lightness of some sections of the line, the softness of the ground and the difficulty of getting sufficient sand and stone for ballasting the line.

Cost.—The actual cost of laying the line, including first lift, has been approximately 14s. per metre run.

Tonnage.—The normal tonnage handled per day averaged 450 tons, which rose occasionally to 600 tons.

Speed of Work.—At first work was slow, owing to lack of material and insufficient labour, but this gradually corrected itself. A large amount of improvisation had to be carried out, especially on points and crossings. An improvised plate roller for corrugated-iron culverts up to 4-in. diameter has effected a great saving, both in time and expenditure, on small bridges.

Total Length of Line.—The extension of the line as far as Gaba Tepe has been surveyed, and makes with the length of *main* line already completed a distance of 8¼ kilometres.

Electric Light and Machinery.

The first electric light plant to arrive was a Siemen-Schukert 110-kw. portable engine. This at first supplied light to the Hospital.

Four electric light stations in all have been fitted up in Kilia :—

(1) At the Hospital, consisting of two Halford 18-kw. sets, run in parallel. These supply about five hundred points in the 21st Stationary Hospital, 86th Field Ambulance, the "S" Coast Battery camp, the N.A.A.F.I. compound, and also the Cinema and Concert Hall.

(2) At Area Headquarters, consisting of a portable Ruston-Proctor steam-engine driving a dynamo, with a Halford set similar to those at the Hospital, as a stand-by in case of breakdown. This lights the Base Supply Depôt, Area Headquarters camp, the I.W. G. C. Compound and the Central Pier.

(3) A Siemens-Schukert, lighting the R.E. camps, the Pontoon Pier and the Seaplane Base.

(4) A 50-h.p. Petter set, at Ordnance, run by Ordnance workshops, lighting No. 9 M.T. Company, the Ordnance Depôt and camp, and the Infantry camps.

In addition to the above electric light stations, there are three or four small sets, such as Petter Juniors, in use at the out-stations.

There are also four deep-well pumps and several Merryweather pumping sets in use, and four saw-benches.

The whole of the machinery and electric light work has been carried out under the supervision of Lieut. L. Delanoy, R.E.

R.E. STORES.

The first consignment of R.E. Stores, consisting of corrugated iron, timber, nails and tools, was received from Constantinople on the 25th September, 1922, and, after being discharged at the only existing pier, was dumped on the site of the present R.E. Stores. This was followed by several more consignments sent down from Constantinople on small boats, arriving about twice a week. The facilities for unloading stores at Kilia were meagre, and there was congestion at the Pier head, where R.E. Stores were mixed up with stores belonging to the R.A.S.C. and the Ordnance. The only means of collecting them into the Dump was by country carts, and there were not sufficient of these to meet demands. The Stores Staff had not yet arrived, and the 24th Company being the only one here and busily employed on works, could not spare sufficient personnel for checking the stores.

During October the claims from Chanak for stores received priority, so that there was an insufficiency of corrugated iron and timber for the works in Kilia. The situation as regards timber was greatly assisted by the requisitioning of some 300 cubic metres in Maidos, but corrugated iron remained a difficulty until the *Lamington* arrived at Constantinople with supplies from England.

The first consignment of stores from England which was off-loaded direct at Kilia, arrived in the *Esperia* in the middle of November. This ship brought, besides 150 Nissen huts, 170 tons of corrugated iron, 162 tons of timber, about 500 tons of stoves and cooking-ranges, the star-drill and 4 deep-well pumps and engines.

Before the off-loading was completed, the *Crosshill* arrived at the beginning of December, with 700 Nissen huts, 80 tons of corrugated iron sheets, 60 sections Martell Girders, more stoves and cooking-ranges, 4 saw-benches, with engines and 1 petrol tractor for the Decauville railway.

This was followed by the *Hillhouse*, which reached Kilia in the

second week of December with 285 Nissen huts, 300 tons Universal shedding, 250 tons of "A" type shedding, 150 tons of stoves, 3,000 sheets of SX boarding, 5 petrol tractors and 10 bogie trucks.

Besides these big consignments of stores received direct from England, smaller boats were still coming down about twice a week with stores from Constantinople—some obtained locally, some from R.E. Stores and some from the *Lamington*, the stores from which were being unloaded and sorted in Constantinople.

During October, November and the first half of December, there was a considerable congestion all along the beach. The Shipping Department with their lighters were able to put 800 tons a day on shore; but it was quite impossible to keep up with this rate in clearing the beaches.

A check of the R.E. Stores landed was impossible, as items urgently required were collected direct from the beach and put into immediate use, without going through the hands of the Stores Staff at all. The stores were not marked to show which boat they were supposed to be carried by, which increased the difficulties of completing a check after the situation had been eased.

In addition, stores coming down from Constantinople, although consigned definitely either to Chanak or Kilia, were indiscriminately landed at either and, though every effort was made to square matters between the forces on either side of the Straits, it was impossible to find all the stores shown on any particular voucher.

The Stores Staff in Kilia consisted of 1 W.O. in charge and 2 Engineer ledger-keepers and Storemen up to the time when the R.E. Central Stores moved from Constantinople to Kilia, which took place on the 21st December, 1922.

About the same time an Officer was put in charge of a small staff with a gang of native labourers, whose duty it was to collect and stack the R.E. Stores which were being landed, and also to issue Nissen huts direct from the dumps on or near the beach.

Nissen hut dumps were formed just clear of the beach in three or four places along the shore, and a second main Dump was formed east of the road running from South Pier to what is now called Hyde Park Corner—the meeting place of the Gaba Tepe and Yalova roads.

After the main rush was over, namely, from the middle of January, the beaches were cleared of R.E. Stores, and only the two main Dumps maintained.

At the present time issues both to Constantinople and Chanak are made from the R.E. Stores at Kilia.

THE OUT-STATIONS.

(1) *R.G.A. Camps.*—Prior to the arrival of the R.G.A. on the Peninsula there were two 4-in. Naval guns at Akbash, under a Naval officer, which had taken up their position on September 25th, 1922.

The 1st Heavy Brigade, approximately 650 strong, landed at Kilia on the 10th October and camped for nearly a fortnight on the ground now occupied by the "S" Coast Battery Camp and the 15th and 29th Companies, R.E. On the same day, three Naval batteries, 220 men in all, took up their positions on the Peninsula; one at Seddul Bahr, one at Soghanli and the third at Kilid Bahr. They were all accommodated under canvas, corrugated iron cook-houses of a temporary nature being hastily constructed.

Between the 19th and 29th October, the four batteries of the 1st Heavy Brigade moved out to their permanent camp sites at Azmac, Akbash, Soghanli and Seddul Bahr, and the brigade camp was taken over by the 5th Medium Brigade, 620 strong. The weather had not yet broken, so that, by making detours, the caterpillars of the Heavy Brigade with their loads were able to avoid most of the road bridges, and, with the help of some heavy timber baulks, climbed in and out of the dry river beds.

During November, battery camps were formed for the 5th Medium Brigade at Boghali and Jambaz and at the end of January, 1923, yet another camp was formed at Cham Burnu. The R.A. Survey Company arrived on the Peninsula at the beginning of December and went into camp at Yalova.

The same principle was observed in the hutting of these out-station camps as in the camps in the Kilia valley, namely, one or two huts were erected in each camp to be used as a protection against bad weather in case of emergency. These batteries were, however, much better able to fend for themselves, as old stone huts, in various stages of decay, existed in most of the camp sites. These, built up, with corrugated iron roofs added, were first used for accommodation. Water was found in existing shallow wells, which were improved and fitted with lift and force pumps, Nissen huts were allotted in bulk, and the detailed distribution was done by H.Q., H.A. In all, 190 Nissen huts have been erected at these R.G.A. camps.

At first the Peninsula, south of an east-and-west line drawn through Maidos, came under the C.R.E., 28th Division, but in the middle of January, 1923, the C.R.E., Kilia, took over the whole Peninsula.

The roads running north and south from Kilia were all lightly metalled. A good deal of work was put in by the Gunners themselves,

in keeping these roads open through the winter, but no extensive reconstruction work was undertaken. The batteries were fed in the latter part of the winter by sea transport, and the roads, for a time, became nearly impassable to traffic.

(2) *R.A.F. Aerodrome at Kilid Bahr.*—It was found when the weather broke that the old aerodrome ground west of Kilia became too sodden for the landing and taking-off of aeroplanes. At first it was decided to experiment with canvas and wire netting laid down as a landing surface, but this was not proceeded with, and a new site was chosen on the Kilid Bahr plateau at a height above sea-level of about 200 metres. This site was very suitable, both as regards landing facilities and through being out of sight from the Asiatic shore, but the great difficulty was road communication with Kilia. The work of constructing a road, to join the main road south of Maidos, was commenced by contract at the beginning of December, and the line of an old country track was followed. The total length of the road to be made was 4,030 yards, from sea-level to the height of the aerodrome. Local stone was used, though of poor quality and very soft. The road had to be used by traffic the whole time it was being built, as the personnel of No. 4 Squadron was already on the plateau and had to be rationed. In addition, a hutted camp was being built at the same time, so that Nissen huts and other material had to be taken up. The road was finally completed and taken over at the end of March, 1923.

(3) *Wireless Stations, Anzac.*—At the end of September, 1922, it was decided to move the Wireless Station from Nightingale Hospital, Chanak, to Anzac, where it would be in a safer position in case of war. The technical buildings were put up by contract, and the station started to function in the middle of October. It was capable of communicating direct with England or Egypt. Living accommodation for the personnel was provided at the same time as in other camps. A listening-in station for Intelligence purposes was also constructed at Shell Green, about two miles south of Anzac, at the beginning of February, 1923.

Special Works.

The following constructions are worthy of being mentioned separately as being somewhat out of the ordinary.

Towards the end of September, H.M. Aircraft Carrier *Argus* landed about a dozen seaplanes at Kilia, and it was necessary to supply a slipway up which they could be hauled on to land without undue strain.

The slipway was made of timber, cased at the seaward end round blocks of concrete, and a concrete platform, about the

size of a tennis court, was built on which the seaplanes were parked.

At the beginning of January it was decided to build a cinema and church for the use of the troops. As this building is fully described under Professional Notes (page 499) no further mention need be made of it here

Engine sheds for Decauville engines were built by raising the curved corrugated-iron sheets of a small Nissen on iron pickets about 6-ft. high.

A signal box was constructed, with its floor 10-ft. above the ground, over the manager's office, and was appropriately named Clapham Junction.

PIERS.

Two new piers were constructed. One, at the northern end of the Bay, near the R.E. Dump, consisted of an iron pontoon anchored in position after much difficulty, and connected to the shore by a roadway supported on a trestle, both road-bearers and trestle consisting of 12 in. × 12 in. timber baulks. This was in use by the 8th of November and proved invaluable, though it gave trouble subsequently on two or three occasions owing to the rough weather. The size of the pontoon was 200 ft. × 40 ft. × 12 ft. high, and was the spare pontoon for the main floating bridge across the Golden Horn.

A concrete pier, at the southern end, was started by contract on the 27th November. The supply of cement became short, and it was temporarily abandoned in an unfinished state. It was eventually completed in January, by the 29th Company, R.E.—a concrete pier-head was made and this was joined to the unfinished portion of the pier by girders and a timber roadway.

DIFFICULTIES.

(1) *Lack of Transport.*—The temporary set-back caused by the sudden departure of most of the available native labour has already been mentioned.

In addition to this, there has been the almost constant difficulty of finding sufficient transport. None of the R.E. Companies had any transport of their own, and all have been entirely dependent on the transport pooled under the L.T.O.

At the beginning there was an insufficiency of all forms of transport, but by December, enough horse transport had been collected for everyone to get as much as demanded. Motor transport has always been a difficulty. The only motor transport permanently

available has been 3-ton lorries, which, owing to the uncertain state of the roads, were almost useless during the greater part of the winter.

The Heavy and Medium Brigades of Artillery brought with them 30-cwt. Vulcan and 15-cwt. Crossley lorries, and about six of each of these were added to the L.T.O.'s pool for general use. There have always been so many applicants for these very useful vehicles, that it was never possible to be sure of obtaining them when required. The planning of work would have been greatly facilitated if each O.C. R.E. Company had definitely had a certain amount of transport permanently under his own orders.

(2) *Unloading of Stores.*—Stores began to arrive in great quantities at a time before the Decauville railway had started to operate, and when the supply of road transport was at its ebb. The shipping department had facilities for landing two or three times as many stores in a day as could be cleared from the beach, so that, of necessity, the beach became more and more congested.

By the middle of November, Ordnance, R.A.F., R.A.S.C. and R.E. stores were in large stacks along the shore, and in a state of considerable confusion. A great effort was then made, and, with the help of the Decauville railway, which, by the end of the month, was removing 500 tons of stores from the beach daily, the tangle was gradually straightened out and the stores position mastered.

(3) *Weather.*—The weather through the winter was comparatively mild, except for two or three blizzards. However, there was plenty of rain and mud and, for a time, it was touch and go whether the roads could be kept open: in particular, the main Gaba Tepe road, leading past Area Headquarters and the Supply Depôt, to the Ordnance Depôt and the Infantry Battalion camps.

This for a short time became impassable for motor traffic, but was always used by horse transport. The difficulty was finally overcome by laying rough *pavé*, similar to that found in French provincial towns. In Constantinople this is termed *pavé ordinaire* as distinct from *pavé cubé*.

R.E. WORK AT CHANAK.

September, 1923—June, 1923

(1) *Personnel and Organization.*—During the summer of 1922 the British Army was represented at Chanak by a single Battalion of Infantry, and the R.E. by one section of a Field Company, the

Section Officer acting as D.O.R.E. The Battalion was billeted in the town, for the most part in buildings belonging to the Turkish Government and previously used as barracks, hospitals, and store-houses. The chief work which fell to the R.E., beyond minor repairs to billets, roads, and the rifle-range, was the maintenance of the water supply, of which an account is given in para. 3.

In September, Chanak leapt into importance on the approach of the Turkish Army. Reinforcements of all arms were sent from Constantinople, Egypt, Malta, Gibraltar and the United Kingdom, and another section of the 55th Field Company was at once sent down from Haidar Pasha. These two sections had to carry on through the most strenuous period of preparations for defence until October 2nd., when the 12th Field Company arrived from England. They then returned to rejoin their own Company. On October 1st, a Division Head Quarters was formed at Chanak, and the C.R.E., Anatolia, took up duty as its C.R.E. His staff consisted of an Adjutant, one Engineer-Clerk Staff-Serjeant, and, later, a Q.M.S.-Mechanist Electrician. In addition he had attached to him two N.C.O.'s on loan from other Companies, one of whom was in charge of the pumping-station, and one acting M.F.W. The 12th Company was approximately at peace strength, and averaged 5 officers and 130 other ranks. For a force of an average ration strength of approximately 6,500 this was naturally weak, and it was difficult to withdraw men for rest or training. Out of this number, too, a full section had to be kept until the end of the year on the Gallipoli Peninsula, which came under the Division for all the area south of an east and west line through Maidos.

(2) *Defences and Field Works.*—In September a defensive line was built in great haste to cover Chanak, and as the garrison increased portions of the line were advanced in order to gain a little depth for the defence. In the first instance the line consisted of strong points, which were first completely wired in, then dug, tactical wire and lateral communications being added. Support and Reserve lines were also prepared with splinter proofs for Battalion Headquarters and Aid Posts in the Reserve positions. Front line wiring was done by Naval and Marine landing parties, 1,200 strong, who then dug the strong points, support lines and lateral communications to front line strong points. The 1st Battalion, the Loyal Regiment, dug their own frontage. About 250 native labour were also employed on digging. Battalions as they arrived took over their own frontage, thickened up wire and dug Reserve line. The two R.E. officers then at Chanak were fully employed in siting and laying out these trenches, superintending their construction and arranging the issue of the large quantities of tools and stores required. Several small farms were blown up to clear the field of fire, and, as the Turks

approached, a road-bridge and a road-mine were blown on the Chanak–Erenkeui road. The batteries dug their own positions and splinter-proof shelters. The defences were of the most simple kind, fire-trenches and apron-fences, and before such improvements as communication-trenches or dug-outs could be put in hand, the Mudania Armistice was signed, on October 11th, under the terms of which no further defensive works were allowed to be constructed.

(3) *Water Supply.*—Chanak is supplied with water from two external sources. The main supply, and much the more important, is from a pumping station on the Koja Chai, about a mile and a half from its mouth. The water, from a well sunk beside the river bank, is pumped by a steam pump to a filter-bed and reservoir 700 yards away on the lower slopes of a hill. From here the town is fed by gravity, but the head is not sufficient to reach the north end of Chanak, where the houses rise in tiers up the hill-side to the building known as Nightingale Hospital on the summit. A small booster pumping-station had accordingly been built by the Army at the bottom of the hill. Its storage capacity was 4,000 gallons, and a Merryweather Valiant pump lifted the water to further storage tanks in Nightingale Hospital.

The secondary and older supply is provided by a pipe fed by a spring in the mountains some two and a half miles south of Chanak. The two systems are interconnected, but this secondary supply has no effect except in the extreme south end of the town, where the piping is very old, rotten, and laid in inextricable mazes. For military purposes this latter pipe is almost useless.

In the event of war, both these sources would have been lost to us. The second pipe could be cut at any point outside our line. The Koja Chai pumping station was only just outside our line, but, even if it had been found feasible to deny it to the enemy, it could only have been a matter of hours before it was shelled to pieces.

Consequently, among the earliest work for the R.E. was the reconnaissance and development of all other potential water-points. There are many shallow wells in Chanak, but all polluted to a varying extent. Inside our wire, but outside the town, a certain number of wells were found of good capacity and yield and of reasonable purity. In addition, the line of hills which connects Chanak with Mal Tepe was found to carry a large quantity of water, issuing in springs at various points, some of which appeared to be connected underground. A reserve up to 12,000 gallons was installed by canvas tanks and filled by water lighter from wells at Kilia.

Until May the bulk of the troops were billeted in Chanak and used the piped supply, and these subsidiary sources were not much drawn on. But, when in May all units were moved from Chanak

into camps to the north and north-east, three additional pumping stations had to be built, each with its own rising main, reservoir, and distributing system. (J.3,733. J.1,435, and J. 0632). Merryweather Valiant pumps were installed at each of these. In addition, the storage at the booster pumping station (*see* para. 3, sub-para. 1) had to be much increased, and the gravity main feeding it repaired to increase the supply obtained in twenty-four hours.

Norton-Tube wells were also sunk with varying results for two or three small units.

(4) *Billets, Hutting and Camps.*—When reinforcements arrived at Chanak in September and October the tentage available was quite inadequate and hutting was out of the question. On this account, as well as on tactical grounds, practically all units were billeted in Chanak. Most of the billets were very bad; ruinous, dirty, and infested with bugs; but there was no choice. That portion of each battalion which was occupying the line lived partly in tents and partly in crude dug-outs and shelters. Large orders for Nissen huts had been placed in England, but these did not arrive till well into November, and a certain number of reconditioned Nissens were sent down from Constantinople. But it was decided that, with minor exceptions, the troops at Chanak should be accommodated in billets and tents, and that the Nissens should be reserved for the European side. This decision was slightly modified when the winter blizzards began, and 20 Nissens were finally erected at Chanak. In the Divisional Area on Gallipoli 115 were erected for the Medium, Heavy, and Naval Batteries between Sedd el Bahr and Cham Burnu.

When, in May, units moved into camp, a certain number of accessory buildings, cook-houses, forges, etc., were provided, and sun-shelters for recreational purposes.

(5) *Decauville and Roads.*—No new Decauville lines were laid. A small Decauville system in use in the Supply Depôt, and connecting it with South Pier, was maintained. A scheme to connect Chanak with Nagara was worked out, but given up as too slow and costly.

The only lateral communication possible for winter use was the Chanak-Nagara road, which followed the sea-shore and was largely protected from view and shell-fire. Its condition was bad, and it was so important that it was entirely remetalled from Medjidieh Fort to Nagara, a distance of over two miles. The *pavé* road through the town was always possible, though rough. Road communications from front to rear consisted of a single lightly metalled road from Chanak to Karaja Veiran. One Infantry Brigade constructed a road from Mal Tepe to Saral Tepe, but, in spite of the large amount of work put into it, it was not an unqualified success.

A good deal of work was done on the European side on the main Maidos-Cham Burnu-Soghanli Dere road. It consisted of digging and cleaning ditches, removing mud and repairing bridges, and no new metalling was attempted. Most of this work was done by the R.G.A.

(6) *Machinery and Electric Light.*—Machinery at Chanak consisted, in September, of :—

(*a*) At Koja Dere pumping station, a steam pump lifting 100,000 gallons a day, and boiler, both belonging to the Turkish Government, but run by the British Army. The pump was in good condition and gave no trouble, but the boiler was a source of constant anxiety, and twice caused a stoppage of some days. On the first occasion it was repaired by the Royal Navy (H.M.S. *Centaur*), and on the second by the R.E. As soon as the cross-country tracks became dry enough, a Rushton-Proctor portable engine was moved out as a stand-by.

(*b*) At the booster pumping-station, a Merryweather Valiant. There were added later :—

(*c*) A saw-bench, run at first by the Rushton-Proctor set and, when that was moved out to the Koja Chai pumping station, by a Blackstone 11-h.p. horizontal oil-engine.

(*d*) Three other Merryweather Valiants. *See* para. 3, sub-para. 5.

Electric lighting in September was *nil.* The following were installed :—

(*a*) At Division Headquarters, Turkish 3-O.K.W. 60-volt portable search-light set, mounted on a limber, feeding 97 points.

(*b*) At Garrison Institute—Lister 3-K.W. 110-volt set, feeding 39 points. This set was no longer required in May, and was dismantled.

A workshop lorry was also used with temporary wiring to provide light for boxing competitions.

(7) *Piers.*—There were originally six piers at Chanak, Nagara Fort Pier, Nagara Pier, Aeroplane Pier, North Pier, General's Pier, and South Pier, and of these only three, Nagara, Acroplane and South Piers, were built out into water sufficiently deep for anything more than a launch or shallow-draught lighter to come alongside. They were all in poor condition, and, in addition to repairs to superstructure, new piles had to be driven at Nagara Fort, Nagara, Aeroplane, and South Piers. Another pier was built under cover of Medjidieh Fort in case of hostilities, consisting of 107 feet of trestle and pile completed by a lighter 146 ft. long, moored at the end ; but even so its head was only in 5 ft. 6 in. of water.

A small pier was also built near Jambaz Dere on the European side. It was constructed of masonry for the first 40 feet from the water's edge, and of piling for the last 15 feet. The roadway was 11 ft. wide, and there was an average depth of 4 ft. 6 in. at the end.

(8) *Transport.*—The Field Company brought with it 1 G.S. wagon and 4 L.G.S., in addition to its tool-carts, water-cart, and mess-cart, and no other transport was permanently allotted to the R.E., except 1 pontoon wagon and 1 G.S. wagon to R.E. Park. Other transport was demanded from the R.A.S.C. as required, and was on the whole adequate, except under any unusual pressure of road work. Sea transport was used between South Pier and Nagara, and between Kilia and various points on the European shore.

(9) *Direct Labour.*—This consisted of two classes :—

(*a*) Civilian subordinates directly employed and paid from the Works' Vote. They included the tradesmen in R.E. Park, carpenters, blacksmiths, fitters, and engine-drivers, averaging 15 in all. The Greeks originally employed were in November frightened by the Turks into wholesale desertion, and their places were taken by Russians, many of them ex-officers of Denikin and Wrangel. Their trade standard was not high, but they were well-behaved, worked hard, and were very satisfactory.

(*b*) Unskilled labour, obtained day by day on indent from the Labour battalion. Though not paid by the R.E., their cost was charged against the Works' Vote. The number employed daily varied from 5 to 50. They were poor workers.

(10) *Contractor's Labour.*—No labour contractor was employed, but a certain amount of work was carried out by contract. The biggest service carried out by contract was the re-metalling of the Nagara road (*see* para. 5), which was done satisfactorily by a contractor from Constantinople. The same contractor carried out the erection of a certain number of Nissen huts on Gallipoli. The only difficulties that arose over his employment were incidents between the Turkish Police and his employees—Armenians.

(11) *R.E. Stores.*—In October and November, R.E. Stores for Kilia and Chanak were all supplied by sea from Constantinople. It was not possible to obtain separate boats from the two places, loading and unloading were always hurried, and it was a matter more of luck than invoicing where the stores were finally landed. Once they were on the shore, Kilia and Chanak used to try to sort out their respective consignments. Soghanli and Sedd el Bahr were supplied mainly from Chanak, entailing two journeys by sea instead of one

THE BASE AT KILIA

274 275 276 277

637

636

CHESHME DERE

CHERLYK DERE

KILIA DERE

KILIA LIMAN

KAKMA DAGH

WELL

RESERVOIR

FOUNTAIN

CEMETERY

86TH FIELD AMBULANCE

21ST STATIONARY HOSPITAL

5 COAST BATTERY R.G.A.

N.A.A.F.I.

RAILWAY DEPOT

121 H.E.C. R.A.S.C.

LABOUR CORPS

ORDNANCE WORKSHOP

ORDNANCE DEPOT

R. FUSILIER BDE. TANKS

BASE SUPPLY DEPOT

POLICE

100 M.T. CO. R.A.S.C.

AREA H.Q.S.

SIGNALS

PUMPING STA.

L.M.G.C.

N.T.O. M.L.O.

NAVAL OFFICERS' QRS.

NATIVE LABOUR HUTS

FUSILIER CAMP

505 S.B. CAMP

AMMUNITION DEPOT

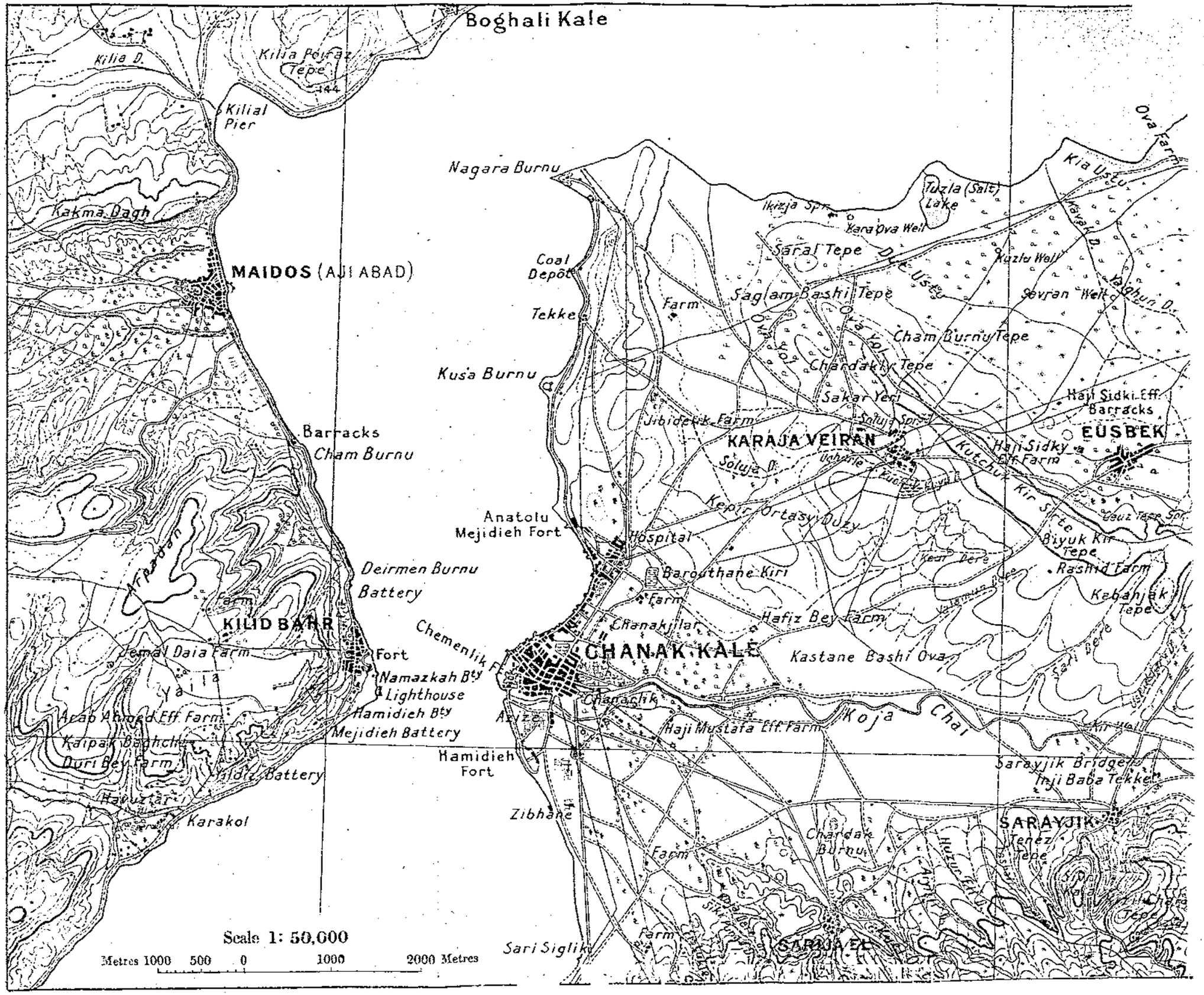
CASUALTY CLEARING STATION

ESKI KEUI

METRES 500 4 3 2 1 0 500

YARDS 600 5 4 3 2 1 0 500

CONTOURS AT 5 METRES V.I.


Boghali Kale
Killia D.
Killia Poiraz Tepe
144
Killial Pier
Nagara Burnu
Kakma Dagh
MAIDOS (AJI ABAD)
Coal Depôt
Tekke
Kusa Burnu
Barracks
Cham Burnu
Anatolu Mejidieh Fort
Deirmen Burnu
Battery
Farm
KILID BAHR
Jemal Daia Farm
Fort
Namazkah Bty
Lighthouse
Hamidieh Bty
Mejidieh Battery
Arap Ahmed Eff Farm
Kaipak Baghchi
Duri Bey Farm
Kilid Battery
Hamidieh Fort
Karakol
Zibhane
Sari Sigliki
Scale 1: 50,000
Metres 1000 500 0 1000 2000 Metres
Tuzla (Salt) Lake
Ikizja Spr.
Yara Ova Well
Saral Tepe
Saglam Bashi Tepe
Farm
Cham Burnu Tepe
Chardakly Tepe
Sakar Yeri
Jibidelik Farm
KARAJA VEIRAN
Soluja Spr.
Soluja D.
Hospital
Kepir Ortasy Duzy
Barouthane Kiri
Farm
Chanakjilar
CHANAK KALE
Chemenlik Fort
Chanaclik
Haji Mustafa Eff Farm
Koja Chai
Kastane Bashi Ova
Hafiz Bey Farm
Ova Farm
Kia Usty
Kavak D.
Yaghun D.
Kuzlu Well
Sevran Well
Haji Sidki Eff. Barracks
EUSBEK
Haji Sidky Eff Farm
Kutchuk Kir Site
Biyuk Kir Tepe
Rashid Farm
Kebanjak Tepe
Saraylik Bridge
Inji Baba Tekke
SARAYJIK
Tenez Tepe
Charda Burnu
Farm
SARIJA EL
Huzur Eff Farm

by land, and consequently were handled four times instead of twice. In the winter storms sea transport by ferry and lighter was most precarious, and stores were frequently carried beyond their destinations or brought back undischarged. In the middle of December, the Officer i/c R.E. Stores moved down to Kilia, and supplied Chanak and Gallipoli direct from there, which was a marked improvement. After April, however, stocks were kept very low, and any large consignment or special stores had to be bought in Constantinople, entailing considerable delay.

The only item procured in any quantity by local purchase was timber. Large supplies of rough scantlings were obtainable locally at very reasonable prices.

PROFESSIONAL NOTES.

USE OF SILICATE OF SODA IN CONCRETE.

AN article in the July number of *The Concrete and Constructional Engineering Journal* calls attention to the use of silicate of soda for hardening the surface and for waterproofing concrete.

There are several forms of silicate of soda on the market, the most common being known as "water-glass."

The forms of silicate of soda in commercial use contain soda (Na_2O) and silica ($Si\,O_2$) in ratios varying between 1 : 4 and 2 : 3.

For the treatment of concrete a silicate of soda with a high proportion of silica, *i.e.*, with three or four parts of silica to one part of soda, should be obtained. Such silicates of soda are called "neutral" or "high-ratio" silicates; water-glass is not one of these.

The general action of silicate of soda on concrete is described as follows:—

> "When a dilute solution of 'neutral' silicate of soda is applied to concrete some absorption occurs according to the degree of porosity of the concrete. The surface of the concrete is thereby hardened and the pores of the concrete are, to some extent, filled. The silicate of soda slowly undergoes chemical changes and insoluble products are formed which act as a permanent filling near the surface and form a dense layer, perhaps $\frac{1}{8}$ to $\frac{1}{4}$ of an inch thick, so that the concrete is more resistant to abrasion and more impervious to water and other liquids."

The silica combines with the lime set free during the setting process of the cement and forms silicate of lime, which is one of the compounds contributing to the strength of cement.

A solution of silicate of soda can be purchased, containing approximately 30 per cent. of silica and 9 per cent. of soda. This should be diluted by adding four volumes of water.

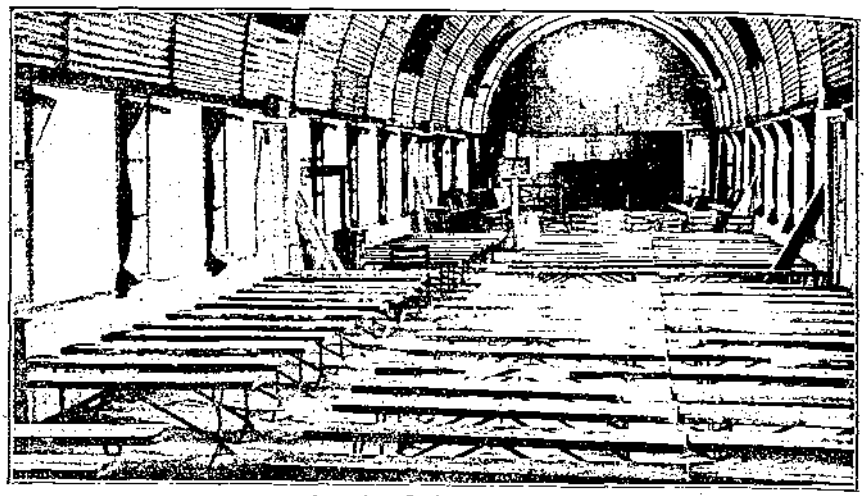
The concrete should be clean, dry, and free from grease before treatment. Three coats of the dilute solution are given, the surface being allowed to dry between each coat.

The solution can be sprinkled through the rose of a watering can and should be brushed over the surface with a soft broom.

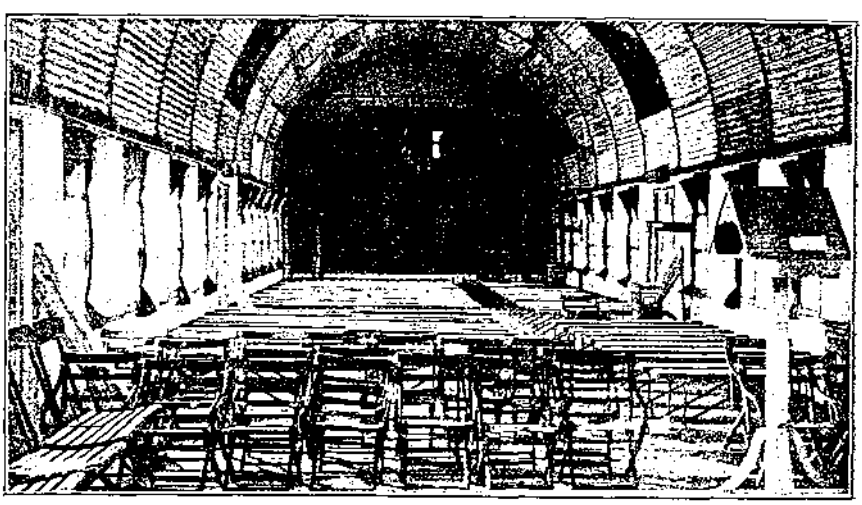
For waterproofing concrete it is recommended that four or five coats be given with a more diluted solution.

Floors and roads treated with silicate of soda have a hard surface and are free from abrasion. Their surface is not rendered slippery.

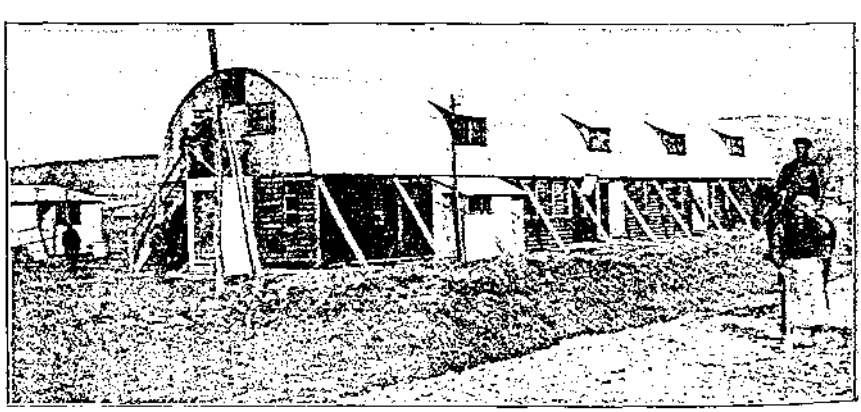
KILIA INSTITUTE.



Interior facing South.



Interior facing North.



Exterior View.

Building blocks may be hardened and rendered denser by pickling in a dilute silicate solution.

The whole process is inexpensive; one gallon of silicate diluted with four gallons of water will cover 1,000 sq. ft. surface with one coat.

D.K.E.

KILIA INSTITUTE.

By Colonel-Commandant A. G. STEVENSON, C.B., C.M.G., D.S.O.

IN December, 1922, instructions were received to construct a hall at Kilia suitable for use as a church, cinema and entertainment hall, with the view of providing some moral and mental stimulus for the troops, who had been living for some time under somewhat trying and depressing climatic conditions.

The following requirements had to be met :—

1. Sufficient height and size to allow cinema pictures to be seen over the heads of men sitting in front.
2. Dressing rooms for concert parties.
3. A screened-off altar and vestry.

As a result of (1) and (2) a level floor was decided on, with a stage at one end and an altar and vestry at the other. It was arranged for the cinema to project its pictures on to the back of a transparent drop, which took the place of the stage curtain.

The available skilled labour at Kilia was busily engaged on other urgent services, so it was decided to make use of units of the Nissen and other portable-type huts. The resulting building is shown in the attached *Photographs*.

In the main it consists of two 60-ft. Nissens superimposed on walls of Malta hospital hutting. The walls were strutted both inside and outside, and each outer strut was enabled to act as a tie, if necessary, by means of two iron straps at the top, which, passing over and down, secured the wall plates. The feet of these struts were also tied down to the transverse bottom bearers, on which the ordinary Nissen floor was laid. Dimensions are :—120 ft. long, 20 ft. wide and 18 ft. to highest point.

Seating accommodation, considered comfortable, is 250 to 300, but the chaplain prefers a congregation of 350 to 400, which he sometimes gets.

Congregations at religious services face north, while audiences at either concerts or cinema performances face south.

The acoustic properties of this somewhat quaint building prove remarkably good.

The work was carried out by the 24th Co., R.E. The M.F.W. was Q.M.S. Fryer, who was partly responsible for the design.

MEMOIRS.

COLONEL CHARLES WILLIAM ROBERT ST. JOHN.

THE many friends of Colonel St. John will be grieved to hear of his sudden death at Simla on 27th June.

Accompanied by his wife, he had gone out to India to pay a visit to his son, and to make the acquaintance of his grandson, whom he had not yet seen; and, in addition, had purposed to visit Mission Stations both in India and China, where he had a large number of friends in connection with both the Church Missionary Society and the China Inland Mission, of which bodies Colonel St. John was a Member of Council.

He was known and beloved by hosts of his brother officers, many of whom had first met him when Assistant Instructor of Survey at the S.M.E., from 1888–93, and in subsequent years many others had enjoyed the genial hospitality of Colonel and Mrs. St. John when stationed at Gibraltar from 1897–1902, and also at Hong Kong from 1909–14, where he was employed as Chief Engineer on becoming a Substantive Colonel, after a term of four years at Belfast as C.R.E.

On leaving China in 1914 he came to England on half-pay, and on the outbreak of the War, in August, 1914, he was sent to France, and subsequently became Chief Engineer at Plymouth to the date of his retirement on August 30th, 1916, having served for nearly 39 years, a bad heart attack preventing his undertaking any further military duty.

He came of a line of soldiers, both his father and grandfather having been Colonels before him.

During his long career he was conspicuous for his sense of justice and perfect uprightness, his unswerving strength of principle being evidenced by the conscientious performance of every duty, seeking in all that he did to do it to the glory of God.

He leaves a widow, a son (Major in R.A.S.C.), and a daughter (the wife of a Naval officer) to whom the sympathies of the Corps will be extended.

J.W.

Lieut. J. W. M. Dickson, R.E.

Photograph by W. Crocker, 103, *Princes Street, Edinburgh*

LIEUT. J. W. M. DICKSON.

THE Corps has lost a most promising and gallant officer by the murder of Lieut. J. W. M. Dickson on the 11th November, 1922, in the Khaisora Valley, North Waziristan.

James White Melville Dickson was born on January the 25th, 1899, at N. Shoebury, the son of Walter George Dickson. He was educated at Bedford and passed into the "Shop" in June, 1917. In his senior term he was a Corporal; he also boxed for the "Shop."

He was commissioned in September, 1918, and joined the S.M.E., where, after two months on the square, he was one of the seven of his batch posted to Signals. After serving in Signal Depôts in England he sailed for India in February, 1920, and was posted to the Signal Depôt at Wellington, whence he was transferred to the Q.V.O. Sappers and Miners at Bangalore in May, 1920.

From that date until his death Dickson was mostly on the frontier. He spent some months with No. 66 Company in the Khyber, returned to Bangalore for a few days and then joined No. 14 Company in Waziristan, in October. After seeing the Wana operations with No. 14 Company, he joined No. 96 Company at Dardoni in February, 1921, being transferred to No. 13 Company, which came up in relief in October of that year.

With No. 13 Company he took part in the advance to Datta Khel in November and December, but went home on five months' leave, rejoining No. 13 Company at Dardoni on the 1st May, just when the Razmak road was being started.

He was the officer selected from the S. and M. Companies to be lent to the M.W.S., for the work of reconnaissance and construction on this remarkable road.

The history of the making of this fine motor road into an enemy country, in advance of the troops, will be found written elsewhere, but the outstanding personalities in this story were three Sapper officers: Major Deed, Lieut. Jefferies, and Dickson, who was killed. Deed and Jefferies received the D.S.O. and M.C. respectively as immediate rewards.

Jefferies and Dickson were in charge of the advanced sections. They went about the country alone in shirt, shorts, *chaplis* and revolver, protected by two or three *badraggas*. They feared nothing, and were taking risks which were only justified by the necessity for rushing on the work.

In December, 1922, the construction had reached the middle of the Khaisora Valley, and Dickson was employed on survey work for the road up the Razmak Pass. He was living then at Tamre Oba, and had just been joined in his sector by a young pioneer officer, Lieut. Bromhead.

About this time the Mahsuds were getting annoyed at the work advancing into their own special country, and one, Musa Khan, an intractable, had already threatened to do something to stop the work. On the 12th December one of his gangs ambushed Dickson and Bromhead in the evening as they were returning to camp, and shot them at a few yards' range. Dickson fell, with a bullet through the chest, Bromhead was hit when pulling Dickson behind a rock, and then Dickson was hit again in the head. The assailants were then driven off by the *badragga* escort, who brought Dickson's body in.

This murder could not be avenged at the moment, but it formed the *casus belli* for the occupation and destruction of the Mahsud stronghold of Makin, which was carried out by two Brigades after Razmak had been reached.

Dickson was of the best type of young Sapper officer. He knew his job, he devoted all his time and thoughts to it, was popular with his brother officers and with his men, whom he drove hard, and was absolutely fearless. He is one more of the gallant fellows the Corps has lost on this turbulent Border.

C.M.W.

BOOKS.

THE DEFENCE OF INDIA.

By "ARTHUR VINCENT." (Humphrey Milford. Oxford University Press, Bombay. Price, Rs 2.)

THIS little book forms the second volume of a series under publication for dealing with the problem of India. We welcome the series as a whole and trust that these books may be read and re-read, not only by ourselves but by the educated Indian, so that the problems that have to be faced may be treated intelligently, courageously and with balanced minds.

The book under review gives a brief but clear exposition of the problem of Imperial Defence in so far as India is concerned. It cannot, therefore, be set aside as one that is only for experts. It affects the whole British Empire. It should form a very wholesome instruction to the people of India, and one which should be carefully considered by them. It may not be pleasant to be told that there is no early prospect of any reduction of expenditure in the cost of the defences and upkeep of military forces in their country, and a necessity for a still further expenditure on Naval defence. It is pointed out, further, that the present small (£100,000) annual contribution of India towards the cost of the British Navy, her first line of defence, is insufficient, and that, owing to the present circumstances, danger of attack, if any, comes from the East. This is realized in England by the necessity for a large expenditure on Singapore which has been recently ventilated in the Press. Such expressions as these—taken from the book—" The centre of gravity of possible naval activity is, therefore, now no longer in European seas, but is in the East and the Pacific," and, " The ultimate goal may be an Indian Fleet, maintained from India and based immediately upon Singapore," need to be taken to heart by Indians themselves.

The book is divided up into chapters dealing with the various frontiers and their respective problems, a large number of the chapters being taken up with the north-western frontier. This has necessitated the much-debated question of the forward policy on the frontier and measures for protection against the Bolshevist being explained, which the author of the book, whom we understand is an officer of the Corps, has treated concisely but clearly and with good common sense. We now hold the main routes for an invading army from the west right up to the Durand line, but these are narrow salients flanked by fanatical, well-armed and still undisciplined tribesmen, who are quite capable of forming a very serious menace to bodies of troops utilizing the valley routes, causing us to deal not only with potential enemies advancing from the west, but with others within our own borders, thus necessitating the distribution of our forces when we should have them all concentrated

at decisive points. The writer is of opinion that in course of time, as a military measure, we shall have to occupy the whole borderland up to the Durand line, and the sooner the better. This is a very large and debated question, involving political as well as military interests. To the military mind there can be no two doubts as to what is right, and by the opening up of forward territories within our "so-called" sphere of influence, by roads, railways, etc., we would be paving the way for far more effective military operations westwards.

This would undoubtedly entail a large outlay and it would be difficult to finance it. At the present time, however, India has to set her own house in order. Internal disputes, constant friction between religious parties, who can never have a common foundation until they construct one for the well-being and welfare of the people, of whatever class and creed, and not for a small selected body of educated Indians and so on, are now hindering progress. It is intended that Indians must realize that, until India can regulate herself and keep law and order within her own border, she must leave her defence in the hands of those who study the subject from the broadest point of view, and accept their decisions, though they may be unpalatable to their minds and expensive.

It is important to bring to light the fact that the tendency of Indian politicians is to complain of the amount voted for military purposes in the Central Budget, which amounts to about 59 per cent. of the total budget. It is considered, however, that the Provincial Budgets should also be included in this assessment, as all must share in the benefit of military protection, in which case the proportion would be reduced to some 30 per cent. In any case, military expenditure brings in a return, as British officers and troops spend their money freely in the country, a large number of Indians are fed and housed by enlisting, and the money expended on the many works services all over the country benefits the Indian tradesman and labourer to a large extent. This is often lost sight of by those who favour a reduced military expenditure.

We cannot conclude without commenting on the inefficiency of the map at the beginning of the book. It gives only a very sketchy outline of the Frontier, but this is probably due to the fact that a really good map would materially affect the cost of production. Readers are, therefore, advised in studying the book to have for reference a really good map.

S.

VAUBAN.

Par DANIEL HALÉVY. (Paris. Grasset. 6·75 francs.)

WE picked up this book with the pleasure of anticipation, expecting to fill a gap in our ignorance, for it struck us, on seeing it in a new book list, that we had read very little about the greatest of French Engineers. Unfortunately, it turns out that very little is recorded about Vauban. The author tells us in the opening pages :—

"This man, whose name is so widespread, what do we know of him? What was his style? What was the tone of his voice? We are entirely ignorant. Vauban is a symbol whose material form escapes us. In

the century in which he moved and proved his genius, Vauban passes by, but is scarcely seen." Apparently none of the diarists mention him.

Later, M. Halévy says :—

"The written work of Vauban is similarly disseminated and unknown. And it will so remain for ever." Practically all that can be found is a mass of correspondence full of technical details :—"From the far end of Catalonia Vauban instructs a contractor, who is building a bastion in Flanders, what wood he is to use for the piles in the foundations ; from the centre of Brittany he directs the contractor, who is fortifying a hill in Savoy, what sand he is to employ for the mortar."

The book, therefore, for the most part, deals with the general history of the period in which Vauban laboured. But a certain amount of biographical detail has been collected, and Vauban himself, in 1700, wrote an *Abrégé* of his services.

Sébastien Le Prestre—the name Vauban is territorial—came of a family of small landed proprietors. He was born 4th May, 1633, in his father's house, in the parish of Bazoches in Morvan. At the age of seventeen he took service under Condé, then in feudal rebellion, as a "Cadet" in the Régiment de Condé. "Having a good knowledge of mathematics and fortification, and not drawing badly," as the *Abrégé* states, Condé employed him as apprentice-engineer on the fortification of Clermont-en-Argonne. and later at the siege of Sainte Menehould. After about two years' service, whilst out riding, he was taken prisoner, and, in the easy manner of those days, transferred his services to his captors. He was sent a second time to the siege of Sainte Menehould, this time to capture his first master, who was invested there. In 1655, at the age of 22, he received a commission as Engineer-in-Ordinary to the King, with Louvois as his chief ; his bravery, rather than his attainments, seems to have brought him to notice. Then comes a long blank. In 1667 we find him accompanying Louis XIV. in his Flanders campaign as his Chief Engineer. Henceforward his life is one of constructing fortresses and besieging them ; in one letter preserved he speaks of "the wandering life that I have led for forty years or more."

In 1703, at the age of seventy, Vauban was created a *Maréchal* of France with nine others ; all of those names, except that of Tallard, famous for his defeat by Marlborough, are unknown. But the promotion practically put him on the shelf. As the King told him, "to take towns is beneath your dignity." The business of a Marshal was to command armies, and there was no army for him.

In this enforced leisure he turned to many plans. One of them was the construction of the La Bassée-Aire-St. Omer Canal, now so well known to the British Army. It was to serve the double purpose of a defence line and a means of communication. The local authorities were afraid that they would have to find the money to construct it, and opposed the project. It was not carried out until 1770.

Another of the activities of his old age brought him into serious trouble. He was of a kindly and benevolent nature and had, in his continual journeying through France, seen the misery of the lower classes, and had, in 1700, gone to the length of personally bringing their down-trodden and over-taxed condition and the malefactions of the *fermiers-généraux*

to the notice of the King. Now in 1706 he was moved to write and print a pamphlet—or, rather, a book—on taxation, which he had long meditated, under the title of *La Dixme Royale*. It advocated that all classes should be taxed, the farming of taxes abolished, and an income tax of one-tenth levied direct for the King. He was too much in advance of his times. The circulation of the book was prohibited and its author narrowly escaped arrest. He died sixteen days after the issue of the decree that condemned his work.

J.E.E.

LA GUERRE EN ACTION, UN COMBAT DE RENCONTRE, NEUFCHÂTEAU (22ND AUGUST, 1914).

By COMMANDANT A. GRASSET, with Preface by GENERAL BUAT. Octavo, with five Plans, of which four are outside the text. Published by Berger-Levrault, Paris, Nancy, Strassburg. Price, 5 francs, net.

AN account of the terrible day on which the Colonial Brigade of Paris held in check the whole 18th German Reserve Corps. Although only one against six, the "Marsouins"* remained masters of the battlefield. Strict historical truth, based on numerous documents, only serves to bring into view the poignancy of the drama, and the heroism of the actors. The complete reconstruction of every phase of the battle, including the action of staffs, companies, batteries, sections, and even of patrols, affords a useful study for officers, and, for the non-professional, an opportunity of realizing the actual emotions of a battle.

A. R. REYNOLDS.

L'ARTILLERIE: CE QU'ELLE A ÉTÉ: CE QU'ELLE EST: CE QU'ELLE DOIT FAIRE.

By General HERR. (Berger-Levrault. Price, 18 francs.)

IN May, 1916, after the defence of Verdun, the writer of this book, General Herr, was appointed by General Pétain to co-ordinate the experiences of the artillery during the defence, and to form for the centre group of the French armies a *Centre d'études d'artillerie* for the mutual instruction of the senior officers of that arm. The idea was taken up by the G.Q.G., and in June the course was thrown open to all the French armies. Later on, in January, 1918, under a new organization, General Herr was appointed Inspector-General of Artillery, and, in addition to the general surveillance of all the artillery in the armies and the command of the general artillery reserve, he was accredited to the Ministries of War, Armaments and Marine, and conducted all questions concerning artillery between the Commander-in-Chief and the Government. He, therefore, writes with authority, but at the same time his book is thoroughly readable and is not too technical to be beyond the interest

* Commandant Grasset, D.S.O., in reply to the Acting Secretary, has very courteously given the following explanation of the word "marsouin":—Le "marsouin" est un cétacé, du genre des phoques (*seals*), qui vit à la fois dans l'eau et sur la terre ferme. C'est pourquoi on a donné depuis longtemps chez nous le nom de "marsouins" aux soldats de l'infanterie coloniale qui vont combattre sur terre ferme dans les colonies lointaines, après avoir traversé les mers.—ED., *R.E.J.*

of officers outside his own arm of the Service. The French, according to General Herr, suffered from possessing an exceptionally good field-gun; they thought it could do everything, and it was sheer good fortune that the war found them ready, at any rate with the designs of heavier pieces for use in the field. Still, he admits that the French never recovered the lost ground and that their guns were always out-ranged by the Germans. They are not likely to make the same mistake again; in fact, we are given a list of eight principal missions of artillery in a future war, almost all of which require special types of artillery weapons. They are the following: (1) guns to accompany infantry—light, shielded, and mechanically drawn; (2) guns for the direct support and protection of infantry—to include a field howitzer, which their divisions have not hitherto possessed; (3) guns for the destruction of the enemy's organized forces; (4) destruction of obstacles; (5) counter-battery; (6) *interdiction* of the approach of the enemy's reinforcements, supplies, etc.; (7) anti-tank; and (8) anti-aircraft. The General thinks that, as the Middle Ages were the era of cavalry, and as infantry has been the queen of the battles of modern times, so artillery has now come to the fore and the next war will find it the principal arm. But its preponderance will be only temporary, until a new arm comes to take its place. Students would find in this book a useful collection of artillery technical words, as, for instance, *régimage*=calibration.

THE PROBLEM OF ARMAMENTS.

A book for every citizen of every country, by ARTHUR G. ENOCK, M.Inst.Mech.E. (Macmillan & Co. Price 6s.).

By the publication in many languages of this book, which contains carefully collected statistics of the cost, waste and destructiveness of armaments, and quotations from speeches on the subject of their restriction, the author hopes to convince his readers of the fallacy of the maxim "If you want peace you must prepare for war." Sir F. B. Maurice is quoted as having said "If you prepare thoroughly and efficiently for war you get war." At the same time it seems to be very difficult to make any practical suggestions on the subject of disarmament. The control and restriction of the manufacture of war-like stores by private firms is a practical suggestion, but it is doubtful if the same can be said of the proposal to form an international fraternity of all chemists, who would interchange their discoveries and so prevent the surprise which might be caused by any nation which possesses a new and exceptionally virulent poison.

SOME MILITARY CONVERSATIONS AND OFFICIAL COMMUNICATIONS IN FRENCH.

Edited by Lt.-Col. J. H. GETTINS, D.S.O., Army Educational Corps (Gale and Polden. Price 3s. net).

The book is arranged for the use of the Sandhurst cadets. The conversations are given in French and there are useful technical vocabularies, English–French and French–English.

F.E.G.S.

MAGAZINES.

MILITÄR WOCHENBLATT.

15th January, 1923.—As was to be expected, the leading article of this number, under the title "Germania sub pondere crescit," deals with the advance of the French into the Ruhr. "With gnashing of teeth one reads the ignominious reports from West and East." That from the East is the occupation of Memel by the Lithuanians, but apart from its mention here the incident is not again referred to. "Spontaneously the hand flies to where our sword used to hang. It grasps at the air: we are weaponless! No war in these days can be waged with flails and hay-forks." And so on, reminding the Germans that this is not the first time that they have slid down into the trough of the wars, but that they have always worked their way out again. The enemy, it says, by his audacious invasion has torn up the peace treaty (the word "Diktat" is invariably used now) and has forced the Germans to a war of liberation. Two allies they claim, right which is on their side, and the interest of world economics. Therefore their right to a revision of the treaty must be proclaimed abroad, while at the same time they prove that this, too, is needed for the sake of the economic situation of the world. "Even to-day the respectable business community on this side and on that side of the sea sees clearly that 'Versailles' was a criminal folly." Only it lacks the conviction that the Germans must be helped. The article ends by preaching the need for co-operation of all parties, requiring the spirit of August, 1914, toned down to a "sober enthusiasm."

General v. Kuhl reviews at considerable length the second and third volumes of *Reminiscences* of Field-Marshal Conrad v. Hötzendorf, the first volume having been reviewed last May, from which the outstanding fact appeared that Conrad was an unconditional believer in a "preventive war" to meet the dangers with which the monarchy was threatened. Vol. II. deals with the years 1910–1912, and Vol. III with 1913, and the first half of 1914. The great value of these books is said to be the reproduction of documents arising from his correspondence with the Foreign Minister and other authoritative personalities.

After dealing with the first and second Balkan wars, the reviewer details at some length the proposals for Italian co-operation with the Triple Alliance in a war with the Triple Entente, which in January, 1913, were said to comprise an advance by 16 Italian divisions from western Italy in the direction of Lyons, and simultaneously a landing on the south coast of France iven local command of the sea. In September, 1913, General Pollio, Italian C.G.S., declared, in conversation with

Conrad and Moltke at the German Grand Manœuvres, that Italy could only place four or five Army corps in the field against France, as the rest were too exhausted by the Libyan campaign; finally, however, he promised to place two cavalry divisions and three, perhaps five, infantry divisions, at disposal for transport through Austria to the German southern flank. In February, 1914, it is said that the King of Italy had given his consent to the dispatch of a force of this strength under the command of General Zuccari to the Rhine in the event of war; the corps were to be ready to move on the 19th day of mobilization. General Count Waldersee was soon, in February, 1914, convinced of the reliability of these promises, and General v. Moltke too repeatedly assured Conrad that he firmly believed in Italy's good faith. Conrad, on the other hand, seems not to have shared this belief, while Count Schlieffen considered the addition of Italian corps on the German left flank on the upper Rhine as an "illusion," nor did he believe in an Italian attack across the Alps against France. The Austrian heir to the throne, Archduke Franz Ferdinand, looked on Italy as the chief enemy and told Conrad that they must win back Venice and Lombardy!

Of greater importance are the reliable data which Conrad gives concerning the agreements with General v. Moltke about operations in the event of a great war. After dealing with the general scheme, with which everyone is now familiar, it is said that Moltke expressed the hope of reaching a decision in the West in three to four weeks, and of then sending strong forces to the East to force a decision there in co-operation with the Austrians. The reviewer admits that this was an optimistic view. In any case, in the early part of 1914 the Germans undertook to employ 12 "and perhaps more" divisions in East Prussia, and contemplated the addition to that force of further troops (2nd line) soon after the opening of hostilities. But all the negotiations tend to show that the German G.S. only met Conrad's wishes for the strengthening of the Eastern force with reluctance. In May, 1914, at a Conference at Karlsbad, Moltke declared that they hoped "in six weeks from the beginning of mobilization" to have polished off France, or at least to have got on so far that they could transfer their main forces to the East. The reviewer then says that the impression is not to be avoided that a great deal was promised to Austria Hungary by Germany, and then proceeds to show that the former were unwise in expecting so much and therefore should not have risked the offensive in Galicia.

1st February, 1923.—The 24th January being the anniversary of Frederick the Great's birthday, General Ludendorff contributes an article entitled "Echoes on Frederick's Day." He reminds his readers that before the war this day was celebrated only in military circles in Berlin; speeches were delivered dealing with his battles and wars. "This was not enough. . . . Certainly the old Fritz was a popular king, people had some notion of his greatness, but they did not understand how to educate a people after his model, and to show them with what heroism and moral grandeur this great monarch, commander and man, with his heroic host and his Prussian people, withstood the assaults of the world in a seven years' struggle, and what circumstances alone contributed to his salvation, in order to prepare them for the

coming war in which Germany would have to preserve its life in face of the enemy's will to destroy, just as the king preserved his country's life after the second Silesian War." After this exhausting sentence, Ludendorff proceeds to show that ever since 1870 they knew this decisive war was coming, but Prussianism was more and more withdrawing into the background, and the general opinion was that the country must just hold what it had got. From this sprang the thought that a less effort was required than for the achievement of definite aims.

" This dangerous fallacy, combined with our pacifistic, international, thoroughly un-Prussian way of thinking, finally produced the result that our armed forces fell far below what was possible, and false ideas about our strength and about the nature of the coming war took firm hold of the whole nation, even though Bismarck's policy of alliances had been given up." Thus, presumably, Ludendorff sets out to prove that the war was lost by lack of statesmanship before it was begun.

After quoting a Chinese sage on the lack of adequate preparation for war, he then turns to Frederick the Great's action after the second Silesian war, bringing his army up to an unprecedented height of efficiency. Then follow the seven years, " a heroic epoch with the king as hero," and we are treated to quotations from Frederick's reports after various disastrous battles, where his situation goes from bad to worse till at last the Empress of Russia dies and her successor makes an alliance with Frederick and Prussia is saved.

After the war Ludendorff observes that the King's policy for the reconstruction of his country was not " the art of the possible " but " the art of dealing with all suitable means always in conformity with his own interests " ; he then recounts the blessings which Frederick bestowed: selfless work, self-discipline, willingness for sacrifice, orderliness and so on. He was the protector of German princelings ; Bavaria he saved from the oppression of Austria ; his princes' league was the forerunner of the empire of 1871. After the collapse of 1806–07 it was the memory of the " hero-king " that inspired Prussia to her resurrection. And so he comes to the point of the article, urging his countrymen to recollect and imitate the great qualities which were, he says, inspired in the German nation by Frederick, and to work for the preservation of Prussia. " Without a strong Prussia as leading power there can be no veritable Germany."

15th February, 1923.—Mr. Lloyd George's articles in the papers have incited the *M.W.B.* to the publication under the title, " The Best Army in the World," of a lengthy attempt to prove Germany's innocence in the matter of the Great War. The writer says that Mr. Lloyd George recognizes as the cause of the world misfortunes of to-day—since Germany's disarmament—the utterly unjustified, exaggerated armament of France and her efforts at the hegemony of Europe. But at the same time Mr. Lloyd George seeks to impute the cause of the outbreak of the Great War to the existence of the German Army of 1914, according to Foch the best army which the world has ever seen. The writer first observes that Foch's dictum about the German army, " no matter how absolutely correct it is," was only pronounced after the outbreak of war. Before the war they thought otherwise in France, and quotations are

given in support from the writings of the French colonel, Boucher. "Kaiser William II.'s love of peace after 'Morocco' and other political transactions was exposed in the French press as fear, which the *Temps* converted into the oft-repeated form—'*Guillaume a peur, il a simplement peur.*'" The Belgian ambassador in Paris is then quoted as labelling the French as chauvinistic, and saying that people are to be met (in March, 1913) who assure one that an early war with Germany is unavoidable. The same ambassador is quoted twice more with even less effect, and then the writer says: "It is remarkable, from the point of view of the world's history, that the same ambassador, shortly before the outbreak of war, *at a time when no man in Germany—politician or soldier—even remotely thought of war*, made report . . . ." and then follows the quotation to the effect that in France those people, experts, who, two years previously, evinced lively fear at the mere mention of possible difficulties between France and Germany, now adopt a different tone; they assert that they are sure of victory, and that the French Army can hold the Germans in check till Russia has mobilized and is ready to concentrate her troops for an attack on her western opponent. The above italics do not appear in the *M.W.B.*

The writer then quotes the Russian ambassador in London as saying in February, 1913, that all the powers are striving for the maintenance of peace, but that France is the one that would most philosophically go to war, due to complete confidence in her Army.

The Anglo-French naval agreement secured the transport of the French Colonial Army. A "French statesman" is then quoted as saying that the French artillery would soon silence the German. In the French Army before the war they believed not only in the admitted, but much exaggerated, superiority of the French field-gun, but also—after the Napoleonic example—in the superiority of the French soldier, his "*élan*," and his superior aptitude for the conduct of modern war. "The bitter experiences of war have then taught the French politicians and military leaders, including Mr. Foch." The same French statesman is then quoted as declaring that the participation of the English was actually settled down to the smallest details, though no written agreement existed, just as though a treaty had been concluded between the two countries; he is quoted as even giving the ports of disembarkation in France. So when Mr. Lloyd George says that "no country can withstand attempting an easy triumph which has been offered for two generations," the writer remarks that with regard to that he has proved to any unprejudiced observer that this can only be laid at the door of France, Russia and England, who likewise believed in a quick victory by the superior forces. On the other hand, responsible military and political circles in Germany, while convinced of the superior quality of their own army over the French or Russian, were well aware of their considerable numerical inferiority!

The writer then takes up Mr. Lloyd George's statement that fleets are by their nature means of defence, and alone can never conquer a country or seize its capital. Why, then, he says, did the English before the war always regard the German fleet as the greatest danger of attack? How is it that England to-day possesses a colonial empire, the like of

which the world has never seen, with which neither the ancient Roman, nor the empire of Charles V., on which the sun never set, can compare? He says that Blake and Nelson would turn in their graves if they heard the assertion that the English fleet had become a means of defence. A speech of Lord Lee of Fareham's on 2nd February, '05, is then quoted, when he says that he hopes that in case of danger the British fleet will be in the position to get in the first blow, even before the other power is aware that war has been declared. "That is the nature of the English defensive fleet"!

Further on the writer says, "It was just the regrettable fate of the political situation of the world in 1914 that the English statesmen, through Edward VII.'s policy, had been directed into false channels, had forsaken the old clear lines of English policy and believed and feared Germany's designs on the political and economic hegemony of the world." The French book, *La guerre qui vient*, published in 1911, is then quoted to show that the economic struggle between England and Germany had inevitably to lead to war, and as an American has said, "The war was not made in Germany, but the 'Made in Germany' was the cause of the war."

French imperialism and Russian chauvinism were strengthened by the Entente; by it England placed herself in the hands of the most turbulent and most ambitious powers of Europe! Finally, it was the panslavistic politicians on the Neva (Sassanow, Iswolski) who put the match to the powder barrel, "and no really great statesman was available, who could still arrest the dire fate of Europe." Anyway, concludes the writer, the 'best army in the world' was not to blame.

This wonderful composition is, then, to teach the English statesmen a lesson. After four frightful years of war and four similarly bitter years of peace, England's world power, thanks to English statesmen, has suffered heavy loss through the treaty of Versailles. France is now the ruler of Europe! Changes in the means whereby war is waged took place during the Great War, and the "frightful effect" of these changes, in spite of the strongest of fleets, signifies the abolition of England's insular unassailability!

France, by Germany having been rendered defenceless, has been given liberty "to pursue unhindered her imperialist and militarist aims of the hegemony of Europe and the world, in both a military and an economic sense."

Mr. Lloyd George's Versailles policy of the "knock-out," which lacked any trait of great statesmanship, is now bearing its sorry fruit to the harm of England and of the whole world. Poincaré is once again *en marche*!

1st March, 1923.—The leading article of this issue reviews Dewar and Boraston's book, *Sir Douglas Haig's Command*. After observing that the book has attracted the greatest attention in the military and political world of the Allies, the reviewer proceeds to state that the object of the book is to prove that the military genius of the English commander-in-chief and the high fighting value of the British troops were responsible for turning the decision in favour of the Allies in all the most difficult situations on the Western front, and finally brought about the victory

over the German Army. The reviewer then quotes a number of facts disclosed by the book, but without comment. He says that the French in general come badly out of the story, whereas the Americans gain a better verdict. "The performances of the German Armies and of their leaders—particularly Ludendorff—meet with high recognition." He notes with satisfaction that the British losses from March, 1918, to August, 1918, and the German losses from the latter date to the Armistice were approximately the same, *viz.*, about 350,000. The difficulties existing between the Government and G.H.Q. are then referred to, concluding with the remark that Lloyd George only believed in one military genius, namely, Marshal Foch.

"History will assuredly not count Field-Marshal Haig as among the greatest commanders, in spite of the military deeds and successes depicted and made conspicuous in this interesting book. . . . He fought numerous battles with great superiority, particularly in *matériel*, and nearly reached a final success, as in Flanders and at Cambrai; but he did not understand how it was to be consummated and exploited." The battles of attrition of 1916 and 1917, he says, can only be designated as "ordinary victories," to use a phrase of Schlieffen's. "That a great success in a similar situation was possible is proved by the German offensives of 1918. If, nevertheless, the English Army under Haig's leadership was destined to wrest great successes in the autumn of 1918 from the German Army, which was no longer fully fit for fighting, the reason is not to be found in the superior genius for leadership of Field-Marshal Haig, but in other well-known causes." And the reviewer leaves it at that.

E.G.W.

HEERESTECHNIK.

(May and June, 1923, numbers.)

THE *pièce de résistance* of the official parts of these two numbers is the continuation of Capt. Justrow's treatise on the theoretical conditions affecting the life of barrels—gun, trench mortar, rifle and pistol—and the effect of wear on fire control. By this time the treatise has appeared separately in print and has been added to the Corps Library. The two portions in question are condensed mathematical investigations illustrated by Formula and Table. Extracts would be meaningless.

Doctor G. Lechner contributes an article on "stops" in field-glasses and telescopes generally. He shows where, in different combinations, these stops should be placed, in order to cut out both reflected light and all such rays as do not contribute usefully to the required image.

A short official statement explains a "simplified book- or ledger-keeping" now being introduced. It is on the "Tally" or "Stock" card principle, without separate "credit" and "debit" sides, and giving the balance in hand after addition or subtraction from the previous total. The headings are given along the top of the page over vertical columns. No periodical "closings" are required and it is claimed that ledger-keeping is much simplified thereby.

New Army Manuals are also explained and reasons are given for dividing them up under technical headings instead of into manuals for the different arms. The different manuals deal with training, equipment, technical stores, supply, repair, ammunition, and musketry and have their distinctive colouring. Private enterprise is to be left a free hand in the provision of small handbooks for each arm. A multitude of such books of semi-official nature had appeared in Germany before the war, and it is considered that they do good service if they are not used merely as a short cut for the mentally indolent. The preparation of these manuals has been a matter of great difficulty, much of which is attributed to the inter-Allied Military Commission of Control.

Major Klingbeil—evidently an engineer of varied experience in fortification, for his name is becoming associated with different aspects of the question—contributes an article on reinforced concrete in permanent and semi-permanent fortification.

After a short historical *résumé*, he concludes that concrete (not reinforced) is unsatisfactory, because of its tendency to break and disintegrate, mainly on account of the shattering effect of a shell bursting after partial penetration. Large masses of concrete are naturally built up in sections and weakness follows between layers.

The use of reinforced concrete is dealt with historically, beginning with the patents of a resourceful Parisian market-gardener. Major Klingbeil is an enthusiastic advocate of the tensile strength and impenetrability of reinforced concrete, and he attributes the fall of the Belgian Forts (so constructed) to errors of design and execution.

For example, he states that a heavy howitzer shell entering a lightly-protected cistern penetrated an equally inefficient retaining wall and exploded in the main shelter of a fort, killing all therein. This shelter was itself sufficiently protected against a direct hit. His criticism of the Belgian fortresses of Liége, Antwerp and Namur is extended to the inadequacy of covering fire arranged over the gaps between the forts, and the editor is thus enabled to remark, in a footnote, on the illegal action of Belgian civilians in joining in the defence of these gaps against a "Völkerrechtlich?" invasion.

Major von Kretzschmann continues his article on the tactical use of railways on the western front. His information is drawn in the main from articles which appeared in the *Verkehrstechnische Woche* from the pen of Professor Blum. The relative advantages of 60 cm. and 1-metre gauges are discussed historically, but there is nothing either informative or peculiarly interesting to note.

Lieut. Balck has interesting opinions to offer on infantry armament. He gives in detail the various weapons carried at the close of the war, and comes to the following conclusions:—The rifle should be an automatic loader, of smaller calibre than their existing pattern, and capable of single or of automatic fire. It should be sighted from 75 metres to 800 metres and its use not contemplated beyond that range. A bayonet, to turn up and down (like an Italian Cavalry carbine pattern), a spade with a sharpened edge, and a light automatic pistol complete the author's idea of equipment for a hand-to-hand combat. The present pattern of light machine-gun he dislikes as too heavy, too intricate, and too flat

in trajectory. He has distinct leanings towards the Lewis gun. As a light machine-gun can be of no anti-tank value, he desires a small calibre to match his ideal rifle, whilst he wants three anti-tank heavy rifles per platoon. The heavy machine-gun should not be included in the company, principally on the score of the ammunition supply difficulty. He would keep hand and rifle grenades, but scrap the heavy automatic and long pistols and the grenade thrower.

The editor states that he cannot go all the way with Lieut. Balck, especially in limiting the range of the rifle to 800 metres.

Capt. Berschmann discusses the relative merits of caterpillar and wheel for mechanicalized artillery. He is of opinion that caterpillar traction is too slow for divisional artillery and suitable only for super-heavies and for guns dedicated to the close support of infantry. The presence of the good and numerous roads in Germany no doubt influences his opinion—and he states that if it were not for the time necessary for fitting the wheels for cross-country work before leaving the roads, wheels are superior in most ways. He also discusses the question of guns carried in or mounted on motor-waggons or carriages, and condemns them as inferior in every respect to the motor limber principle.

Lieut.-General von Schwarte begins a description of the assault on Nowo Gieorgiewsk. He points out that the operation was undertaken with Ersatz-Landwehr and Landsturm battalions. The fortress itself was a modern and well-designed one and had been improved during the early war period. Modern and well-designed field fortification filled the intervals between forts and between the three definite defensive lines. The northern front was selected for the attack, but no advance was possible before the advance of the Gallwitz Army, on the left, gave room for the necessary deployment. The field artillery available was mainly armed with the old 9-cm. or with captured Russian guns, and the heavy artillery allotted consisted of 17 Batteries (11 heavy howitzer, 2 mortar, and 2 high-velocity). This included, however, five 40-cm. and nine 30·5 howitzers and one 15-cm. gun.

Position immediately facing the Russian front line was taken on the 8th of August. The attack began on the 13th. After two hours' ranging and registration, fire for effect was opened at 10 a.m. and three hours later the infantry advance began and was carried forward successfully, but with severe casualties, up to 1,000 yards from the outer range of forts. On the 14th, fire on the forts themselves was opened, and good observation from balloons contributed to its success. The German flying corps brought intelligence of three lines of obstacles, continuous along the whole front—and here the story breaks off temporarily.

The concluding articles of both numbers are the beginnings of the history of a "*Vermessungs-Abteilung*," or field Survey Company, on the Russian and Roumanian fronts. The author seems to have had much to do and little to do it with.

He mentions his joy at finding printing machinery in Warsaw and, on appropriating it for the cause, does not seem to have invoked the severe rebukes which some of us incurred under similar circumstances.

It appears that transport was wholly lacking at first, and, of course,

it soon became apparent that a mapping unit was of little value if it could not get there to map.

The interesting point of the articles is the mention of the transport of maps to the Roumanian Front by aeroplane from Vienna.

H.ST.J.L.W.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(*Nos. 5 to 7 of 1923 inclusive.*)

THE account of the operations of the Belgian Army during the Great War, 1914–18, is continued in Nos. 5 and 7 of the issue for the current year. In response to the urgent representations of King Albert and his Ministers for assistance, the Marine Brigade, R.N.D., which had been landed at Dunkirk on September 20th, was the first of the British reinforcements to be sent into Antwerp; on arrival there on the evening of October 3rd it was at once attached to the Belgian 5th Division. The Brigade was ordered to push forward to the neighbourhood of Lierre and to take over the trenches held by the 1st Brigade Mixte on the Nethe. Although the Belgian High Command was glad to utilize the Marine Brigade for the purpose of reinforcing the Sector of the Antwerp defences which was weakest, the *Conseil de Défense Nationale* was too fully cognizant of the true position of affairs to be deceived into thinking that the small addition of 2016 rifles and 12 machine-guns to the Belgian garrison could materially delay the advance of the Germans then attacking the southern Sectors of the *place forte*; particularly in view of the fact that the enemy was being continually reinforced by fresh troops from Germany. The presence of even a handful of British troops no doubt had an important moral effect; at the same time, there is no disguising the fact that the arrival of the British Marines in Antwerp caused a little embarrassment to King Albert and his Staff, tending, as it did, to interfere at a late hour with their plans. The King had two contending factions to deal with; those who favoured an immediate evacuation of Antwerp and those who held firmly to the tradition that the continued existence of the Kingdom of Belgium was indissolubly tied up with the fate of the famous Belgian citadel, and therefore urged that a final stand should be made by the whole Belgian Army along the ramparts of the old city on the Scheldt. The Germans apparently expected that this age-long tradition would definitely determine the course of events, and that they would thus be able to entrap the whole of the Belgian forces. A surprise was, however, in store for them. The views of King Albert were perfectly sound, and he intended that the Belgian Field Army should not tarry too long in the vicinity of the fortress, and took measures which, while they enabled the Field Army to put up a vigorous defence under the guns of the detached forts, at the same time secured the withdrawal of the mobile divisions sufficiently early to ensure that they should join up with the Franco-British forces which were racing to reach the Belgian coast. Fortunately, the Belgian King did not allow himself to be turned from carrying out his own plans by the various promises made to him that reinforcements would be sent to succour the Belgian Army. Attention is called in the original article

to the fact that a large number of Territorial Divisions, which could safely have been utilized for a defensive war in Belgium, were timorously retained in the British Isles. On the other hand, the Germans boldly took risks and began almost at once to weaken their forces in Alsace and Lorraine with a view to reaching the Belgian coast quickly, in connection with their great outflanking movement (" the race for the sea "), and, having better railway communications at their disposal than those available to the Entente Powers in the coastal regions of France and Belgium, nearly succeeded in their purpose. The exhibition of equal courage in the matter of the transfer of the British Territorial Divisions to Belgium could not but have proved most advantageous to the Entente armies, and, *prima facie*, there seems to be some justification for the view that the British Government failed to show sufficient enterprise in connection with the utilization, at this juncture, of its second-line troops.

Questions affecting the rôle of artillery in a modern war are dealt with in Nos. 5 and 6 of the *Bulletin*. In the article in No. 5, Colonel A. E. P. M. Nuyten analyses and examines the experiences of the Great War in relation to the employment of artillery. The pre-war formula, he points out, postulated that " artillery no longer prepares attacks, it supports them." The practice in the Great War did not conform with the theory embodied in the foregoing formula ; on the contrary, it was conclusively proved that " artillery, *under centralized control*, must, in the offensive, undertake to facilitate and protect, by indirect action, *the attacks of the infantry* ; it must, at the same time, *prepare these attacks*, and, in particularly difficult circumstances, when called upon, the artillery must, so far as it is possible to do so, open the way for the infantry advance." Recent regulations on the employment of artillery issued in France and Germany are discussed in the original article, which will well repay any time spent on the study of its contents. The article in No. 6 of the *Bulletin* is from the pen of General Hellebaut, who writes to clear up certain points in relation to his article on " The Rôle of a Division in War," which appeared in the number of the *Bulletin* for July, 1922. The General favours the employment of artillery in mass and, to some extent disagrees with the views of certain junior artillery officers who advocate the employment of group formations of artillery acting in close *liaison* with the infantry.

The question : " Is Cavalry necessary ? " is discussed in Nos. 5 to 7 of the issue for the current year. The author of the original articles, Major A. E. M. Peteau, sets out to confute the suggestion that the cavalry failed in its rôle in the Great War. Cavalry enthusiasts had, in the years preceding the Great Conflict of 1914–18, built up a theory that a modern war would open with great combats *à l'arme blanche* between large cavalry masses, combats which would quickly determine the whole future of a campaign and at once decide as to the side to which victory would ultimately fall. There was, needless to say, nothing recorded in military history to justify conclusions of the kind alluded to. Disappointment has undoubtedly been occasioned in some quarters that the cavalry did not play the part predicted for it by theorists, and it would seem that irritation exists by reason of the fact that it was the voices of false prophets that made themselves most

loudly heard on the subject of the rôle of cavalry in a modern war. Other false prophets there are now who, since the conclusion of the Great War, have been proclaiming that, in view of the trend of modern inventions, which enable an army to utilize aeroplanes, wireless telegraphy, armoured cars, tanks, motor-buses, cycles, railways, etc., for its own purposes on a very considerable scale, the cavalry arm has become redundant and should be suppressed. Major Peteau cites many instances in which cavalry played its distinctive rôle, and did useful and valuable work in Belgium, France, Italy, Macedonia and Palestine, and puts forward a very able argument for the retention of cavalry as an arm, although he is not prepared always to concede to the *new mechanisms* their true and proper value. The actual position of affairs is, of course, that many of the duties falling to the lot of the cavalry soldier can now be more rapidly and efficiently carried out by a skilful use of the new machine-equipped arms, and to this extent cavalry does not now occupy in an army a position of the same importance that it did half a century ago, but this, relatively, is also true in the case of the infantry. As in the ordinary business affairs of the world, so also is it in the case of armies, the technically trained man and his appliances are by degrees acquiring a dominant position in the situation; in the one case, in connection with the winning of supremacy in industry and commerce, and, in the other, in connection with the winning of victory in a conflict of arms. This does not, however, mean that an army can do without cavalry altogether, any more than that it can do without infantry; the situation is to be met rather by reconsidering what is the rôle that each of the older arms can most effectively play in the battle zone in combination with the *new mechanisms*, which are in no way rivals, but rather friendly companions of cavalry and infantry, and can, by complementary action, add enormously to the chances of obtaining success in a common cause, much in the same way that the older technical arms have, since their existence, augmented the offensive and defensive power of an army. Major Peteau examines closely into the causes of the failure of the cavalry to fulfil expectations and deals comprehensively with the present-day rôle of cavalry.

Capt.-Commandant A. E. M. Rootsaert contributes an article on Bridging to No. 5 of the *Bulletin*; it is based on contributions on the subject contained in various numbers of this Journal, the British official publication, *Bridging—Provisional*, 1921, the American *Military Engineer* (Sept.-Oct., 1921) and the *Revue du Génie* (March, 1923). A brief description is given of the British bridging equipment and attention is called to certain experiments carried out in the U.S.A. with a view to testing out the relative merits of aluminium, steel and wood as materials for the construction of pontoons. The results of the experiments are tabulated under fifteen heads, *e.g.*, weight, buoyancy, maintenance, cost, etc.; aluminium and wood possess the maximum of advantages and disadvantages.

Very little information has been published, except in Germany, as to the part played by Russia in the Great War. General J. Daniloff, who was Deputy Chief of the Russian General Staff for the five years preceding the outbreak of war, and later held important positions in the

field, contributes an interesting article to No. 6 of the *Bulletin* (accompanied by three sketch maps) dealing with the strategic deployment of the Russian Army and its initial operations. Owing to the alliance entered into between France and Russia in 1899, the officers of the General Staffs of the two armies met periodically to discuss the proposed plan of operations in the event of a European War and to amend it as required, owing to changes in the strategical situation. General Daniloff points out that the coolness which arose in 1906–1907 between Italy and the Central Powers was all to the advantage of France; on the other hand, with the progress of time, so far as Russia was concerned, the situation, for various reasons, became more and more complex. The General recognizes that, theoretically, the western salient of the Polish frontier was strategically advantageous to Russia, but, he points out, it was not possible to obtain the full benefit of this geographical configuration; first, because the mobilization of the Russian Army could not be effected as rapidly as that of the German and Austro-Hungarian Armies, and secondly, because the possibility, remote though it was, existed that Germany might attempt first to crush Russia before throwing her main weight against France. In such an event it was probable that, while Austro-Hungarian forces struck from Galicia in the direction of Brest Litovsk, German forces would simultaneously advance from East Prussia in the direction of Bielostock. It was felt by the Russian General Staff that in the event of a double offensive launched from Galicia and East Prussia, immediately on the declaration of war, a Russian force in the Polish salient would be placed in a perilous position during the initial stages of its mobilization and concentration. Consequently, it was, in 1910, decided to withdraw the part of the Russian Army stationed in peace time in the Polish salient to a line further to the east: the adoption of this course had the effect of leaving the Russian fortresses on the middle Vistula, the Bug and the Narew "in the air," and led to the situation being closely reviewed. It was fully recognized by the Russian General Staff that, in view of the proximity of certain important centres of German industry to the French frontier and the fact that France would be ready to strike earlier than Russia, and almost as soon as Germany, it was highly probable that the Kaiser's main armies would, in the first instance, concentrate against their western foe. The Teuton General Staff, needless to say, took measures with a view to keeping Russia in ignorance and in doubt as to the course intended to be adopted; however, the steps taken in connection with the strengthening of Germany's western defences and the railway developments on her western borders did not pass unnoticed in Russia, and fairly correct conclusions were reached by the Russian General Staff regarding the German plan of campaign, as it actually was opened. The French General Staff was naturally desirous that offensives should be launched simultaneously from the West and the East against Germany, but this was out of the question, and the Russian General Staff made it quite clear to their Allies that the Russian Army could not possibly undertake any offensive operations until the 15th day of its mobilization. Before the outbreak of the war, Russia possessed 37 Army Corps, but of these it was expected that 28 alone could be

concentrated on the Western frontiers of Russia within the first three or four weeks from the date upon which orders to mobilize were given. The nine remaining Corps were, in peace-time, stationed in Siberia, Turkestan and Transcaucasia, and it was not likely that they could be available for operations against Germany and Austro-Hungary under a couple of months. In preparing her plan of campaign, Russia had not alone to concentrate her attention on Germany and Austro-Hungary, but she was obliged to take into account (i) the possibility of having to meet a Swedish attack in Finland; (ii) the probability of Turkey espousing the cause of the Central Powers, either on the outbreak of war or almost immediately thereafter; and (iii) the uncertainty as to the side with which Roumania would throw in her lot—at one time the Roumanians were distinctly hostile to Russia. Further, so far as Germany was concerned, there was always the possibility that, in addition to an advance on land in East Prussia, the German General Staff would take advantage of the superiority of the German Navy over the Russian Navy in the Baltic to effect the landing of a German force on the shores of Russia's Baltic Provinces. To meet the foregoing situation, the Russian 6th Army was, in the first instance, placed in observation of Sweden and the Baltic shores, while the Russian 7th Army took up a position in the South to keep a watch on Roumania and the shores of the Black Sea. For the main operations against Austro-Hungary and Germany two independent commands were formed, namely, that on the "South-Western front" which was given to General Ivanoff, and that on the "North-Western front" under General Gilinsky. General Ivanoff had two groups of Armies under him; one, consisting of the 4th and 5th Armies (seven Corps), was formed up south of the line Lublin–Kholm, while the other, consisting of the 3rd and 8th Armies (nine Corps), took up their initial position on the line Rovno–Proskurof. The objective assigned to General Ivanoff's Armies was to defeat the Austro-Hungarian Armies deploying in Galicia and to seize the mountain passes giving access to the plains of Hungary. The main attack was to be delivered by the 3rd and 8th Armies, and, in consequence, a special effort was made to get them ready to start operations at as early a date as possible. General Gilinsky had under his command the 1st Army (Rennekampf; eight Corps) and the 2nd Army (Samsonoff; five Corps); the 1st Army was deployed on the middle Niemen, while the 2nd Army took up a position along the Narew and Bobr. These two Armies had assigned to them the common objective of defeating the German forces in East Prussia. The 1st Army was to advance to the north of the Masurian Lakes, while the 2nd Army was to invade East Prussia from a line permitting it to advance in a north-westerly direction, so as to leave the Lake District on its right flank. Of Russia's 28 Army Corps mobilized on her western frontier, 20 were initially placed north of the Pripet and 8 only (3rd and 8th Armies) were south of this river.

When war was declared, the intelligence received at the Russian G.H.Q. indicated that the German II Corps (Stettin), the V Corps (Posen) and the VI Corps (Breslau) were proceeding westward by train, and it was accordingly assumed that the Germans did not intend to effect a landing on Russia's Baltic coast line; it was further ascertained that, in addition

to these three German Army Corps, Russia would initially only have certain reserve, landwehr and formations to deal with. This intelligence led to certain modifications being made in connection with the dispositions of the troops told off for observation purposes, and a 9th Army was formed; it was concentrated near Warsaw and, southward of its position, a strong bridge-head was hastily constructed on the left bank of the Vistula covering Ivangorod. Among the tasks allotted to the 9th Army was that of securing the routes leading to the Vistula, on the front Cracow–Posen. On the eighteenth day of the Russian mobilization (August 17th), the main body of the Russian 1st Army crossed into East Prussia and three days later advanced troops of the Russian 3rd and 8th Armies entered Austria-Hungary.

W.A.J.O'M.

THE MILITARY ENGINEER.

The Military Engineer, published bi-monthly in Washington, is the Journal of the Society of American Military Engineers. Price 75 cents per copy.

Attractively produced and well illustrated, it contains, in addition to military matter, many items of general engineering interest and evidently enjoys a considerable circulation.

Its list of advertisers numbers over two hundred, and includes some of the leading engineering and contracting firms in the country.

In the May—June, 1923, number, Colonel B. O. Johnson, formerly of the Russian Railway Service Corps, contributes an account of the exploits of a party of American engineers who, in April, 1918, were sent to assist in the reorganization of the Trans-Siberian Railway. Their experiences under Soviet régime and their handling of 300,000 German and Austrian prisoners of war, who seized rolling stock and started a repatriation movement of their own, are well worth reading.

"Flood Control," "The Destructive Effect of Marine Borers," and "The Revetment of River Banks with Reinforced Concrete Mats," contain up-to-date matter on subjects which directly concern American Military Engineers.

"The War-Time Control of Industry" has recently received much attention. Two further articles are included in this issue.

Under the heading of "Psycho-Physiology and Military Training," Captain Gillette, Corps of Engineers, favourably contrasts the British system of elementary training with that in force in the American Army.

Other articles include "Air Service and the Corps of Engineers," "Preparation and Distribution of Maps," and "The Crossing of the James River, in 1864."

Space is allotted to news of the Society of American Military Engineers, the National Guard, The Organized Reserves, and to the usual Correspondence.

July—August.—"The Service of Military Roads in France," by Lt.-Col. Durham, describes the French national highway system and the methods of co-ordination adopted by the various Allied road services. Washington prepared an elaborate road scheme for the A.E.F., but,

as a result of the military situation on its arrival, the bulk of the personnel was drafted into fighting units. The Force made good its road damage, estimated at 1,000,000 cubic metres, before leaving.

Major Kirby contributes a second article on "Army Map Reproduction in France." In addition to its base reproduction plant at Langres, the A.E.F. assembled mobile topographical trains, a section consisting of four lorries, carrying one large rotary lithographic press with accessory plant. These sections proved very useful in following up the advance, and were loaned to the French and British. A complete train of forty lorries was tried after the Armistice with equal success. This is still in use with the Eighth Corps at Texas.

Maj.-Gen. Farnsworth, Chief of Infantry, outlines the characteristics of modern infantry, with special reference to the co-operation of Engineers.

Other items include a description of the American tanks, a design for a temporary suspension bridge, and a study of tidal action on coasts and in estuaries.

Correspondence indicates that pacifism is still proving an obstacle to recruiting.

R.I.M.

REVUE MILITAIRE GÉNÉRALE.

(*March*, 1923.)—*The Army General Organization Bill.* By Lieut.-Colonel de Thomasson.—The bases of military organization in France are the three Acts regulating recruiting, general organization, and cadres and effectives. The first has recently been passed, after many delays; the second, the subject of this Article, has only just been finally drafted, so that the Chamber has been compelled to abrogate part of its functions, and to give the War Ministry *carte blanche* to put the principles of the Bill into practice before it has been passed. In bringing the Recruiting Bill before the Senate, General Bourgeois showed that from 1872 to 1914 the army in peace was the framework of the army in war, and, leaving aside the territorial, the latter was completed by the incorporation of reservists. As to mobilization of the resources of the nation, all that was expected was certain supplies, of which the late war evinced the insufficiency, at the same time making such heavy demands on the man-power of the nation as almost to paralyse its life. To-day, instead of mobilizing the whole army at once, the principle is introduced of first rapidly mobilizing the covering troops up to a fixed establishment, and then, by means of mobilizing nuclei left behind by them, of raising and grouping new units to form the national army. But as the whole organization is not required to function at once, the size of the nucleus can decrease in proportion as the length of time increases within which the new unit is required. The peace establishment is therefore governed by consideration of the numbers required for covering duties, for the mobilization centres, for producing the necessary numbers of reservists and for instruction and ordinary peace duties.

Admitting the above principles, the new Bill must clearly differentiate between the peace establishment and the mobilizing units. The former

must, for many reasons, be a variable quantity, while the latter must form a network so fine that no resources utilizable in war-time can escape its meshes. The highest military authorities have now agreed with the Army Commission of the Chamber that the peace establishment shall be 32 divisions of three regiments each. The division, equipped with the most recent armament, is adopted as the battle unit, the late war having demonstrated that it is the real permanent unit, the army corps consisting of a variable number of divisions. Besides the divisions, troops which cannot be permanently incorporated in them, such as machine-gun battalions, tanks, heavy artillery, aeroplanes and cavalry, must be provided as a general reserve in the hands of the higher commands. Their numbers and composition will appear in the Cadres and Effectives Bill.

The commands of the mobilization regions will be quite distinct from those of the army, and, as mobilization of all the resources of the nation is intended, will include representatives of the civil services, public works, mines, forests, manufactures, and hydraulic and electrical enterprises. A proposal to place a civil administrator at the head of each region has not found favour, owing to the multitude of purely military duties involved. The number of regions has been fixed at 20, which, oddly enough, roughly coincide with the old French provinces. The subdivisions, which have stood the test of 50 years, will remain exactly the same. *Liaison* between the regional and troop commands is ensured, for the time being, in that the latter are responsible for training and in most cases supply the personnel for the mobilization centres. Later on, centres may be established which will be independent of the troops and more schools of instruction will be set up. To ensure this *liaison*, a higher command over both troops and regions is instituted, corresponding to the army corps command. In view of their responsibility for organizing the whole country, the latter will be in communication not only with the Minister for War, but with the ministers of all the services affected. The number of army corps commands has been fixed at 16 for the present, *i.e.*, the number required to be functioning on mobilization.

A map is attached showing the boundaries of the regions and the distribution of 26 divisions, the six remaining divisions forming the Army of the Rhine. In each region is stationed a white division. In the five frontier and one other region there are also mixed divisions, each consisting of one white and two native regiments. The 16 army corps will be three on the Rhine, and 13 in the interior. Five corps commanders will each command a frontier region and two divisions, one white and one mixed. One will command the military government of Paris with one white division. One will command two regions and three divisions, two white and one mixed. Six will each command two regions and two white divisions. The organization of the colonial forces is hardly touched upon in this Bill, as it presents difficulties which must be dealt with in the Cadres and Effectives Bill.

It has been objected to this Bill that, in arranging for progressive mobilization, a prolonged war is pre-supposed, but there is nothing to prevent war from being prosecuted vigorously from the very beginning,

assuming that the probable enemy is Germany. The covering troops could be quickly moved into the enemy's territory and his mobilization interfered with, seeing that it must take place in the region of the Elbe, whilst that of the French would proceed in full security. But even this latter, and the inviolability of the French frontier are not absolute certainties, owing to want of knowledge in regard to the future development of aviation and chemical warfare, but no system of organization can ward off these dangers. If Paris can be destroyed in a few hours, the best defence is to be in a position to destroy Berlin in a still shorter time. The constant care of the French Government must be to assure the army mastery in the air on the outbreak of war, and to this end aeronautics must be kept fully equal to this task in times of peace.

Another objection is that raised by the partisans of mechanism and material in place of men, but even machines require men to work them. The total man-power must be the same, but its centre of gravity is displaced further to the rear, and as an extreme case it is pointed out that a chasing aeroplane carries only one or two men, while about forty are required for it between the aerodrome and repair park. In the writer's opinion the gravest objection is that the second line to follow the covering troops is to be mobilized on the outbreak of war from the resources provided by *disponibilité* and the active reserve, *i.e.*, in each unit there will be men of different ages, and such bodies cannot be equal in quality to the peace army. After all, values are relative and the 32 first-line divisions will be as much superior to the Reichswehr units as the French effectives of 1914 were to the Imperial Army and, should hostilities be prolonged, there is no doubt that the second line will be fully equal to the tasks assigned to it. The great point is to see that there is a good framework for the second-line troops, and this affords the strongest argument for raising the professional army of 100,000, provided for in the Recruiting Act, but which is far from being realized at present.

It is regretted that the drafters of the Bill have stopped short at the army corps, and have not proceeded further to lay down army districts commanded by those who will exercise the army commands in war, and who, in peace, should be stationed in the provinces with the formations which will come under their orders. It would cause no further expense, as the staffs are retained as *Inspectorates* in Paris, and it would admit of decentralization of command and administration and relieve the War Ministry of a heavy burden. The Minister for War would then have only four or five immediate subordinates, instead of some fifteen, and a great source of friction and delay would be removed. Promotion in all grades should be carried out inside each army, which would be large enough to make advancement fair to all, and small enough to allow of a personal interest in candidates. A right of appeal to the War Minister, as constitutional head of the army, must be reserved.

Our Marshals of France.—A lecture delivered at the Grand Chancery of the Legion of Honour on 30th June, 1922, by Capt. René Audriot, consisting of a series of anecdotes of former marshals of France, told in a chatty manner, and in no regular historical order. Should be read in the original. In the days of the first two French dynasties the *marishalk*,

or, in Low Latin, *marescalcus* or *marescallus regis Franciæ*, was merely a sort of head groom, or esquire of the stables. By degrees his duties acquired a military character, and under the Capets he became Chief of the Horse, but in time of war only, and the great feudal lords entertained similar retainers. As the king's authority increased, his marshal acquired greater prestige, and ultimately became Marshal of France, since when his authority and eminence have been continually augmented. After the war of 1870 the appointment lapsed; the last existing, Canrobert, appointed under the Second Empire, died in 1894, and it was not until 1916 that the office was re-established by the appointment of Joffre for his services in 1914.

The Rhine Advanced Guard. By Commandant A.G.—The object of this article is to study the conditions which may obtain in case of a further conflict between France and Germany, assuming that France will be, as now, in occupation of the Rhine provinces. While after 1870 Germany held the whole left bank of the Rhine and Alsace-Lorraine, where she collected a mass of warlike material enabling her to strike a stunning blow in the direction of Paris, she has now been thrown back across the Rhine, and is so threatened by the French Army of Occupation that she must withdraw further east her base of concentration, probably to the Weser. In place of 25 well-equipped army corps, capable of duplication by almost equally valuable reservists, Germany now only possesses an army of seven divisions of infantry and three of cavalry, for, although she has more or less disguised auxiliary formations, such as Sicherheitspolizei, Schutzpolizei, etc., they are unprovided with artillery, unless any important quantity of the latter has escaped the attentions of the Inter-allied Commission. Two arms, however, of which she will make use are aviation and toxic gases.

On the other hand, France now occupies the Rhine Provinces with bridgeheads on the river, where she has an army of occupation fully mobilized and ready to move at once into hostile territory. Behind this force four army corps on the frontier could be moved forward in a few days, and the main portion of her forces could follow in three or four weeks, fully staffed and equipped. The Belgian Army would also be ready to co-operate. It is evident that France, at the outset, would have the advantage in men and materials, but this would gradually decrease as Germany produced her new formations and plant, until, in the end, the superiority would pass to the latter, owing to her larger population, and better developed industries.

It may be expected that Germany has some plan for quickly increasing her armed forces, say, that each battalion becomes a regiment, which would triplicate her strength to 21 divisions of infantry and 9 of cavalry, with an unknown number of auxiliary formations, the latter with few or no guns. The time necessary for mobilization and concentration can only be guessed, and may be assumed at five or six days for the former and six or eight more for the latter. Parallel with this mobilization an air force will be organized, for, although aviation as an arm has disappeared (Treaty of Versailles, Art. 198) plans for its employment have been stubbornly pursued, and are not likely to be left in the experimental stage by Germany, and the treaty may be modified on

this, as it has already been on so many other points. Fleets are likely to replace squadrons, and it may reasonably be expected that the Germans will strive to shatter French morale by bombarding the large towns and industrial centres. Again, the use of gas, although forbidden by the Versailles Treaty, is certainly being prepared for by Germany—witness the accident at Ludwigshaven in September, 1920. New gases may be discovered and rapidly produced from the huge plants existing in Germany. Tanks may be improvised from agricultural tractors.

Covered by this first line, Germany would proceed with the general mobilization of the country in order to raise a national army. In estimating the time required for producing the material for this army, assume that all warlike stores unauthorized by the Treaty have been handed in, and that all new manufacture has ceased; but preparation for manufacture cannot be prevented, and construction might even be clandestinely commenced somewhat before the date fixed for opening hostilities. Experience gained in the late war has shown that material for war, all details having previously been arranged, takes five or six months to manufacture, or, deducting the time during which manufacture may have been secretly going on, say, three or four months. The problem for the German High Command is, then, to determine how best to employ their covering troops on the ground they will have available to manœuvre over, should the French decide to cross the Rhine after their concentration is completed. The latter could not advance beyond the river with all their forces united in less than three or four weeks, and in this period the German covering troops would be organized in their positions and ready to fight. Carefully thought-out plans for holding the zone between the Rhine and the Weser would include numerous demolitions, the denial of certain tracts by inundations or gas, the preparation of successive positions, and experience has shown that an advance through such country resolutely held by thoroughly trained troops, even if relatively small in number, is a tedious matter, and might even result in giving Germany the breathing-space she requires.

In view of the above possibilities it is a great question whether it would not be better for the French to take advantage of their peace-time superiority of force, and at once to advance boldly into the territory the Germans hope to reserve to themselves for manœuvre, more especially having regard to the damage German aeroplanes may be causing during the delay. Such an advance would compel the Germans to retire the concentration of their covering troops further east, would deprive them of the advantage of the barrier of the Rhine and of a portion of the ground they require for defence, and would check the activities of their air force by fear of reprisals on such towns as Frankfort and Essen. It would not do to advance at once for 150 or 200 km. to avoid the risk of a German counter-offensive in considerable force, but to lay hands on the Ruhr basin and Frankfort (first phase), and advance the concentration of the main army close to the Rhine, say, between the Maine and Ruhr (second phase). The first even might have the effect of incapacitating Germany for further operations.

It may be objected that this plan violates the principle of strategy which enjoins concentration of force at the decisive point, and avoidance

of division of force and engaging in detail, but that refers to a battle against the main enemy forces. The assumptions on which this study is based show the conditions to be quite different. It has been estimated that the Germans will require about a fortnight to mobilize and concentrate their covering troops, and, adding two or three days' marching to reach the French assemblies, there can be no question of battle before the eighteenth day. The French advanced troops, assumed as ready to proceed before the end of the first week, will only have to surmount detached bodies and, later on, destroyed communications. Having reached their objectives and been reinforced about the fifteenth day by the frontier corps, they will have acquired the strength of an army group and be capable of any action required. The troops available will be the French and Belgian armies of the Rhine with several cavalry divisions ready on the fourth or fifth day, and the four frontier corps ready to follow in a few days. About the fifteenth day eight or nine army corps would be on the selected covering position, assuring the detrainment of the main army on the Rhine, and by the middle of the third week, before which it has been shown that the Germans could not attack, part of the corps from the interior will have detrained and be in a position to intervene. Again, it is hardly likely that the Germans, whose main object is to gain time, would adopt an offensive attitude which would in the end bring them up against the main French armies. The risks are, therefore, slight and the advantages considerable, whether from the strategic or political point of view, and might even nip the German mobilization in the bud.

Remarks on the material required follow. All wheeled vehicles must be replaced by those moving on tracks, and the steering and pace of these must be improved. Tanks should be capable of speeds up to 25 km. per hour, should carry crews of at least three, and be fitted with an apparatus to enable the commander to see as well as if he were in the open air. Thus powerfully equipped, with guns and supply vehicles, the advanced troops, soon to be reinforced by a second echelon, should rapidly overcome the weak German covering force, and enable the main scheme of operation to be realized, that is, to carry the war as soon as possible into the base of concentration of the German national army.

Records of Foreign Armies.—Major de Vallière contributes a short description of the Swiss cavalry. The Czecho-Slovak budget for national defence is analysed, and some information afforded in regard to the methods adopted for providing and training officers for the active and reserve formations.

Bibliography.—The following books are favourably reviewed:—

Essai sur la fortification permanente moderne, by Colonel Levêque (Berger-Levrault) which is said to afford a sound foundation for anyone who wishes to commence a course of study of permanent fortification adapted to modern conditions.

Ou va le monde? Considérations philosophiques sur l'organisation sociale de demain, by Walther Rathenau; French translation by S. Sankélévitch (Payot).—The ideas expressed in this book found no favour in Germany, and excited such dislike that the author, who hoped, as a

Minister, to make them the foundation of his activities, was assassinated. They are, however, based on sound reflection on subjects which canno be neglected at the present day.

Les lois éternelles de la guerre (Berger-Levrault), by General Arthur Boucher.—Struck by the fact that the small Greek nation not only successfully opposed, but ultimately conquered the much larger Persian nation, the author has drawn the conclusion that even at that remote period the art of war had reached a degree of perfection hard to surpass. To compare the methods, and show that the principles which then held were still applied twenty-three centuries later, is the object of this interesting work. A second volume is expected which will deal with the art of war in the 1914–18 campaign.

(*April*, 1923.) *The Rupture of the Bulgarian Front at Dobro-Pole.* By Commandant Paul Casson, from documents supplied by Lieut.-Colonel Theodoroff of the Bulgarian General Staff.—When the Great War began Bulgaria saw a chance of reversing the injustice done to her by the Treaty of Bucharest, and of recovering Macedonia and the Dobrudja which she had won at the cost of so much sacrifice. In November, 1915, the Serbian Army had been defeated, but not entirely destroyed, when Mackensen's Staff decided that sufficient had been done to serve Germany's purpose, and gradually withdrew from the Southern front all but three German divisions. Operations were left to the Bulgarians with slight assistance from Austria and Germany, and the Serbian Army was driven out of the country. The Bulgarian Army was then reduced to inactivity on the Greek frontier, to serve Germany's political ends, of preserving Greek neutrality and of retaining a portion of the Entente forces at Salonica, in spite of Bulgaria's protests that the Expeditionary Forces should be driven from Macedonia and not left at liberty to reorganize the Serbian Army and ultimately to be in a position to invade Bulgaria. The period of inactivity was marked by a gradual deterioration of the morale of the Bulgarian Army, owing to difficulties of supply, due to the mountainous country and lack of roads and railways, to defeatist propaganda, to the unfavourable decision regarding the Dobrudja, to the alteration of the Eastern frontier in favour of Turkey, and to the exhaustion of the country by Germany's requisitions of foodstuffs. In 1918 desertions were frequent and mutinies broke out, while the supply arrangements grew worse, many soldiers were in rags and barefooted, food had to be rationed, and many horses died of hunger or had to be sent to the rear, or even back into the interior, to be fed at all. Another source of weakness was that the Bulgarian forces were staffed by Germans, who, although efficient in military matters, altogether failed to realize the Bulgarian point of view and difficulties, refused to appreciate the actual situation, and worked on their pre-conceived idea that the war on the Southern front must be prolonged, while denying Bulgaria the assistance she demanded.

From the foregoing the state of the Army in September, 1918, may be imagined. It was condemned to a passive, even though it might be a stubborn, resistance, and all initiative was abandoned to the enemy. The impending attack was foreseen by Bulgarian Headquarters in June, and attempts were made to form reserves for the threatened sector.

It was known that British troops in the Struma sector had been replaced by Greeks, and sent to the Vardar to relieve French troops required to form a striking force, and by August it appeared certain that the Allied offensive would take place in the mountainous region of the Moglena, yet the Germans were still removing their troops from Macedonia to the Western front. Early in September the Bulgarians held the whole line of 573 km., from Albania to the mouth of the Maritza, joining hands with the Turks to the East and Austro-Hungarians to the West. The troops in line consisted of the 11th, 1st, 2nd and 4th Armies with, of Germans, 3 battalions, 40 batteries, 4 squadrons, and 342 machine-guns divided between the 11th and 1st Armies. The sector attacked was held by the 2nd and 3rd divisions, both belonging to the 11th Army, but, although the broken ground was favourable for defence, this did not compensate for inferiority of numbers. The 2nd division held a front of 17 km. with 18 battalions and 86 guns, the 3rd a front of 40 km. with 21 battalions and 66 guns, an average of 1½ km. per battalion. In reserve the 2nd division had 7 battalions two to eight hours' march to the rear, the 3rd division one battalion close to the line. The Army Corps Reserve was 3½ battalions, some two days' march to the rear, the Army Reserve, two German and three Bulgarian battalions, three or four marches off. The reserve of the Army Group was one German and five Bulgarian battalions with three batteries, two or three days' march away, and the General Headquarters Reserve seven battalions and nine batteries at four to eight days' distance by rail and road. These isolated battalions were not organized in brigades or divisions, they were destitute of transport, and in no way represented formations fitted for manœuvre.

It soon became evident to the Bulgarians that the main attack would be on the Dobro-Pole sector, with possibly a secondary attack up the Vardar Valley, and reinforcement of this front was demanded. The Germans held that the attack would be made on a much wider front, would be preceded by a long artillery bombardment so that surprise need not be feared and time would be afforded to bring up reserves, and that the reserves were sufficient to meet all eventualities. No representations of the Bulgarians could modify this attitude. At this time the German G.Q.G. sent a landwehr division to the Struma sector to spread defeatist propaganda among the Greeks. Every day groups of the latter with their officers deserted to the enemy, but the division would have been better employed if placed in reserve at Gradsko in the threatened sector. Bulgarian Headquarters cannot be absolved from blame for not pressing with greater vigour their own rights and the national interests.—(*To be continued.*)

How Remigenos Gabu, Prince of the Mirhattas, Studied the Arts of War. By Malo.—Describes how the Prince, after receiving his father's blessing and a sum of money, travelled in the neighbouring countries to study their methods of waging (or avoiding) war. Each had some sovereign specific, generally unpractical, on which it relied. On returning he found his father, the old king, on the point of death, having evolved a scheme of his own for ending war. This was to ensure that all men might have everything they require for their bodily needs. When this is

the case a desire for ease, and affection for their fellow men, will remove every incentive for killing them. Written of medieval times, in somewhat medieval French, the article is not without a vein of humour, a somewhat bold innovation which the editor hopes may possibly be appreciated by readers of the *R.M.G.*

Strategy and Operations of the Allies in the North.—A continuation of the article by Capt. Kuntz.—The retreat of the French 5th Army on August 24th and 25th, 1914, is shortly described, also that of the British Army on the same dates, including the engagement at Landrecies on the night 25th/26th.

Bibliography.—The following are some of the books reviewed:

La Bataille de Montdidier. By Commandant Daille. (Berger-Levrault).—Describes the operations of the 1st French Army (General Debeney) which was placed under Field-Marshal Haig's orders for the battle of Amiens, 8th to 10th August, 1918. Ludendorff, in his *War Memories*, refers to the 8th August as "Germany's black-letter day."

L'Afrique Orientale Allemande, et la Guerre de 1914–1918. By Commandant Breveté J. Buhrer (Fournier), is said to be an excellent work.

(*May*, 1923.) *The Fatal Quarrel between a Chancellor and an Admiral.* By Capt. de Gaulle.—For two years there was strong antagonism between the government of Germany and the Navy; the decision reached in opposition to the advice of the man best placed to know all the issues involved, the head of the government, was the direct cause of the German defeat. If the government had been free to conduct the war according to accepted principles, Germany might have found a way out of her difficulties. Without the intervention of America and the hopes built upon it by the Entente, the Russian revolution and the moral consequences of the check to the French arms in 1917, combined with the efforts in London of Lansdowne and Ramsay Macdonald, would have placed the Empire in a favourable position to negotiate a peace with the aid of the mediation opportunely offered by President Wilson.

Until early in 1916 Grand Admiral von Tirpitz was Secretary of State for the Navy. Even before the war there had been bitter and continuous enmity between him, a Prussian Junker, and the Chancellor, Bethmann Hollweg, a lawyer and a democrat. While the former was virtual father of the German fleet, and the moving spirit in the struggle for supremacy in armaments directed against England, the latter had been desirous of an agreement with London, and had favoured Lord Haldane's visit to Berlin, and the limitation of naval construction. From the commencement of hostilities the Grand Admiral did not disguise his opposition to the war policy of the Chancellor. Bethmann hoped one day to reconcile Germany and England, and intended to make Russia pay for the war. Tirpitz dreamed of an understanding with the Czar and the overthrow of the democracies of the West, and had devoted his life to preparing for war with Great Britain.

Tirpitz, whose proper place was in Berlin, wished to accompany the great General Staff in hopes of making his influence felt in its deliberations, but was mistrusted by both the Emperor's cabinet and

the army staff. He took his revenge in sarcastic references to the army, and definitely proposed that the fleet should take the first favourable opportunity to put to sea and seek an engagement, but this did not appeal to the Emperor, to the fleet, or to Falkenhayn, C.G.S. of the army. In the height of his bitterness he indulged in fierce denunciation of his personal enemy, the Chancellor, whom he accused of keeping the fleet inactive from fear of England.

On 4th September, 1914, the friends of v. Tirpitz made a diversion in his favour in the Reichstag by inviting the government to introduce a bill declaring the urgency of fresh naval construction, and Count Reventlow, his personal friend, commenced in the *Deutsche Tageszeitung* a campaign in the same sense. But before the battle of the Marne everyone expected an early termination of the war, while it would take three years to complete new battleships. The Chancellor obtained a vote against the proposal, and by so doing increased the resentment of v. Tirpitz. The latter thereupon decided, without any great enthusiasm, since he had always been an advocate of big ships, to support submarine warfare, but only on condition that it was conducted on a scale large enough to obtain a quick decision before the Entente could devise adequate means of defence, and neutrals, especially America, could define their attitudes, and perhaps prepare for intervention. This was not the opinion of v. Pohl, the C.G.S. of the Navy, a narrow-minded, vain and ambitious man, who, jealous of v. Tirpitz, was inclined on principle to oppose his recommendations. It appears, too, that v. Pohl owed his appointment to this well-known hostility, and to the hope of the Emperor's cabinet that he would tend to neutralize v. Tirpitz's activities. Von Pohl then decided at once to embark on the submarine war, the more so as he was about to take command of the fleet, and wished to sign the order for this novel method of warfare before he quitted the great General Staff.

With little grasp of the technicalities of naval warfare, Bethmann, at all events, realized that submarine attacks on merchant shipping would raise acute difficulties with foreign countries, and that the ruthless submarine warfare proposed by the Naval General Staff, which meant sinking ships without warning, and thus depriving passengers and crews of any chance of escape, would certainly lead to a difference of opinion with Wilson, and war with the United States. He was resolved to do all he could to prevent the latter joining the Entente, as, besides the moral and material support they would afford, he foresaw the ruin of his hopes of their mediation at some favourable moment. Once Tirpitz grasped the Chancellor's opposition to submarine warfare, he set to work to demand it with the same energy and tenacity with which he had hitherto condemned it. When at the end of December, 1914, v. Pohl proposed to declare a submarine blockade of the coasts of Great Britain and Ireland at the end of January, v. Tirpitz evinced his disapprobation of the date, which he considered premature, at the same time declaring his adherence to the principle. The Chancellor saw that the Emperor and G.Q.G., depressed by their recent check on the Yser, and the prospect of a winter of stabilization, were ready to listen to the restless protagonists of the Navy, who promised to bring England to

her knees in six weeks, and to gain time approached v. Tirpitz, who wished to postpone the declaration of the blockade. At the end of January the latter agreed to oppose v. Pohl's precipitancy, and Bethmann set the Ministry of Foreign Affairs to work to draw up the text of the declaration of blockade. This would take some months, and by the spring great military events could not fail to arise and the Emperor would have something else to think of. But on 4th February the Emperor, without the Chancellor and Foreign Minister, paid a visit to Wilhelmshaven, and allowing his dormant maritime ambitions to be stirred by what he saw, signed a declaration of blockade drawn up by v. Pohl which the latter told him had previously received the assent of the Chancellor. Tirpitz was present and offered no opposition, confining himself to the modification of certain details. The only explanation of this change of front on his part is his hatred for Bethmann, and his desire to involve him in difficulties in the hopes that he might tender his resignation. The declaration was immediately published, and Bethmann accepted the *fait accompli*, not having the strength of character to oppose it openly. On 12th February the American protest against the declaration of the blockade arrived in Berlin, warning Germany that she would be held responsible for damage to life and property of United States citizens caused by submarines. On its receipt the Chancellor obtained from the Emperor an order to await further instructions before commencing operations, and, distrusting Tirpitz, and the new C.G.S. of the Navy, Bachmann, took the precaution of directing all submarine commanders to respect neutral ships in the blockaded area. He also induced the Emperor's cabinet to send a telegram to v. Tirpitz asking if he could guarantee bringing England to terms in six weeks by the war against her commerce. Although six weeks earlier Tirpitz had told Bethmann, and written to the Emperor, that in his opinion submarine warfare ought to be postponed owing to want of sufficient means to prosecute it thoroughly, he now, carried away by personal animosity, boldly replied that he and Bachmann were convinced that in six weeks from the commencement of the new submarine war England would be brought to terms. This promise prevailed with the Emperor's cabinet, and on 20th February orders were issued for the blockade. Once it was proclaimed Tirpitz and Bachmann set themselves to intensify it in spite of adjurations from the Wilhelmstrasse. They began by exempting commanders from the order to spare neutral vessels, on the pretext that all vessels of the Entente sailed under neutral flags. The free passage at first reserved for Swedish and Norwegian vessels was soon closed, and at length, on the plea that the safety of German crews outweighed all other considerations, ruthless submarine warfare was enjoined. It was in vain that the Chancellor counselled moderation in the light of foreign affairs. Italy was inclining towards war, and Bulgaria was offering her help. To calm the one and draw on the other it was necessary that the policy of the Central Powers should not be condemned by neutrals; but if Bethmann realized this he had not the power to order, nor the character to insist.

The *Lusitania*, filled with Americans, was sunk on 7th May. Wilson protested, and claimed compensation, and the Chancellor judged that

the time had arrived to offer resistance to the Navy. The G.Q.G. was absorbed with the French attacks in Artois, and with Mackensen's advance after Gorlitza, and took little interest in the submarines. Falkenhayn, overwhelmed by the Austrian outcry at Italy's entry into the war, was anxious to induce Bulgaria to fight and to placate the neutrals. The Emperor and public opinion were on the Chancellor's side, and on 31st May, at a Council of War held at Pless, Tirpitz and Bachmann were alone in advocating the continuance of submarine warfare as it was being carried out. William II. signed an order that neutral vessels were to be spared, and, a few days later, that no passenger boats were to be sunk even if enemy ships. To heal the Grand Admiral's wounded feelings the Emperor a few weeks later sent him the order "*Pour le Mérite*," which was received with emotion, but not with joy. His was not the nature to accept defeat in consideration for a riband, and fresh agitation was commenced against the Chancellor, who was but feebly supported by his friends. To secure peace the Chancellor dismissed the Reichstag.

A few days later the *Arabic* was sunk without warning, in violation of the Emperor's orders. On this Bethmann acted vigorously, and Bernstorff at Washington hastened to assure Wilson that the event was due to an error of the submarine commander, who had been punished, and that Germany was fully disposed to indemnify the victims. Tirpitz and Bachmann were sent for and met by the Chancellor, who told them that he wished to be able truthfully to telegraph to Washington that passenger ships would not be sunk without warning. They then proceeded to see the Emperor, where Tirpitz's habitual haughtiness left him, and he proposed that all submarines should be withdrawn from the British Isles and sent to the Mediterranean. He agreed to dispatching a conciliatory note to America, insisting only that the principle of submarine warfare should not be sacrificed. Bachmann was less compliant and argued that it was not necessary to send to Washington "a declaration of weakness." If it was necessary to appear conciliatory it would suffice if the Chancellor were to request commanders not to sink passenger ships without allowing measures to be taken to save the passengers, and that this should be published in the press. Next day von Treutler, Bethmann's representative on the G.Q.G., came to Tirpitz and told him that the Emperor had directed the Foreign Ministry to address to Washington a note in Bethmann's terms, and on the Admiral's ejaculation that he should be consulted in the wording of the note, v. Treutler replied that it had already been sent. During the day the Emperor's order that no more submarines were to be dispatched for war against commerce "until the situation was cleared up" was communicated to Tirpitz and Bachmann. In the evening Tirpitz, Bachmann and v. Pohl asked to be relieved of their duties. Von Pohl, a mediocre personality, was merely told that he had nothing to complain of in the Emperor's orders. Bachmann, pre-eminently a soldier and with no political influence, was dismissed. Since Tirpitz in retirement could be very troublesome, his resignation was refused, and a strong letter was addressed to him stating that the Emperor declined to consult him regularly on naval matters when matters of

policy were also involved, owing to the impossibility of collaboration between him and the Chancellor. In spite of the bluntness of the imperial letter v. Tirpitz felt that he was feared, and was confirmed in this opinion by the number of influential visitors who came to assure him of their devotion. With this support the Grand Admiral repeated his request to be relieved, declaring that "he could not remain in his position if he was not consulted on questions which were the very reason for its existence." The Emperor yielded, and replied, "It is my intention to ask your advice on all important naval questions," an extraordinary concession from a supreme ruler, and indisputable proof of a clash of authorities which was the true moral cause of the defeat of the Empire.—(*To be continued.*)

The Rupture of the Bulgarian Front at Dobro-Pole. The article by Capt. Paul Casson is concluded.—It is a wretched story of continual friction between Bulgarian Headquarters and the German Commander and Staffs, the one issuing orders, the other countermanding, or evading compliance with them. The broad outlines of each day's events are narrated. After three days of registration, 11th to 13th September, the attack opened with a violent bombardment on 14th. Next day the infantry advanced, directing their main attack just where it had been expected by the Bulgarians. The first position Dobro Pole–Vetrenik was overwhelmed, many of the defenders deserting without firing a shot. On 16th an attempt to hold a second position on Mount Koziak with the remnants of the two brigades defeated the day before and such reserves as could be collected, ended in failure. Although the defence held in other sectors, the centre had been definitely breached and the inner flanks of the 11th and 1st Armies were exposed. The retreat of the 2nd and 3rd divisions gradually deteriorated into a rout, demoralization spread to the two adjoining armies, large bodies from which deserted and in many cases drew off with them reserves which were hastening up to the front. Bold attacks on the flanks of the Allied salient by troops drawn from the more quiet sectors might have changed the fortunes of the battle, but the Germans would not risk attack. Or a general retreat to a position further to the rear, which could be consolidated without interference from the enemy, might bring some success, but again the Germans refused to retire the 11th Army in time, possibly from fear of uncovering the left of the Austrian Army in Albania. By 25th the situation appeared to be so hopeless that the Bulgarian government sent a flag of truce and asked for an armistice, addressing their proposals to General Milne, commanding the British Expeditionary Force, and soliciting his mediation with the French Generalissimo. The general retreat, already begun, continued until 29th, on the evening of which date the armistice was signed, to commence at 11 a.m. on 30th September. The Germans seem to have withdrawn their troops and staffs, including the German and Austrian reinforcements then arriving, in time to escape the consequences of the armistice.

Duties of the High Command in Regard to Economics.—The article by Pierre Bruneau is concluded.—The former portions have not been mentioned in the *R.E. Journal*, but it may be of interest to record that in France instructions have been issued that the army is to be thoroughly

imbued with a knowledge of modern economic problems. A course of political economy has been introduced into the military schools, and at the *Ecole de Guerre* " military science is considered inconceivable if it is not closely associated with the other sciences." The special training is completed by lectures bearing on the great political, economic and social questions which exert their influence on the conduct of war. Visits to workshops supplement the theoretical instruction. Pupils from the administrative services study commercial methods. The writer regrets the abolition of the economic section of the General Staff, or rather its absorption into different sections of the 2nd Bureau. In case of another war the high command ought to have records on which to base its economic mobilization which only a service constituted for that purpose can provide.

Allied Strategy and Operations in the North. The article by Capt. Kuntz is continued.—In this number he deals with the Belgian scheme of defence based on Antwerp, and its want of harmony with the plans of the remainder of the Allies. The military value of the fortresses of Antwerp and Maubeuge is considered, and the investment and capitulation of the latter shortly described.

Evenings on the March.—A series of reflections and aphorisms selected from a book which is being written by one of the most distinguished French officers of high rank, who wishes to remain anonymous. Many of them are more appropriate to French conditions, others are of more general application. The book should be of interest as an expression of French Army opinion on military matters.

Bibliography.—The following books are favourably reviewed :—

Le 1er Corps d'Armée pendant la guerre, 1914–1918. (Berger-Levrault.)—Written by the General Staff of the 1st Army from official records and individual recollections.

La conduite de la guerre jusqu'à la bataille de la Marne. By Lieut.-Colonel Grouard. (Berger-Levrault.)—Lieut.-Colonel Grouard is well-known as the author of the *Maximes de guerre de Napoléon* and *La guerre eventuelle*. The strategy of the early days of the war is subjected to strict investigation. The writer holds that the victory of the Marne was not the consequence of Gallieni's action, but entirely due to Franchet d'Esperey's offensive. He argues that if this had been deferred for two days the whole of the German right wing, imprudently pushed forward by von Kluck, would have been enveloped. The blame for losing this opportunity rests with Gallieni, since it was by his insistence that Joffre decided to attack. The reviewer is sceptical as to the beneficial results of any delay, and asks whether the morale of Sarrail's and Langle de Cary's armies could have stood the strain of two more days of retreat. Besides, there were many ardent partizans of an offensive on 6th September at General Headquarters, who should all share the blame, if any there be, with Gallieni.

A. R. Reynolds.

CORRESPONDENCE.

HOT-WATER APPARATUS, CHANAK KALE.

SIR,

With reference to the Report on "Hot-Water Apparatus" contained in the Professional Notes of the June number of the *R.E. Journal*:

The note at the end reveals the fact that this article has, to some extent, missed its mark. The furnace and coil as used are not an essential part of the scheme at all, and are the outcome of purely fortuitous circumstances, *i.e.*, the materials of the coil happened to be lying about and the simplest possible furnace was made to fit them. There is nothing subtle about the furnace or coil—the latter would have been a boiler if chance had willed it, in which case the furnace also would have been quite different.

The article was published in order to bring to notice results which are attributed entirely to the points mentioned in (*c*) and (*d*) of para. 3, which are summarized in the last sentence of that paragraph.*

Similarly, the results alluded to in the first part of para. 5 are attributed entirely to these same two points with the addition mentioned lower down in para. 5.† In this latter case these three changes (total cost, 32s.) were the only ones made in an apparatus on the old lines, so the improvement could hardly be attributed to anything else.

I must apologize for taking up your time again, as I feel that if the article has not been fully comprehended it is certainly the fault of the article itself, for which I am partly responsible.

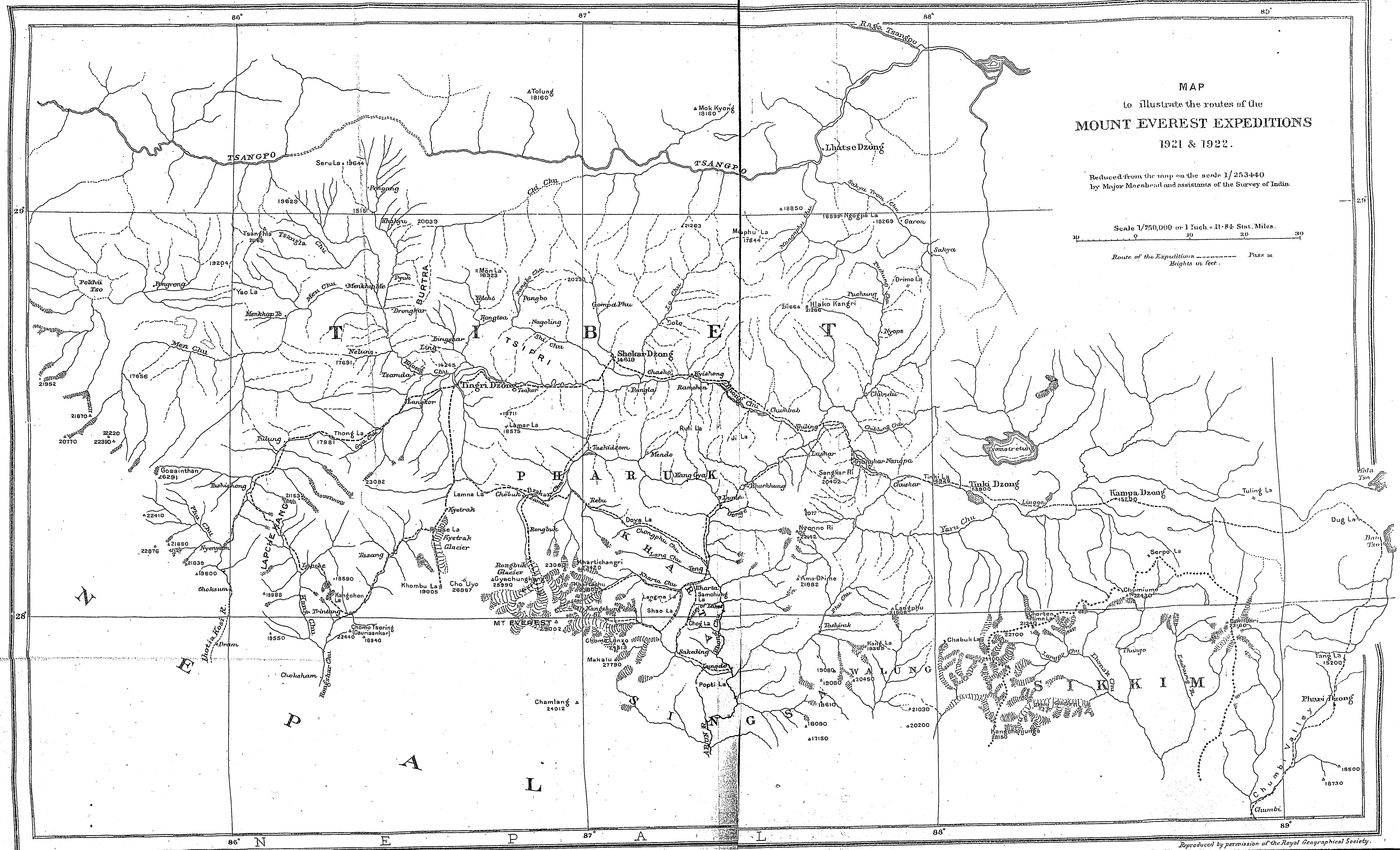
Yours sincerely,

K. B. S. CRAWFORD, *Captain, R.E.*

The Editor, *R.E. Journal.*

* This paragraph reads:—Captain Crawford's contention is that the admission of the cold-water supply to the bottom of the cylinder, instead of to the boiler, and the extension of the return pipe up to two-thirds the height of the cylinder, results in a continuous flow of hot water to the baths.

† (*f*) Secondary return delivering into the cistern at a height above the bottom equal to two-thirds the height of the cistern, *i.e.*, at the same height as the primary return.


MAP
to illustrate the routes of the
MOUNT EVEREST EXPEDITIONS
1921 & 1922.
Reduced from the map on the scale 1/253440
by Major Morshead and assistants of the Survey of India.
Scale 1/750,000 or 1 Inch = 11·84 Stat. Miles.
10 0 10 20 30
Route of the Expeditions ---------- Pass
Heights in feet.
TSANGPO
Rago Tsangpo
Lhatse Dzong
Shekar Dzong
Tingri Dzong
Tinki Dzong
Kampa Dzong
Phari Dzong
Chumbi
Chumbi Valley
T I B E T
N E P A L
S I K K I M
MT EVEREST
Makalu 27790
Cho Uyo 26867
Kangchenjunga 28150
Gosainthan 26291
Rongbuk
Rongbuk Glacier
Kharta
Chomo Tsering (Gaurisankar)
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