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bamboos in the valleys. The only living things encountered were rats, snakes (grass, bamboo and krait), enormous grasshoppers with a pink body about 3 in. long and capable of jumping about 20 ft. with the aid of their wings, and also a few varieties of small birds, together with the francolin partridge, which is a grey speckled bird with a persistent cry of " Come to the Peak, Ha ! Ha ! "

The weather in the winter is ideal, clear blue skies, a moderate temperature and a cool wind from the N.E. ; in the summer the breeze blows fitfully from the S.W. or S.E. and the atmosphere is extremely humid, which, together with a temperature of about 90°—95°F. in the shade, makes life very moist ! In the summer also comes the rain in heavy downpours coinciding with the presence of a typhoon within about 200 miles. As the total rainfall of the colony is nearly 100 in. a year, and of this about 75 per cent. falls in four months, it will be realized that constructional work is severely hampered in the summer.

When the W.D. decided to use the Stanley Peninsula, there existed on the site a small Chinese village named Wong Ma Kok, approached only by a boulder-strewn path. The decision to build barracks on this site was made with a certain amount of misgiving, for it was at Stanley Village that the first British barracks of the Colony were erected, and later abandoned, about 1895, owing to the numerous deaths amongst the garrison. Modern medical research has decided that the epidemics were mainly typhoid, caused by drinking water from a polluted well, and to a certain extent malaria. At that time the Medical Faculty's prescription for the women and children in the hot weather was a pint of stout and a glass of port a day. The dire results of the epidemics are witnessed to-day by the rows of graves, many those of little children, in the Old Military Cemetery, which is still maintained at Stanley.

Now the same site is occupied by St. Stephen's College and it was in one of their bungalows that the first G. E., Stanley, lived for nearly three years. During that time, there were only three cases of malaria among the two hundred odd members of the Staff and pupils. Whereas the Old Barracks were approximately 100 ft. above sea-level, the new sites around Wong Ma Kok have an elevation of 400—500 ft. During the hot weather, the barracks catch any breeze that may be blowing from the S.W. or S.E., and they are on the whole singularly free from mist. This southern portion of the peninsula may fairly be described as a first-class residential site now that the " usual facilities " have been laid on.

Access Road.

The first necessity was means of access to the proposed sites from the Island Road System at Stanley Village. Survey work for the

STANLEY, HONG KONG.

THE FIRST THREE YEARS.

By LIEUT. G. P. SHEARER, R.E.

SOME time about 1933, the War Office decided to re-arrange the armament of the coast defences of Hong Kong, and to move some of the existing guns to a new position at the south of the island. The site chosen was the end of the Stanley Peninsula; but before describing the work done there, a brief account of the Peninsula is necessary. It lies on the south of the island of Hong Kong and is joined to the main mass of the island by a low-lying, narrow isthmus, on which stands the Chinese village of Chik Chu (Stanley). (See sketch map.) Just to the south of the village lie the modern buildings of St. Stephen's College, at an average height of about 100 ft. Southwards again the ground falls to a valley running up from the pier to the New Prison, and on the far side is a steep slope running up to just over 600 ft. at the peak.

Within the W.D. area there are three main features, a ridge some 500 ft. high running from N.E. to S.W., a broad valley parallel to it, and on the far side another smaller ridge.

North of a line from the Pump House to the east end of the W.D. boundary fence, the ground is of decomposed granite, light brown in colour, with outcrops of solid grey granite and massive boulders of the same material. East of a line from the same end of the fence to the indentation on the south coast, it is the same except that the amount of outcrop is very much greater and the overburden of decomposed granite much thinner, being nowhere more than about 8 ft. thick. The intervening wedge is of a red and rather clayey soil with small boulders of blue "granite." This latter stone is not a true granite, but is actually harder, of finer crystalline structure and attractive appearance.

The hills are covered in long grass, with bushy undergrowth and

8.—Panorama of site before barrack contract started.

Dining-room and cookhouse. Barrack block. Serjts.' Mess. Transit shed. Workshop.
M.I. Room.

9.—Panorama of site in February, 1937.

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road was started by the G.E. in July, 1934, but it was not completed until September, a delay chiefly due to the wet (summer) weather and the need for clearing the line in two or three bad places. The provisional bills of quantities were prepared immediately and the work ordered on the successful Chinese contractor on 8th November, the term of the contract being for eighteen months.

The survey was originally carried out on the lines of a road in mountainous country. Grades up to 1 in 8 and curves as sharp as 80 ft. radius were allowed and the provisional B. of Q. were worked out for this alignment. The accepted contract proffered very low rates for excavation and carrying spoil to form into embankments—*i.e.* approximately 5d. a yard cube for earth and 1s. 6d. a yard cube for rock. The rates for concrete drains, granite soling and tarmacadam carpeting, however, were high in proportion although by no means unusual. The Chief Engineer, Col. E. St. G. Kirke, D.S.O., who arrived in the Command shortly after the contract was let, and who took a very keen personal interest in the road during the whole time of its construction, saw immediately that the proportion of these rates might well permit of the alignment being considerably improved without extra cost. The easing of sharp curves, and in some cases, the elimination of easy "S" curves together with the reduction of the steeper grades had the effect of curtailing to a certain extent the total length of road to be constructed. The consequent financial saving in soling, carpeting and side drains balanced the comparatively low extra cost of far bolder cuts and fills than were originally contemplated.

In each case, the costs of the possible alternatives were worked out by the G.E., at the rates quoted, for each section of the road and an optimum line decided on without imposing any check on the work which had begun on the first and easiest portions of the road. The whole of the work had to be measured up before payment, in any case, as it was impossible to forecast with accuracy the amount of rock which would be encountered in any one cutting. It was therefore often possible, *e.g.* when a cutting proved to be practically all soft earth, to improve the road still further by flattening the curve to a somewhat greater degree than that originally calculated to give a financial balance; or to ease the grade; or alternatively to make use of the saving on some other portion of the road.

The net result of taking each opportunity as it presented itself was that the road as finally completed had no curve sharper than 200 ft. radius and no grade steeper than 1 in 10. The general construction was governed by the fact that the road should be suitable for fast motor traffic to the barrack area. The camber on the straight was kept down to 1½ in. on the half-width and proved satisfactory throughout the rainy seasons, due to the waterproof surface given by the tarmacadam. All curves were given super-elevation about the

centre line of the road in accordance with their radius, working to a theoretical speed of 21 m.p.h. This brought the maximum super-elevation, *i.e.* on the 200 ft. radius curves, to 1 in 7 or approximately 18 in. on either side of the centre line. In practice, it was perfectly safe to drive up to 35 m.p.h. on any part of the road in any weather.

For gun tracks, single-way reinforced concrete slabs laid direct on the formation were used. The tracks were made 12 ft. between curbs and to avoid great expense (since they were driven through solid granite), the minimum radius was 80 ft., the maximum grade 1 in 8. Owing to the lower speeds anticipated, the super-elevation on the sharpest curves never exceeded 1 in 12.

In view of the very heavy loads that the main road would have to carry, it was designed to have foundation of 9 in. of hand-packed granite soling covered with a layer of tarmacadam rolled to 3 in. The roadway was 20 ft. 5 in. between the curbs of the concrete side drains on the straight and widened to 22 ft. 6 in. on the curves.

The local roads on the island of Hong Kong, made in the early days of motor-traffic, are not banked. In fact their normal barrel camber appears to get more pronounced at the corners, of which there are many on the roads winding in and out of the spurs on the hillsides. So much so that one's tyres only last about 5,000 miles before they are worn to the canvas. This new W.D. road, with its up-to-date super-elevation, was an entirely new departure as far as the natives were concerned and it was amusing to watch the Chinese drivers during their first encounter. Practically all slowed down to a snail's pace to avoid overturning and the best sight of all was a motor-cyclist doing about 20 m.p.h. and working very hard to keep his machine vertical!

The first mile of road entailed crossing a valley on a 40-ft. fill (Photo No. 1) and traversing the side of a steep hill at a 1 in 10 gradient. The ground here was all decomposed granite with large boulders and occasional spurs of solid rock (Photo No. 2). The biggest obstacle in the road was the ravine shown in Photos 3, 4 and 5. It was eventually crossed by filling in with rubble behind a masonry retaining wall, laid with open joints. The bridging of the ravine and the completion of the adjacent cutting, which was found to be nearly solid granite, held up the rolling of the formation and soling beyond for some time, as although the roller arrived on 21st June it was unable to pass this point until November. Incidentally, by an alternative item in the tender—surfacing (a) with W.D. roller or (b) with roller provided by the contractor—it was found cheaper for the W.D. to buy a Diesel roller at home and send it out than to allow the contractor to provide his own. This same roller has since rolled miles of new military roads on the mainland of the Colony in spite of the misadventure related in the next paragraph.

The roller driver's mate, when driving one Saturday afternoon

(the Chinese work seven days a week) on a steep bit of road, forgot to apply the brake before changing gear from forward to reverse. Eye-witnesses stated that he stayed in the cab until the roller came to rest in the position shown in Photo No. 1, then he got out and ran away to "Canton more-far." Certainly we never saw him again. The work of restoring the roller to the road was given to a Chinese haulage contractor and it was back at work in 70 hours.

Another incident during the road construction took place on the evening of the 18th July, when the contractor's explosive store watchman's hut blew up, nothing being left but the four corner-posts. It transpired that the watchman had been making "gun-powder" and substituting it for the dynamite that he was supposed to issue to the foreman blaster, the pair of them sharing the profit from the subsequent sale of the dynamite to fishermen. The watch-man kept his stock under his bed and a spark from an earthenware cooking-pot sent it off. Luckily for him he was not present.

A few technical points may interest the reader. The cost of the road was approximately $11 per foot run, or at the present rate of exchange, £2 per yard run, the tarmacadam accounting for 36 per cent. of the total cost. The rock drilling was all done by hand at an average rate of 9 in. of ¾-in. diameter hole per hour; a blaster dealing with about 2½ yd. cube per day. Nine-inch soling was hand-packed at the rate of 600 ft. super a day per gang of 4 to 6 men, material being on site. Tarmacadam was made on the roadside and laid hot at about 13 yd. cube per day by a gang of 20 men. This hand-made tarmacadam was, however, rather inferior to plant-made as there is some difficulty in getting consistent results in practice. The minimum diameter of culverts was 18 in., so as to allow of easy access for cleaning. Embankments were formed by simple tipping, no consolidation other than the normal construction traffic was attempted, but all important banks were allowed to stand for a whole rainy season before any soling was laid. In large banks further settlement can be traced, but if the above procedure is allowed to take place, the tarmacadam surfacing is sufficiently elastic to allow of such settlement without interrupting the traffic. The sides of the em-bankments were planted with tufts of local grass, which grows in tussocks rather than in turf form. Sidelong fills were benched before any filling took place so as to give a better bond with the surface of the ground.

Pier.

As the Hong Kong Government would not allow loads greater than 5 tons on their roads outside the city, it was obvious that all the heavy items such as gun mountings would have to come by water, be landed on the peninsula and go up the W.D. road to their destination. After a considerable amount of discussion it was decided to build a permanent concrete pier.

There was an obvious site ready to hand at the foot of the valley running up to the New Prison (sketch map); it was naturally sheltered and close to the W.D. road. Trials showed a rocky substratum at a small depth and as a pile pier was therefore out of the question, a solid pier was built. It was desirable to have a low freeboard at high tide and yet enough water alongside the working portion of the pier to float the largest R.A.S.C. lighter at low tide. The limits set were 1 ft. freeboard at H.W.O.S.T. and 6 ft. as the minimum depth of water at L.W.O.S.T., the maximum difference in high and low tides being 9 ft. The requirements necessitated a pier 240 ft. long, and it was designed with a width of 15 ft. so as to allow working room on either side of the widest part of a mounting that might be landed on it, and for the easy movement of heavy lorries backwards and forwards to the pierhead.

The work was put out to lump-sum tender, was started on 5th January, 1936, and was finished on 25th June; the cost being about £4 15s. 0d. a foot run or 7½d. a foot cube. The foundations were dredged out by a native "bucket" type dredger mounted on a large sampan and worked by man-power. On the prepared bed, sacks of dry-mixed concrete were placed by a diver and finally brought up to level with smaller bags. Pre-cast concrete blocks, one month old, each weighing about half a ton, were then lowered from a junk and positioned by the diver. These blocks by a miscalculation on the contractor's part were still submerged by about 6 in. at low tide. Shuttering was erected and made watertight with clay and at low water, dry-mixed concrete, previously prepared and stored in sacks, was poured in in an almost continuous stream, about 200 sackfuls being used, ramming taking place the whole time. This method was successful. The scene underneath the temporary decking with the dry concrete pouring down into the forms, the half-naked rammers working by the light of paraffin pressure lamps and every one of the 100 odd coolies shouting at the top of his voice whilst striving to beat the rising tide was simply amazing; and the dust, terrific. Finally, the walls were brought up to the finished level with ordinary wet-mixed concrete, the interior was filled with rubble and well rolled, and a decking of 6 in. of reinforced concrete laid over the whole. Expansion joints of bitumen and felt with steel dowels were provided at every 60 ft. At this same sheltered site, convenient to the pier, the Hong Kong Government kindly allotted to the W.D. a bathing beach for the future occupants of the Stanley Barracks, and the writer hopes that by the summer of 1938, the "Stanley Lido" will be in full swing.

In August, 1936, a typhoon passed over the Colony and during this period, the seas were running some 3 to 4 feet over the top of the decking and washed off three pieces of gun mounting each weighing over six tons without, however, damaging the pier.

1.—Embankment and roller after accident.

2.—A rocky cutting.

3.—Start of toe wall across ravine.

4.—The retaining wall grows.

5.—The ravine crossed (taken from opposite side).

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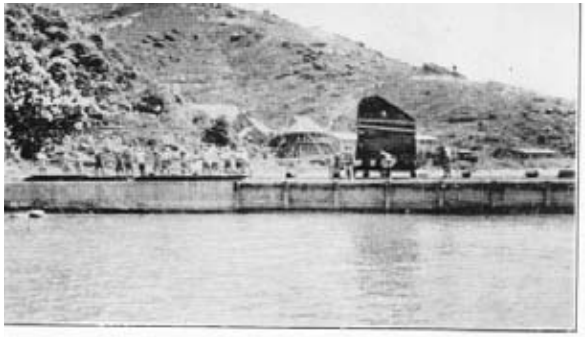

6.—R.A. Party at work on finished pier.

7.—Former village of Wong Ma Kok.

10.—Coolie lines after typhoon.

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Since its construction, the pier has been used extensively both by the R.A. (Photo No. 6) and the W.D. contractors. The latter use it not only for heavy loads but also for cement, sand and other building materials, which can be sent more easily and cheaply by sea than by land. The busiest day on record was when 19 junks were cleared in 24 hours.

Anti-Malarial Work.

It was realized from the beginning that the site for the barracks around Wong Ma Kok would require considerable anti-malarial work; the fact being forced home by the grim reminders in the Old Military Cemetery.

Incidentally, the original inhabitants of Wong Ma Kok were directly responsible for some of the graves, as they were pirates as well as farmers and fishermen. Two of the headstones in the cemetery are those of a Corporal and a Private who "died of an attack of Chinese Pirates," whilst escorting the pay round from Victoria in a sampan; and later the pirates beheaded a couple of officers on Slaughter Point in full view of the garrison. As a result of this episode, the troops assaulted the village and when we took over in 1935, there were only about eight houses still standing.

The work of draining the obvious minor water-courses started in January, 1935, and has continued ever since. When this anti-malarial work started, the villagers were still in possession of the paddi-fields and as they gradually left the fields became fallow, forming ideal breeding-places for anopheline larvæ. The W.D. had agreed with the Hong Kong Government not to drain the paddi until all the crops had been gathered, in fairness to the displaced villagers. In consequence, a certain amount of malaria broke out amongst the coolies living in the matsheds near the village and lasted until we were able to drain the fields in December, 1935. At the worst time, about 20 men out of 120 were ill. During this period, the contractors contributed to the Stanley Village Dispensary and their men were issued with free quinine under the supervision of the R.E. Staff.

The worst anti-malarial problem that arose was a stream that ran, at times on the surface, and at times some 6 ft. down under large boulders. This was overcome by blasting out a straight trench, building in it a V-shaped concrete channel with weepholes at 3 ft. intervals and then filling in the surrounding depressions so that all surface-water drained into this channel. One or two places, which were below the general level, were dealt with by a concrete surface drain discharging into the main channel some distance downstream in order to get the necessary fall.

The R.A.M.C. interested themselves in the work at an early date

and were extremely helpful. Since July, 1936, they have had a gang of coolies on the site carrying out anti-malarial work under a specially trained orderly. This squad themselves tackled all minor local troubles, and reported any new places that required the construction of permanent drains. The paddi and surrounding low-lying ground were dealt with by first constructing a system of French drains, and then filling over the whole with spoil from the various works. This area when turfed over will form the playing-fields for the new barracks.

Another protective measure that was enforced after December, 1935, consisted of banishing all coolie lines to a site well over half a mile from the northern boundary of the W.D. reserve. The number of watchmen, etc., sleeping inside the W.D. area was reduced to a minimum and special "rounds" are made to see that they sleep under mosquito nets. A clause to effect these measures is inserted in all contracts for this area. By this means, it is hoped to prevent any anopheline mosquitoes, that may still be breeding in the area, from becoming infected.

Battery and Defence Works.

For obvious reasons no constructional details can be mentioned, but some general points which may be of interest are included below.

The preliminary surveys were made before the first G. E. Stanley arrived and they were sent home to the War Office for the contracts to be prepared. When they came back it was found that no permanent marks had been made on the ground and recorded on the plans. The sites were covered with boulders and outcrops of rock so that few, if any, contours ran for more than about 20 ft., and it was then that the truth of the definition of a contour as "an imaginary line on the ground" was realized.

Whilst the battery contract was out to tender, the G.E. was given a passage in a Royal Fleet Auxiliary to Singapore for a short visit (48 hours), where he was shown both a finished battery and one in course of construction and had several talks with the Works Officers concerned. This visit proved to be of great value, giving as it did an insight into the magnitude of the work, the amount of storage space required and the volume of materials to be handled. As a direct result of this visit work was at once started by the T.C. on a transit shed for the storage of W.D. supplied stores, and it held at one time something like £10,000 worth of material. This building was 70 ft. by 27 ft. and proved to be on the small side.

The contract was let to a British-owned firm who installed a central air-compressor for working jack hammers, and, eventually, two stone-crushers for producing aggregate and crusher dust, which was used

instead of sand for waterproof work. (All sand in Hong Kong is supplied by the P.W.D. and is sea-sand.) The magazine sites were found to be almost entirely fissured granite and blasting was carried on day and night for seven months before the first site was ready for concreting, approximately 4,000 tons being excavated. Incidentally, during the heavy summer rains (record during construction 8·74 in. in 24 hours), the best way of emptying water out of the excavation was found to be a siphon made of 2-in. pipes.

Concreting once started also proceeded by night as well as by day and the first emplacement was ready for the R.A. mounting party in just under 11 months, while the R.E. part of the work was completed in 17 months from the start. One of the Chinese foremen had a very good idea for transporting the concrete from the mixer to the point of deposit. He built a staging and on it placed a length of light track and then mounted a banker on wheels. The concrete was tipped from the mixer on to the banker, which was then run along the rails to the required place, and deposited, whilst the mixer was preparing the next batch. This worked very well and obviated the transfer into buckets and carrying in small quantities, which was the normal method when the mixer and point of deposit were some distance apart.

It was found that ordinary "wrought shuttering with edges shot" as used by the contractor gave a poor finish, owing to the warping of the wood when in contact with wet concrete on one side and exposed to the hot sun on the other. This fact is well recognized by the Chinese builders, who normally use rough shuttering and then render afterwards. This, of course, could not be allowed in a battery and it was found that the best solution was to use rough shuttering faced with the very thin sheet-iron that can be obtained locally; this type of shuttering is easy to clean and can be used several times.

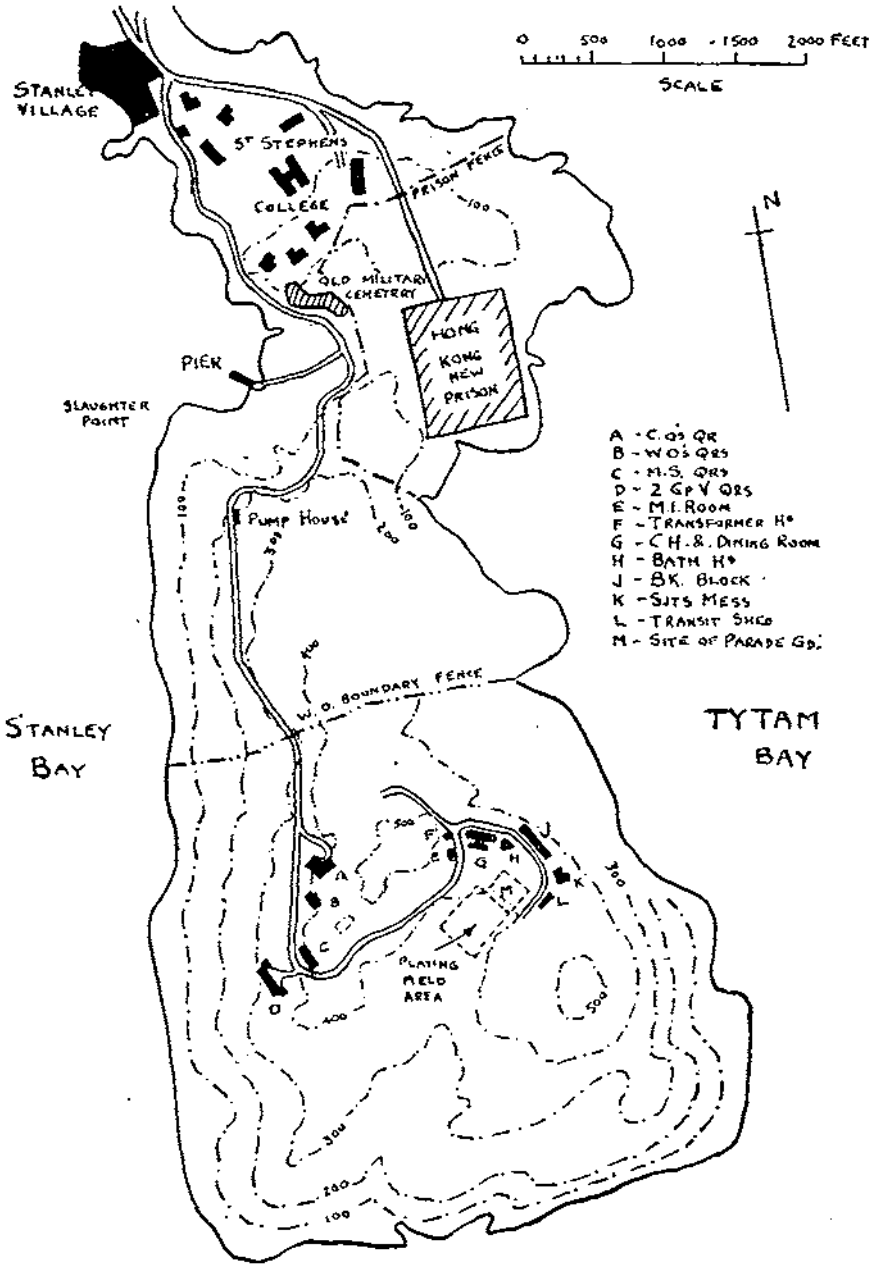
Concreting was supervised to a great extent by Sappers, lent by the Fortress R.E., and they proved invaluable after a short time. They were given some tuition first, especially in the use and meaning of the "Slump Test." Shuttering of the main walls, etc., was struck after 24 hours. Two interesting points were noticed in connection with some concrete 7 ft. 6 in. thick. Firstly, that the temperature of the interior rose to 115°—120°F., which corresponds to a stress of about 448 lb. per sq. in. if the outer layers are assumed to be set and elastic. Secondly, after some eight months, water was still draining out from the under-surface of this thick concrete. It was covered over with two waterproof layers soon after its construction; these prevented evaporation from the surface and also precluded the passage of subsequent rainwater, which could not, therefore, have been the cause of the seepage.

BARRACKS.

When the W.D. started work, the villagers of Wong Ma Kok (Photo No. 7) were still in possession of their houses. The Hong Kong Government agreed to dispossess them for military purposes if the W.D. rehoused them as well as compensating them. Actually the Hong Kong Government did the building of the new houses and the provision of new ground, etc., and the W.D. footed the bill. Eventually, they moved out and their houses were immediately reoccupied by coolies and their families, who were working on the road. They were warned twice that they were to be out by a certain date, but when the G.E. arrived to take possession they were still there. A gang of coolies was summoned and told to take off the roofs. This they were chary of doing, for after all the people inside were their friends; so the G.E. himself scrambled up and started to remove a roof. When they saw that he really meant to have them off, the coolies joined in and thoroughly enjoyed tearing away the roofing materials. When this commenced, all the people inside started to rush out their pots and pans and other paraphernalia amidst the jeers of the onlookers. The G.E.'s effort was, however, rather marred by the roof giving way and his rapid descent into the house below.

The houses were razed and the paddi-fields in front, after draining, were filled up with the surplus rock spoil from the battery as a base. This was covered with earth spoil from the barrack contract excavations, so as to form the playing-fields for the new barracks. One of the most amazing things to a newcomer to Hong Kong is the apparently airy manner in which an engineer will say "Oh, we'll just take the top off that hill and fill in the valley here." The newcomer is even more impressed when he sees it done. Hordes of coolies with picks, shovels, and squeaking wheelbarrows, aided by women and children with baskets, will attack the hill and it is duly carried into the valley. This can be done because labour is so cheap. One contract at Stanley gave "excavate and remove not exceeding 250 yards, and spread" at about 4½d. per yd. cube.

Another cause of wonderment is the Chinese bamboo scaffolding. It is put together with split cane lashings and is made out of light bamboo about 1½ to 2 in. in diameter. The vertical members are about 4 ft. apart and frequently not vertical (this gives a very false impression of the uprights in a new building) and the horizontal members are about 3 ft. apart; the scaffold planks are about ½ in. thick and bend underfoot. In fact, the whole thing looks as if it would collapse at any moment if even a cat moved on it, yet you can climb over it in any direction with confidence. The Chinese raise all their building materials by carrying them in small quantities at a time up large ramps made of bamboo, whole strings of women moving up and down all day. (Photo No. 9.) It was not until 1934 that a steel-



STANLEY PENINSULA.

workers' erection crane was seen at work on the new Hong Kong and Shanghai Bank Building.

The barrack contract was put out to tender in the face of certain difficulties since the War Office could not, at the time, commit themselves as to how many men were to be stationed at Stanley; consequently the size of the communal buildings was in doubt. Eventually tenders were put out for a "lump sum per building" contract, on a brief specification backed by the W.D. schedule and sketch designs. This left a great deal to be decided on site by the G.E. and his Staff. The successful tenderers were a Chinese firm and work was ordered on 11th June, 1936.

The buildings of the first contract were :—

1 Barrack block.
1 Serjeants' mess.
1 Dining-room and Cookhouse.
1 Bath house.
1 Medical inspection room with a 2-bed ward.
1 Gp. 3 Qr. for the Brigade Commander.
1 Block of Gp. 5 Qrs.
1 Block of 2 W.O.'s Qrs.
1 Block of 12 Married Soldiers' Qrs.

These took about a year to complete.

The barrack layout may be seen from the sketch map. The first barrack block is sited on a ridge some 400 ft. above sea-level and overlooking the parade-ground and playing-fields. In the distance are the officers' quarters and the sea. At the back, the block overlooks Tytam Bay. The serjeants' mess has a similar outlook (Photo No. 9). The officers, warrant officers and soldiers' quarters all look out to sea and are sited with a south-westerly aspect so as to get the benefit of the prevailing summer wind and to avoid glare from the setting sun.

The buildings were all constructed of R.P.C.C. frames with brick panels rendered over either in Shanghai plaster or cement rendering. All the main buildings had flat reinforced-concrete roofs, covered with a layer of bitumen and felt. Over that was a layer of insulated tiles, thus providing for both weatherproofing and coolness. Experience has shown that this is the best form of roof for resisting typhoons. The roof of the barrack block has, in addition, a further (thin) layer of R.P.C.C. so that it can be used as a roof garden if so desired. Eaves gutters are omitted in all buildings, as at Singapore; they would have to be very large to cope with the sudden heavy rains and very soon become breeding-places for mosquitoes. The drainage system for the whole camp is to septic tank, the sullage water being piped separately to the outfall of the tanks and thence to the sea by a common pipe.

Throughout the contract, great difficulty was experienced in getting the Chinese bricklayer to lay his courses straight and level. The idea of using a string seemed to be a complete novelty to many of them, and after much talking their first effort at getting the courses level was to mark off every one of them on the columns at each end of a panel, but they did not worry about keeping level in between so long as the end bricks registered with the marks. Another habit of the Chinese is to apply paint with a rag in preference to a brush, even if one is provided free. They dip their hand into a pot of paint and smear away cheerfully all day; and as is usual, the younger the painter, the more he paints himself as well as his work, so that the paint boys of the Naval and shipbuilders' yards are red from head to foot with red lead at the end of the day. (Shades of the Home Office regulations !)

The combined cookhouse and dining-room was designed to feed 400 men at a sitting and is equipped with "all steam cooking" plant and a hot-air oven for roasts. No coal is brought into the kitchen as all stoking is done from the outside. The kitchen, preparation rooms, stores and wash-up are all white-tiled, with large windows, so that the general effect is very clean and airy. The Medical Officer of Health for the island, who visited it, declared that it was one of the best that he had seen.

The barrack block is just short of 100 yards long and is three storeys high, with men's accommodation on the upper floors and battery offices and stores on the ground floor. It has sanitary annexes at each end, with a wide verandah all along the front and behind each room, an unusual feature being the absence of all vertical pillars opposite to the barrack rooms, the pillars coming opposite to the stair wells and annexes only. The rooms have steel doors and windows so that they can be shut up in times of typhoons without the necessity for the extra shutters and bars required with wooden casements. The floors are covered with polished teak parquet laid on bitumen.

It is interesting to notice how this parquet flooring is made under cheap labour conditions. The contractor buys his teak in the log, and it is sawn into planks in his yard by two men working, one on top and the other underneath, as in the old fashioned saw-pit. These planks are sawn into battens, cut into blocks and tongued and grooved all by hand. The resulting blocks are of varying thickness, the average being about 1 in. thick. After laying, they are twice planed and polished, again by hand, and even then they compete in price with an ordinary hardwood floor.

The water-supply for the area is obtained from the P.W.D. filtered supply, taken off from a balance tank just above the prison and follows the line of the road as far as the pump-house. From the pump-house, about 220 ft. above M.S.L., it is pumped to the main storage

tanks on top of the hill to the north of the M.I. room, a lift of about 300 ft., by a three-stage centrifugal pump, driven by a Lister Diesel engine. There are two sets, so that one set can be rested or overhauled whilst the other maintains the daily requirements. The main pipe line, which is 4-in. victaulic, was laid by a detachment of sappers from the Fortress R.E.

A bulk H.T. electrical supply is taken from the Hong Kong Electric Company. A 6,600-volt 3-phase cable was laid on to the W.D. transformer house by the Hong Kong Electric Company; from there it is distributed at 346/220 volts by W.D. cables. In all, some 70 tons of cable were laid, some of it over very difficult country where the trenches for its reception had to be blasted through granite. This A.C. supply also serves the defences for lighting in addition to, and as a standby for, their own D.C. power plant.

The works suffered from two "Acts of God" in 1936. The first was the close approach of a typhoon causing a wind of about 130-140 m.p.h. on the site, and a very high sea ran. The coolie lines were completely wrecked (Photo No. 10). Luckily, there were no deaths, the only serious casualty being a broken arm, and, on the works site one of the R.E. offices was blown down. However, all the important documents had been placed in the "strong room" at the back of the other office, so all was well. The roof of the transit shed was partly blown off and all the contractors' scaffolding demolished. The other event was fire, which broke out in the coolie lines in November. The fire spread rapidly, the flames mounting to a height of about 100 ft., and within three-quarters of an hour nothing was left but glowing embers. The Hong Kong Fire Brigade arrived after a 10-mile drive when it was all over; their hose would not reach and so there ensued the delightful sight of professional firemen queuing up to get a bucket of water from a $\frac{3}{4}$-in. pipe, and when they had got it, walking away to a smouldering piece of timber, emptying the bucket over it and returning to the queue.

In April, 1937, the first G.E. Stanley handed over to his successor, who is married and now lives in one of the original group 5 quarters. He carried on with the work of creating a new R.A. barracks, by the construction of two more barrack blocks, soldiers' quarters, officers' quarters, school, church, brigade mess, etc.

May he enjoy his term of office as thoroughly as did the first G.E., who will never forget Stanley.

ENGINEER TRAINING.

(Winning Essay for the Cooper's Hill War Memorial Prize, 1938.)

By LIEUTENANT J. INNES, R.E.

SUBJECT.

The Royal Engineer Officer must be qualified to make full use of the developments in science and engineering for the benefit of the Army.

He must have sufficient practical knowledge of civil engineering to be able to consult the civilian experts in peace and control their activities in war.

Discuss the educational qualifications and training of the Royal Engineer Officer to meet these conditions.

INTRODUCTION.

ENGINEER Training is defined as " the practical and theoretical education by which officers and other ranks of the Royal Engineers are instructed in the duties which will be required of them in war." (*E.T.* 1937, preface Sec. II.) In any discussion on engineer training this definition must be kept constantly in mind. The value of all training must be measured by the extent to which it assists in preparing officers, and other ranks, to fulfil their role in war.

The purpose of this paper is to discuss certain aspects of the training of the R.E. officer. The first is that of the training required to enable him to make full use of the developments of science, and of engineering, for the benefit of the Army; the second is that of the training required to give him sufficient practical knowledge of civil engineering to enable him to consult the civil experts in peace, and to control their activities in war. In such a discussion, however, it must be remembered that the particular aspects of training under review are but parts of the whole subject. A general picture of engineer training as a whole must be kept in mind in order that a sense of proportion may be retained. Special requirements must be balanced against general requirements, and an attempt must be made to satisfy the demands of both.

It is proposed, therefore, to begin by presenting a general picture of the role of the Royal Engineer officer in war, and of the training required to fit him for this role. An attempt will then be made to review the importance of his special responsibilities to the Army in

relation to science and civil engineering, and the special training required by these responsibilities will be discussed. Finally the system of training will be examined in the light of these various requirements, and suggestions will be made for the improvement of this system.

THE ROLE OF THE ROYAL ENGINEER OFFICER IN WAR.

Engineer Training 1937 states, vaguely but comprehensively, that "the role of the military engineer in war is to apply engineering knowledge and resources to the furtherance of the Commander's plans." Something more definite than this is required, however, to give a general picture of the work of the R.E. officer in war, or to give a useful guide to the requirements of engineer training in peace. On the other hand, an attempt to analyse in detail the work the R.E. officers may be called upon to do would be outside the scope of this paper. It is suggested, therefore, that such work may be roughly classified into the three main divisions which are discussed below.

Military Work.

As Royal Engineers are fighting troops, it is of the first importance that officers should be trained in the art of war. Moreover, R.E. officers may be employed on the staff, or as Commanders in the field; in action the command of mixed forces may suddenly devolve upon them. It is necessary, therefore, that R.E. officers should be competent to perform such duties, and that they should be fit to assume such commands.

It must be remembered also that every engineer problem in the field is affected, to some extent, by the military situation. The relative values of military and technical considerations must therefore be appreciated by R.E. officers. A thorough knowledge of military principles and organization is necessary to enable them to retain the confidence of the Commanders under whom they work, and of the other arms, with whom they must co-operate.

Royal Engineer officers may thus be called upon to carry out military duties; in addition, military knowledge is an essential in the execution of their technical work. A sound military training is therefore necessary for all officers of the Corps.

General Engineering Work.

Under this heading is classed all the ordinary work which is expected from Field Company officers on active service. Its scope is

almost unlimited; almost every branch of engineering science has its counterpart in the field. The following, however, are the most important subjects for which training must make provision:—field defences, demolitions, water-supply, accommodation, roads, bridging, communications generally, defence against gas, and elementary electrical and mechanical work of all sorts.

In considering this formidable list, however, it must be remembered that the majority of the problems encountered are not of a very intricate nature. Engineer work in the field is normally of a rough and ready order; cost and durability are of less importance than speed of execution and a good margin of safety. The ability to improvise from materials at hand is of more importance to the military engineer than the ability to produce elaborate designs in special materials.

It is clear, therefore, that the military engineer must be capable of dealing with a variety of different problems. These may not be in themselves obscure, but conditions will seldom be alike in any two cases. For this purpose prolonged specialization in any one branch of engineering is of little use. Practical experience, a general knowledge of engineering principles, a knowledge of the requirements of military engineering and, above all, a flexible mind, are the requirements of the military engineer.

Special Engineering Work.

While the majority of engineering problems in the field are not of an obscure nature, there will always arise a certain number which will be beyond the scope of general military engineering; such problems may be classed under the heading of special engineering. Examples occur in survey and railway duties, and in advanced electrical and mechanical work. The execution of work of this nature requires officers with the advanced technical knowledge which can only be obtained by prolonged specialization.

In order to avoid calling upon civilian experts, on occasions when only the Regular Army and its Reserves are engaged, it is necessary to have, within the Corps, a cadre of specialist officers to undertake this special engineering work.

The training of such officers must combine the military and general engineering training of the ordinary R.E. officer with the intensive specialization necessary for the execution of their special work. As has already been said, specialization is not a suitable form of training for general engineering. The number of specialists must therefore be kept to the minimum required for carrying out the special engineering work required by the Army in the field.

The General Picture.

It is now evident that two classes of officers must be recognized within the Corps: the regimental officer and the specialist officer.

The regimental officer must be a soldier, thoroughly trained in military duties and competent to appreciate military considerations. He must also be an engineer with a general knowledge of the principles of engineering science. He must have practical experience and a sound knowledge of military engineering problems. Finally, and most important of all, he must have a mind trained to independent thought, flexible to cope with ever-varying conditions, and capable of improvisation with whatever materials are ready to hand.

The specialist officer must aim at attaining the same general standards as the regimental officer, but he must, in addition, acquire a very high standard of practical and theoretical knowledge in his own branch of engineering.

The training of Royal Engineer officers must therefore provide for a sound military education. Technical training must be based upon a broad engineering education, to serve as a foundation for acquiring, by further study and by practical experience, a high standard of general engineering knowledge. There must be sufficient preliminary instruction in military engineering to serve as a basis for future study, and to enable officers to take command of engineer troops. There must also be variety in the work, and opportunities for independent thought. Finally, provision for the specialist training of a limited number of officers is necessary.

The special responsibilities of Royal Engineer officers in relation to science and civil engineering, and the particular training required by these responsibilities, will now be reviewed. With this general picture in mind, there should be no danger of exaggerating the importance of what is but a part of the whole subject of engineer training.

Special Responsibilities of the R.E. Officer.

In the preceding paragraphs an attempt has been made to review the general nature of the work of the R.E. officer in war. In addition to this work, however, the military engineer has certain special responsibilities to the Army, the importance of which is frequently overlooked.

The first of these is the position held by the Royal Engineers in relation to the developments of science and civil engineering. The outstanding characteristic of the present century has been the rapid progress made in the world of engineering. Moreover modern warfare tends to depend more and more upon the use of machines and scientific or mechanical devices of every kind. Every major development in civil engineering is ultimately adapted for military

purposes, and this work is largely the responsibility of the Royal Engineers. Between the soldier, who is concerned with the military application of new ideas, and the inventor, who is concerned with their mechanics, there is a vast gap which must be bridged by the Royal Engineers. The military engineer must be able to appreciate both the requirements of the soldier and the difficulties of the inventor. He must be able to gauge the possibilities of military requirements being translated into practical designs, and he should be able to indicate the lines which research should follow.

It is obvious that this responsibility will demand engineer knowledge of a very high order, and that specialist officers will be required for this purpose. But a somewhat similar responsibility, which cannot be delegated to the specialists, will devolve upon all R.E. officers in the field.

In this age of mechanical progress technical surprises are inevitable ; new weapons and new machines, the products of the scientist and the inventor, will be devised. There is at present no corps of scientists in the Army, and engineers are the most highly trained technical troops in the field. The history of the Corps shows that it is inevitable that, in the first instance, all new ideas will be passed on to the Royal Engineers for experiment and development. Moreover it is upon the Royal Engineers that Commanders in the field rely to anticipate and to guard against technical surprises by the enemy. These responsibilities must rest upon every R.E. officer in the field, and it is therefore most essential that all military engineers should be in touch with the latest developments in science and engineering.

A further responsibility will fall upon the R.E. officer on the expansion of the Corps in a national mobilization. In a major war there will be a large influx of civilian engineers, from all branches of engineering, into the ranks of the military engineers. These men will have little knowledge of the special requirements of military engineering ; they will have little military training, and no experience of Army methods; they will be essentially specialists in one particular branch of engineering, and they may well be men of considerable standing and experience in their own professions.

It will be largely the duty of the regular officers to direct the activities of these men. The whole work of the Royal Engineers in war will depend upon the establishment of a relationship between them based upon mutual confidence and respect. In the abstract this may not sound a very formidable task, but events in the past have shown that it is more difficult than it would appear. To the civilian engineer military engineering methods often seem clumsy and uneconomical, while to the business mind Army routine is frequently confusing and irritating. Occasions will often arise when the civilian engineer will be employed on work at which he is an expert, under the supervision of a military engineer whose knowledge

is relatively elementary. The military engineer must have sufficient knowledge of the subject to be able to appreciate the attitude of the civilian engineer; he must be able to accept the expert advice so far as it conforms to military requirements, and to convince the expert as to the simplifications or modifications considered necessary. Friction can only be avoided, and the best results can only be obtained, by cordial co-operation and understanding, and by the establishment of mutual respect for the knowledge of the other.

TRAINING REQUIRED BY SPECIAL RESPONSIBILITIES.

The problem now arises as to how Royal Engineer officers are to be trained in peace to assume these special responsibilities in war.

To make full use of the developments of science and civil engineering for the benefit of the Army demands, as has been said, officers of more than general engineering ability Officers who are to work in collaboration with civil engineers require a specialized training, somewhat similar to that of the civil engineer himself. The foundation of this training, it is true, must rest upon a broad engineering education, but, subsequently, prolonged specialization will be necessary, and very close touch with civilian engineering must be maintained. At the same time military training must be continued, in order to fulfil the role of connecting link between the soldier and the civil engineer. The training of specialist officers must make provision for these requirements. Officers must be selected for specialization in engineering; they must be given opportunities for the study of advanced engineering, and arrangements must be made for them to keep in close touch with civilian engineering. Provided that there are a number of well-qualified specialist officers in contact with civilian research, the Corps as a whole will be in a position to fulfil its responsibilities to the Army, by ensuring that full use of the developments of science and civil engineering is made for the benefit of the Army.

The similar responsibility that falls upon all R.E. officers is more difficult to meet. The initial engineering education must be supplemented by further training to produce a high general standard of engineering knowledge, without which any attempt to keep abreast of engineering progress will be useless. Such further training must be followed, if possible, by practical experience of civilian work, in the form of attachments to firms, actual work on major engineering schemes, or instructional tours. There is, in fact, no limit to the study of engineering that can usefully be undertaken for this purpose, other than the limitations of time available. But it must be remembered that the standard of military training must be maintained, and that practical experience of military engineering problems is also necessary. A high standard of engineering knowledge can only be of benefit to

all officers, but to concentrate upon this to the exclusion of other forms of training would be a grave error. In the consideration of methods of training, which will follow later, these conflicting claims must be balanced, and a compromise must be reached.

The responsibility for controlling and co-operating with civilian engineers in war is also one which will rest upon all regular R.E. officers. The establishment of mutual confidence will depend primarily upon the personalities of the officers concerned, and cannot be guaranteed by any method of training. It is possible, however, to prepare the ground in advance, and the training of R.E. officers should make provision for this purpose.

The first essential is that R.E. officers should possess excellent engineering qualifications; the importance of this in relation to civilian engineers is very great. The extent of specialization in civilian engineering has already been stressed, and it must be realized that civilians in one branch of engineering have but little knowledge of other branches. On the other hand, the fellow feeling between all civilian engineers is most marked. Anyone who has worked in contact with them, or who has served with a Territorial Engineer Unit, cannot have failed to notice the sharp cleavage between those who are regarded as engineers, and those who are not. Amongst civilian engineers their positions relative to each other are judged by their engineering qualifications, by the nature of their work, and by the standing of their firms. But, of these, the qualifications are the most important, and it is principally on their qualifications that engineers are recognized.

To a Royal Engineer officer, therefore, an engineering degree is of very great importance, for it is, in itself, a passport to the respect of civilian engineers. It should, if possible, be supported by practical experience of civilian engineering work. To have had a part in major engineering works, or to have served with important engineering firms, is, to an engineer, a guarantee of good faith, such as an account with the Bank of England is to a financier.

The various requirements of the special responsibilities of R.E. officers have, therefore, much in common. In the case of the regimental R.E. officer an engineering degree, a high standard of engineering knowledge, and practical experience of civilian engineering work have been shown to be necessary. There must, in addition, be a number of engineering specialists, whose knowledge and training must be such that they can keep in close touch with advanced civilian engineering research.

The general conclusion is that the special responsibilities of R.E. officers require a higher standard of engineering knowledge, from both regimental and specialist officers, than is necessary for the bare execution of ordinary military engineering work. Further, practical experience of civilian engineering is very desirable. But since

ordinary military engineering is the primary role of the R.E. officer in war, the requirements of this work must be the first charge upon training. It is only when these requirements have been at least partly satisfied that the additional training in higher engineering can be undertaken. The problem of how this general training can be carried out, and the possibilities of making provision for higher engineering training, will now be reviewed.

THE SYSTEM OF TRAINING.

It has thus been decided that the first requirement of the system of training must be that it will prepare R.E. officers to carry out the normal duties of military engineers in war. The qualities required are a thorough military training, a sound general understanding of engineering principles, and a knowledge, combined with practical experience, of military engineering problems. In addition, the power of original thought—a mind governed by principles and not by rules—was declared to be essential.

The next requirement of the system of training is that it should make provision for the training of a number of specialists in Survey, Railway and E. and M. duties, in order that suitable officers may be available to fill key positions on major expeditions.

It has been shown, also, that provision should be made for the higher engineering education of military engineers, and that this should include an engineering degree and practical experience of civilian engineering work.

Finally, the need for a small body of advanced engineering specialists has been emphasized. The training of these officers must be such that, while retaining contact with military engineering requirements, they will have sufficient knowledge and practical experience of civilian engineering to be able to keep in close touch with the developments of science and engineering.

In the remaining sections of this essay the existing system of training will be reviewed to see how far these requirements are being met, and an attempt will be made to indicate the general lines along which any extensions to the system should be undertaken.

Before proceeding with this, however, the definition of engineer training, given in the opening paragraph, must again be emphasized. Training means preparation for war. It must also be noted that "in peace the first responsibility of the engineer officer is to fit himself for his role in war; the second is the discharge of the various technical duties connected with peace administration." (*E.T.*, 1937, Sec. 2 (1).) In the consideration of the work of R.E. officers in peace the demands of engineer training must therefore be met first; the execution of work which cannot be classed as training is only a secondary consideration.

The Existing System of Training.

The training of R.E. officers may be conveniently divided into two stages, preliminary training as a young officer, and subsequent training as a serving officer.

Preliminary training as a young officer consists of a series of courses at the School of Military Engineering, the School of Electric Lighting, and at the R.E. Mounted Depot, Aldershot.* In addition, sixteen months are spent at Cambridge University studying mechanical sciences. The period spent at Cambridge, at the end of which officers are expected to obtain an Honours Degree in the Mechanical Sciences Tripos, is designed to give officers a sound general understanding of theoretical engineering principles. The various courses are intended to teach officers the military applications of these principles, to give them a basic knowledge of military engineering problems, and to continue the military training begun as a cadet at the Royal Military Academy.

It is clear that this preliminary training is well suited to the purpose for which it is intended. On completing this stage of their training officers should have a sound basis of theoretical knowledge, and an understanding of military engineering requirements. It is not intended, therefore, to examine the various courses in detail. It would appear, however, that a riding course at Aldershot is unnecessary after the schooling at the R.M.A., and that too much time is devoted to Survey, a subject in which the knowledge required by non-specialist officers is only elementary.† Curtailment of these courses would be universally regretted throughout the Corps, but in a mechanical age, and when time is a ruling factor, it is hard to justify them. New responsibilities, such as anti-gas defence, are constantly being entrusted to the Corps, and the scope of existing subjects is continually expanding; preliminary training must therefore be confined only to essentials if it is to keep pace with progress.

Subsequent training as a serving officer consists of the knowledge and experience gained from the work carried out by the Royal Engineers in peace. There are also various courses, such as Railway and E. and M. courses, for the training of specialist officers.

In order to estimate the value of this training a brief examination of R.E. work in peace must be undertaken. Broadly speaking, such work may be divided into the categories shown below. The numbers of Captains and Subalterns employed in each category, taken from the *Quarterly List* of January, 1938, are also shown. These figures

* *Editor's Note.*—The courses at the S.E.L. and R.E. Mounted Depot have now been abolished.

† *Editor's Note.*—The Survey course was reduced in 1934 to seven weeks devoted to work which may fall to any R.E. officer, and a special six months' post-graduate course for officers desiring to specialize in Survey was approved. Owing to shortage of officers and lack of applicants the last-named course has not yet been held.

must clearly be treated with considerable reserve, since many appointments are difficult to classify, but they serve to give some indication of the present distribution of junior officers to the various types of work available.

1. *Military employment.*—Captains and Subalterns employed—70.
2. *Military and engineering work.*—Captains and Subalterns employed—368.
3. *Specialist engineering work.*—Captains and Subalterns employed—77.
4. *Works services.*—Captains and Subalterns employed—130.

Military employment.—This consists principally of employment on the Staff, and it may be regarded as concentrated military training.. As the importance of sound military knowledge has already been stressed, staff employment may be considered to be a legitimate and valuable part of engineer training.

Military and engineering work.—Under this heading are grouped all appointments in which both military and military engineering experience are obtainable. It includes service with field companies, Sappers and Miners, Searchlight Units, the Training Battalion and T.A. Adjutancies. In most cases valuable military experience can be gained, but it must be admitted that the practical experience of military engineering that can be obtained is only of a very elementary nature. Very few opportunities are provided for the further study of engineering, and there is no definite system for this purpose.

Specialist engineering work.—This includes the appointments held by officers employed on Survey, Railway, E. and M., and special engineering work, and those under training for such appointments. The need for such specialists has already been explained, and it is clear, from the numbers employed in this category, that ample opportunities are available for the training of the necessary officers.

Works services.—The value of works experience to R.E. officers is a question that has been debated many times. From what has been said above regarding the role of the R.E. officer, and regarding the requirements of training, it is now suggested that works service cannot be classed as training for war. The usual nature of the work is totally different from that of military engineering in the field. In works services economy is normally the all important factor ; speed is seldom a vital consideration ; improvisation never arises ; designs are standardized ; opportunities for independent thought are few, and initiative is stifled by regulations. Work of this nature is the antithesis of military engineering.

On the other hand, it must be admitted that the nature of works service varies from station to station, and that occasions do arise, particularly on the North-West Frontier, when useful practical

experience can be obtained. Opportunities may also arise, when major contracts are involved, of making contacts with civilian engineering.

It would be unwise therefore to condemn all works service out of hand, but it is considered that works appointments should be carefully reviewed, and that only those should be retained which can be shown to be of real value as training for war. A large number of officers could thus be released from what might be termed sterile appointments. Suggestions as to the employment of such officers on useful training are given later.

Comments on existing system.—From this review it is clear that the existing system of training provides for a number of the requirements specified.

All officers are given a thorough initial military training, and ample opportunities are provided to keep military knowledge up to date by service on the Staff, or in military and engineering employment. The preliminary training of young officers ensures a sound general knowledge of engineering, and an understanding of military engineering problems. There is great variety in the work that officers may be called upon to do, and there are opportunities for gaining practical experience in elementary military engineering. The arrangements for the provision of the required specialist officers are excellent, both as regards the initial period of specialist study, and as regards subsequent practical experience.

The existing system thus provides for the essential requirements of the training of military engineers competent to carry out both the normal and the specialist work required of the Royal Engineers in war. The only criticisms that can be raised are that there are insufficient opportunities for obtaining practical experience of engineering work, other than that of the most elementary nature, and that there is no organization for the study of engineering after the completion of preliminary training.

On the other hand, it is equally clear that this system fails almost entirely in the provision of those requirements of training found to be necessary owing to the special responsibilities of R.E. officers. The higher engineering education of officers is entirely neglected; no opportunities of gaining experience of civilian engineering are provided; and there are no arrangements for the selection or training of advanced engineering specialists. Only one of these special requirements is met, that of the need for good engineering qualifications.

The conclusion is, therefore, that existing methods of training require to be extended to provide for these additional requirements. The main features of the existing system of training must be retained, however, since it has been shown that, under this system, R.E. officers are fitted to undertake their primary duties in war.

EXTENSION OF SYSTEM OF TRAINING.

The final problem is thus in two parts; firstly, arrangements must be made for the selection and training of advanced engineer specialists, and secondly, the general standard of engineering knowledge and experience must be raised throughout the Corps.

It is clear that no drastic alterations are necessary in the existing system of training. Preliminary training as a young officer has been shown to be essentially on sound lines; the greater part of the work carried out by R.E. officers in peace has been proved to be useful engineer training; it is only in regard to works service that serious criticism has been raised, and it has been suggested that a number of officers should be withdrawn from such employment. A system of higher engineer training should now be evolved for the officers thus freed.

The whole problem has its roots in one fundamental weakness within the Corps. Lack of incentive, combined with lack of opportunity, for the study of engineering has resulted in a general slackening of interest in engineering throughout the Corps. At present the ambition of almost every junior officer is directed towards the Staff College. The magic letters "p.s.c." are regarded as the key to promotion, and as the hall-mark of success. The keenness of the competition for admission to the Staff College, and the extremely wide scope of the examination syllabus, inevitably result in junior officers concentrating upon military study to the exclusion of engineering. Officers who have passed through the Staff College tend naturally to continue their military studies, with a view to ultimate promotion to the higher ranks of the Army. Officers who have failed in the entrance examination have normally lost touch with engineering theory, and are unwilling to resume the study of it without suitable facilities. Other officers specialize from the first in order to obtain technical appointments, or continue as regimental officers, content with the interest and variety of work presented by the life of a military engineer. They have no incentive, outside their innate interest, to continue their initial studies of theoretical engineering beyond the point required for the understanding of elementary military engineering.

The effect of the Staff College on the study of military training has been intentionally stressed, because it would appear that useful lessons can be drawn from it. The Staff College provides an immediate incentive for the study of military training; it presents a means whereby officers can improve their prospects of promotion, and ensure appointments of particular interest in the future. There is consequently a direct stimulation of interest in military training. The first step towards reviving a general interest in engineering

within the Corps would thus appear to be the application of a similar stimulant to engineer training.

A stimulant of this nature could be provided by the institution of, say, an advanced engineering course, which in effect would correspond to the Staff College course. The necessary incentive would have to be provided by the reservation of a number of important technical posts for graduates of the course. Such appointments might include various instructorships, experimental and research work, and special appointments designed to keep the Corps in close touch with the latest developments of civil engineering. Admission to the course should be by examination, the syllabus for which should cover a wide range of theoretical engineering knowledge. The course itself should be designed to improve the theoretical knowledge of the students, to bring this knowledge into line with modern developments, and, by means of attachments to civil firms and instructional tours, to bring students into contact with civil engineering.

This plan would serve a double purpose. By holding out definite prospects of promotion, or appointments of exceptional interest, to officers with engineering qualifications, it would stimulate interest in engineering throughout the Corps. It would also provide a solution to the first part of the final problem. The selection and preliminary training of advanced engineering specialists would be done by means of this course. Their further training, and the fulfilment of the purpose for which they are required, would be served by experimental or research appointments, and by the attachment of specialist officers to civil firms to keep in touch with the trend of modern developments.

These proposals would also serve as a basis for the solution of the second part of the problem, by providing the necessary incentive for raising the general standard of engineering knowledge throughout the Corps. Further measures, wider in their application, would however be required; some suggestions are therefore discussed below.

Examinations.—A technical examination in engineering theory and practice might be introduced as a qualification for promotion to field rank. This would be an unsatisfactory solution. The object of raising the general standard of engineering knowledge is to broaden the outlook of the R.E. officer, so that he can keep in touch with the latest developments in civilian engineering science. A compulsory examination must, in fairness to candidates, have a fixed syllabus and must set only a moderate standard. This would not act as a true stimulant to interest, and would not produce the type of knowledge required.

Refresher courses in engineering.—Courses might be introduced at the S.M.E. for senior subalterns and captains, designed to bring up to date the knowledge acquired as a young officer. Interest in

engineering could be aroused, and contact with civilian engineering could be established, by including in these courses periods of attachment to important civil firms, or extensive tours of civilian works and major engineering schemes. Such courses must be designed for non-specialist officers, and should not be regarded as preliminary to the advanced engineering course.

It is considered that they would provide a useful and interesting means of raising the standard of general engineering knowledge among R.E. officers.

Engineering appointments with civil firms.—The study of engineering theory is of little value unless opportunities for practical experience can be provided. It is suggested, therefore, that a number of attachments for R.E. officers should be arranged with civilian engineering firms. Every possible chance should also be taken of allowing R.E. officers to take an executive part in major engineering schemes. This would have the double advantage of bringing military engineers into close contact with civilian engineering, and of giving them practical experience of engineering work.

It may be objected that such attachments will be difficult to arrange; until the attempt is made it is impossible to judge. The writer can vouch for one case at least in which the proposal, when tentatively discussed with a director, was enthusiastically received. A great many of the important men in civil engineering have served with the Royal Engineers in the past, or are now connected with them through the Territorial Army; such men are usually found to be only too willing to do all in their power to help.

A further objection may arise from the financial implications of the proposals. These cannot be assessed until the scheme is worked out in greater detail than is possible here. Provision will obviously have to be made for the permanent replacement of officers withdrawn from works service, and new appointments may have to be created. The cost should not, however, be prohibitively large, and it should not be permitted to bar progress. As the most highly trained technical troops in the field, it is most essential that the training of R.E. officers should aim at reaching the highest standard possible.

SUMMARY OF PROPOSALS.

The proposals for extending the scope of the existing system of training can now be summarized.

It is suggested that "refresher courses" for senior subalterns and junior captains of the Royal Engineers should be instituted at the School of Military Engineering. These courses should be designed to bring up to date the knowledge and experience already acquired by these officers, to bring them into contact with civilian engineering work, and to stimulate their interest in the developments of engineer-

ing science. In addition, there should be a number of attachments to civilian engineering firms available to officers, who have completed refresher courses, but who are not to be classed as specialists.

It is suggested also, that an advanced engineering course should be instituted for Royal Engineer officers, to correspond, on the engineering side, with the Staff College course in the Army. From the graduates of this course, officers should be selected to fill important technical posts with the object of keeping military engineering abreast of the latest developments in civil engineering.

These proposals are intended to extend the scope of the existing system of training to include all the requirements of training. The main features of the existing system, with all the results that it achieves, would remain unaltered; its one weakness would be removed. The withdrawal of a number of R.E. officers from works service would liberate a corresponding number for training which would improve their engineering experience and knowledge. This additional training would raise the general standard of engineering knowledge; it would provide opportunities for officers to establish contacts with civilian engineers, and to gain practical experience of their work. Finally, it would allow for the selection and training of advanced engineering specialists. Thus all the additional requirements of training, which were found to be necessary owing to the special responsibilities of R.E. officers, would be satisfied.

KHAISORA ROAD.

By COLONEL R. L. BOND, C.B.E., D.S.O., M.C.

WORKING quietly in the office one Saturday morning in Dera Ismail Khan, the telephone bell rings . . ." H . . . speaking; get in your car at once and come to Mir Ali, you are wanted for a conference." Mir Ali is 112 miles away; it is a shade disappointing when, rounding a corner some five miles from the finish, a bare three hours later, a posse of beflagged cars passes at high speed in the opposite direction, the " conference " making for home. Round we go and, late in the afternoon, run it to earth to be told that before breaking up it had been decided to start work on the Khaisora road at daybreak on Monday . . . essential politically to show progress at once . . . " speed and economy " our watchwords. At break of day then, on Monday morning, the road-builders start out from Mir Ali, Monday, November 30th, 1936, a keen clear frosty morning, and by night the first formation of ¾ mile of road has been constructed over water-channels, irrigated fields and mud walls, firm indication of our intentions for the future. Let us look for a moment at the setting in which this work has been begun.

Traversing Northern Waziristan from west to east is the Tochi river valley, the most fertile part of that hard country. Patches of cultivation from 1 to 2 miles wide and 6 miles long alternating with belts of mountain ridges, forming barriers through which the river has forced a winding course in a series of gorges, provide fertile fields and rich orchards supporting a dense population. The owners of this fertile strip along the river are the Daurs, not much accounted of by the Wazirs who hem them in on either side. Had it not been for British protection afforded by a string of military posts from Bannu to Datta Khel, the Daurs would probably long since have been dispossessed by their more virile neighbours, and for this protection they had submitted to a measure of administration and revenue payment. In the small village of Ipi, almost within rifle-shot of Mir Ali, lived a fakir of some local fame with the peculiar reputation of refusing to take alms. Early in the year in which this story begins occurred a trivial event which was destined to cause the loss of many hundreds of lives and to engage us in a campaign lasting for over a year.

A Mahommedan in Bannu removed a Hindu girl from the care of her parents and married her. The parents brought an action for abduction against the man in the civil courts, an army of legal

advisers appeared on each side, the case dragged on for weeks, communal feeling in the town ran high, and without warning a dangerous twist was given to the affair by the fakir of Ipi, who moved out of protected territory with a following of Daurs into the Khaisora valley 15 miles to the south where, being joined by numbers of hot-headed youngsters and disaffected Wazirs, he announced his intention of marching out of the hills on Bannu and forcefully intervening in the course of justice. Political, military and economic pressure and the termination of the case in the Bannu courts, caused the break-up of the *lashkar*, but the fakir remained in the Khaisora in Wazir country with a small following and began to raise a campaign of propaganda against the Government on all sorts of grounds. The tribal Maliks, who had nothing to gain and a great deal to lose by conflict with the Government, were far from pleased at the fakir's interference with their authority over their tribes and foresaw that the considerable incomes that they were drawing from Government contracts for road building and maintenance, supplies and so on were being endangered. To put an end to this situation and to assist in restoring the authority of the maliks it was decided to move columns from Razmak and Mir Ali by different routes into the Khaisora. The movement took place on November 23rd and following days, but the fakir having attracted more sympathy than had been realized, the passage of the narrow rugged gorges of the Khaisora, as well as of the open plain to the north of that river, was strongly opposed by many hundreds of tribesmen, the columns suffering considerable casualties. A stampede of a few mules led to the loss of some blankets and an important item of bathroom furniture which, magnified by rumour into the loot of an army, brought greedy adventurers from all parts of Waziristan and even farther afield to join in the fun, making it imperative to take punitive action at once. The two columns had meanwhile completed their movement and were concentrated in Mir Ali, where before long they were joined by the 2nd Infantry Brigade from Peshawar and other troops from outside the District.

The Khaisora, which gave its name to this part of the campaign and to the road, takes its source in the high mountains near Razmak and for many miles runs close to the main Razmak-Mir Ali road. Some 20 miles from the Administrative border which runs along the feet of the outermost hills, the river turns away from the road and winds in a narrow bed between high and rugged hills, the stream in perennial flow meandering from side to side of its boulder-strewn bed. About 6 miles down stream from this point, a tremendous feature bars the way and the river turns abruptly south and then again east round the toe of the mountain in a deep and narrow gorge. On leaving this gorge, the river-bed widens and runs between high and precipitous banks for another 6 miles, to the north being a plain

lying like a trough between two ranges of hills and leading to Mir Ali 16 miles away. This plain is deeply seamed with cross nullahs which formed the only awkward obstacles to the road which was to run from Mir Ali to the Khaisora. Above the south bank is a narrow stretch of plain lying at the foot of hills rising 1,000 feet abruptly above it. At the end of this 6-mile stretch, the river breaks through a last narrow gorge before passing through the foothills and out into the plains.

A loop road from Mir Ali to the Khaisora and thence west up that river to its junction with the Razmak road had long been one of the projects in the minds of the authorities, but the heavy cost of the construction up the rugged defile and a desire not unnecessarily to disturb the inhabitants of this not very friendly area had made the project academic. A revival of interest the previous year had led the writer to accompany the column and to carry out a very rapid reconnaissance in the course of the march. As a result, a provisional alignment was selected and a skeleton project prepared, with a very approximate estimate, and pigeonholed. This was most fortunate in the event as it fixed the ruling points, saved time in selecting one of several possible alignments and made it possible during the campaign to concentrate on reconnaissance for the detailed line of the road. To complete the picture, it may be said here that the road having reached the Khaisora, where it would have ended rather aimlessly in the air, it was decided to loop it eastwards down the river to the border and thence north along the border to the main road at the twin-towered post of Dreghundari 8 miles from Bannu.

Thirty-three miles in length, the road took off at the 23rd M.S. on the Bannu-Razmak road and was divided into seven sections. The first section up to the Tochi river, 2 miles, was over heavily cultivated *kach* land, cut up into numberless small fields separated by minor irrigation channels and crossed at right angles to the road by several main channels up to 8 ft. wide and 5 ft. deep. In cases where the fields had recently had their turn to be irrigated, the soil was wet many feet deep and the formation gave endless trouble.

The second section, from the Tochi, a 300 yard wide gravelly bed with three streams running in it, to the Katira nullah was again 2 miles in length, the first 300 yards over heavily irrigated *kach* over a deep 10-ft. channel, up a 15-ft. perpendicular bank and out on to a flat plain of sandy clay soil, glutinous when wet and powdery when dry and crossed at frequent intervals by undisciplined old water-channels. The next three sections ending at the Jaler Algad, the Khaisora and Sein Gorge respectively, in all 15 miles, were over open rolling country, the soil being the same sandy clay, but heavily plummed with stones of 2-in. to 18-in. in diameter and often very much larger. Many small nullahs entailing side cuts crossed the line of the road and there were two main nullahs, Jaler Algad (Photo

No. 6) and the Khaisora (Photo No. 10) whose approaches required much work and in which the trail-builder machine was invaluable. The real difficulties began at the point where the road dropped from the River camp plateau back into the Khaisora before passing through the Sein Gorge (Photo No. 12). In order to keep the road out of the nullah and above high flood level it was necessary to make a heavy cut along the face of a 1 in 2 slope seamed with enormous boulders many tons in weight (Photo No. 12). Sein Gorge is formed by the river cutting its way through a 50-ft. thick perpendicular stratum of hard rock rising 150 ft. or more above bed level. This peculiar formation like a giant spine traverses almost the whole of Waziristan from north to south and is responsible for certain famous gorges in all the rivers which give access to the heart of the country, Shinki on the Tochi, Barrari on the Takki Zam and the Shahur Tangi on that river, all places where hard fighting has taken place at one time or another. Sein Gorge made it essential to descend into the nullah bed and to cross to the north bank, leaving it to a later stage of development to bridge the gap. It is, however, of no particular importance as if the Khaisora is in spate, not a frequent occurrence, it is almost certain that the Tochi will be also and therefore the road will not be open to traffic in any case.

When the Khaisora is in spate, it may rise to as much as 17 ft. or more on either side of the gorge. It was therefore necessary in the sixth or defile section, as it was called, to keep well up the hillside, which entailed cutting through a series of perpendicular strata running parallel to the main one (Photo No. 15) over a distance of 1,000 yards. After this, the alignment had to climb at 1 in 15, the ruling gradient, up on to a series of small plateaux high above the river till reaching a camp known as Rucha Camp. It then dropped once more, circling with difficulty through and round numerous graveyards till, climbing over a last ridge, it reached the border at a point known as 10 R. The final section, 9 miles to the main road at Dreghundari, was over heavily boulder-strewn country, a series of low humpbacks and shallow dry watercourses where the flood water from the foothills spreads in constantly changing channels at frequent intervals, until, ¾ mile from the end after negotiating a wide and deep irrigation channel, it dropped sharply to the Tochi and then up again to the last flat stretch.

As has been said, the work started with a rush. The C.R.E. arrived in Mir Ali about noon on Sunday, 29th November, with a nucleus office staff; Captain Battine (A.G.E. Bannu) who had been out with the column in the previous fighting took up duty as Brigade Major and Captain E. H. W. Clarke arrived from Peshawar as A.F.E. that afternoon. Two days later, Captain Havers joined as F.E., followed the next day by Lieutenant Ian Boyd as Staff Captain and O. i/c Stores. Later still, when the road had progressed so far that

consolidation and maintenance could not be handled as well as new construction by the existing staff, Lieutenant A. S. Barton came from Wana as A.F.E. and in January, Captain Fea joined and took over Field Engineer from Havers.

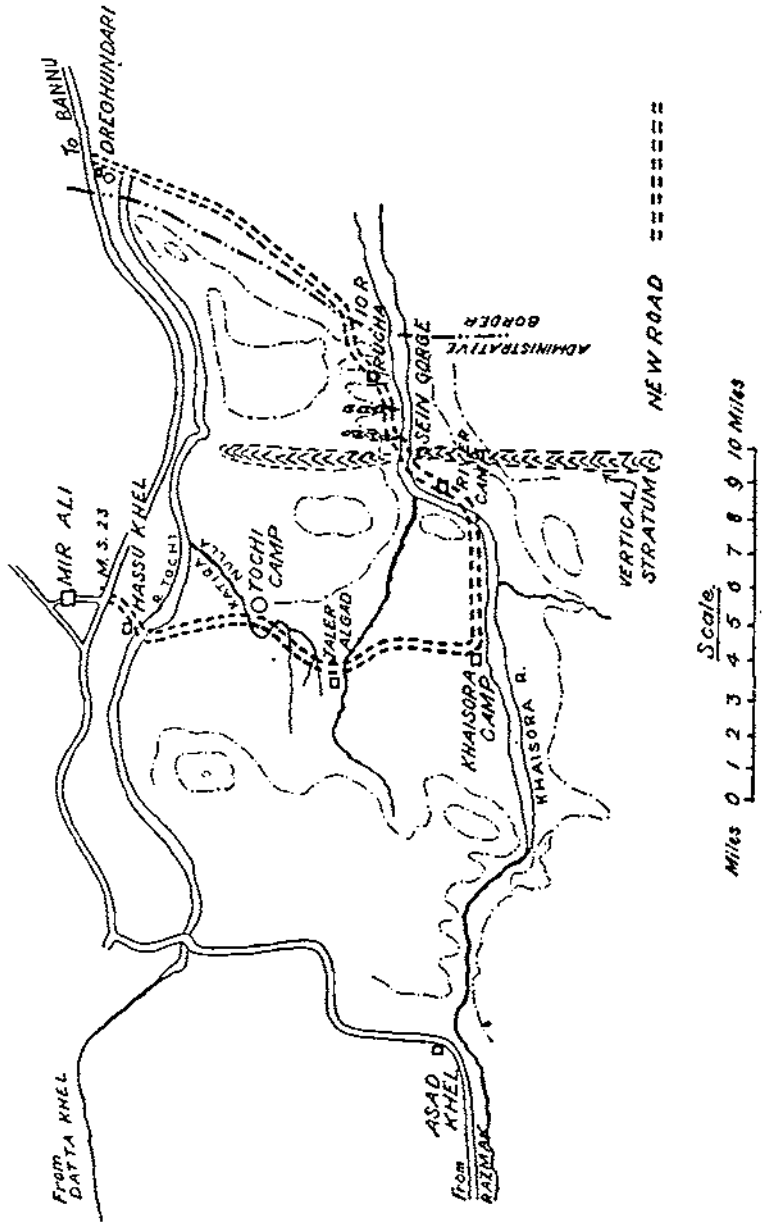
At the outset, only 15th Field Coy. Q.V.O. Madras S. and M. was available. This Company had been split between the two columns on the earlier operations. During 30th November, 18th Field Coy. R. Bombay S. and M. arrived from Kohat, followed on 2nd December by 4th Field Coy. K.G.Vs'O. Bengal S. and M. from Rawalpindi and later by 22nd Field Coy. R. Bombay S. and M. from Kohat. All four units threw themselves unsparingly into the work and the healthy and friendly rivalry between the three Corps and the excellent co-operation between them was productive of the most admirable results.

The machines available for the operation were in the first place a P.W.D. auto-patrol from Bannu, followed by an M.E.S. auto-patrol, a trail builder from Kohat on 2nd December and one by one by other machines until the tally was two auto-patrols, two tractors and graders, two trail builders generally known as " monsters," eleven steam rollers and five compressors. The Kohat trail builder (Photo No. 7), driven by an imperturbable gentleman in a green jacket, did sterling work, was only out of action for one short period and was worth 600 men a day. Green Jacket was indeed a master of his craft and an important factor in the speedy completion of the road.

A detailed description would be too long and tedious ; it will be sufficient to describe some of the more typical difficulties. It should be said, however, that the specification laid down by the Government of India (when the road had already progressed about 13 miles) was for an 18-ft. shingled road fit for occasional M.T. in dry weather. As, in the course of the operations, the road had to carry a traffic density of up to 400 lorries a day and had to be used for heavy traffic in wet weather, the specification was not entirely adequate. The cost was not to exceed 5 lakhs (about £37,500) including not more than 50,000 rupees for the 10-mile " Civil " section from Dreghundari to 10 R. The actual specification used was a formation from 24 ft. to 30 ft. in width according to the nature of the soil with 18 ft. of shingle, 4 in. in depth, though in many places it was necessary to exceed this figure considerably. In general, the troops laid the first two inches of shingle and the last two were laid by contract.

The normal daily procedure was as follows. The column moved about 7.30 a.m. from camp, protective troops, cavalry, tanks and infantry with the Engineer reconnaissance party ahead. Next came the engineer column with its ungainly circus of auto-patrols looking like enormous spiders against the dawn sky, trail builders and traction engines following close on the heels of the Sappers and Miners and finally the infantry battalions detailed for working parties. The F.E. or A.F.E. with the protective troops would be ready to lay

SKETCH MAP OF N. WAZIRISTAN and KHAISORA ROAD



out the line of the day's work, probably only partially surveyed through glasses from the foremost picquet the day before. This work had to be rapidly carried out to ensure that no delay occurred in getting the troops to work. The normal distribution was one Field Company with half a battalion on the new formation at road head, one Field Company with half a battalion completing the previous day's formation and one Field Company with one battalion shingling in rear of the first two. The fourth Field Company acted as C.R.E.'s reserve but was probably employed on water duties and on completing odd jobs at places where the road already subjected to heavy traffic might be giving trouble, such as wet spots, nullah crossings and so on. Troops returned to camp on the conclusion of each day's work, with the result that to enable the rearguard to be in before dark it was frequently necessary to stop work at 2 p.m. having only started at 10 a.m. When the 2nd Infantry Brigade was established at River Camp, permanent picquets were installed well forward and this saved an immense amount of time and almost an 8-hour day was possible on the most difficult section of the road. There is no doubt that where the situation permits road making will proceed twice as fast in the shelter of permanent picquets than when the column has to move out each day establishing picquets before work begins and withdrawing at an early hour in the afternoon.

Once the day's work was started, the Engineer reconnaissance was carried out from the forward line of picquets to decide on the line for the following day. In certain cases, the F.E.'s were able to go ahead in tanks and reconnoitre the line in detail; this was particularly valuable before crossing the Khaisora the first time to determine the best line to descend from the plateau into the nullah and up again on to the River Camp plateau on the far side. Again, it would have been impossible to be certain that the drop from the latter into the nullah at the Sein Gorge end was practicable without tank reconnaissance. Air photos were helpful, but required confirmation. Air reconnaissance was also used and was most valuable. For example, on reaching Khaisora camp, the G. of I. having approved the proposal to carry the road eastwards and finally back to Dreghundari, it was a question whether the best line was not north of the Khaisora all the way back to 10 R. Reconnaissance from the ground from the east end of the defile had indicated the possibility of a satisfactory route, at any rate from the ridge north of the gorge to 10 R.; air photos showed a somewhat forbidding prospect on the west side of the razor-edged ridge. Air reconnaissance made it clear that not only was the passage of this ridge a very formidable problem, but the approach road was over such intricate, tumbled hills that it would have been a very long job to carry the road that way with miles of side cuts, whereas the River camp plateau route was all plain sailing besides being tactically by far the simpler task. This

Photo No. 1.—Upper Khaisora.

Photo No. 2.—New road south of River Tochi, Hassu Khel village top right, camel track left.

Photo No. 3.—4-ton shingle lorry in Khatira Nullah.

Photo No. 4.—Negotiating a small nullah. Before smoothing and shingling.

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Photo No. 5.—Auto-patrol in action.

Photo No. 6.—Jaler Algad.

Photo No. 7.—Green Jacket and his Monster widen a corner.

Photo No. 8.—A completed stretch.

Khaisora Road 5-8

air reconnaissance will long remain in the writer's memory. The day was one of those perfect keen clear sunny days of the N.W. Frontier winter, visibility illimitable, the snowy line of the Safed Koh standing up, white and dazzling, apparently only a few miles away and forming a white background to the tumbled, jagged brown and purple hills of North Waziristan and the Kurram beyond; below, the ribbon of the new road stretching away to Mir Ali and looking as if it had been there for years. Then as the aeroplane circled over the plateau on the south side of the river, immediately below there started to grow with incredible speed an enormous brown and white mushroom. The columns were in action and this, the first of several, was the fine new tower of the fakir of Ipi dissolving in the smoke of a very fine demolition by the Sappers and Miners. All three corps had demolition parties out on this day with the various columns and had a respite from road-making. This, however, is a digression.

To return to the day's time-table, the reconnaissance being completed, and the programme for the next day's work settled by the C.R.E., the latter attended a conference at Force H.Q. and arrangements for the operations were agreed. This was followed at 6 p.m. by the C.R.E.'s conference with the F.E.'s and Officer i/c Stores and Transport. Either the F.E. or A.F.E. spent the night at H.Q., the other being at the most forward camp. The forward Sapper had by 6 p.m. finally completed his list of requirements in stores and transport and machines for the next day and telephoned them to his opposite number at H.Q. At this conference, the detailed programme was completed, including the allotment of stores and lorries to the Field Companies and the contractors, and everyone could then get on with his job. The arrangements were confirmed in a formal order later. This drill worked very satisfactorily and few hitches occurred. It was fortunate that the telephone to the advanced camps worked on the whole very well; at one time the enemy began to cut the wires at night but this was stopped by joining the telephone circuit on to the power station in Mir Ali one night with admirable results, for we had evidence that someone had " bought it " properly. On another occasion the stoppage was traced to the auto-patrol which had cut the line as it widened a drain; " but Sahib," the driver protested, " I tied it up again very tight." So he had, a neat reef knot.

As regards stores, an Advanced Engineer Park was established at Mir Ali on the first day and stores of the most useful description, ordered by the Chief Engineer, poured in. Particularly valuable were large numbers of water tanks, miles of army track wire (a heavy wide-meshed wire netting for laying on roads in soft spots), Hume pipes, tools and explosives. When columns moved to the forward camps, it was found necessary to open advanced dumps there which were run by a British N.C.O. of the S. and M.

To return to the narrative of the road construction, as has been said above, the work commenced on Monday, 30th November, with such tools as were available. Under cover of protective troops who picqueted the large village of Hassu Khel whence shots had been fired at the rearguards the week before, two battalions and 15th Field Coy. started on the first 1,000 yards of formation, digging side drains 21 ft. apart (we were still under the influence of the original project designed to reduce compensation to a minimum and quickly changed to 24 ft.) across the fields in which crops were already beginning to show. Colas drums wired together were used to bridge the irrigation channels, later on replaced by Hume pipes and in the larger channels, in which the volume of water flowing was often large, by concrete slab culverts. On the wet patches, the spoil from the side drains came up in large chunks which were difficult to smooth down into a satisfactory formation and, in order to get lorries along, Army track wire was laid. This quickly sank and the only solution was to put heavy soling on the netting and eventually more netting on that and more stones again until at last the surrounding fields dried out sufficiently to enable diversions to be made, the wet patches to be taken out, dried and relaid completely. These wet patches were something of a nightmare during the unusually prolonged period of four days' heavy rain from 11th–13th December, as there were then three brigades in the forward area and traffic was heavy. It was not, however, until the fourth day of rain that all M.T. traffic had to be taken off the road except for some specially-designed 4-ton lorries with double back wheels and large tyres which did no damage to the road surface and were invaluable; they were made with ridge-shaped floors and sides that hinged on the upper edges and were excellent for shingling, as well as for the conveyance of stores over the roughest country and up the steepest gradients.

After the second day's work, it was possible to get the auto-patrol and grader on to the job except in the wet portions. Shingling started, first of all from a nullah behind Mir Ali and later from the Tochi. The shingle in the first nullah was large, up to 3 in. or more, but it rolled into the soft soil well and was the saving of the road in the rain as it formed a sort of macadam and threw the water off, standing up to the continuous traffic in an admirable manner. A day's fine weather and the surface was perfect.

The troop working parties available were only sufficient for road construction at the head of the road and for shingling. It was early obvious that extra labour would be needed for completing the work behind and for maintenance. The general method of work was for sappers to lay out the line, anything up to a mile a day, and for the road-making parties to clear the bigger stones and boulders and to start on the side drains and formation. The trail builder was fully occupied in dealing with the side cuts, the descents into the nullahs

and other heavy work, but even so, the amount of work to be done only made it possible to use it for the first cut or two up to 12 to 14 ft. of formation, the remainder of the widening being done by troop labour. Shingling went on about two to three days' work behind, troops laying 2 in. of shingle, 18 ft. wide, though in some places 4 in. or more was necessary. It was found that it was much quicker to work with a long lead up to two or three miles from a good nullah with ample space for proper organization than to use nullahs closer to the work but cramped for room ; the running time over the odd mile or two was very small compared with the other parts of the work and was amply made good by the quicker turn round. The shingle when watered and rolled made a good surface and was then ready to be taken over by the M.E.S. organization. A contractor was obtained, who, having been out of favour with the M.E.S. for some years was anxious to reinstate himself, and three contracts at a very reasonable price were arranged ; (i) for supply of labour only, the men working on maintenance under the M.E.S. staff, (ii) for the supply of shingle, another 2 in. up to 18 ft. in width, (iii) for road works, culverts, etc. This contractor did very good work indeed under conditions of great difficulty and it was necessary to revise his contract more than once, to make up for unforeseen delays and for the shorter and shorter working days and the number of days on which no work was possible due to rest days or operations when the road was not picqueted.

Apart from minor troubles, most of which were solved by Green Jacket and his monster, no serious difficulty was met until the gorge section was attacked. 4th Field Coy. threw itself with immense energy at the long side cut where the size of the boulders made the use of the monster impracticable. The air resounded with the noise of compressors and explosions and the area was more dangerous than the picquet line ; ten-ton boulders were being split in all directions. Almost the only accident here was due to a British soldier throwing a cigarette end into a charge-hole in which was the remains of a charge of unexploded country gunpowder.

Through the gorge, the chief trouble arose from the perpendicular strata already described. Thick and full of large cracks making tamping difficult, very high and awkward to work on and entailing the removal of large quantities of rock above road level, they were a long and irksome job. As flood level was as much as 17 ft. above nullah bed level and the force of the water was terrific, there could be no question of building out round the toe of the rock except in one place where good rock foundations for a masonry wall were available. 18th Field Coy. did excellent work on this section in the course of which, unfortunately, a sapper was killed, having incautiously and contrary to orders put his head above cover to watch the effect of a charge. A stone hit him in the head at a distance of over 200 yards.

Troops moved forward to camps as the road progressed so hard on the heels of the work that the lorry columns made the work difficult, especially shingling. Tochi camp was established by Razmak Brigade (6 battalions) on 5th December, Jaler camp by the same brigade on the 9th, Bannu Brigade in Tochi camp being joined on the same day by the 2nd Infantry Brigade. The road only reached Jaler camp 8 miles from the start on this day and the problem of getting the whole of the baggage and supply lorries into camp and out again before picquets had to withdraw and the road closed was no easy one, as the camp site was separated from the road alignment by a nullah 200 yards wide with steep sides. Green Jacket saved the day, cutting a one-way track down one side of the nullah and up the other in record time, the sappers completing the surface enough to get the lorries up and down. On 18th December, Razmak Brigade moved forward to Khaisora camp followed on the 21st by 2nd Infantry Brigade, Bannu Brigade moving to Jaler. Over 400 lorry trips moved over the road on this day without difficulty, lorry columns doing their trip out, turning round and back during road-open hours although Khaisora camp was 18 miles from Mir Ali. On 31st December, 2nd Infantry Brigade moved forward to River Camp and began the heavy work on the gorge section.

Over the River camp plateau, for three miles it had been possible to do practically the whole of the formation work by machinery owing to the absence of any considerable boulders.

In the meantime, on 21st December, work was begun on the Dreghundari—10 R. section. The local *khassadars* had remained loyal and under their protection and with a small escort of Frontier Constabulary, mounted reconnaissance was practicable up to 10 R. and beyond, though the Constabulary ponies and saddles left their trace for some days afterwards! The general line having been selected, there was no difficulty in fixing an alignment consisting of two long straight legs of nearly 5 miles each. The whole work was done by machines and contract. The latter was for 2,500 rupees a mile for clearing the larger stones, digging side-drains and shingling to a depth of 2 in. This form of contract was useful as we had an exact knowledge of our liabilities and it saved a good deal of trouble over measurement and generally made for speed; the work was well and quickly done. No troops were needed on this road and in order that the work should go ahead without interruption, a rough track was cleared parallel to the main road to take inspecting officers' cars, coolie and store lorries and so on, all traffic except shingle and water lorries being kept off the road; actually, the contractor used donkeys almost entirely for carrying shingle. The soil was a mass of stones and small boulders and, as the available machines had more work than they could cope with, the preliminary clearance of the formation by coolies was essential; on the other hand, the small stones when

Photo No. 9.—Little Willy does his best. A grader-built road before shingling.

Photo No. 10.—Out of the Khaisora bed on to River Camp plateau.

Photo No. 11.—River Camp plateau from a piquet looking towards gorge.

Photo No. 12.—Side cut. Sein Gorge behind.

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Photo No. 13.—Sein Gorge from the east.

Photo No. 14.—The rush for Rucha.

Photo No. 15.—Strata. Eventual road level above the path.

Photo No. 16.—A good blow.

(With acknowledgments to Capt. R. H. Havers, o.b.e., *for Nos. 2, 3, 4, 5, 12 and 16.)*

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shaped up with the soil into the formation formed a sort of soling for the shingle and made a fine fast surface. Ian Boyd, taken from his store duties to take charge of this job, hurled his massive self at the work like a tornado and infected his staff and contractors and everyone else with his enthusiasm ; his boulevards unrolled themselves at remarkable speed. Almost the only set-backs were, first, when the local inhabitants removed in the night the girders and corrugated-iron sheeting of the bridge over the irrigation channel at the top of the Tochi bank ; secondly, the night after the whole of the milestones and furlong stones in the ten miles of formation had been put in position and painted, the entire collection was stolen. As they consisted of 6-ft. angle irons driven four feet into the ground, it was not a bad effort on the part of the thief. The machines on this section consisted of a trail builder, two graders, an auto-patrol, three road rollers and ten lorries fitted with water-tanks and sprinklers. The one constructional difficulty was the very steep rise out of the Tochi and over a 10-ft. irrigation channel in full flow at the edge of the bank crest. A side cut was not possible and it was necessary to make an awkward ramp into the river-bed protected by a bund and hope it would stand up in the flood season.

Ahead of 10 R it was decided to continue the road by contract as far as Rucha camp, halfway to the gorge. The alignment required careful survey as there were numerous graveyards on the line and, in any case, the nature of the intervening hills restricted the possible alignment within narrow limits. Deputations of local tribesmen followed one about with grieved expressions hoping against hope that some incautious act of ours might enable them to turn their ancestors into sources of hard cash, but we were able to allay their fears, if also to disappoint their hopes, and the road went through without disturbance. This part of the road being in tribal territory and the attitude of the locals being uncertain, the contract was given to one Shah Alam, a good contractor and loyal man of considerable influence. The price was reasonable and it was made clear that the machines would be used. The contractor produced ample labour in very short time. Amongst these, the writer noticed one day a gang of fine cheery fellows working like beavers ; on asking the contractor who they were he was informed " Afghans—from Kohat." The latter statement, in view of conditions up the Khaisora valley, was open to question, but as the men were working well and seemed happy, we accepted it at its face value.

Urged on by Boyd and his invaluable henchman, Rai Sahib Moti Ram, a fine S.D.O. well known to all officers who have served in Waziristan, all difficulties were rapidly overcome and the work developed into a race for Rucha camp with the troops working from the west. On the last day, Boyd with his car at the foot of the hill on one side, spurring on the monster and the coolies, who had fully

entered into the spirit of the thing and were encouraging themselves with loud chanting (Photo No. 14); Havers with his car at the foot of the hill on his side with Green Jacket and troops; but the latter had farther to go and Boyd won by a few lengths. On the following day, 15th January, 1938, a car for the first time completed the circuit of 33 miles and the writer was able to hand over his task to his successor and turn his nose for home.

Nothing has so far been said on the subject of water-supply. This presented little difficulty in spite of occasional alarms At one time, the supply at Tochi camp looked like failing as the tribesmen diverted the irrigation water normally running near camp, into more distant channels, incidentally crossing the road at most awkward places threatening to flood the "pat" and wash away the road. Political pressure was, however, sufficient to restore the flow. To cope with the possible breakdown, it had been necessary to fit up at great speed ten 3-ton well-decked lorries with two 268-gallon tanks apiece. The work was done and the lorries filled with water and fitted with L. and F. pumps in 2½ hours. Again, on the night before the move to Jaler camp, there was an alarm that the water reported to be there did not after all exist, and Boyd, overcoming a strike of carpenters, fitted up ten 2½-ton civil lorries with an assortment of tanks between 9 p.m. and 1.30 a.m. Subsequently, fifteen more lorries were fitted with tanks, making a mobile water reserve of 19,000 gallons. When adequate water was found at all camps, these lorries were dismantled except for those fitted with sprinklers for road work. Incidentally, the D. I. Khan cantonment motor road watering cart holding 1,500 gallons was invaluable.

This article has dealt primarily with the road construction aspect of this campaign. Although the work proceeded peacefully enough, the enemy withdrawing as the formidable column covered by tanks and cavalry moved out each day, operations took place on more than one occasion and the Sappers and Miners of all three corps had their share in the congenial task of demolishing towers, houses and caves belonging to those of the enemy who were known to be in arms against us. In all, about 16 towers and 40 to 50 houses were demolished. Attempts were made to blow in caves, but these places, often five or six rooms, the roofs supported by massive pillars of concrete like conglomerate, were unsatisfactory objects for demolition and required quantities of explosive beyond our resources. Some typical cases of towers demolished were:

(*a*) Tower with 15 ft. square base of stone and mud and 20 ft. high walls—32 lb. of guncotton in a hole in the centre of the floor, one N.C.O. and 8 men, 1¾ hours.

(*b*) A similar tower with 30-ft. walls, 50 lb. of guncotton, 1¼ hours.

(c) Another similar tower, 16 lb. of guncotton brought down the tower but left the base. With the heavier charges, the towers were razed to the ground.

There was only one real failure on one occasion and that was due to bad local powder.

The writer had unfortunately to leave the scene of operations before the work was entirely completed. Although the road was passable from end to end, much remained to be done to complete it in every respect, a task which it is understood took about another three weeks or so. Nevertheless, for the greater part of its length, the road was complete, cars could move at speed and lorries move in column at their steady 10–12 miles an hour. The actual number of working days between 30th November and 15th January was 37. The hours of work rarely amounted to more than six or seven and on many days were little more than four. That the work was completed in the time, remembering, too, that ahead of Jaler camp much of the maintenance had to be carried out by Sappers and Miners, meant a high standard of work and unremitting enthusiasm on the part of the Field Engineers and all ranks of the Sappers and Miners, the troops and the M.E.S. subordinates. This, combined with the never-failing help and encouragement of Commanders and staffs, made the operation one that all those who took part in must remember with enjoyment and legitimate satisfaction.

THE USE OF DEMOLITIONS IN THE CAMPAIGN IN SOUTH POLAND DURING OCTOBER, 1914.

By CAPTAIN MELTZER

Commanding 2/49th Engineers, German Army.

(From the *Militärwochenblatt*, 9th July, 1937.)

THE campaign in South Poland in October, 1914, deserves, as General Ludendorff has pointed out in his *War Reminiscences*, one of the foremost places in the annals of the history of the war, since it has provided almost more vicissitudes than any other campaign. One of its most remarkable characteristics is the extensive use made of demolitions. As the value of the interruption of communications is constantly emphasized in military literature of the day, a study of this campaign seems to be specially instructive. In no other sector of the front have demolitions found such extensive use in mobile warfare.

Our knowledge of the South Poland campaign has recently been enriched by a study by Kurt Matthes: "The 9th Army in the Vistula Campaign of 1914." This publication, from which the details given in this article have been obtained, gives the actual text of many of the orders issued. This enables us to trace the connection between operations and demolitions, and shows how the latter were prepared on a large scale on a regular plan, and were carried out in the order laid down.

On the 17th September, 1914, the German 9th Army received orders to advance against the flank and rear of the nearest Russian Army group that was pressing upon the Austrians. With this object in view it concentrated round Cracow and in Upper Silesia, with portions in South-West Poland, and on the 10th October, it commenced an advance north of the Upper Vistula. On the northern wing, the Frommel Corps was to advance along the Pilitza, with instructions to secure the unprotected flank farther north by permanent demolition of all railway lines. The railway troops on the whole of the army front received orders that, while repairing railway lines, they were to prepare them at once for demolition in view of a possible retirement. (*E.T.* 1937, *sec.* 97, *para* 2 *lays down that the responsibility for demolitions of railways rests with the engineers allotted to that service.*)

The fight at Opatow on the 4th October showed that the Russians were in no great strength north of the Vistula. On the other hand, it

was established that the Russian line on the eastern bank of the river extended approximately to Ivangorod. It was not feasible to cross the Vistula south of this fortress, as the crossing would have been taken in flank from the north. The Army Command decided, therefore, to swing round sharp to the north, in order to make an encircling attack on Ivangorod with the left wing. The right wing of the 9th Army was to cover this movement. The easiest way to do this was to make use of the Vistula as an obstacle. On the 7th October, the Army Command issued orders to the Woyrsch Landwehr Corps to make dispositions for observing the Vistula and preventing a crossing, adding: "All boats found on the main river or on its tributaries are, as far as possible, to be destroyed; all traffic on the river is to be stopped."

On the other flank, the right wing of the Army received orders to carry out numerous railway demolitions. These orders, for the protection of the left flank, were issued between the 5th and 7th October, and the demolitions were carried out by the 11th in the Koluski-Tomaszov section (including the bridge over the Pilitza) and the Lowitsch—Lodz section. On the 7th October, the 8th Division received orders to interrupt the Warsaw-Skierniewice railway, and to destroy the Warsaw-Lowitsch line. It will be noticed that the northern line was to be thoroughly destroyed, the southern one only slightly damaged, as the latter might, in certain eventualities, be of great value for the subsequent operations of the 9th Army. It should be possible to repair it again quickly. On the other hand, the use of the Warsaw-Lowitsch line must be denied to the Russians for a long time, or they might be able to execute a wide turning movement in the direction of Thorn. It is clear that the execution of the demolitions was, to a great extent, influenced by the German situation and intentions. (*This is an illustration of one of the objects of strategical demolitions mentioned in E.T.* 1937, *sec.* 97, *para* 3. "*The object may be to deny certain courses of action to the enemy or to confine him to certain lines of approach.*")

On the 8th October, at 1.40 hours, the Army Command received information that the enemy occupied a wider front than had been supposed, apparently as far as half-way to Warsaw. There was now no object in the encircling attack on Ivangorod, as the attackers were themselves threatened with encirclement. General von Mackensen received orders to make a rapid advance with the left wing of the Army and occupy Warsaw. If, contrary to expectation, the attack were to fail, the Warsaw-Lowitsch and the Warsaw-Skierniewice railways were to be permanently destroyed. The difference between these orders and those of the 7th is instructive. Owing to the presence of strong Russian forces round about Warsaw, the 9th Army could no longer count upon using the Warsaw-Skierniewice railway. The line was therefore to be thoroughly wrecked. (*The German General*

Staff evidently realized the importance of making a co-ordinated demolition plan well ahead in case of need. Here the Germans were proposing to advance, but orders were given for certain sections of railway to be blown up if the offensive broke down. The engineers were given as much warning as possible. It is interesting to compare the foresight shown in this case with the lack of any co-ordinated demolition plan during the retreat from Mons in 1914.)

A Russian order captured on the 9th made the distribution of the enemy's forces clear. Five Army Corps were assembling in and around Warsaw alone. The capture of the Polish capital was now impossible, and a prompt retirement of the Mackensen group was to be anticipated. Foreseeing this contingency, the Army Command issued orders on the 11th: "The 8th Division will thoroughly destroy railway and road bridges—the latter to be burned, with straw packed underneath—commencing with the line Grodzisk-Blonie. No bridge is to remain intact." (*This line was clearly designed as the primary belt mentioned in E.T., sec. 97, para 6. The writer does not say if the further demolition belts, indicated in the orders, were to be nearer the enemy or farther away. Our own regulations say that subsidiary belts should usually be formed successively closer to the enemy.*) On the same day, orders were issued: "The 8th Division will proceed as soon as possible to the region north-west of Sochatschew (25 km. west of Blonie) and will destroy (by burning) all bridges over the Bsura from the mouth of the river upwards." By this method, a turning movement on the part of the Russians south of the Vistula could at any rate be delayed. But the superior strength of the Russians along the whole front made it imperative to withdraw the right wing and centre of the German Army. Consequently, orders were issued for extensive demolitions on the cross line from Tomaszow to Bsin, which was of minor importance for the 9th Army. These demolitions were carried out between the 12th and 18th October. In addition, orders were given to destroy the line between Piotrowice (14 km. east of Radom) and Ivangorod, although the Command of the Guard Reserve Corps had their misgivings about such a procedure, as it hampered their munition supply. But there was nothing for it but to interrupt this section of the railway in good time. In the absence of major bridges, a good deal of time was necessary in order to break up the railway in many places. (*A good example of "preliminary demolitions."*)

The Army Command hoped that, by carrying out all these demolitions in the region west of Warsaw, the Russian advance would be delayed to such an extent that a blow struck in the meantime by the combined German and Austrian forces from the lower Pilitza on Warsaw would hit the Russians badly. But, although such an attack offered excellent prospects of success, it had to be abandoned because General von Conrad refused the co-operation of Austrian forces.

Consequently the Russians were able to throw themselves in full strength upon the Mackensen group. "To accept the battle would have been too risky." (Ludendorff: *War Recollections.*) Arrangements were made for an immediate withdrawal, and orders were given to General Mackensen on the 18th October: "Special attention is again drawn to the extreme importance of all bridge demolitions. (Engineers should be given a free hand in the destruction of railways and roads.)" In this Army order, it was laid down that the Mackensen group should stand fast for at least 48 hours. No really efficient demolitions could have been carried out in less time. (*The Germans realized the importance of proper engineer reconnaissance before demolitions are executed. See E.T., sec. 97, para. 9, which says: "No demolition scheme formed without detailed engineer reconnaissance on the ground can, however, be regarded as reliable.*) The Mackensen group was to fall back upon the line Rawa (25 km. south of Skierniewice)—Lowitsch in the night of the 19th/20th October.

The result of the demolitions ordered was everywhere satisfactory. The Russians followed cautiously (State Archives, Vol. V., p. 494): travelling over destroyed roads the 2nd and 5th Armies could only advance slowly; on the 22nd October, General Russki ordered a day's rest. Eight German infantry divisions—half of them Landwehr—and two cavalry divisions had been enabled to extricate themselves, under cover of demolitions, from 18½ infantry divisions and 6¼ cavalry divisions and take up a fresh defensive position.

Even after the retirement of the Mackensen group to the Rawa—Lowitsch line, the counterstroke contemplated by the 9th Army Command—across the lower Pilitza against Warsaw—would have promised good results. The fact that the 2nd and 5th Russian Armies were greatly hampered in their mobility by demolitions, prevented them both from quickly pursuing the Mackensen group, which was greatly inferior to them in numbers, as well as from warding off the blow on Warsaw. An attack on Warsaw across the lower Pilitza would have had the Vistula as an obstacle on the right flank, and would have made an outflanking movement on the part of the Russians very difficult. But on the 20th a reply to the German request was received from the Emperor Francis Joseph, declining to place Austrian troops at the disposal of the Germans for the proposed counter-stroke. Instead of that, the 1st Austrian Army was to allow strong forces of the enemy to cross at Ivangorod and then throw them back in a counter-attack. German warnings against such a doubtful proposal remained unheeded.

It was obvious to the 9th Army Command that an Austrian success was very improbable, and that the Mackensen group could not hold out long on the Rawa-Lowitsch line if it were not relieved at an early date. The probability of a further retreat lay, so to speak, in the air, as General Ludendorff expressed it. A short movement away from

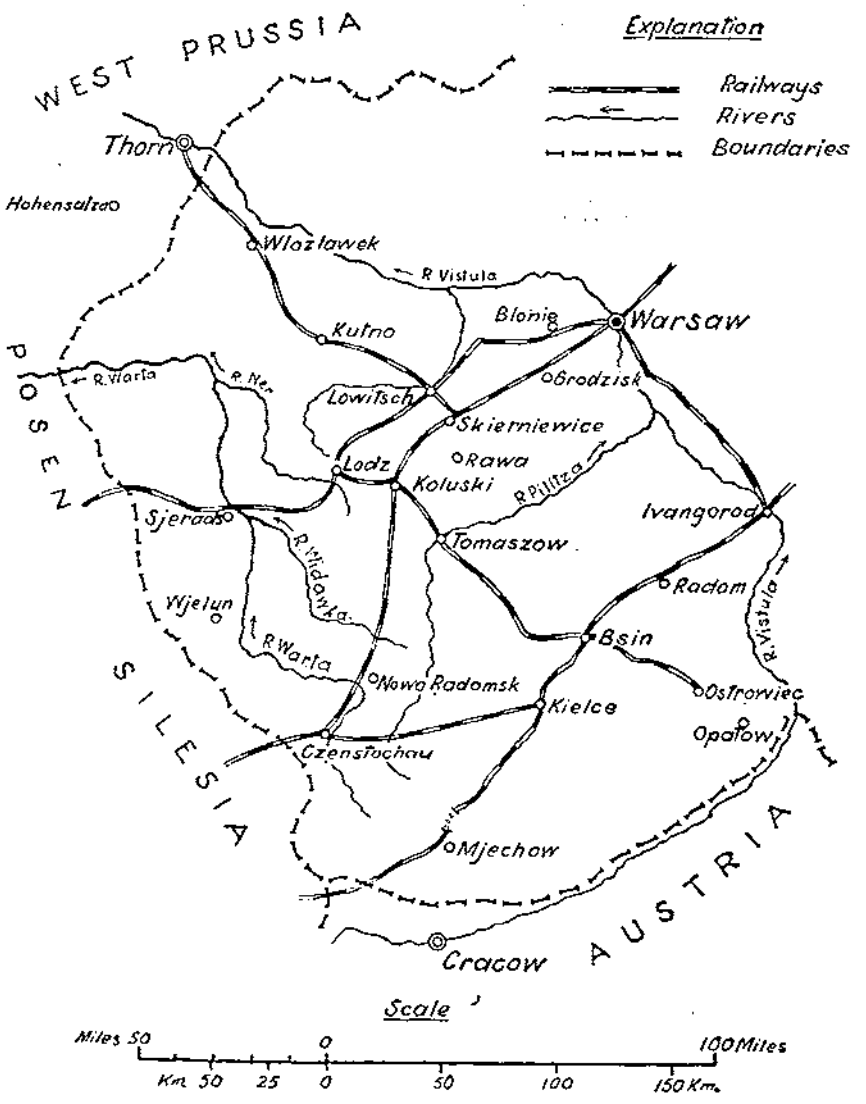
the enemy would not have helped much. The 9th Army would very soon have been attacked afresh by an enemy in superior numbers, and overwhelmed in a frontal attack. It was necessary to carry out an effective operation against the Russian flank, and this meant first withdrawing the Army a considerable distance. The Russians would have to advance so far from their railway termini that an organized pursuit would be impossible. (*This is the normal strategical object in a big demolition scheme—see E.T., sec. 97, para. 3.*) Previous experience showed that this would be the case at a distance of 120 km. A retirement to such a distance greatly simplified the question of provisioning the allies, whose rearward communications were severely strained at the time. It may be noted that General von Conrad was not at all in agreement with the intention of the 9th Army Command, but wanted to confine the retirement to a much shorter distance. But in that case, the shortness of time and the small number of Engineers and railway troops available would have made it impossible to carry out sufficient demolitions in the abandoned area. The demolitions could only be properly effective if the depth of ground were ample.

Orders for demolitions on a large scale were now issued with an eye to the future. Skierniewice railway station and the section of the Warsaw-Czenstochau railway as far as Rogow (10 km. north of Koluski) were thoroughly wrecked by the 23rd October. The authorities in Thorn received orders to put demolitions in hand at once on the Wlozlawek-Kutno railway in the direction of Lowitz and to carry them out as thoroughly as possible. This railway was of special importance, because, if it had remained intact, it would have enabled the Russians to bring up troops in the direction of Posen, where they would only have encountered slight German opposition. The interruption of this line secured the left flank of the 9th Army effectively.

Demolitions were also continued behind the front. Besides these, the Army Command ordered the construction of a position in the line Noworadomsk-Wjelun to be carried out through the agency of engineers and civil labour.

The Austrian engagements before Ivangorod met with no success, as the 9th Army Command had feared. The Austrians had left too large a force beyond the river and were now themselves hard pressed. When, on the 26th October, the Austrians were compelled to break off the fight, the 9th Army was also obliged to retire. Orders for a retreat were issued at noon on the 27th. The demolitions that had been prepared of railway lines, bridges, roads and railway stations, were promptly carried out. Special attention was given to the Warsaw-Vienna line and the Vistula line, both of great importance for supplying the pursuing Russians, which were completely wrecked. On the latter railway, the Mjechow tunnel was of special value. With

DEMOLITIONS IN SOUTH POLAND



the expenditure of 1,000 kg. of dynamite, it was effectually blocked in three places by the material brought down. Several railway companies were employed under the direct orders of the Army Command. "In spite of all preparations," writes General Ludendorff, "it was not easy to put the railway demolitions through, the troops always wanted to postpone them. But it was of no use. I issued orders and superintended their execution." (*A good example of deferred demolitions being carried out on a pre-arranged time-table—see E.T., sec.*

97, *para.* 8 (*ii*).) Railway troops made a deliberate destruction of railway lines and buildings. Besides demolishing railways, the main duty of the engineers was the destruction of roads and buildings. Use was also made in different ways of inundations, rendering stretches of country impassable.

Between the 30th October and the 2nd November the 3rd/11th Engineers blew up or burnt no less than 17 bridges and footbridges, across the Ner, the Widawka and the Warta ; put the electric railway between Lodz and Pabianice (S.W. of Lodz) out of action and destroyed the railway equipment along the line.

The effect of these demolitions was most satisfactory. The Russians were greatly hampered in their movements. They only progressed slowly and soon abandoned their advance completely.

As early as the evening of the 31st October, a wireless message of the Russian 4th Army was intercepted, which contained instructions that the Army should stop its advance at a distance of about 120 versts from the Vistula. " The restoration of the railway must be regarded as the most urgent question in connection with rearward communications. It will not be possible for the Army to advance until it has been completed." Further intercepted wireless messages showed that the Russians intended to stop their advance very soon afterwards.

A long delay was inevitable before the enemy could repair his broken communications and attack again. On the 3rd November, General Ludendorff was in a position to propose to his supreme commander that the 9th Army should be withdrawn and held in readiness in the Hohensalza district for an attack on the northern flank of the Russians.

Now, too, the re-grouping of the Army was made secure by further demolitions. In the Army order of the 4th November, the XVIIth Army Corps was entrusted with the complete demolition of all existing bridges over the Warta and Widawka. In order to conceal the projected march to the Hohensalza region, demolitions were continued on the Thorn—Skierniewice line. The drawback to this procedure was realized, since a future German advance would necessitate the re-establishment of this railway.

Hesitatingly, the Russians pushed weak forces forward across the Widawka and Warta. This did not disturb the transport of the German corps. The 9th Army was able to carry out its march without appreciable delay, and to launch a surprise attack on the northern flank of the enemy on the 11th November. The " Russian steam roller " that was ready to roll into Poland and Silesia and decide the war, was brought to a standstill.

This result was obtained mainly by the employment of demolitions on a scale never before known in the history of war. As General

Ludendorff writes: "We were successful in completely holding up the Russian masses outside our own frontier without serious fighting."

* * * * *

Translator's Notes.

Captain Meltzer follows up his account of the operations in South Poland with some general remarks.

In the retreat from Poland, it was necessary to delay an enemy, greatly superior in numbers, for a considerable time, and it was not possible to defend each individual obstruction. Hence depth was essential in the plan of obstructions. Time was short, and the number of engineers was limited. Explosives were available in fairly large quantities. The ground was, on the whole, not favourable for effective demolitions. All these points indicated the desirability of a series of obstructions, one behind the other. Each demolition could be very thorough.

The relative merits of arranging obstacles in breadth and in depth are discussed at some length. The writer is convinced that in this instance a distribution in depth was the correct method, though this did not preclude a distribution in breadth in a few selected places.

As regards the objects selected for demolition, there were only a few major bridges in South Poland, and the destruction of railway stations was found to be a very effective way of holding up the enemy. It was a class of work that occupied a good deal of time and involved a heavy expenditure of explosives, but it was all the more necessary to make a thorough job of it because of the small number of bridges available for demolition.

The Army Command issued orders extensively direct to the railway troops and engineers. This enabled the latter to concentrate on a few important jobs and carry them out effectually. It is a great mistake to fritter away the strength of engineers, by distributing them in small detachments to units who often have no better use for them than to employ them on infantry duties.

Orders for demolitions should always be given as early as possible. During the advance, the Army Command had issued orders that at the same time that repairs were being carried out to the railway, preparations were to be made for the demolition of bridges and railway stations in the event of a subsequent retreat.

There is no doubt that the railway demolitions carried out in South Poland had the greatest influence on the result of the campaign. But it must be borne in mind that demolitions are the means to an end and not the end in themselves.

In these days of motorization demolitions are far more effective than they were during the Great War, and there is a valuable lesson to be learnt from what was done in South Poland in 1914.

GENERAL COMMENT.

The strategical use made of demolitions is very instructive. The article shows how the Germans were able to keep their 9th Army, much inferior in numbers to the Russians, highly mobile and, while holding the Russians by means of belts of obstacles in one area, to transfer their Army elsewhere and regain the initiative.

The German general staff were not afraid, while their Army was still advancing, to issue orders for demolitions to be carried out, if a retirement became necessary.

The British Army in August, 1914, were in a somewhat similar condition of numerical inferiority. Admittedly our information then was not so good as that of the Germans in Poland, but no thought of what we should do if forced to retire seems to have been in the minds of our general staff. Certainly, the engineers at Mons did not work on a co-ordinated scheme.

Such a situation may well face the British Army again. It is for this reason in particular that the lessons demonstrated by the Germans in Poland in 1914 are worth study by staff officers as well as engineers.

SINGAPORE.

The Founding of the New Defences.

By COLONEL L. N. MALAN, O.B.E.

IN 1926 it was decided by the Cabinet to proceed with the construction of the Imperial Naval Base at Singapore, and the three Services concerned were instructed to take action, each for its own particular share of the work. This article deals with the work carried out under the direction of the Army Council.

A scheme of defence for such a base at Singapore had been under consideration at the War Office for some time, in consultation with the Admiralty and the Air Ministry, and tentative plans had already been worked out on broad lines, with the help of the Headquarters Malaya Command. The work was, however, of such magnitude and the conditions unique and so complex, that it was decided to send out a Commission of three officers to investigate the problems on the spot, and to make recommendations, before working out the scheme in detail.

The Commission was composed of Lieut.-General Sir Webb Gillman, afterwards to become Master General of the Ordnance, the writer as Chief Engineer Malaya, designate, and Lieut.-Col. R. F. Lock, R.A., Secretary to the Ordnance Committee. Its Terms of Reference were, to visit Singapore and, after consultation with the General Officer Commanding and the local artillery and engineer advisers, to report and make recommendations on the following subjects :—

(1) The exact siting of the guns and lights within the areas already approved by the Army Council.
(2) Command and communications for guns and lights.
(3) Distribution of (defence) troops.
(4) Principle of the layout of the Eastern Cantonment.
(5) (Certain defence questions.)
(6) General layout of Ordnance Depot.
(7) Nature of piers and cranes and sites for the former.

This Commission left England on March 11th, 1927, and reached Singapore on April 10th. During their stay in the island, these officers were in frequent consultation, not only with the military officials referred to in the Terms of Reference, but also with the Governor of

the Colony and other members of his Government, in order to endeavour to ensure that their recommendations should not clash with local schemes, and to avoid subsequent correspondence.

The Commission lost no time in getting to work, visiting every part of the island that could conceivably be of military importance. For the most part, the exploration of the forests and swamps necessitated the scantiest clothing and many changes of it, particularly for the drive home in the cool of the evening. The density of the jungle and the necessity for clearing it, made it difficult, if not impossible, to fix all the sites for guns and lights exactly. Nevertheless, after sufficient clearing had been effected, the Commission succeeded in fixing the majority of them and was able to leave Singapore without any doubts as to the approximate positions of those not exactly fixed, or as to the suitability of the sites. As a result of their investigations, the Commission recommended certain local alterations, as well as certain modifications in the defences generally, which were subsequently accepted but added to at the War Office. These cannot, however, be discussed here, and for the same reason the actual names of defended localities have been omitted. Important factors governing their recommendations, amongst others, were the necessity for protection, the expense of anti-malarial measures and the question of amenities for the garrisons.

In addition to considering the defences, the Commission also made recommendations for the siting of the barracks required for the extra garrisons proposed at that time, which have been considerably augmented since then. Changi had already been approved by the Army Council as a suitable site for part of the new garrison, and there were other sites on which a report was asked for. A rough plan of the northern part of Changi had been sent home by the Malaya Command in 1926, showing a possible grouping of buildings. This plan was useful to the Commission as a starting point for their investigations. Closer examination showed that Changi, apart from its strategic advantages, offered possibilities for expansion to any degree that might arise and it was therefore recommended as the best position for the major portion of the new garrison, including some infantry protection for the works of defence. Other places were recommended as suitable for certain troops who would be more conveniently located there than they would be at Changi. Detailed proposals were made for the layout of the buildings estimated to be required at Changi, complete with all the roads and other amenities as well as the railway. By that time, a new survey of the northern part of the Changi area had been completed, but the southern part had to be enlarged from the four-inch map, to complete the plan of the layout. An admirable description of Changi, and its state when taken over by the War Department, has been given by J.F.F. in *The R.E. Journal* for September, 1937, and it is not

necessary to repeat it here. It is, however, interesting to compare subsequent development with the plan prepared by the Commission.

Recommendations were also made in regard to the other questions in the Terms of Reference, and those that are not secret will be discussed later on. A schedule of the works, estimated to be required for the project as a whole, together with a detailed time-table, was also prepared and submitted.

When the Commission arrived in Singapore, the only land that had been handed over to the War Department was the site of one of the works of defence and a part of the northern portion of the Changi area, practically wholly covered with impenetrable forest jungle or mangrove swamp, but after representations to the Colonial Government, an area was obtained on which it was possible to begin work. The first necessity was to provide accommodation and ground on which men could be employed, and on which contractors could operate. Until such provision had been made, there was nowhere for anyone to live at Changi, and further personnel could not be sent out from England, nor could work be undertaken on a large scale. The work at Changi was actually started with a party consisting of one officer, one foreman of works and eighteen coolies. This small party came out daily from the town, by motor transport, until they had cleared enough ground and were able to build some huts and make paths to them. Many months elapsed before much of the farther land essential to the project could be acquired.

In order that there should be the minimum of delay when instructions on the report of the Commission should be given, and the necessary staff should arrive in the colony, steps were taken to start as many services as practicable. A firm of naval architects was engaged to get out a design, and to obtain tenders, for a gun-barge, and boat-building firms were invited to submit designs and tenders for a motor-boat, to a given specification. Sites for piers on two of the islands were fixed. A rough design of a pier suitable to these sites was prepared for consideration and further elaboration at the War Office, and instructions were given for borings to be taken at these sites, and elsewhere. A survey had already been made for a railway from Fairy Point, but further reconnaissance disclosed a shorter and better line for this railway to follow, and the Federated Malay States Railways were asked to survey it and to submit a tender for its construction, which they did.

Arrangements were also made for the remainder of the Changi area to be surveyed, and this was completed by the end of the year by the R.E. In spite of the difficulties of the ground and the necessity for cutting jungle to enable sights to be taken, these two surveys of Changi were creditable pieces of work, and proved to be of the greatest value in later development. In addition to this survey, instructions were given for the clearing of the forest of all undergrowth less than

six inches in diameter, and for the reclamation of the northern swamp, which is now the recreation ground. Also for the erection of four officers' quarters, to a design that had been specially prepared for the particular sites chosen: for two blocks of married soldiers' quarters, to a design that had recently been erected at Tanglin, and for temporary accommodation for the rest of the British and Asiatic personnel. The necessary approaches were also laid out and ordered to be put in hand.

On July 1st, the Commission left Singapore for England with a quantity of notes and plans, from which they compiled their report during the voyage home. This report was finished the day before the ship reached Marseilles, and one copy was taken overland to London, and the other round by sea. While the report was being considered at the War Office, arrangements were made for stores and materials required to start the work, which included light railway material, small electric light and pumping sets, a steam roller, a submarine cable, and a cement testing set and the training of two foremen of works in its use. A design for a barrack block was prepared and left at the War Office for the steel framework and bills of quantities to be worked out, and sent out to the Command later. The architectural completion of this skeleton framework was subsequently designed in Singapore to suit the local conditions of site and surroundings.

Before the Commission went out to Singapore, the question of the staff required for this project, and its organization, had been under consideration at the War Office. It was decided to create the post of Chief Engineer and to appoint him first as a member of the Commission, with which he would return to England for the consideration of the report. It was evident, in view of local conditions, that some considerable time must necessarily elapse before the full staff could be profitably employed, and it was decided that the Chief Engineer himself should take personal charge of the development to start with, and that only a small but carefully selected staff should be sent out until development enabled more to be employed. This staff began to arrive in December, 1927, and by the beginning of January it was possible to make a start on a larger scale. The arrival of this personnel was spread over a number of weeks, partly for the reasons given above, and also to allow their temporary accommodation to be made ready. As it was, construction went hand in hand with planning and the greatest care had to be exercised to ensure that what was done would fit in with what might follow. By the middle of 1928, sufficient clearing had been done to enable accommodation to be provided, and steps were taken to increase the staff by the provision of a C.R.E., and other officers, for Changi.

Since the Commission left the Colony, the R.E. in Singapore had been hard at work and by the end of the year, when the new staff

began to arrive, great progress had been made and Changi was completely transformed. Some of the coveted coastal strip had been acquired, the Malay village had disappeared and the reclamation of the swamp was well under way. Drainage had dried it out and it had been filled up to high water-level, which was about as much as was practicable at that time owing to the necessity for keeping the track across it open until another approach to Fairy Point could be opened up. The jungle had been cleared of all undergrowth and it was at last possible to walk freely over the ground almost anywhere. The survey of Changi was completed and survey on one of the islands was in hand. The approach roads to the four officers' quarters were nearing completion and the houses themselves were well above first-floor level, while good progress had also been made with the married quarters. A temporary water-supply had been arranged, and electric light had been in operation from the very beginning. Quarters and a water-supply for Asiatic labour had been put up, and it had become possible to engage and accommodate a considerable working party. There was also room now for contractors to put up temporary accommodation for their workmen, so that it was soon possible to let larger contracts. Hutting had been erected for the unmarried works staff and sappers, and also for offices, workshops and stores.

All this had not been done without struggle and adventure, apart from the restriction, already referred to, due to not being in possession of all essential land. The feeding of the party was in itself a problem, for nothing was procurable nearer than the town of Singapore, fifteen miles away, and it was not until the middle of October, and then only after urgent representation, that a motor-van could be secured to ease this problem. Even then the driver was so incompetent that it was some time before the service could function properly. Much later on the N.A.A.F.I. opened a branch in Changi and native Chinese shops were established, but these did not mature in a moment.

The following extracts from letters from Changi at that time give some picture of the conditions. " October 15th . . . a tree fell right across the road by the entrance to the Government Bungalow at 8.15 p.m. and four of our five cross-cut saws broke one by one, and it was 1.45 a.m. before the road was clear again, this meant bed at 2.15 a.m. On the next day, *i.e.* yesterday, I noticed that the tide tables predicted a very high tide at 11.30 p.m., so I stayed up and went down to the swamp and found an appalling state of affairs. The sea was level with the highest part of the shore, and the latter had given way for about thirty yards. The consequence was that my bund and sluice gates were rendered useless, but I have this morning built up a sandbag seawall as far as we are allowed to go, and to-night at 11.45 p.m. when an even higher tide is predicted, I hope to find things under control." The above extract illustrates the restriction in not possessing all the land, and is interesting, for when later on

trees had to be deliberately felled, it was the Chinese contractor's idea to cut them nearly through and then depart to the comfort and security of his home, hoping that the tree would come down of its own will during the night, regardless of the possibility of its doing so in the cool of the evening, when it was very pleasant for his employers to walk among these trees. Another adventure is dated October 17th and runs ". . . we caught a big cobra, over four feet long, but unfortunately it was so damaged while being killed, that I did not think it worth while sending to the museum, the authorities of which are very keen on our sending every snake we catch, as we sent them one the other day belonging to a species not found before on the island." Snakes were, of course, common at Changi like everywhere else in Malaya. On one occasion later on, a thirteen-foot python was found coiled up asleep in the mess pantry, and on another a six-foot hamadryad, or king cobra, which is one of the most deadly snakes known, was killed just outside Fairy Point House, after it had been occupied for some time. Cutting paths through the jungle had, for this reason, to be done with care. Such work was also sometimes impeded by quite another form of obstruction in the way of bees, and when these were encountered they had to be avoided and the path cut somewhere else.

The only accommodation existing at Changi, in those early days, besides the Government Bungalow and Mr. Manasseh's house, neither of which was available, was an old wooden bungalow at Fairy Point, a wooden Japanese hotel built over the sea on the edge of the swamp, and a privately-owned wooden bungalow beyond repair. Fairy Point Bungalow was occupied as soon as the land on which it stood was handed over, and an opportunity presently arose to purchase the hotel, which for the next few years served very well as an officers' mess and quarters.* Later on, a house at Telu Paku, three miles away, fell vacant and was rented by an officer. All other accommodation for the coming staff had to be provided by building wooden huts, and as these could not be built until suitable sites had been acquired and cleared, it was rather a rush to complete them in time. Although representations had been made that only single officers should be sent out to start with, so far as possible, owing to the difficulty of arranging accommodation, three of them were married, one with a wife, two children and a governess and another a subaltern not yet entitled to married allowances. In the first case, it was only by a few days, and very strenuous work, that a hut could be completed in time, but in the other case, the officer in question suffered much hardship, as Singapore was at that time exceedingly expensive, colonial allowance quite inadequate to meet this expense, and to rent a house, even if one could be found, was beyond the means of most officers, especially one of junior rank.

*See October, 1937 *Supplement to The R.E. Journal*, page 304.

In a country like Malaya, where the mosquito flourishes and bites, the anti-malarial problem is of the first importance and, without adequate measures, no development can be brought to a successful conclusion.* Large and costly enterprises have been ruined and abandoned owing to the ignorance or lack of such measures, not only in Malaya but the world over. For example, the first efforts to construct the Panama Canal were brought to a standstill by yellow fever and malaria, and the work had to be suspended for nearly twenty years, until the causes of these diseases had been traced to the mosquito, and methods discovered for his extermination. These methods are simple enough, if understood, but are costly and in any case must be carefully thought out before any work is attempted, especially in the way of clearing forest or reclaiming swamp. It is first of all necessary to make certain that no mosquito can breed within a distance of half a mile of any place where men may live or work, which may mean the acquisition of considerably more land than is required for the undertaking itself. In the case of jungle clearing, care must be taken that any pools of water, that may become exposed by the clearing to sunlight, should at once be treated with oil until they can be filled or drained. It is not sufficient only to drain and fill a swamp, without at the same time draining away the subsoil water before it can reach the surface and form the swamp. This is best done by first of all marking the places where the subsoil water begins to show on the surface, towards the foot of the slopes bordering the swamp, and then running an agricultural drain along a contour, well above this line of seepage, to collect and run the water off into sea or river. In the preliminary work at Changi, this necessity had not been fully understood, and a situation had been allowed to develop which the S.M.O. described as dangerous. This was taken in hand just in time, and much useful knowledge gained thereby. To ensure that every R.E. officer and Foreman of Works should fully realize the importance of anti-malarial measures, arrangements were made for everyone, on arrival in the country, to undergo a short course of instruction by the medical staff, including visits to anti-malarial works in hand and completed. In the beginning this very important work at Changi was seriously handicapped for want of a resident medical officer. The Navy had begun their work with two medical officers, and the War Office had been asked in May, 1927, for an officer to be sent out in four to six months' time, but it was not until the following February that he arrived for this especial duty, in addition to his care of the health of the troops. His arrival was very welcome to the engineers, and his presence was largely responsible for the remarkable degree of freedom from

* An article written subsequently by Major Craig, R.A.M.C., entitled "Anti-Malarial Drainage Work in the New Changi Cantonment," can be obtained from Messrs. John Bale and Curnow, Ltd., Oxford House, 83-91 Great Titchfield Street, W.1.

malaria or other tropical disease enjoyed by the little garrison during the time of its development, which, judging by the usual standards, should have been the most dangerous.

At the end of the year, the completion of the survey of Changi made it possible to make sure of the layout, and to work it out in greater detail, without departing from the general recommendations of the Commission. The next step was to construct a new approach to Fairy Point, which could then only be reached by a track over the swamp. This track had to be kept open, chiefly for the construction of the quarters, but it was hindering the reclamation, since the level to which this area had eventually to be raised was about two feet above the level of the track. So New Road came into being and its formal opening, as the first completed work in Changi, was a ceremony and a landmark. In the construction of this road, and all other works in the vicinity of the swamp, heavy earthwork was rather encouraged than otherwise in order to obtain the spoil for the reclamation.

Another and equally urgent work was the reclamation of the swamp on the bank of the Selarang River, in order to provide the sites for the many important works required in this locality. The work was actually begun by starting the earthwork of the Changi Railway from the site of the proposed pier through the middle of the mangroves, which at the same time were being cleared away as fast as such tiresome work would allow. It is interesting now to look back and to remember that what is now a wide open station yard, was then a fairly deep cutting through the edge of Fairy Point Hill and a railway bank across a swamp. As soon as the railway was out of the way, and there was room for another contractor to work as well, the shifting of earth was begun in earnest and the railway bank used for tipping it into the swamp. This was carried out by several hundred Chinese labourers, who were camped on Temple Hill, which was as far away from the European community as they could be placed, and this was necessary. The cutting through Fairy Point Hill soon ceased to exist as such and the hill was cut into more and more, partly to obtain the spoil and also in the hope of being able to provide solid sites for the power station, workshops and stores, which would otherwise have to be founded on piles. In spite of these provisions this hope was not fully realized and later on the framework of these buildings and the foundations of the generating sets had to be supported on *bakau* piles.

It had been the natural desire of all concerned that the Changi Railway should be metre-gauge, to conform to the standards of the Federated States Railway, in case it should ever be extended to the east coast, and also to simplify the question of rolling stock. At that time, however, none of the armament firms at home appeared able to guarantee the stability in transit, on so narrow a gauge, of the large railway crane that would be required. It was reluctantly, therefore,

decided that the line would have to be the standard 4 ft. 8½ in. gauge, but it was felt that it would be simple to change it to metre-gauge later on if it should be found possible to adopt it. This decision led to the necessity for getting the rolling stock out from home, but only a bare minimum was asked for and sent. The completion of the railway, so far as it was intended to take it for the time being, was celebrated in due form. The "Changi Express," consisting of a locomotive and one four-wheeler, converted by the judicious use of a few flags and a bench into an excellent observation car, proceeded to the end of the line, with much of the population of Changi, and there at the level-crossing it successfully held up the car of the G.O.C. and brought him back, an honoured and willing passenger, to suitable refreshment at Changi.

The first idea had been to use the gun barge for the landing of the rolling stock, but this idea had to be given up. It would have meant allowing the barge to ground on the mud, and the builders advised against this, as likely to put too great a strain on the frame of the vessel. Moreover, further acquaintance with the country, and especially with the Chinese, led to this operation being entrusted to a Chinese contractor to carry out in his own way, which he did most successfully. The methods he adopted were not exactly orthodox, according to western ideas, but they did the job. A locomotive balanced precariously on the deck of a Chinese junk and thence transferred to land over a crazy contraption of sticks and string, gave the audience some anxious moments but did not appear to worry the Chinese workmen in the least, and very soon all the vehicles were safely on the bank of the Selarang River, without hitch or accident.

Before the Commission left England, a visit had been paid to Woolwich to study the methods followed there for the transfer of big guns across the water. These methods seemed likely to be suitable for the conditions to be expected in Singapore, and steps were taken to obtain drawings and specifications. On investigation of this problem on the spot, these views were confirmed and a firm of Naval Architects was engaged, while the Commission was still in the island, to prepare a design and to invite tenders for a barge on similar lines but of steel instead of wood, and with one rather curious addition. At Woolwich, the tides are certain and the barges are in constant operation with men well trained in their use, who can be reasonably sure of completing an operation in one tide. Those conditions would not obtain in Singapore with its exceptional incidence of tides, and it seemed probable that the barge might be used for other and different services, some of which it might not be practicable to complete in one tide. Arrangements were therefore made for the provision of a large sea-cock in the bow of the vessel, to enable it to be sunk on the grid, in the event of the rising tide

overtaking the off-loading of an awkward load. In view of the uncertainty, at that time, of the gauge to be adopted for the railway, the barge was so designed that either gauge could be fitted into it. The idea was that this barge should carry the load, on its special railway mounting, direct from the ship to a grid, designed to support it. It would be floated over the grid at high water and as the tide fell it would be allowed to ground. When the tide had fallen far enough, doors at the stern of the barge would be opened, the rails in the barge would be connected on to a track running down a slipway and then the load could be drawn out of the barge and up the slipway by a locomotive. This idea, which it is believed has since worked satisfactorily, necessitated the piles of the grid being designed to take the load direct from the rails in the barge without strain on the plates. Owing to the extraordinary variation in the tides of Singapore, there is not much margin to play with, and the level of the grid required the most exact and careful calculation in order to ensure that the barge could be operated as nearly as possible on any tide throughout the year. Even so, it was estimated that there might be five occasions in a year when the tide would not allow the barge to be used. Tenders for this barge were also invited at home as well as locally, but a local tender was accepted and the barge was built in Singapore and completed by the end of 1928.

As the reclamation of the swamp progressed, it became possible to consider in detail the layout of the station yard, and the arrangement of the pier and its approaches. The first idea at home had been that this pier should be provided with broad-gauge track in continuation of the Changi Railway, and that some form of wharf might be feasible in the Selarang River. The clearing of the site, however, suggested that these requirements might profitably be combined in one scheme together with a grid for the gun barge. A design was accordingly prepared for a lighter form of pier, in combination with a wharf, alongside the grid, carrying a broad-gauge track on which a railway crane could operate. The design included two 24-in. gauge tracks on the pier, laid in connection with a large stores depot, which it was proposed at that time should be established on this site, and for which proposals were asked for and submitted to the War Office. As a result of observations, however, noted while the filling of the swamp was proceeding, the War Office was advised to postpone any building on the reclaimed portion of this swamp for a period of three years, to allow for settlement and solidification, which would obviously take some time. This layout and design were approved at the War Office, and the pier, wharf and grid were built, but they took some months on account of the very large number of concrete piles that had to be cast and then driven, for all three parts of the work. In this pier, and in the other one built about the same time, reinforced concrete was only adopted after an exhaustive examination of

other forms of construction that had been tried out in Singapore. The chief objection to this form of construction for a pier, or other form of wharf, is the danger of the concrete being cracked by a vessel coming alongside, and so admitting water to the reinforcement. As an endeavour to guard against this danger, the piers were protected by wooden piles, driven in front of the pierhead to act as fenders, but whether this has proved successful in practice, the writer does not know.

The layout of the pier and grid enabled the remainder of the station yard to be planned, the running shed to be built and the approach roads to the pier and station to be laid out. One of these roads was urgently required to enable the W.D. quarry, which had just been acquired, to be worked, in order to save the expense of bringing stone from Pulau Ubin, which, till then, was the only other source of supply. And so Quarry Road came into being. At the same time, Pier and Ordnance roads were planned and laid out, so that eventually the road system should provide a double line of approach to this vital centre and one-way traffic could be adopted if ever that should be necessary. A railway triangle was constructed, to enable rolling stock, especially the crane, to be reversed, and a 24-in. tramway was laid from the quarry to a platform on the triangle, for the easy loading of broken stone into broad-gauge trucks. A similar line was also laid to a concrete factory, which was established for the construction of such articles as lintels, flooring slabs, fence posts and rails, and posts for marking the edges of the roads. The latter were very necessary at that time, since street lighting could not be practicable for a very long time to come. This line was extended to the site of the pier, to supply the stone for the casting of the piles. It has already been told how a cement-testing machine had been ordered and men trained in its use. This plant arrived early in the year and proved to be of the greatest value, not only in the testing of our own manufactures, but in keeping a check on the cement and concrete supplied by contractors. Samples were cast on every work, and sent to the test-room for report at frequent intervals, so that faults could be remedied while there was yet time. This was necessary since cement deteriorates quickly in Malaya, unless it is kept in a dry place, and then it only remains good for a limited time. Although the local price was high and a D.F.W. contract would have been much cheaper, the Commission recommended that, until stores could be built, contractors should be allowed to supply cement up to W.D. test and standard. Careful supervision and testing were therefore necessary, and there can be little doubt that these precautions helped to prevent bad work.

In the meantime, work had not been confined to Changi, and as soon as the survey on the other island, already referred to, was sufficiently advanced, the light railway was built from the site of the

proposed pier as far as a creek about a mile and a half away, to facilitate the construction of a bridge across it, which was included in the contract for the building of the pier. This line was 24-in. gauge, built from the material sent out from home, part of which was first used in the reclamation of the two swamps at Changi. Although a lighter section of rail would have served for the purpose anticipated at that time, 20-lb. rail was specified to allow for corrosion due to the climate, and later on it was intended to put in concrete sleepers, when they could be made. The use of the heavier rail was fortunate in effect, as very much heavier loads were eventually carried on this line than were contemplated when it was built. During this period, communication with the island was rather difficult and was dependent on a launch being available from the Command pool, which was not often. This made the employment of small parties alone possible and then only intermittently. The completion of the motor boat, which had been under construction in Singapore since January, enabled work on the pier and bridge to be started in July, 1928. The arrival of their very own ship was hailed with great delight and it was felt that at last the work could go ahead that had been so delayed for the want of it. After rather a struggle with the Command Transport Branch, the launch was allowed to be given the name of *Ubique*, on the plea that she would be required mostly, if not altogether, for the service of the Royal Artillery and the Royal Engineers. The pier was designed with two decks to facilitate landing at any state of the tide, and it was provided with 24-in. tracks in continuation of the railway. While this work was going on, the rest of the survey for the railway and for the defences was completed, and as soon as the bridge was finished the rest of the line was laid. When soon afterwards the War Office plans of the defences for this area arrived, it was comparatively easy to get out to the site and fit the plans to the ground. To facilitate the construction of these works, a proposal was submitted to the War Office that the barrack should be built at once, to house the staff required for the construction of the defences. This proposal was received at the War Office with sympathy, and would no doubt have been carried out, but by that time, the work was on the point of being closed down and they were not in a position to accede to it.

The necessity for the provision of accommodation has already been referred to, and two more blocks of married soldiers' quarters were taken in hand, but their completion was delayed for weeks by a strike in Marseilles, where the tiles required were made. Local roofing tiles were only good enough for inferior buildings, at that time at any rate, and the only other source of supply seemed to be India. While this possibility was being considered the strike fortunately came to an end and the houses were roofed and completed. Road approaches to the married quarters as a whole were also planned, and

1.—The future cricket pitch as it was in 1927.

2.—The future Padang in 1927.

Singapore 1&2

3.—Hill 77, near Fairy Point in 1927.

4.—The same in 1928.

Singapore 3 & 4

those immediately required were built. Amongst the earliest designs required by the War Office were those for more officers' quarters, specially the Group III for Fairy Point and a Group V. The former was taken first in order to have it ready by the time that the completion of the four quarters under construction would enable Fairy Point Bungalow to be demolished and the new house built in its stead. The new quarters should have been completed in May, but their completion was giving the D.C.R.E. more trouble than the rest of his work together, and he had difficulty in getting the work finished off. Everything that could be wrong was wrong, and there was hardly a detail that had not to be done twice. The contractors were handicapped at that time, like the W.D., by not being able to persuade good workmen to leave the comfort of the town for the isolation of Changi. However, the buildings were finished at last and occupied in July, much to the joy of the fortunate tenants. The old bungalow was demolished (indeed it wanted little more than a push) and on its site sprang up Fairy Point House, but it was not until August the following year that it was completed and occupied. Two Group V quarters were also built about the same time close to Fairy Point.

The siting of the Group V quarters was something of a problem owing to uncertainty in regard to other items of the project. The temporary R.E. Store occupied one valuable site and interfered with another, and it was not until the reclamation of the Selarang swamp was well advanced that a permanent store could be built and the site set free. Fairy Point Hill could not be used until the question of the Officers' Mess was settled, as that would be the most likely site for the mess if the Government Bungalow site was not made available. Negotiations for the purchase of this house had been proceeding for some time, and even went to the extent of having a new site chosen at Telu Paku, and a design prepared by the P.W.D. for a new building. Temple Hill was a possible site, but it was obviously undesirable to build only two or three houses on so isolated an area, which was one that should be developed as a whole or not at all. Moreover, this hill could not be occupied until the adjacent piece of swamp had been handed over to allow anti-malarial measures to be undertaken.

As soon as New Road was opened to traffic and work could be continued on the recreation ground, a contract was made for the earthwork, which included the careful removal of the top dressing of rich black soil, before the removal of the earth for the filling. The completion of this area as a recreation ground necessarily took some time, partly owing to settlement and partly owing to the difficulty of getting rid of the land-crabs. These persistent creatures maintained with the utmost tenacity their hold on the homes they had inhabited from time immemorial, and every morning the whole ground was dotted about with the results of their nightly excavations.

It was not until a complete system of agricultural drainage had been laid all over the ground that the last was seen of them.

The sites for five of the barrack blocks, as well as other buildings, were included in the above contract, partly in order to use the spoil in the filling of the swamp, and partly so as to have the sites ready when the drawings of the barracks should be received from home. Also because experience with the four Group IV quarters had shown that better tenders for buildings could be expected if the sites, and the approaches to them, had been made ready before tenders were invited. In the preparation of these, and all other, sites, care was taken to leave the finest of the forest trees to form an attractive setting to the buildings. When the drawings of the barrack blocks did arrive from home, the drawing staff was so occupied with other and equally important work, that time could not be spared for the preparation of the designs for the architectural completion of the buildings, so a contract was let for the construction of the steel framework, floors and roof only. The floors were covered with concrete slabs made in the W.D. concrete factory. While this contract was being carried out, the remaining parts of the buildings were designed and subsequently put out to a separate contract. It had first been proposed to utilize the ground floors of the barrack blocks as an institute and as a dining-room, and plans were actually drawn up for both services. The dining-room was carried out, but it was not found practicable to make a really good job of the institute, so the idea was given up, and new designs for an institute, combined with a gymnasium, were prepared for a separate site, which was also made ready. It is believed that the site has been used for an institute but it is not known whether the original design was followed or not. The roads to all these barracks were planned and laid out, but only the parts required to serve the two blocks being built were constructed. Pathways, useful to the community generally, were also laid out and constructed in various parts of the cantonment.

An unusual feature in barrack design was the inclusion in the buildings themselves of the sanitary arrangements. Like most tropical buildings, the barracks at Changi were surrounded by verandahs, and as they were sited on a ridge that would be likely to get all the breeze there was, it was decided to make use of the end verandahs as sanitary annexes. Water-borne drainage had been installed in all the officers' and married soldiers' quarters, draining into septic tanks, in the several small systems to which the area lent itself, with the sea or river so conveniently near.

The story of electricity supply in Changi forms one of the darkest, as well as one of the brightest, episodes in the history of its growth.* By good work on the part of the officers and men concerned, the

* The full story of these beginnings has been told by Lieut. W. M. Blagden, R.E., in *The R.E. Journal* for September, 1929.

place was never without electric light from its first occupation, although it came perilously near to being in darkness, and for many months was on rations to such an extent that candles had to be used. The installation at the very beginning was a toy 1¼-kw. set taken over with Fairy Point Bungalow, and this did very well for a time while the party was small. The next effort was a queer collection of ancient generators, but the best that could be found in the local shops in Singapore, where there is little demand for second-hand stuff and no large stock of new. These had many homes and were eventually installed in a still queerer shanty in the middle of what was then forest, but is now a high road. Every evening after an honest day's work, instead of going to a well-earned rest, the steam roller was coupled to the collection to contribute, till 11 p.m., even more to the welfare of the community. In 1927, some second-hand sets, said to be available at Woolwich, were asked for as early as possible for temporary use until the permanent installation could be determined and erected. After some delay, two small sets were dispatched in February, but they were not as good as they might have been and required the utmost efforts of the electricians to keep them going at all. Two larger sets appear to have been also ready in February, but for some reason or other, their dispatch was delayed till July. Unfortunately, the ship they were in caught fire in the Thames, but as the newspapers reported that her cargo was being reshipped it was hoped that all might yet be well. The progress of the ship was watched with eagerness, but when the cargo arrived in August, there was no electrical plant. The Command was then informed that the sets had been damaged in the fire. The little garrison was not amused, for with electricity installed in every house it was poor fun having to wash by candle-light, apart from being unable to use the fans. An offer of 15-kw. sets in their place, but not to be delivered for nine months, made it obvious that the permanent installation, of which they would form part, must now be awaited. The offer was accepted, but it was not until November of the following year, fifteen months later, that these sets were received. For many weary months the temporary power-station had to be kept going as best it might, and the fact that it never failed to produce light for more than a temporary breakdown reflects the greatest credit on the electrical staff. Long before the new plant was due to arrive, the working drawings had been obtained and then it was possible to get on with the design of the new power-station and its layout. While these designs were being examined at the War Office, the hot well, cooling tanks and the foundations of these small sets were built, with the result that when they did arrive they were erected and in use in four days, a creditable job. Over these sets, a grass hut was erected to protect the machinery while the power-station was being built over and around them. The

completion of the building and the removal of the hut disclosed the two sets in their final positions. The larger sets had not been ordered when the instructions were given that no more contracts should be let, and they did not therefore mature.

The design of the power-station, and of the running shed before it, is of some interest. Being sited in a position that might become exposed to shell-fire, an important consideration was to make them, and their valuable contents, as little liable to damage as possible. With this object chiefly in view it was decided to adopt steel frame construction. The stanchions were enclosed in masonry, to protect them and to support the panels, which were of reinforced brick $4\frac{1}{2}$ inches thick. This method of using brick had been much in vogue in Quetta before the war, for lintels and small culverts etc., using as reinforcement two strips of ordinary hoop iron $\frac{3}{4}$-in. from the edges of each course. For such purposes, a lintel can be built at site as a small wall, and then lifted into position, which is sometimes more convenient than concrete built in a factory and carried to the site of the work. The reinforcement used at Changi was expanded metal, laid in each course as the panels were built. Reference has been made to the hope that piling might not have to be used in these buildings but it was found necessary to support the stanchions and the foundations of the generating machinery on piles, owing to the fact that underneath the firm red soil of Fairy Point Hill, there appeared to be a stratum of soft mud, in which it would not be possible to find a firm foundation. The presence of this mud was not expected, as the buildings were sited well within the area formed by cutting away the hill. It shows the extent to which the surface of hills is washed down in the course of ages on to the neighbouring levels. For this piling it was decided to adopt the local native practice of *bakau* piles, which consists of a large number of short piles of small diameter, cut from a local timber, and said to last for an almost unlimited time. In addition to the foundations of the small sets the opportunity was taken to drive the piles required for the larger sets as well, in order not to have to do this rather messy job later on in the completed power-station.

Water-supply was another item that did not run altogether smoothly, but this time the trouble was entirely due to local causes. It is generally easy enough to find water in a country where it rains almost, if not quite, every day. One has only to dig a hole. Near the sea, however, the water would often be brackish, and care had to be taken in choosing the site of the hole, but a supply of good water for the small population there to start with did not present any particular difficulty. For a larger population of the future garrison it was quite another matter. Every effort was therefore made to explore local resources. The best advice available in Singapore at the time was obtained, and it was fortunate that this could include the advice of

5.—Near the Government Bungalow in 1927.

6.—The same in 1929.

Singapore 5 & 6

7.—Clearing Mangrove for the Railway Terminus 1927.

8.—The same in 1928.

Singapore 7 & 8

the consultant who had designed the Johore water-supply, and who happened to be in the town at the time. With the agreement of all these experts, that the site was the best that could be chosen, and that good water in abundance should be obtainable from it, a well was sunk at the foot of Barrack Hill near Quarry Road. The curb was carried down to a considerable depth when a stratum of laterite was encountered, and then the trouble began. The laterite was so saturated with water as to be in a state of actual movement to such an extent that it carried the curb over three feet out of alignment. In spite of the most noble efforts on the part of the engineers to remove the laterite and keep the curb straight, nature won the battle and the well had to be abandoned.* This was, however, not the only possible source of water-supply, and other avenues and possible sources had also been considered, the most promising of which appeared to be the idea of collecting water at the junction of "The Marsh" and "Chinese Valley." There appeared to be an abundance of water at this point, and the notion was to collect it into reservoirs, filter it and pump it up into other reservoirs on Barrack Hill. One of the reservoirs on the hill was built and some of the piping had been laid when the work was stopped in 1929. Nothing had, however, been done in regard to the collection of this water, so the temporary supply was connected to the new reservoir and distribution system, and served very well for the comparatively small numbers then living in the place.

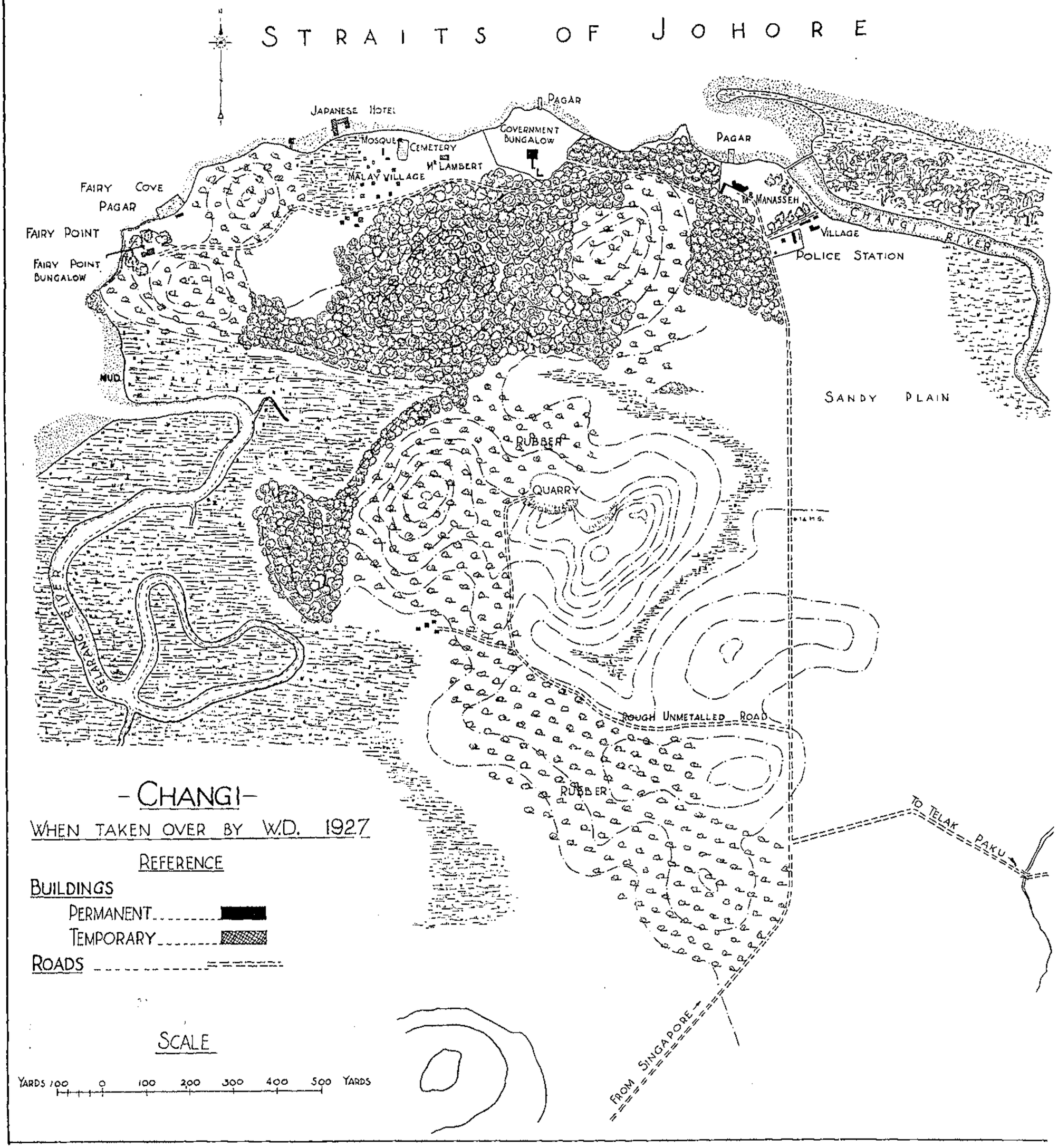
While most of the activity was going on at the eastern end of the island, work was also progressing in other parts as well. Defence works were planned and laid out, and War Office designs were fitted to the sites, but that is all that can be said about it in this article, except that a lot of work was involved. An Ordnance Depot was planned and another railway was surveyed and pegged out on the ground. The requirements of the Navy, in connection with the land defences, were worked out with the Senior Naval Officer and other officials of the Admiralty. Magazines and communications were considered and proposals submitted, and one battery was built, while proposals for the remodelling of others were considered. The Commission had recommended that in some cases experiments should be carried out with defence electric lights before finally fixing their exact positions. It was proposed to mount the projectors on wheels, and to put the generators into lighters, for the purpose of these experiments, and the necessary equipment was on order, and some of it had been shipped, when the order to stop work was issued in 1929.

In the early days at Changi the work was so absorbing, and kept everyone so much out of doors, that any other form of recreation was not needed even if there had been time for it. But as time went on

* The story of this well has been told by Lt.-Col. A. T. Shakespear in *The R.E. Journal*, about the end of 1930.

and office work increased, the need arose for something better than a walk, which could only be taken on the scene of the day's work, and did not therefore offer the change of ideas so necessary to maintain health. Thus the matter of refreshment after labour became a question of importance both for officers and men. Changi offered nothing in this way and Singapore was too far off for any of the men, and only within limits accessible to officers, on account of the expense. Authority was obtained for the construction of a squash court, and tennis courts were built for officers and for other ranks, on sites that would fit in with future construction. The sea, of course, offered the greatest attraction of this part of the island, but a tragic occurrence a year or two before had led to an order that no bathing should be allowed outside suitable protection from sharks. Fortunately an old bathing *pagar*, or enclosure, was already in existence at Fairy Point, and though it was almost on its last legs it could be made serviceable, and was a veritable godsend to all ranks, who shared it in turn. This *pagar* was, however, very small and so expensive to maintain, that a design for a new and more permanent one, based on all that was best in the many *pagars* in Singapore, was prepared and submitted home, but the stoppage of the project prevented its then being built. The question of transport, which played so important a part in life at Changi, has already been referred to. The situation was eased by the grant of an allowance of £50 per annum to enable the troops to leave Changi for the purpose of playing in matches elsewhere, and at the same time, by authority being given for other ranks and their families to use government transport into Singapore, on payment of a reasonable fare. These concessions were of the greatest benefit, especially to the married families, for whom there was no other means whatever of getting into the town, whether for shopping or any other purpose, except an occasional lift in an officer's car. This giving of lifts was almost, if not quite, a moral duty, but it had to be organized and as the numbers grew it became something of a burden to the officers, so the concessions were welcome also to them.

Changi was well represented in Singapore in cricket, tennis, golf and squash, in all of which matches were arranged. Football matches for the men were organized against local teams, including the Malay Police, and a good deal of welcome and healthy amusement was got from them. Whist drives for the families were a regular feature, generally held in the officers' houses, and they were most popular. Two of the officers bought an ancient yacht with the laudable idea of doing her up in their spare time and of starting a local branch of the R.E.Y.C. But a *sumatra* arose and wrecked the boat and these aspirations as well. It is hoped that this was only for a time, for around the island of Singapore is ideal for sailing, and Changi would make an admirable anchorage. As some compensation for this


STRAITS OF JOHORE
JAPANESE HOTEL
PAGAR
MOSQUE
CEMETERY
GOVERNMENT BUNGALOW
PAGAR
Mt LAMBERT
MALAY VILLAGE
FAIRY COVE
PAGAR
FAIRY POINT
FAIRY POINT BUNGALOW
Mt MANASSEH
CHANGI RIVER
VILLAGE
POLICE STATION
MUD
SANDY PLAIN
RUBBER
QUARRY
SELARANG RIVER
ROUGH UNMETALLED ROAD
RUBBER
TO TELAK PAKU
FROM SINGAPORE
- CHANGI -
WHEN TAKEN OVER BY W.D. 1927
REFERENCE
BUILDINGS
PERMANENT
TEMPORARY
ROADS
SCALE
YARDS 100 0 100 200 300 400 500 YARDS

disappointment, the two officers concerned both entered for the visitors' race, given annually by the Singapore Yacht Club, and managed to gain both first and second prizes.

For work of this nature, the wearing of uniform was not practicable, but its existence was not forgotten. Apart from visits of state to Fort Canning, everyone was expected to turn out in their best for Church Parade, which was held every Sunday, and they did. The service to start with was held in an officer's quarter, and conducted by a senior officer, but later on a real chaplain was found kind enough to come all the way out from Singapore, as often as he could. On one celebrated occasion, Changi had a ceremonial parade all to itself for the presentation of medals, and although the numbers were scarce large enough to form fours, no detail of the proper procedure was omitted. The children were not forgotten and a school was organized in an empty married quarter. There were no official teachers, nor likely to be for some time, but the wife of one of the men and the daughter of one of the officers were kind enough to officiate, and very well they did it too.

The embellishment of Changi was a matter to which particular attention was paid, and a nursery garden was established, under a zealous horticulturist, to provide the plants required to complete the natural beauty of the place. The garden was stocked from the gardens of Singapore by kindly hosts who never allowed a guest to depart without a basketful of cuttings. In this climate the cuttings grew with the most amazing speed, and soon developed into plants large enough to move and to give pleasure to all who passed by. At that time, boundary hedges between the quarters were purposely omitted with the idea of Changi being itself the garden, in whose charm all could share. This ideal worked very well for the little band of brothers at the beginning, but whether it would work as well in a larger community was then a matter for the future alone to tell.

Towards the middle of 1928, the climate began to affect some of the party at Changi, and it was necessary to send away two of them, who had been there longest, for such change as the country could offer. Since neither of them could afford to take leave or go to a place that would really benefit them, temporary duty elsewhere had to be found for the sake of the change. This raised a question of the greatest importance, not only to enable work on the new defences to be maintained, but for the welfare of the future garrison as well. There appeared at that time, to be only one place in Malaya that offered at once the possibilities required, and that was the fairly recently developed hill station on Bukit Fraser, a very pleasant place in which to enjoy a holiday or to recover from sickness. The place contained a fair number of houses and was still being developed, but there was not room for very much more expansion. Most of the houses were

owned by the Government of the Federated Malay States and were reserved for the use of officials in need of a change, or sometimes for others if not already booked. The houses were only let for a short stay of from two to three weeks, in order to give the benefit of a change to the maximum number of people, but houses, even if they could be secured, were beyond the means of many officers and out of the question for other ranks. Two unallotted sites were, however, secured from the Government, and proposals were submitted to the War Office for the erection of two houses, one for officers and one for the married families. These proposals were received with sympathy and an allotment was promised for 1929-30, but the stoppage of the work on the defences prevented this allotment from being made. Meanwhile, however, designs were prepared and handed over to the P.W.D. for the preparation of the working drawings, specifications and quantities, but they could only be put away for a perhaps distant but more hopeful future. Perhaps they have now been built.

Another place that appeared to present possibilities in the future, was Cameron's Highlands, but very little information about the place could be gleaned, for to most people it seemed to be but a mysterious spot hidden away somewhere in the midst of inaccessible mountains, and indeed for many years after its discovery by a certain Mr. Cameron, its very existence was doubted by many. Recently, however, the F.M.S. Government had decided to do something about it, and a motor road was said to be under construction and exploration to be in hand at the place itself. Obviously this was a case for personal reconnaissance, so, accompanied by the Senior Naval Officer, it was decided to go up and explore its possibilities for a combined Convalescent Depot for the three Services. The visit was paid in July, 1928, and necessitated a two days' march on foot along a rough mountain track, by the side of the road being made, but it was well worth while. At that time, the place was almost entirely covered with forest jungle of such density that its total extent had not yet been fully gauged. Clearing was proceeding as fast as the natural difficulties of the site allowed, and enough had been done to give a very fair idea of its possibilities, which were considerable. The climate at this height, though only about 6,000 feet above the sea, was a wonderful change after the close heat of the sea coast, and the nights were really cold. The officials in charge had already tentatively car-marked a site for any military development that might be needed, and from what could be seen in a visit of five days, no site could have been better chosen for the purpose. The choice was accordingly agreed to and a tentative layout for a Convalescent Depot, of the size required for the contemplated garrison, was prepared and submitted to the Admiralty and to the War Office. It was, however, clear that many years must elapse before such a depot could materialize, so proposals for Bukit Fraser were made as a temporary measure

STRAITS OF JOHORE

JAPANESE HOTEL
PAGAR
FAMILIES PAGAR
PAGAR
MOSQUE
CEMETERY
GOVERNMENT BUNGALOW
OFFICERS MESS
M.S. QUARTERS
W.O.
PAVILION
OFF QRS
B
GUARD RM.
K.K.
M.
FAIRY COVE
OFFICERS PAGAR
STABLES
PADANG
LAUNDRY
M MANASSEH
CHANGI RIVER
A/A
REQ OFFICES
INSTITUTE
SGT'S MESS
W.O.
FAIRY POINT
M.D. OFFICERS QRS
SCHOOL
W.O.
MARRIED S/SORT'S
A.A.
VILLAGE
POLICE STATION
FAIRY POINT BUNGALOW
GYMNASIUM
RESERVOIR
M.D. OFFICERS QRS
U/I
W.O.
B.B.
M.S. QUARTERS
C.C.
PIER
DINING RM
W.O.
SLIPWAY
R.E. & RASC.
ORDNANCE
TARGETS
ELEC P.S.
RE WORKSHOPS
ORDNANCE (ASHY)
OIL & PAINT
STORE SHEDS
RUNNING SHED
MUD
WHARF
CHURCH
W.S. FILTER BEDS & PUMPING STATION
QUARRY
M.D. OFFICERS QRS
14 M.S.
40 M.S. QRS
W.O.
W.O.
W.O.
W.O.
SCHOOL
SGTS MESS
D. COY
OFFICERS MESS
M.D. OFFICERS QRS
DINING ROOM
GYMNASIUM
INSTITUTE
PARADE GROUND
A COY
BARRACKS FOR INFANTRY BATTALION
GUARD ROOM
B. COY
ORDERLY ROOM
C. COY
BAND
SELARANG
RIVER
200
300
400
500
600
700
800
900
1000 YDS. RIFLE RANGE
TO TELAK PAKU
FROM SINGAPORE

- CHANGI -

LAYOUT PREPARED BY THE GILLMAN COMMISSION

1927

	TEMP	PROPOSED	SITE FIXED	EXISTING
BUILDINGS				
ROADS				
RAILWAYS				

SCALE

YARDS 100 0 100 200 300 400 500 YARDS

for use until the depot on Cameron's Highlands could come into being.

During the whole of this time in Malaya close liaison was maintained between the Naval, Military and Air Force engineers by frequent interchanges of visits and by a monthly conference at Fort Canning. This liaison was most helpful for the purpose of exchanging ideas and experiences, and with a view to ensuring co-operation. Close touch was also maintained with the civil officials of the Government, all of whom gave what help they could. This especially applies to the civil medical officers, who could not do enough in placing their expert anti-malarial knowledge at the disposal of officers and others new to the country. Without their help and advice, particularly at Changi, it may be doubted whether the work could ever have made the successful start it did.

In spite of the willingness of the civil officials, the acquisition of land continued to be troublesome and unsatisfactory, right up to the end of the period under review. The procedure was first to obtain an estimate of value from the Commissioner of Lands, and this price would be reported to the War Office. When, and if, the purchase was approved the Commissioner would be asked to gazette the land, assess the price and make an award. The case of the sandy plain between the Changi Road and the Changi River illustrates the difficulties that the Commissioner was up against, and it has its amusing side as well. This piece of land was duly gazetted and assessed at a value of £15,000, which was not much more than had been estimated as the probable price. The very next morning, a newly dug sand-pit appeared by the side of the road, where there had never been a sand-pit before. This seemed strange until it was learnt that the owners of the land had put in a claim for £120,000, on account of the very great value of the sand for the manufacture of glass. The next step, therefore, was to have the sand analysed and to find out why this enormous wealth had been allowed to lie hidden and unused ever since there had been any Singapore. Enquiries did not, however, have to go very far, for the next thing that happened was the stoppage of the project and so the deal fell through. It might have been assumed that these cunning Chinamen got their glass after all, but if report be true, they did not, for this land was acquired a few years later for a fraction of the price, so perhaps the stoppage of the work had some advantage after all.

During these eventful years, the drawing office at Fort Canning, and indeed every other place where it was possible to put up a drawing table and find someone to use it, was more than fully occupied with the preparation of the many plans, maps and surveys that must necessarily be required in a development of this size. The number of new designs required may perhaps be imagined, and their preparation taxed the staff to its utmost, especially when it is

remembered that the production of a clean and tidy drawing in a damp, hot climate is not the simple matter that it is at home. It may be mentioned that the Commission took home 37 plans and drawings, though it is true that they were not all prepared for this especial purpose. A shortage of drawing staff was a serious handicap all the time, and survey also presented something of a problem. At first, it was possible to spare R.E. officers for this duty, but later on it was no longer practicable to do so and other arrangements had to be made. The Johore Survey Party, then carrying out a large survey in that State, had quite enough work of their own; the Straits Government Survey helped a little, but they could not spare the men to do much, and the Federated States Railway were unable to help for a long time. When they did they also seemed to be handicapped and had to change their surveyor twice and to do a job three times to get it right.

Progress plans and reports were sent home from time to time, and their preparation was useful by ensuring that planning was kept well ahead of construction. Selections from these plans are reproduced in simplified form to illustrate this article. The first shows Changi as it was when taken over by the W.D. in 1927, and the last as it was left in 1930 and as it remained until the work was started again in 1933. This last plan also shows how it was proposed then to continue with the construction of the cantonment. It is of interest to compare it with the last of the plans in *The R.E. Journal* for September, 1937, showing the place as it has actually been completed. Apart from these and other ordinary drawings, the preparation and distribution of secret plans raised a question of interest and importance. The first of such plans to come out from home were complete with names and titles, and were therefore easy to identify with the site. There were unfortunately not enough draughtsmen to make less secret copies, so they had perforce to be used for the invitations to tender and by the contractor on the works. This was for obvious reasons very undesirable, but fortunately did not have to happen in connection with a work of real importance. Before any more drawings arrived an arrangement was made with the War Office that the only complete copy of a secret plan should be the general layout, and that that copy should not leave the possession of the officer in charge of it. No other copies, or plans, of the work should bear any title, name or other identification mark, and a drawing should be confined to one item only of the work, so far as practicable, with sufficient indication to enable it to be joined on to any other part. There would then be no need for the contractor to do more than see the complete layout in the R.E. office, and the complete plan need never be taken on the works at all.

In 1929, the Labour Government came into power, and very soon there were signs of the approaching check to local enthusiasm.


STRAITS OF JOHORE
FAMILIES & OTHER RANKS PAGAR
PAGAR
TEMP' OFFICERS MESS
MOSQUE
CEMETERY
GOVERNMENT BUNGALOW
PAGAR
TEMP' OFFRS QRS
M.D. SOLDIERS QUARTERS
PARK & PLAYING GROUND
FAIRY COVE
OFFICER'S PAGAR
PADANG
RE OFFICE
SGTS MESS
HOSPITAL
INSTITUTE
SQUASH CRTS
OPEN TENNIS CRTS
RESERVOIR
GYMNASIUM
M.D. SOLDIERS QRS
WD COOLY LINES
SHOPS
POLICE STATION
VILLAGE
CHANGI RIVER
PIER
GRID & SLIPWAY
NURSERY GARDEN
R.A. & R.E. CANTONMENT
GUARD RM
MD ASIATICS
WD CONTRACTORS' YARDS
WELL
GUN PARK
STORE SHEDS
MUD
BARGE WHARF
ELECTRIC POWER STN
CONCRETE FACTORY
ANTI-MALARIAL DITCH
TRAMWAY (2' GAUGE)
OFFICERS' QUARTERS
CRUSHER
QUARRY
14 M.S.
OFFICERS QRS
QM QUARTERS
OFFICERS QRS
MD SOLDIERS QRS
SCHOOL
W.D. ASIATICS QRS
INSTITUTE
SGTS MESS
TO CHANGI POINT
INFANTRY OFF'S MESS & QRS
INFANTRY CANTONMENT
PARADE
GUARD ROOM
DINING ROOM
COY BARRACKS
RECREATION GROUND
SITE FOR POST OFFICE
TO TELAK PAKU
FROM SINGAPORE
SELARANG RIVER
-CHANGI-
AS COMPLETED AND LEFT IN
1930
TEMP
PROPOSED
SITE FIXED
EXISTING
BUILDINGS
ROADS
RAILWAYS
PATHS
SCALE
YARDS 100 0 100 200 300 400 500 YARDS

Finally, the blow fell and the order went forth that there should be no more contracts. Leave was given for works in hand to be completed, which was well, for it enabled things to be tidied up and left shipshape. So the adventure, so keenly begun, came suddenly to an end. But the foundations had been laid and completed, and, whenever it might be decided to go on with the work, it would be practicable to carry it out with far greater speed than had been possible at the commencement. A report could therefore happily be sent home that the stoppage of the work need not necessarily be viewed with dismay, and provided that what had been done was maintained, especially the clearing and anti-malarial works, and that plans, specifications and contract documents for future works were prepared, then an adequate staff could complete the whole scheme in very much less time than had been proposed in the official programme. In this connection it is interesting to note that in 1927, it was proposed to complete the project in ten years, that is by 1937, the very year in which this work, described in a newspaper as the greatest enterprise of its kind ever undertaken by any country, has in actual fact been further advanced than was ever contemplated at its inception.

THE 56th (LONDON) DIVISIONAL ENGINEERS AT THE CROSSING OF THE CANAL DU NORD.

By BREVET LIEUTENANT-COLONEL E. N. MOZLEY, D.S.O.,
C.R.E. 56th Division in 1918.

This article is greatly indebted to Captain Trouillet, of the 3rd Engineer Regiment of the French Army, who, at the request of the British Embassy in Paris, made a reconnaissance of the Canal du Nord and the River Agache at Marquion, near which the bridges described in the article were built. Captain Trouillet's information is embodied in this article. Our Corps will be very grateful to him as well as to General Doumenc, commanding the 1st *Military Region at Lille, who permitted and arranged the reconnaissance, and to Stanley H. Gudgeon, Esq., H.B.M. Consul at Lille, through whose good offices the assistance of the French Army was obtained.*

ONLY on very few occasions in the war did the R.E. have an opportunity to carry out in the actual presence of the enemy the bridging of a considerable width of water, which we practiced so often in peace training. Twice, in September and October, 1918, the writer was fortunate enough to take part in such operations. The first was an almost ideal occasion, on which the 56th Divisional Engineers were able to execute in 72 hours the lightest of floating bridges for infantry in single file, a medium pontoon bridge at night, and, still under occasional fire, a heavy steel cube bridge capable of carrying all traffic except tanks.

The enemy in the latter part of September, 1918, were, of course, not the dangerous opponents that they had been. They were in retreat. The 56th Division were in the XXII Corps which belonged to the First Army. About September 20th the C.R.E. was ordered to prepare material for crossing the Canal du Nord near Marquion in the projected offensive operations towards Cambrai.

The Canal du Nord in this region lies in the valley of the Agache, a shallow valley between higher ground rising slowly to about 100 feet above the valley floor. On the front concerned the line of the Canal was west of the river at a distance varying from 200 to 400 yards; the Canal was under construction in 1914 and has never been completed. The section on the 56th Division's front was principally between raised embankments, and the earthwork was more or less completed. The width at bottom was 40 feet and

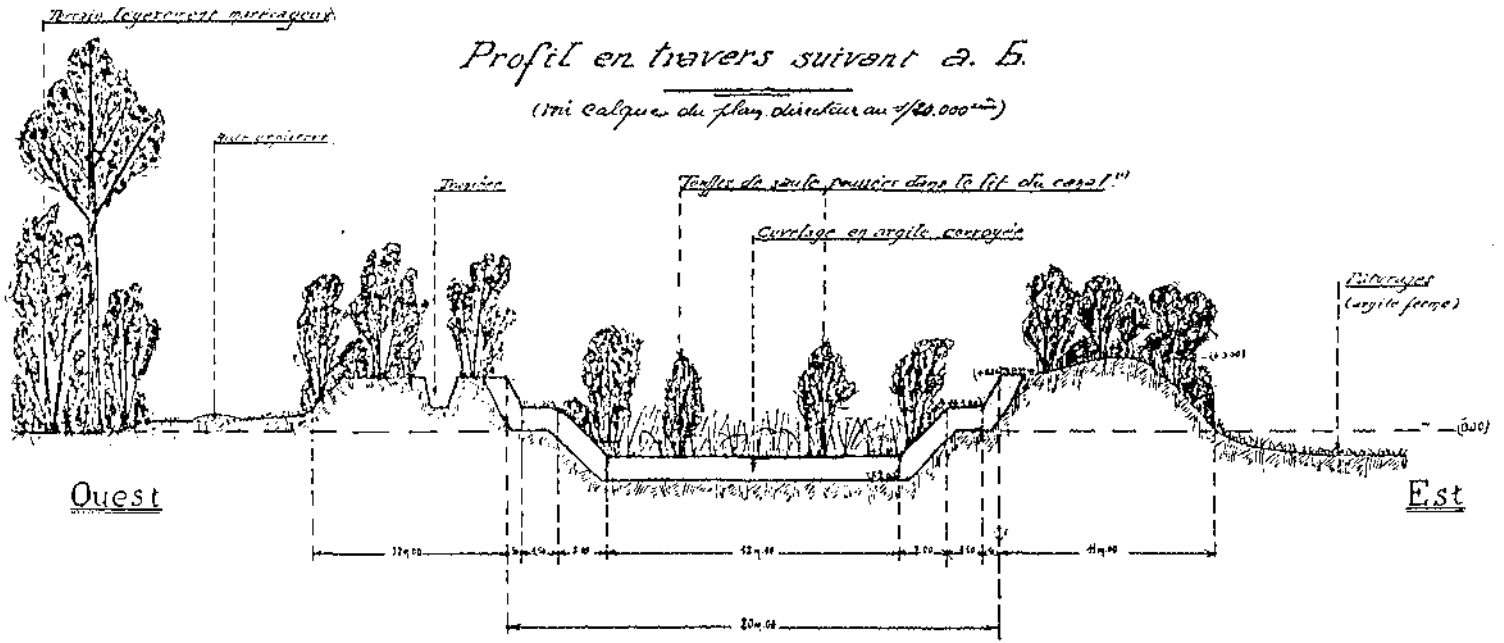
Croquis N° 2

Canal du Nord

(Entre Marquion et Sains-lez-Marquion)

Profil en travers suivant a. b.

(Tiré calques du plan directeur au 1/20.000ème)



(1) Cette expression est beaucoup plus abondante aujourd'hui. Ce croquis a été établi d'après les renseignements fournis par l'état-du Canal en 1918

Dressé par le Capitaine Trouillet du 3ème Régiment du Génie à l'issue d'une reconnaissance du Canal effectuée le 17 janvier 1938, et d'après les renseignements théoriques fournis par le service des Ponts et Chaussées de St Quentin

Arras le 18 janvier 1938

Le Capitaine Trouillet, du 3ème Régiment du Génie

SECTION OF THE CANAL

from a drawing by Capitaine Trouillet, 3me Régiment du Génie.

(It was not possible to reproduce Capt. Trouillet's map of the area to which there is reference in the above.)

the depth below berm level 10 feet. South of the Arras–Cambrai road there was generally less than two feet of water in it. A little south of the road a lock or basin had been in process of construction. This was about 200 yards long and 90 yards wide: it was 8 feet deep, and held water to a depth of 5 feet; it was divided from the Canal to the south by a bank, 15 feet wide, through which a channel 7 feet wide had been cut.

South of the road the ground between Baralle and the Canal was somewhat marshy and covered with poplars, scrub and thick bushes; there was, however, little physical obstacle to the passage of infantry. There was a metalled track, about 7 feet wide, running along the Canal outside the embankment.

North of the road, for a distance of 400 yards, the Canal had not been dug at all. After that, to the north, it had been dug and held up to 7 feet of water. The country to the west of the Canal was more open here.

To the east of the Canal the flat valley of the Agache is chiefly pasture land, mingled with marsh and ponds. The Agache is about 25 feet wide; its banks are about 7 feet high and it contained about 3 feet of water.

Along the high ground to the east of the valley the Germans had an organized defence line. They also had a fire trench in the west embankment of the Canal.

All R.E. units were at work for a week, day and night, collecting stores and making all necessary arrangements. On 24th September an Operation Order was issued by the Divisional Commander, Major-General Sir Amyatt Hull, K.C.B. The Division was notified that the 169th Brigade would take over the frontage with their right on the Arras–Cambrai road. That Brigade was ordered to follow the Canadian Corps and the 11th Division, to cross the Canal du Nord north of the road and then attack. The 32nd Brigade would be on their left. Map reference sites for crossing the Canal were named.

The paragraph which contained orders to the R.E. ran as follows:—

> "The C.R.E. will reconnoitre the crossings over the Canal du Nord in the area allotted to 169th Infantry Brigade, as far as possible.
>
> "He will arrange to assist 169th Infantry Brigade infantry to cross the Canal du Nord and Agache River and, subsequent to the attack, to improve the crossings of the Canal du Nord and approaches to them on the Corps front for horse traffic, as early as possible, for the use of the 11th Division, in order to relieve congestion at the crossing of the main Arras–Cambrai Road."

The same day the C.R.E. issued consequent orders to his three Field Companies (the 416th Edinburgh, the 512th and the 513th

London Field Companies) and to the 1/5 Cheshire Pioneer Battalion. The paragraphs of this Order, which should be quoted here, were as follows :—

" The 169th Infantry Brigade is to cross the Canal du Nord north and south of the Arras-Cambrai Road on a certain date.

" It will then wheel to its left and move N.N.E. on a front between the Canal and the road running from W.16.b.6.5 to W.5.d.8.8 ; 168th Brigade co-operates by clearing west side of the Canal from W.4.c.0.5 to Mill Copse, keeping pace with left of 169th Brigade.

" B.G.C. 169th Brigade proposes to cross the line of the Canal where it has not been dug, viz., between W.9.d.2.3 and W.9.b.6.4, but may also alternatively cross it by the track and bridge just north of the Basin at W.9.b.9.8 and by a bridge at W.15.a.9.6.

" After crossing the Canal the Brigade will cross the River Agache.

" The Divisional Engineers and the Pioneer Battalion will assist the Brigade to cross the Canal and the Agache.

" The hour of zero is not known, but assuming it to be 3 a.m. the time-table of Engineer and Pioneer operations would be as follows :—

" 2 a.m. —* wagons report at Dump V.6.a.7.2 where they will be loaded with stores by an R.E. officer superintending a party of one officer and 20 infantry. These wagons will take forward principally fascines, infantry bridges, wire netting, pickets, mauls and flags.

" 4 a.m. Wagons move forward from the Dump under an escort to be detailed by O.C. 513th Field Coy. who is marking on the ground the route to be taken.

" The O.C. 513th Coy. will send forward officers' reconnaissances from his own Coy. at the earliest hour permitted by the progress of the operations to ascertain the best means of crossing the Canal Line between W.9.d.2.8 and W.9.b.8.8.

" O.C. 416th Field Coy. will take no part in the arrangements for the Canal Line crossing (unless called upon to do so in case of emergency). He will forthwith arrange with B.G.C. 169th Infantry Brigade :—

" (*a*) To mark out with green flags a line of approach from the Cambrai Road to the wood, and lines across the crossings of the Canal and the Agache and between them.

" (*b*) To detail a party of his Coy. to go forward from the Canal to the Agache with the leading troops of the Brigade, carrying sufficient infantry bridges and tools to place them across the Agache, and will place and maintain these bridges (or surviving German ones).

" O.C. 512th Coy. will detail officers' reconnaissances to move up the west bank of the Canal as nearly abreast of the advancing 168th Infantry Brigade as is reasonably safe. These officers will send

* Number of wagons were stated later.

reports of the state of the Canal and especially of all crossings and of suitable new crossing-places, giving all span and depth dimensions and detail of all Engineer material near by. These reports will be sent to C.R.E. at his report centre.

"O.C. 416th Field Coy., after he has assisted the 169th Infantry Brigade across the Agache, will detail Engineer reconnaissance parties behind the advancing Brigade to search for enemy R.E. stores, dug-outs, water supply, etc., and to report upon the general character of the area, including roads and tracks."

The C.R.E. arranged an "Advanced Centre" at W.1.d.05.70, ¾-mile N.N.W. of Baralle, for himself with the following personnel: his Adjutant; an officer of the Pioneer Battalion; three mounted orderlies; six cyclists; two clerks. To this centre all reconnaissance and other reports were sent, and orders emanated thence consequent upon those reports. A stray shell landing within a few yards of this post laid the C.R.E. on his back, but with no serious ill-effects.

We now turn to the dispositions and the reports received by Field Company officers during the course of the day.

To take the work of the companies in detail, the O.C. 416th (Edinburgh) Company, with Nos. 1 and 4 Sections, moved forward at 7 a.m. on the 27th to reconnoitre the Canal crossings and "at 1.30 p.m., when the tactical situation permitted" No. 1 Section (Lieut. Campbell) was able to get across at an unopposed point and carried forward and erected infantry bridges across the Agache at W.10.a.25.55. No. 4 Section (2nd-Lieut. Brown) picketed and marked with flags two tracks to Canal bridge crossings at W.9.b.7.8. Lieut. Thomasson reconnoitred the water-supply of Marquion.

(On the 28th, Nos. 1 and 4 Sections of 416th Company strengthened and strutted a bridge over the Canal and refixed their infantry bridge over the Agache.)

No. 2 Section, at 3.20 a.m. (28th), repaired a broken culvert on the lorry road at Saudemont, P.30.b.80.45. No. 3 Section reconnoitred for water in Sauchy-Lestree and Sauchy-Cauchy. The Company H.Q. moved to Marquion at 2 p.m. this day. The outstanding work of this Company was their heavy bridge on the 29th and 30th, described later.

The following reports from 512th and 513th Field Companies during the light bridging operations up to 2.10 p.m. on the 27th give a vivid picture of R.E. Field Companies in action.

Referring first to the doings of 513th Company, at 12.50 the C.R.E. received from Captain Bourne the following message he had received from Lieut. Kidman, who had been sent forward to reconnoitre the Canal:—

"Have been up to the Canal and looks dry and marshy in places. I saw Boche on east side of canal running northwards. The wood itself is clear but all marshy. If transport comes along it must

keep to north side of wood, or else come down behind it. I never met any infantry of L.R.B.'s* at all and I can't find out whether they have mopped up or not. Machine-gun fire still strong, also shelling. I think the infantry should send over first, before you start fascines, as it appears that infantry could very easily get through and clear Boche of east side.

"I am sending word to the Major. I cannot locate any of the 169th Brigade to tell them. I have three of my runners wounded.

"Place for crossing infantry, W.9.b.8.8."

At 2.55 p.m. Major D. H. Steers, O.C. 513th Company, reported that the Canal could easily be crossed at W.9.b.8.8, but was extremely marshy.

Later, a section of 513th Company built a bridge for wheeled transport in W.9.

The 512th Company, who were south of the 513th Company, were at an earlier hour in grips with the enemy.

Two sections of the 512th (London) Field Company, under Lieuts. Robertson and Farfan, went forward at 9.55 a.m. to construct infantry bridges over the Canal at W.15.a.9.8 and over the Agache at W.15.b.7.7. They found the enemy still in occupation of the eastern bank of the Canal and fighting took place. The bridging stores† were unloaded at 11.15 a.m. 400 yards west of the Canal. The site was easy though marshy.

The following field messages were received by the C.R.E. at his report centre :—

"Received 10.15 a.m.

C.R.E. 56th Division.

I have the transport with bridging material forward to road north side of Baralle, W.7.d The Company is just behind this point. Lieut. Farfan went forward at 8.30 a.m. to make a reconnaissance of crossing. I am expecting him back here any minute when we will move forward with Company and Transport. At 9.0 a.m. the position would not allow of the Company going forward to work.

My Company H.Q. will move forward with Sappers; location will be reported later.

(Signed) T. F. HENDERSON, *Major*,
O.C. 512th Field Coy., R.E.

9.30 a.m.
27.9.18."

In the meantime "A" Company of the 1/5 Cheshire Pioneer Battalion had been ordered at 10.15 to move forward to the east side of Baralle Wood. They encountered m.g. and artillery fire but passed through the infantry in W.8.c. who were advancing in

* London Rifle Brigade.

† Cork piers prepared in bundles Roadway of trench boards for infantry in single file.

sectional rushes. On reaching the enemy's side of the wood the Company sent forward a strong patrol with Lewis-guns to the Canal, as the enemy were holding the west bank and were covering the passage of the Canal with machine-guns. The enemy were engaged with Lewis-guns and rifle fire and were driven off. This Company did admirable work and took 17 prisoners.

The following messages were next received :—

"D.10.

C.R.E. 56th Division.

Copy of report just received from Lieut. Robertson, timed 12.45 :—

'I have got through the station and dump at W.9.c.7.3. and am pushing on to bank of Canal. Machine-guns and snipers are still firing bursts. I want all the Sappers and material to the station, as soon as they arrive I'll get across. A large party of the enemy appeared and I had to spread out the Sappers, open fire and drive them back. We followed them up to the Canal and I now hold the bridging site with the party of Sappers. We are now very short of S.A.A. Infantry are now approaching from the right and are still about 400 yards away. When they come forward there will be no difficulties as far as work is concerned.'

The material has been sent forward to Lieut. Robertson* and work on bridging the Agache commenced.

27.9.18. (Signed) T. F. HENDERSON, *Major*,
1.10 p.m." O.C. 512th Field Coy., R.E.

"C.R.E. 56th Division.

Infantry can cross the Canal now two deep south of Basin, W.15.a.9.7. Crossing being improved, fuller details later.

12.30 p.m. (Signed) T. F. HENDERSON, *Major*,
O.C. 512th Field Coy., R.E.

Forwarded to G.

1.6 p.m. (Signed) E.N.M."

"D.9.

To

C.R.E. 56th Division.

The crossing over the Canal south of the basin was very much delayed by the ground on the other side of the Canal being still in the occupation of the enemy (estimated number of enemy that had to be driven back, 150). The advance party of Sappers had to clear the ground before any bridging could take place. The route to the Canal crossing is being flagged, and crossing improved now.

* The material was carried forward by a company of the 1/5 Cheshire Pioneer Battalion.

A party of the Pioneers have moved forward to clear ground up to the Agache, but I don't think there will be very much opposition. The Brigade Major (Captain MacCarthy) is in touch, and knows all details.

(Signed) T. F. HENDERSON, *Major*,
O.C. 512th Field Coy., R.E.

27.9.18.
12.55.
Forwarded to G. 1.15 p.m. (Signed) E.N.M."

	Sender's Number	Day of Month
To O.C. 512th Coy., R.E.	A.4.	27.

Report of crossing prepared at W.15.a.9.7 received and forwarded by gallopers to Division. Well done!
2. Report also received (D.9). Still better.

(Signed) E. N. MOZLEY, C.R.E.

From C.R.E.,
Report Centre.
1.6 p.m."

"To
C.R.E. 56th Division.

Crossings over the Agache River complete, maintenance parties left at these crossings and the Infantry across.

1.45 p.m. (Signed) T. F. HENDERSON, *Major*,
27.9.18." O.C. 512th Field Coy., R.E.

"To
C.R.E. 56th Division.

Cork bridge over Canal at W.15.a.9.7 completed, also dry crossing at W.15.a.8.5. Track from bridgehead to W.15.b.5.9 is in good condition and is being used by Infantry crossing the bridge. A maintenance party has been left on bridge at the Canal and the situation is now quite clear. Work is being continued with crossing at Agache River. Reconnaissance parties have been sent out to search squares W.15.b, W.16.a and b, and W.10.c and d, also W.14.d; report will follow.

2.10 p.m. (Signed) T. F. HENDERSON, *Major*,
27.9.18." O.C. 512th Field Coy., R.E.

The 512th Company subsequently reconnoitred Wanicourt Farm. It should be added that the bridges made by the 416th and 513th Companies and the marshy tracks between them were made fit for wheeled transport by the morning of the 28th.

So far so good. We had got the 169th Brigade across the Canal and the River Agache.

In the evening of the 27th the attack had progressed so far north-

ward that it was possible to reconnoitre for a pontoon bridge for guns across the Canal just south of Sauchy-Cauchy at Q.34.d.05.80. An officer of the 513th Field Company selected a good site and sent back for timber for trestling; at 10 p.m., however, the C.R.E. determined that the drop from the bank to the water at this site was not too great for a pontoon bridge, and the pontoons were ordered up. The message to them was delayed, but at 12.30 a.m., 28th, they passed W.1.d on the main road, and thence proceeded at a fast pace to the site of the bridge, with the result that the 513th Field Company had the bridge completed by 5 a.m. and the Company of the Cheshire Battalion working with them got through the heavy work of cutting down the ramps by the same hour. This bridge carried guns, and the approaches to metalled roads on both banks were reasonably good.

A quotation from the C.R.E.'s letter home perhaps gives the picture most adequately :—

> "Meanwhile we R.E. were charged with getting bridges for wheeled traffic across the Canal and the little river Agache east of it, at a point further north. The subaltern in charge had chosen by 7 p.m. a good place, but made the mistake of reporting that it wouldn't do for pontoons. Now pontoons are far quicker than any other form of bridge, and I had prepared for and got up the material well forward. I rushed up at 11 p.m. in a car, saw that there was no chance of finishing the bridge that night without pontoons, ordered them up and after seeing the work flew back to meet the wagons. It was now 12.45 a.m. when we met them 3 miles back on the road. It was a great night, the moon drifting through the clouds, villages alight around and the noise of battle everywhere. The pontoon wagons were walking. We leaped out and whooped them up into a gallop and the column thundered along the Cambrai road to its destination, so fast that my returning car had its work cut out to catch them. Well, by 5 a.m. the bridge was through and we to bed in our cubby hole living like subalterns of platoons, full of buck."

O.C. 513th Field Company (Major D. H. Steers, R.E.) reported at 5.45 a.m., 28th September, the completion of the bridge and that the approaches had been made good.

The Edinburgh Field Company's turn was now to come.* On the 28th, that Company's H.Q. moved forward to Marquion, W.16.a.0.8. They were ordered to blow up the old bridge over the Canal du Nord, but this order was cancelled. Instead they received orders per First Army to make a bridge for all traffic except tanks across the Canal

* This account of the 416th Company's steel bridge is much indebted to Mr. W. J. M. Thomasson, A.R.I.B.A., then a subaltern of the Company, who has fortunately preserved his records and measurements. Acknowledgments of help are also due to Major T. F. Henderson, M.C. (then O.C. 512th Coy.), Borough Engineer, Aberdeen; to Mr. D. Gilmour, D.C.M., M.S.M. (then C.S.M., 416th Coy.); and to Mr. J. Brown, M.M., a Serjeant in 416th Coy.

at Q.34.d.05.80, where the span was 90 feet. The Company reached the site from their H.Q. in Marquion, 1¾ miles away.

On the 29th, at 5 a.m., 12 O.R. of the Company took soundings from a pontoon at the named site (Sauchy-Cauchy). At midday 47 tons of material had been got up to the site and a 90-foot bridge of two main piers and two shore piers built of steel cubes with heavy timber bearers was begun. The bridge was in 7 feet of water (total depth 18 feet) and was to carry all traffic except tanks. Erection proceeded without stop, two sections working at a time in six-hour shifts. Enemy fire was considerable and five men were wounded. It was completed at 5.30 p.m. on the 30th, having taken 27½ hours.

The bottom was hard. The approach was by a good road from S.W. (see map). The steel cubes (4 ft. x 4 ft. x 4 ft.) were assembled on the bank, bolted together into a four-cube "tower" (two towers to a pier). Each "tower" was lowered with levers, head-ropes and foot-ropes down the bank into position, then pushed upright, connected together into pier, and then by heavy superstructure (bearers 12 in. x 5 in.; decking 3 in. or 4 in. thick) into bridge. This was done simultaneously from both banks, one section of 416th Company working on each bank. The whole of the bridge material had been sent up from First Army Heavy Bridging Depot with a serjeant-instructor. O.C. Depot stated that the time was the best he had known. The Company had not handled steel cubes before. They also built a shorter bridge over the Agache for big guns.

Shortly after the steel bridge was built, Lieut. Brown of the 416th Company built a sham bridge of light scantlings and canvas over the Canal a short distance away; this attracted a good deal of attention from enemy aeroplanes. It was so realistic that an infantry officer tried to cross it before he discovered that it had only a canvas floor, with sad results for himself.

Such were the bridging operations of the 56th Divisional Engineers on these great three days.

The C.R.E.'s letter home ended thus:—

> "It was a great day, the 27th, perhaps the most successful fighting day I have ever known. Every sort of bridge we have made, from cork bridges for infantry balanced on one leg, to a heavy 90-foot bridge for 17 tons on one axle. On the 28th, Generals of all sorts overwhelmed us with congratulations. It was a great chance."

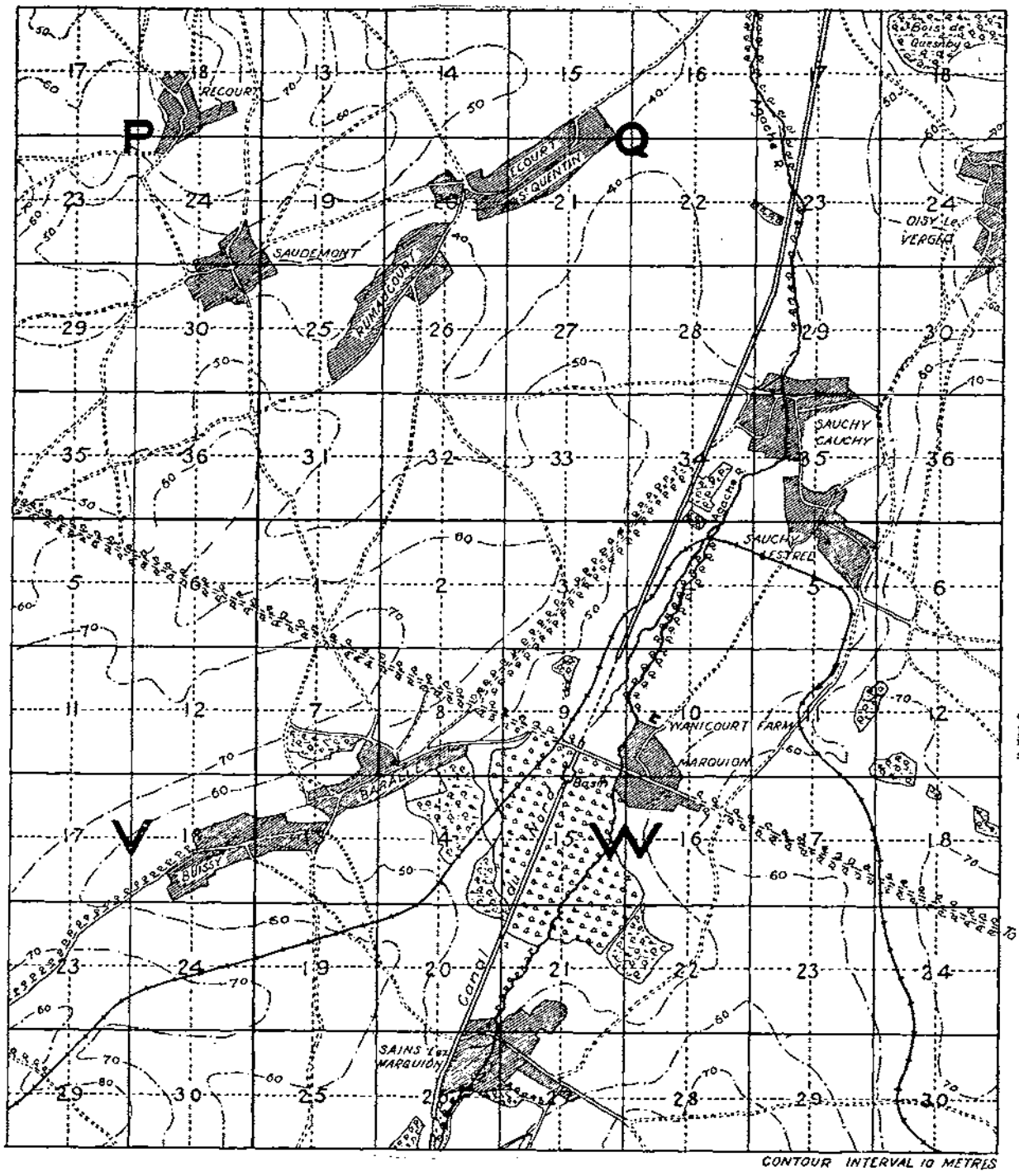
The 56th Divisional Engineers received messages of hearty congratulation from the Corps Commander, the Army Commander and the Engineer-in-Chief, and the following is an extract from the communiqué issued by the Field Marshal Commanding-in-Chief on September 28th, with reference to the British attack on the previous day:—

"At the same time the 56th Division, passing northwards along the Canal, captured over 500 prisoners with the defences north-east of Sauchy-Cauchy.

"These operations have been materially helped by the admirable work of the Engineers. In less than four hours from the opening of the assault and in spite of hostile shell-fire, they successfully threw across the Canal du Nord a number of bridges capable of carrying transport, thus permitting our advance to be continued without check.

* * * * * * *

"OVER 10,000 PRISONERS AND MORE THAN 200 GUNS HAVE BEEN CAPTURED."



NOTE.—The Northern end of the undug portion of the Canal is W.9.b.6.4, not as shown on this map.

Scale of Yards.

Yards 1000 0 1000 2000 3000 4000 5000 6000 Yards

RAPID ROAD CRATERING.

By MAJOR W. W. BOGGS, R.E.

INTRODUCTION.

ALTHOUGH sapping and mining is no new branch of military study, the great delaying power of a thorough system of road craters was not realized until the Germans carried it out in the Great War. Since then there has been a large increase in the use of mechanical vehicles for all military purposes and it is now clear that the cratering of roads will be a means of creating a formidable obstacle to the advance of a modern army.

Facilities for practice in cratering are not readily available and this article is written in the hope that it may be of assistance to officers who can get no practical experience. It is not intended for those who are already experts.

The official books give information on the subject, but they do not describe the practical details, which, as every good sapper knows, are " half the battle " in demolition work.

It is proposed, therefore, to discuss two ways of cratering rapidly and to give a short description of a demonstration of crater blowing carried out last year by the 7th Field Company at Colchester.

METHODS OF RAPID CRATERING.

In the first place, it must be pointed out that the methods about to be described are not suitable for placing large single charges. Probably 200 lb. of explosive is the biggest charge which can be laid in these ways with the equipment available at present. For larger charges one must resort to mining a shaft. This, however, is " deliberate " cratering and does not fall within the scope of this article.

1. THE CAMOUFLET METHOD.

This, as probably all know, is carried out by driving a pipe to the required depth, exploding a small charge at the bottom to form an underground chamber and then filling the chamber with the cratering charge.

The advantages of this method are that it is very quick and

requires few men. It suffers, however, from the following disadvantages :—

(*a*) It cannot be used in soils which contain large stones or are of a loose nature. In the first case, the pipe may be stopped by the stones, and in the second, the sides of the hole or the chamber, or both, may fall in during the filling process.

(*b*) The size of the chamber varies with the type of subsoil in which it is blown. The chamber may therefore be either too large or too small. Either case may lead to difficulties. If the chamber is much too large, one runs the risk of failure through the charge being dispersed and only partial firing taking place. If, on the other hand, it is too small, the fact may only be discovered through the failure of the chamber to hold the whole charge.

What is required is some sort of measuring instrument and until one is evolved, this uncertainty will remain.*

(*c*) In wet ground the chamber, of course, fills with water and although it can be dispersed for a time by blowing a small charge, the explosive is bound to get wet.

For this reason, explosives such as ammonal may fail to detonate, if used by this method.

It should be explained here that smoke from the camouflet charge makes it impossible to see down the hole and examine the chamber for some time after it is fired. The chamber can only be examined by lowering a torch or inspection lamp down the hole and it is always difficult to judge its size.

In suitable soil the following technique has been employed with success :—

1. A pipe, provided with a pointed nose and a driving cap at the top, is driven to the required depth. G.I. water-piping of at least 2½-in. diameter is suitable. It can be driven by sledge-hammers or by means of a small hand-operated monkey, which is now undergoing trials.† Should the top surface be very hard, as in the case of a concrete road, it must be broken through first, either by using tools or explosives.
2. The pipe is then withdrawn and the camouflet charge lowered down. An indication of the size of the charge is given in the *R.E. Pocket Book* and owing to the local variations, which are encountered in all soils, it is improbable that we shall ever get more than an indication.

* A suitable measuring tool is likely to be produced shortly.—ED.

† *Note :* An amendment to *M.E. Vol. IV* dealing with this equipment is about to be issued.

If it is available, the charge should be fired by F.I.D., as not only is the necessity for a detonator at the bottom of the hole obviated, but in exploding the F.I.D. widens and consolidates the sides of the hole. This widening effect can be increased by tying a number of lengths of F.I.D. together. The charge can be fired by using electrical detonators, but on no account should safety fuses be used. It is advisable to tie the whole charge to a stout stick, which can be pushed down, if the hole becomes partially blocked with small stones or pieces of earth.

3. If the resulting chamber is suitable, filling of the main charge can then begin. Care should be taken that no smouldering remains of the first charge are burning in the chamber, which might ignite the main charge. An accident due to this cause has occurred.

   If the explosive is in powder form, or if the sides of the hole are likely to crumble, the pipe should be lowered down and the explosive filled through it. When dynamite, plastic H.E., or other "sticky" explosive is used, the cartridges must be broken into pieces of suitable size for loading down the hole.

   The hole should be examined frequently to ensure that the explosive is dropping through into the chamber. If this is not done the hole may become clogged up and though the charge can be forced on down, once the sides of the hole are sticky, no more will fall freely into the chamber.

4. When the chamber is about two-thirds full, the firing primer should be lowered down and the remainder of the charge filled in on top of it. It should be noted that, although ammonal and other "lifting" explosives do not require an air space, explosives, which have a high velocity of detonation, do require one if the best results are to be obtained. When an explosive, not in powder form, is loaded into the chamber, this air space is provided automatically by the gaps between the pieces.

5. The firing primer is best made up of a length of F.I.D. with a G.C. primer at the top and bottom. The top primer is to take the detonator and the bottom one should be encased in a ball of about 1 lb. of "plastic" explosive. If this is not available, a number of G.C. primers can be strung together on the F.I.D. at the bottom. It is essential to have a good-sized primer to initiate the detonation, but the reason for mentioning 1 lb. is that it is sometimes difficult to mould a smaller amount round a G.C. primer, so as to ensure good contact.

   The whole length should be tied securely to a stick, so

that there is no danger of the charge at the bottom being knocked off in the final filling of the chamber.

6. Finally, the hole should be plugged up to prevent the firing primer and F.I.D., etc., being shaken before it is time to fire it.

2. The Earth Auger Method.

Earth augers up to 9 in. in diameter are part of the equipment of a Field Company and if larger augers are available, holes up to 12 in. in diameter can be bored without any difficulty. The bigger hole, of course, allows the larger charges to be concentrated.

This method has the following advantages:—

1. It is quick (but not so quick as the camouflet method, especially if the hole is deep).
2. The hole can still be made, even if the soil crumbles.
3. There is, or should be, no chance of bad contact between the different portions of the charge.
4. If the hole fills with water, the charge can still be laid. Should it be necessary to protect it, as in the case of ammonal, the charge can be waterproofed before being placed in the hole.
5. Should an obstruction be encountered, the hole is large enough for crowbars, etc., to be used, or for a small charge to be placed against it.

It suffers, however, from the following disadvantages:—

1. The auger is very hard to use in stony ground. The work can be held up or stopped by small stones, which would not stop the camouflet method. Roots of trees are another cause of delay.
2. When, during the boring process, the hole fills with water, it washes the earth off the auger and very little is brought up after each spell of boring.

The process of laying the charge is similar to that employed with the camouflet. It is quicker in this case, because the hole is larger and one has a good view of the proceedings.

The writer considers the auger method to be less risky than the camouflet method and, other things being equal, would use it in preference.

The Crater Blowing Demonstration.

The South Essex Water Company are constructing a large reservoir near Colchester and kindly gave us permission to carry out this demonstration in the area which they are enclosing.

The Setting.

The demolition was considered to have the immediate tactical object of enabling a retiring force to extricate itself. It was assumed to be one of a series, but was not a " last minute " demolition.

The Site.

The site chosen was at a place, where a second class road crossed a stream by a bridge with a ford alongside. It was assumed that deviations round were not possible. In other words it was a defile.

The road had a tar macadam surface, which had deteriorated. In places the bottom had broken up. The subsoil was stiff clay.

The stream was shallow with steep banks in places and was assumed to be a tank obstacle. The ford had a good hard bottom.

The bridge was a small R.S.J. and concrete slab, resting on two concrete abutments, 15 feet long and having a cross-section of 3 feet by 3 feet. They were not reinforced in any way.

The Plan.

It was decided to blow all the craters simultaneously, owing to the risk of interference with the firing arrangements, if they were fired in two or more batches.

Five craters were required. One behind each abutment, placed eccentrically, with the object of breaking up the abutments and throwing the bridge slab away to one side. The slab itself was not to be cut. It was expected to break up in the shock of the explosion.

One crater was sited on the enemy side of the ford to break up the hard surface, and two craters in the approach road on the enemy side to give length to the obstacle.

The approach road on the south side sloped up from the bridge and it was expected (and proved so in practice) that water would be present in all the holes, except that on the south side of the demolition (No. 1).

Accordingly, it was decided to blow this one with ammonal, using the camouflet method. For the remainder, auger holes and plastic H.E. were used. Twelve-inch auger holes were sunk behind the abutments, where the biggest charges were required, and 8-inch for the other two.

The charges and the spacing of the holes were arrived at by calculation, modified by previous experience. They were arranged so that the lips of the craters should just overlap, but were not so close that the debris from one would fill up the others.

The two holes in the approach road were staggered in order to give length to the obstacle.

ORGANIZATION.

The working party consisted of 1 officer, 3 N.C.O's and 14 sappers, and had one 30-cwt. lorry and a compressor. The lorry towed the compressor up to the site and was then driven away to a distance sufficient for the explosives to be taken out and prepared for use in safety.

One 12-inch and two 8-inch augers were available for the auger holes and Drivall equipment (the portable monkey mentioned before) for the camouflet. The pneumatic tools were used to break through the hard surface behind the abutments.

One N.C.O. was put in charge of the explosives. Whilst the holes were being bored, he, with two sappers, was preparing the camouflet charge, the firing primers and the cratering charges. The latter were put ready in sandbags to be taken up to the holes when required. He then connected up the detonators and rolled out the electric cable to the place from which it was to be fired.

It was estimated that the whole work would take 1½ hours, but actually it took 2¼ hours. This was due partly to the fact that one of the auger holes (No. 3—see below) was made too close to the abutment and stones and small pieces of concrete were encountered, and partly to the activities of spectators.

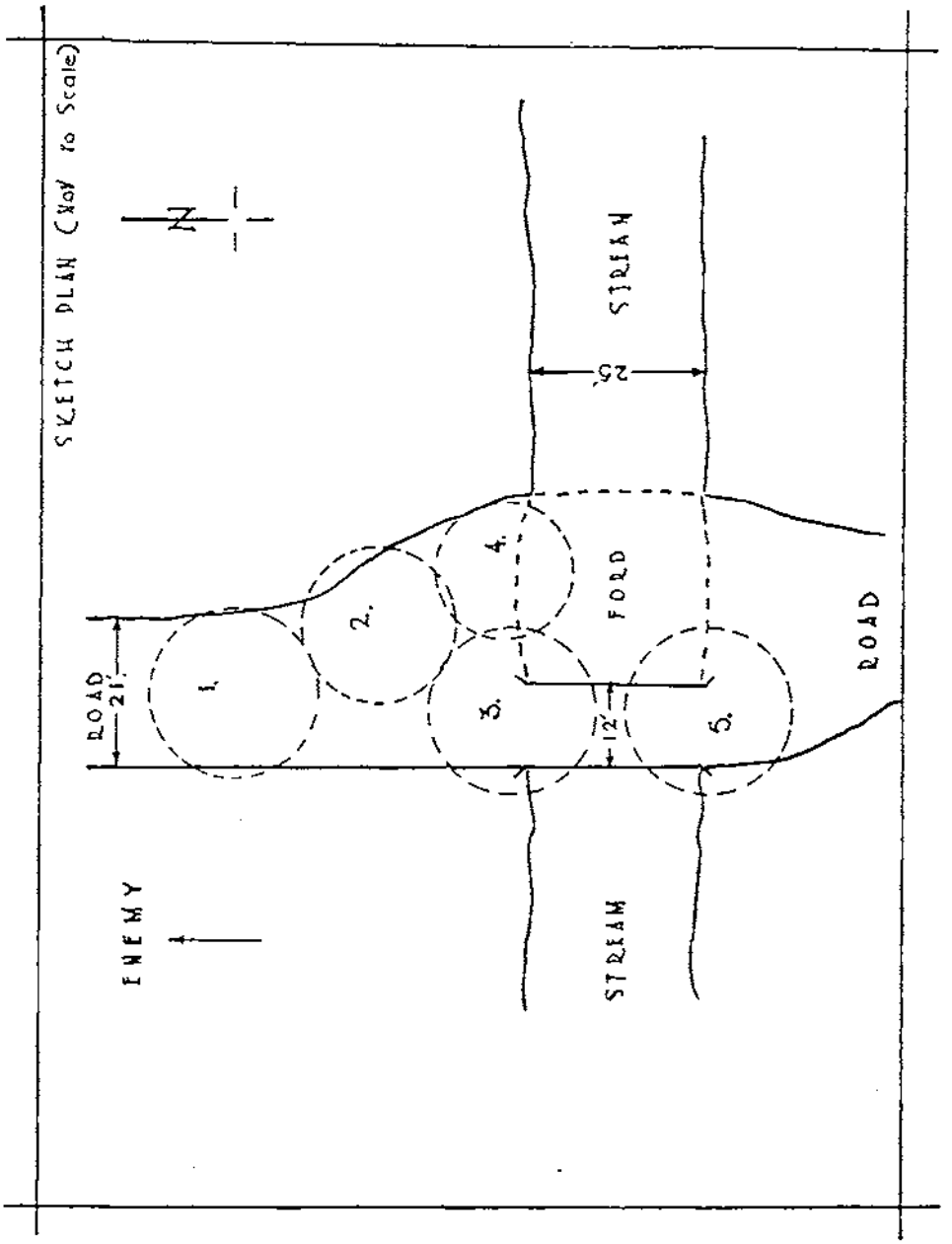
RESULTS.

The photographs give some idea of the results.

The following were the details of the craters:—

No. on plan	Charge	Method of placing	Depth of centre of charge	Resulting crater
1.	Ammonal 50 lb.	Camouflet	5 ft. 3 in.	8 ft. deep 25 ft. diameter
2.	P.H.E. 60 lb.	Auger hole	5 ft. 9 in.	8 ft. deep 22 ft. diameter
3.	P.H.E. 60 lb.	Auger hole	4 ft. 2 in.	7 ft. deep 24 ft. diameter
4.	P.H.E. 40 lb.	Auger hole	5 ft. 2 in.	7 ft. deep 19 ft. diameter
5.	P.H.E. 60 lb.	Auger hole	5 ft. 5 in.	7 ft. deep 24 ft. diameter

The abutments were shattered and the bridge behaved as it was expected to do. It was turned over in the air and sufficiently broken up to be useless.


SKETCH PLAN (Not to Scale)
N
STREAM
25'
4.
FORD
2.
1.
3.
5.
ROAD
21'
12'
ROAD
ENEMY
STREAM

An obstacle about 100 feet long was created. On the next day, the craters near the stream had filled with water, thereby increasing the difficulty of repairing the damage.

OBSERVATIONS.

1. It has been mentioned that the two craters in the approach road were staggered in order to increase the length of the obstacle. This procedure may increase the difficulty of repair in another way. If the craters are blown in a straight line in dry ground, there may be nothing to prevent the enemy from making a speedy, if only temporary, repair by ramping down from either end and making a track by levelling off the bottom of the craters. If the craters are staggered, however, he finds himself confronted with a zigzag line of shattered earth, interspersed with mounds of solid soil and his digging operation becomes more difficult.
2. It should be noted that frequently it will be necessary to keep the road open to traffic, both whilst work is proceeding on the preparations for cratering and in the interval between its completion and the firing of the charges.

   In such circumstances it is almost certain that the charges will have to be staggered. Moreover, the work is bound to be delayed. Steps will have to be taken to protect the working parties in the first place and the firing arrangements in the second from passing traffic.

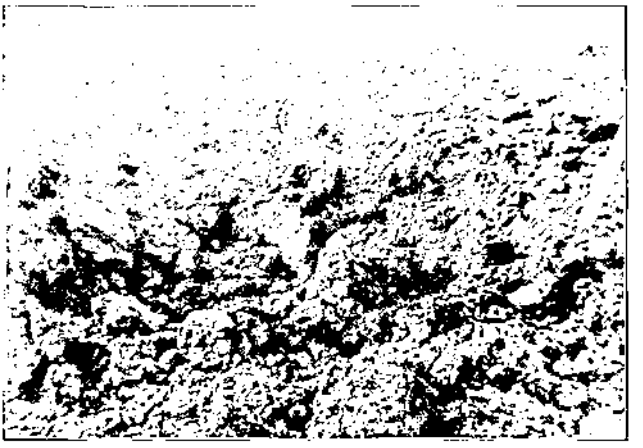
   Probably some sort of barrier would suffice to protect the men, but to protect the charges, sentries will have to be posted and some fairly large and heavy objects, such as boxes or barrels, placed over each hole.
3. It will be noticed that in this case the bridge and ford were assumed to be a defile. Therefore, within reason, the longer the obstacle created the better. In most cases it will be possible to make a deviation and there is, therefore, no object in making the task of repair grossly heavier than that presented by a good deviation.

   The gap should, however, be made longer than the spans of the enemy's standard bridging equipment, if their lengths are known.
4. In conclusion, the writer would advise any officer, who can, to include crater blowing in his demolition programme. Apart from its training value, it is a safe way of exploding a comparatively large charge and the troops see something for their work. It need not be very expensive in explosive, as a charge of only 30 lb. makes quite a good crater in ordinary soil.

RAPID ROAD CRATERING.

Before.

Note :—The sappers are working on the near end of the bridge, the rest of which is hidden. The railing in the centre is that of a small foot-bridge, which was not cut. The ford lies between.



After.— Crater No. 1.

Next Day.—Craters Nos. 4 and 3.

UNUSUAL FIXED COAST DEFENCE CONSTRUCTION IN AUSTRALIA.

By MAJOR E. H. B. SCRIVEN, *Australian Staff Corps.*

THE following article gives some account of rather unusual methods of constructing the permanent works for new fixed coast defences on an island off the coast of Australia. For obvious reasons the location of the works is not stated ; but the works include gun and defence electric-light emplacements, magazines, observation posts and facilities for a tented camp.

The island is composed entirely of sand. A range of hills, 900 feet high, runs down its centre. It is covered with dense undergrowth and trees of little value. The beaches on the western side are straight and have no sheltered bays or boat harbours to protect small craft from the short high seas which rise during the strong westerly winds which are prevalent in winter. With the exception of lighthouse-keepers the island is uninhabited.

The island is infested with white ants, termites with a voracious appetite for wood.

From the foregoing it will be gathered that the design and construction of the new fort presented some problems beyond the normal. These are briefly stated as follows :—

1. All building materials had to be brought by sea and landed on an exposed beach. Fortunately it was of hard sand.
2. No local materials were suitable or available. The sand was too fine for use in concrete. The local timber was unsuitable. No stone existed.
3. To reduce the cost of transport, timber-framed buildings were largely used. These had to be carefully protected from the white ants.
4. The humidity and high summer temperatures preclude the use of iron except where covered with concrete or other material. Even galvanizing will not stand against the cutting action of wind-driven sand.

All other coast defence works in the present rearmament programme have been carried out by contract in the normal manner. In this case, however, the work was done by the Commonwealth Lighthouse Service of the Department of Commerce. This Service has been building lighthouses of concrete or steel on the Australian

coast for many years and has built up an organization and plant very suitable for this particular work. To these men the work was a holiday compared with that of building a tower on a coral reef submerged at half-tide, or on a rocky islet ringed with surf. Their plant ranges from 1,400-ton ships to the smallest detail. A very complete workshop, power-driven winches, pumps, tools and even a small joinery factory were landed on a surf beach and in working order in four days.

The lighthouse steamer, with 250 tons of building material, some 45 tradesmen and labourers, anchored off the site at 7 a.m. on 5th December, 1936. Half an hour later unloading was well in progress. Three surf boats and a motor launch were over the side and as each boat was loaded it was towed to the beach, the launch returning with an empty boat.

The workmen's camp filled the first boats; and here an example of good and tested organization was demonstrated. All tents and huts were pitched on frames quickly bolted together, so that before nightfall 30 tents, a large men's mess hut, three smaller officers' huts, including one for visitors, kitchen, baker's oven, sheep yards, etc., for a nine months' camp were in being. Nor was this the only work in progress. Soon the beach was strewn with timber, rails, machinery and other stores, and the erection of workshop and sheds went forward apace. On the third day a north-westerly wind brought in a moderate surf sufficient to make the landing interesting, but swamped surf boats could not deter the foreman, who with richly-coloured language was in all places at once, urging and directing his gang in his eagerness to get his gear in its appointed place in record time. In Australia we watch our surf club crews shooting a breaker in their light, well-balanced boats at Bondi or Manly, and think it sport. Here were concrete mixers shooting the breakers in heavy boats with a lonely, bearded seaman at the steering oar and hard words for him if his boat filled.

The first shipment landed, steps were taken to improve conditions for the future. The first was the construction of a temporary jetty of interesting design. This was made of 4″ × 4″ angle piles, pointed at one end and driven with a sledge hammer as far as they would go, with timber transoms clipped on with U-bolts, and 8″ × 4″ bearers with tram-rail already spiked on. The jetty was built out until a surf boat could approach it at low tide. Beside the end and clear of the jetty a derrick was rigged on a timber triangle screwed into the sand and allowed to bury itself. A petrol winch was placed ashore above high tide and the fall ran over the sand to a snatch block under-water at the foot of the jib. The position of the derrick was such that it could pick up a load from a surf boat riding free to a buoy and clear of the jetty head and load on to the tramline on the jetty. By this means the boats did not damage the very light jetty

nor themselves in quite rough weather. In this way an average of 80 tons a day was transferred from ship's hold to dumps at the place where it would be used. One hundred and ten tons was the record for the job. Coal baskets were used for materials such as metal, sand, etc., and sufficient baskets were available for four boat-loads, viz., one lot in ship's hold being filled; one on the way ashore, filled; one on tramline to dump, filled; one returning empty to ship. Other materials, such as timber, were slung in bundles. Every care was taken to keep timber clear of the sea water, though, of course, many accidents occurred. The 4″ × 4″ piles to the jetty offered very little resistance to the sea and a few hours after driving would carry one ton per pile with safety. This jetty stood for nine months and carried 2,400 tons, and except for the end bay being washed away in a storm, required no attention. It has since been used to carry a pile frame and 15-cwt. monkey driving concrete piles for the permanent jetty. This type of light steel jetty is ideal for beach conditions where the sand is firm or where there is a rock bottom overlaid with sufficient sand for stability. Similar construction could be used in mud, though a much longer pile would be required to produce the required friction. This jetty had been used many times before and the angles since recovered are undamaged except for burring at their tops.

The permanent jetty was built to carry personnel, small packages and ammunition, heavy equipment being landed by beaching a lighter at high tide and unloading direct on to the sand. A 6-ft. range of tide made this possible and therefore the jetty could be of light construction. It is 300 feet long with 9-in. hexagonal concrete piles and with an L-head of 12-in. piles to give a more robust construction where it is most exposed to the sea and to damage by boats. This length gives 6 feet of water at low tide, which will allow, say, a 40-ft. launch to come alongside in all conditions of tide. The area of piles was kept as small as possible to offer a minimum resistance to the seas. They are reinforced with six $\frac{1}{2}$″-diameter bars and connected at their tops by cross-heads 2 ft. deep. 8″ × 4″ wooden girders are bolted to the cross-heads with G.I. bolts in loose holes in the concrete.

The emplacements are designed with a central drum standing on an 18-in. reinforced-concrete slab of 43-ft. diameter. The gun floor is supported on webs radiating from the drum and the spaces between webs were filled with sand. This sand filling, being contained within the concrete of the emplacement, therefore provides a considerable and cheap addition to the mass resisting the forces of recoil.

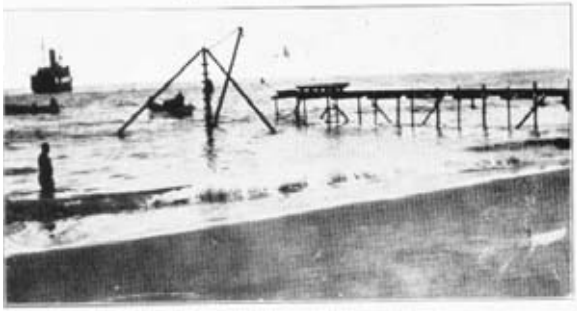
The ammunition supply is organized under field conditions in four surface magazines and shell stores with an immediate supply on the gun floors. Magazines are connected to each other and to the guns

by means of concrete paths on which hand-trucks will be run. The magazines and shell stores are of brick with double walls forming a 2-ft. wide cavity round three sides, and with an 8-in. concrete ceiling covered by a fibro-cement hipped roof, supported on concrete blocks to give free passage of air above the ceiling. The sides and ends towards the guns are protected by earth banks, the opposite wall being unprotected and providing access. This design provides a means of filling the building with cool air at night and sealing off in day-time, the wide cavity providing insulation between the outer walls and the inner chamber. A liberal overhand also protects the outer walls from direct sunlight during the hottest part of the day.

The battery range-finders are mounted on a steel-framed tower sheeted with fibro-cement. Such a tower, however strongly it is braced, will vibrate badly in a wind. In fact, any tower, even of masonry, would be quite unsuitable as a base for precision instruments if its height appreciably exceeded its base length. Vibration has been allowed for by carrying the instrument pedestals down to the ground level without touching the tower. These pedestals are in the form of tapering reinforced-concrete columns standing on concrete bases each containing $5\frac{1}{2}$ yards of concrete and linked underground by a reinforced-concrete beam. These bases are independent of the column footings to the tower. The pedestals pass through two floors of the tower with $1\frac{1}{2}$ in. clearance all round. The accommodation provided on the lower floors of the tower is used for storage and for a 2,000-gallon service tank.

The manning of this battery is by militia troops with a small nucleus of regular artillery and engineers. So no provision has been made for barracks beyond two cottages for maintenance personnel, but certain camp facilities such as mess huts, stores, latrines, etc., have been built to improve the conditions of a tented camp. All these buildings are of timber framing and fibro-cement sheeting and roofing and in their design the danger of white ants was carefully considered. These pests are sufficiently numerous to warrant special measures being taken to guard against them. Certain Australian hardwoods and one or two softwoods are reasonably proof against white ants, but pine is to them like beer to a thirsty man. They will travel long distances to get it. White ants live in the ground and travel up the building to feed, building a covered passage either inside an unpalatable timber, or on the outside through a tunnel constructed from chewed wood. They may travel over the surface of cement, but metal defeats them. The practice, therefore, is to separate the wooden structure of a building from the ground with metal plates. The cottages are built approximately three feet above the ground on concrete piles or stumps, each stump being covered with a Muntz metal cap turned down on the edges. The wooden

1.—Unloading surf-boats.



2.—Temporary jetty and derrick.

3.—6 in. × 6 in. concrete piles of permanent jetty.

Unusual fixed coast defence construction 1-3

4.—Magazine and command tower.

5.—Militia mess hut and kitchen.

Unusual fixed coast defence construction 4 - 5

floor plates are secured to the stumps by straps, thus avoiding punctures in the metal caps.

The camp buildings are built on the ground with concrete floors, and the wooden framing is carried on dwarf walls covered with Muntz metal plates, on which are placed the wall plates bolted through the metal into the dwarf wall. Even these bolts provide a possible source of danger unless the Muntz metal is sweated to the bolt to leave no crack. Protection is still not absolute as ants have been known to eat through lead-covered cable to get at the paper insulation. A frequent means of entry for the ant is *via* wooden stairs leading to a raised building. The precaution was taken here of building cottage stairs of brick and standing them two inches clear of the building.

These precautions may appear meticulous to one who has not yet met these termites, but they are commonplace in some parts of Australia, where one's house may appear quite sound until close examination reveals that the vital timbers consist of a thin matchwood shell with the whole of the inside eaten out. I have even heard of the rudder of a lightship being eaten while the ship was moored three miles out to sea.

Water is the only commodity that the island has in abundance. The swamp is drained by sandy creeks which flow to the beach about every half-mile and always at an angle of about 45 degrees to the line of the beach or parallel with the line of low sand ridges formed by wind action before the present growth appeared. A very fine water-supply is being obtained from one of these creeks by pumping to the Command Tower and reticulating from there to the various water points. As well as by the creeks, a constant flow exists through the ground to the sea. This appears on the beach at low tide in the form of a line of moderately fresh water springs.

The swamp itself contains excellent water below the surface mat of growing reeds. These reeds float on the water and have reached a thickness and buoyancy sufficient to support a wooden footbridge built of simple trestles of 4" × 4" hardwood, driven about five feet into the mat with a ledger bolted across bearing on it. This bridge gives access to the observation post in the foothills.

The most extraordinary feature about the swamp is its freedom from mosquitoes. The surrounding area, with its many mangrove swamps and islands, is notorious for its mosquitoes and, at a similar fresh-water swamp in the near vicinity, the mosquitoes are almost a menace to life, yet at the fort site there are none. This immunity is due to some natural cause, the nature of which I have not yet discovered.

A rainfall of 62·66 inches, well distributed through the year, also provides a source of pure water free from any ground contamination and storage for 9,600 gallons is being provided at the kitchens.

Soon after work was started it was realized that some form of transport between the various parts of the work was necessary. It will be remembered that the ground was entirely of sand, so horses, drays and scoops were one's first thought. After consideration, however, a second-hand Buick high-powered car was brought, the body removed and the chassis landed in a surf boat. With half-inflated tyres and stripped of all its trimmings, this vehicle has given wonderful service and has proved a most economical solution to the problem. At the conclusion of the work, its value was considered to be less than the cost of removal, so there it remains for the rest of its useful life, for what it is worth, to carry firewood, etc. The buying of such a vehicle requires careful selection, for it must be sound enough to last out the job and no more. American-type vehicles are the best in such circumstances as they are high-powered for their weight and can, when stripped, give remarkable performances on steep grades and in soft sand. In Australia their spare parts are also much more procurable than the equivalent British vehicle.

Construction was completed in September, 1937, when the landing and mounting of the guns and E.L. equipment was commenced.

HISTORIES OF THE INFANTRY BATTALIONS, TERRITORIAL ARMY,

Which have become Anti-Aircraft Battalions, Royal Engineers.

[*As all R.E. officers will be interested in the Territorial Army Infantry Battalions, which have recently become part of the Corps, the officers commanding these battalions have been asked to furnish the* ROYAL ENGINEERS JOURNAL *with short summaries of the histories of their units. Many have already been received and the first three are now published. They will be continued in the next* JOURNAL *and it is hoped that the series will eventually be a complete one.*]

32ND (7TH CITY OF LONDON) ANTI-AIRCRAFT BATTALION, R.E. (T.A.)

THE history of this Battalion dates back to the reign of George III, it then being a voluntary military organization known as the " St. Paul's and Temple Bar Association," which afterwards became the 3rd Loyal London Volunteers, and existed until about the close of the first decade of the nineteenth century. In 1798, Colours were presented to the Battalion by Mrs. Sylvester, wife of the then Common Serjeant of the City of London, they having been previously consecrated in St. Paul's Cathedral. These Colours are still in possession of the Battalion.

The 3rd London Rifles came into existence in the year 1860, and was the first Volunteer Battalion to adopt the scarlet uniform in England. It is said that this unit was originally raised by an old officer of the 3rd Loyal London Volunteers making a speech from the steps of St. Paul's, thus preserving the connection with the old Battalion and, through them, with the Association's Trained Band. The new unit had the distinction of numbering amongst its Honorary Colonels the Duke of Clarence, and—the first contact with the Royal Engineers—Lord Napier of Magdala.

About the close of the year 1889, a movement had been started to approach the Corporation of the City of London with a view to obtaining assistance towards the erection of headquarters for the London Rifle Brigade and the 3rd London Rifles. The two petitions were presented to a full Court by two Field Marshals—H.R.H. The Duke of Cambridge, and Lord Napier. Both of these illustrious soldiers addressed the Court, and it is believed that this interesting and historical occasion is the only instance on record of anyone not a

member of that ancient body being permitted to address it except in reply to questions from the Chair.

The training of the old Volunteer had to be performed during the evenings and week-ends. Easter holidays were given up to training at some military centre, such as Chatham, Winchester, Colchester or Shorncliffe. It is worthy of note that when the Battalion went to Chatham in 1893, the town turned out in great force to line the route from the station to Chatham (now Kitchener) Barracks, flags and bunting being displayed from the houses.

In the same year, Parliament decided that a medal should be presented to all members of the Volunteer Force who had completed 20 years' service. On the first distribution, 47 members of the 3rd London paraded, which constituted a record for the whole of London.

At the outbreak of the South African War a large number of men volunteered for the C.I.V. In this year, the Battalion mobilized for four days at Sheerness, one Company being quartered in a battleship and the remainder in the Artillery Barracks. On being demobilized, the Battalion took over the camp at Well Marsh for the remainder of the fortnight, this being the first time the Battalion had been in training for 15 days.

1903 was a memorable year, in so far that the Battalion came into possession of its present Headquarters, which were opened by the Lady Mayoress (Lady Samuels). Prior to this, all drills had to be done in the open ; on wet evenings, the drills had to be cancelled.

On March 31st, 1908, the Battalion ceased to exist. The Territorial Force Act came into force on April 1st, 1908, and all old Volunteers were invited to join the new Force. The conditions of training under the new Act were somewhat different, in that a yearly training of fifteen days instead of seven had to be performed.

On June 19th, 1909, the existing Colours were presented to the Regiment by King Edward VII at Windsor. The Regimental Colours bear a representation of the west front of St. Paul's Cathedral, in commemoration of the old Regimental Colour, which bears on the obverse a representation of St. Paul's Cathedral, and on the reverse that of Temple Bar.

In 1914, Annual Camp was held at Eastbourne and lasted for four hours only. The Battalion marched into Camp at 4 p.m. on August 2nd, had dinner, struck Camp, and returned to London at 8 p.m. to await orders. The Territorial Force was mobilized on August 5th and, with the ranks full, the Regiment left London within a few days for Bisley, marching with the remainder of the Brigade—the London Rifle Brigade, the City of London Rifles and the Post Office Rifles. At Bisley, 70 per cent. of the men volunteered for foreign service and, having become an Imperial Service Battalion, the Regiment moved to Crowborough by road, marching past the King at Horley. After

further training at Watford and Braintree, the Battalion sailed for France on March 17th, 1915, and proceeded to Auchel, close to Bethune, where a week was spent in training. After attachment in the line at Festubert to Regular Troops, the 47th Division (as the 2nd London Division became) took over the line completely, and the first attack of the 7th London followed on May 16th and earned for the Battalion a special mention in Divisional Orders. At about this time, the remarkable cleanliness of the Battalion in most adverse conditions brought about the introduction of the Regimental nickname—" Shiny Seventh."

At the Battle of Loos, the Battalion lost very heavily, but consolidated the positions they had won and then rendered assistance to the Guards Division who were held up at Hill 70.

Meanwhile, on September 3rd, 1914, the 2/7th Battalion had been formed and, on April 5th, 1915, the 3/7th Battalion followed. The 2/7th eventually sailed for France, landing on January 27th, 1917, but the 3/7th remained at home throughout the war as a Reserve Battalion.

Throughout the war, the Regiment served with distinction on the Western Front and was awarded twenty-two battle honours. In addition, especially during 1917, drafts were sent to various units in Salonika, Egypt and Mesopotamia.

On December 31st, 1921, in consequence of the reorganization of the London Regiment, the 8th (City of London) Battalion, the London Regiment (Post Office Rifles) was amalgamated with the 7th Battalion, and henceforward the unit was known as the 7th City of London Regiment (Post Office Rifles). The Post Office Rifles were direct descendants of the 24th Middlesex Volunteers, and brought with them the oldest overseas battle honour granted to a non-regular unit—" Egypt, 1882." This honour is carried on the present Regimental Colour.

On December 15th, 1935, the Regiment underwent its latest change when it accepted conversion to a Searchlight Battalion of the Royal Engineers and was re-designated the 32nd (7th City of London) Anti-Aircraft Battalion, R.E.

43RD (5TH DUKE OF WELLINGTON'S REGIMENT) ANTI-AIRCRAFT BATTALION. ROYAL ENGINEERS (T.A.).

There are records of Volunteer Military Units in Huddersfield dating back to 1794, but the present Battalion can only claim uninterrupted descent from the volunteer movement in 1859, when Napoleon III was making a strong bid for European supremacy. The feeling of this country against France ran very high and we came very near to war, which was, however, averted by the champions of peace and economy. A lasting benefit, nevertheless, remained over

to England from the war panic, in the shape of the volunteer movement, which embodied all the ideals of Victorian England. Tennyson, as Poet Laureate, wrote a song for the original Volunteers of 1859, "Riflemen, Form," which is a denunciation of Napoleon III:

> "*Storm, storm, Riflemen, form,*
> *Ready, be ready, against the storm.*"

The poem was published in May, 1859, and soon afterwards the Secretary of State for War issued a general circular authorizing the formation of Volunteer Corps. The inhabitants of Huddersfield and district were quick to move in the matter, and in the same year the Huddersfield Rifle Volunteers were formed, and in 1860 the unit made its first appearance in the *Army List* as 6th West Riding of Yorkshire Volunteers.

In 1862 the Battalion, with a company at Holmfirth, became known as the 5th Administrative Battalion of the West Riding of Yorkshire Volunteers. In 1864 a Company was raised at Mirfield, and in 1868, further companies at Meltham and Saddleworth were added to the Battalion. In 1880 the loosely organized 5th Administrative Battalion was consolidated into one Corps as the 6th West Riding of York Rifle Volunteer Corps, whilst in June, 1883, its name was changed once more to the 2nd Volunteer Battalion The (Duke of Wellington's) West Riding Regiment. The recruiting area at that time extended from Mirfield through Huddersfield and the Colne and Holme Valleys, taking in Holmfirth and Meltham and crossing the Pennine Hills between Marsden and Diggle as far as Mossley.

In March, 1900, a Volunteer Service Company from the Battalion proceeded to South Africa and returned home at the end of the war in 1902. For its services, the Battalion was awarded the battle honour "South Africa."

In 1908, under Lord Haldane's Territorial Force Scheme, the district was divided, and the bulk of the old Volunteer Battalion became the 5th Battalion The (Duke of Wellington's) West Riding Regiment, T.F. The remainder, consisting of the Colne Valley Companies, was left to start the new 7th Battalion The (Duke of Wellington's) West Riding Regiment, whose recruiting area ran from Longwood on the west of Huddersfield to Mossley and the borders of Oldham.

The new 5th Battalion had five companies at Huddersfield, with outlying companies at Holmfirth, Mirfield and Kirkburton, with a detachment at Meltham.

On the outbreak of the Great War the Territorial Force was mobilized. The Battalion was at annual training in camp on the East Coast, and returned at once to Huddersfield to mobilize on August 4th, 1914. After this process was completed, within twenty-four hours, it moved into Lincolnshire to take over the defences at

Grimsby and the coast southwards. Drafts from Huddersfield rapidly brought the unit up to strength. After volunteering for foreign service, the Battalion then went for intensive training to Riby, in Lincolnshire, and later on to Doncaster.

Soon after mobilization, in November, 1914, the Battalion supplied the framework of a new Battalion which became the 2/5th Battalion, and went eventually to France with the 62nd West Riding Division, when a third Battalion was formed, called the 3/5th Battalion Duke of Wellington's Regiment. The Reserve Battalion supplied drafts for the 1/5th and 2/5th Battalions, and towards the end of the war was merged into the 4th (Reserve) Duke of Wellington's (West Riding) Regiment.

On April 14th, 1915, the Battalion went to France with the other units of the 49th (West Riding) Division, and went into the line for the first time at Fleurbaix. At the battle of Aubers Ridge on May 9th, 1915, it was in reserve. From July to December, 1915, it was in the Ypres Salient, one of the storm centres of the Allied Line, and was subjected to the German gas attack of December 19th, 1915. On the Somme, the Battalion was engaged in operations during July, August and September, 1916, suffering severe casualties. The remainder of 1916 was spent at Fonquevillers, near Arras. In 1917 the Battalion was in the line at Fonquevillers, Rouge de Boût, Hulloch and Nieuport. At Nieuport it had a very bad time in appalling weather after the capture of the bridgehead by the Germans, which occurred just prior to the Battalion going into this sector. In September the Battalion moved once more to the Ypres Salient, and took part in heavy engagements between October and December, 1917. On October 9th, 1917, it took an active part on the attack on Passchendaele and suffered accordingly. In January, 1918, when Brigades were reduced to three Battalions each, owing to shortage of men, the 1/5th Battalion was amalgamated with the 2/5th Battalion and joined the 62nd (West Riding) Division at St. Aubyn, near Arras.

The 2/5th Battalion had gone out to France on January 10th, 1917, and fought its first battle at Bullecourt on May 3rd, 1917. It greatly distinguished itself at Cambrai, Havrincourt and Bourlon Wood.

The amalgamation was carried out very smoothly in a quiet sector near Arras, and the combined Battalion had in 1918 an unbroken sequence of remarkable successes. It helped to stem the retreat before the victorious German attack of March, 1918, by filling, with other troops, the gap between the Third and Fifth British Armies. It greatly distinguished itself with the French in the second battle of the Marne in July, 1918. When the great British advance began, it took an active part and fought successfully at Vaulx Vraucourt, Havrincourt, Marcoing Crossings, St. Python, Forêt de Mormal

and Maubeuge. In September, 1918, it had the special distinction of being mentioned by name in the Commander-in-Chief's daily communiqué.

After the Armistice, the Battalion with its Colours marched into Germany with the first troops of the Army of Occupation, and arrived at Mechernich on Christmas Day, 1918. In Germany, the Battalion was gradually demobilized, and the cadre returned to Huddersfield on May 9th, 1919, and was accorded a civic reception by the town.

The casualties of the 1/5th and 2/5th and amalgamated Battalions during the war were :—

Killed or died	1,116
Prisoners	189
Wounded and sick sent to U.K.	2,965

These figures do not include the sick and wounded treated in France or Belgium, which amounted to some thousands. No fewer than 429 individual honours were conferred upon the unit during the war, including one Victoria Cross.

After the war, the Battalion was reconstituted as part of the Territorial Army in February, 1920, and its title was changed slightly to 5th Battalion The Duke of Wellington's Regiment (West Riding).

The very handsome War Memorial at the Drill Hall, Huddersfield, was unveiled by Field Marshal the Lord Plumer, G.C.B., G.C.M.G., G.C.V.O., G.B.E., on Saturday, August 30th, 1924.

A fine memorial picture of the 1/5th Battalion holding the line at Ypres in 1915, painted by J. Hodgson Lobley, also hangs in the Drill Hall.

In December, 1936, the Battalion was converted from an Infantry Battalion to an Anti-Aircraft Searchlight Battalion of the Royal Engineers and became the 43rd (5th Duke of Wellington's Regiment) A.A. Battalion, R.E.

The Battalion is still very proud to be affiliated to the Duke of Wellington's Regiment and retains its Colours.

44TH (THE LEICESTERSHIRE REGIMENT) ANTI-AIRCRAFT BATTALION, R.E. (T.A.)

The 1st Volunteer Battalion Leicestershire Regiment was recruited from the City and County of Leicester, and organized in 16 companies. When, in 1908, Lord Haldane's reorganization scheme came into effect the volunteer movement ceased to exist, and the Territorial Force came into being. Those of the Volunteer Battalion who desired to be transferred to the new organization were allowed to do

so and thus became the first members of the 4th and 5th Battalions The Leicestershire Regiment, T.F.

The first Commanding Officer of the 4th Battalion was Lt.-Col. E. C. Atkins, and the strength of his Battalion at this time was in the neighbourhood of 700. He was succeeded in 1909 by Lt.-Col. C. F. Oliver, who remained in command till 1913, when he handed over to Lt.-Col. W. A. Harrison.

In August, 1914, the Battalion was in camp at Bridlington, and, on receipt of the War Office telegram " x 100 Mobilize," it returned to Leicester and was quartered in various schools. After being recruited up to war strength, it received a great send-off from the citizens of Leicester when, on August 12th, it entrained for Belper. Later, the Battalion moved to Luton, St. Albans and Bishop Stortford where it was inspected by his late Majesty King George V, on February 15th, 1915. On March 2nd the Battalion commenced to embark at Southampton for overseas, and before the end of the month they were in the front line.

In the meantime Lt.-Col. C. F. Oliver, T.D., had been gazetted in September, 1914, to raise the 2/4th Battalion. Plenty of material was immediately forthcoming, in fact the difficulty was to know whom to enrol, and whom to refuse. During 1915 the Battalion was trained at Luton and St. Albans, and in the autumn the 59th Division was reported on by the War Office as ready for overseas.

In March, 1916, orders were received to prepare for service abroad, but were cancelled on the outbreak of the Irish Rebellion. The Battalion was sent, with the rest of the Division to Dublin, where they were chiefly concerned with " mopping up " operations. In May they left Dublin for Fermoy to carry on " police " duties in the South. At the end of the year, to the satisfaction of all, they moved to Salisbury Plain, and on February 17th, 1917, left for France.

In 1915 the 3/4th Battalion had been formed, its role being to supply drafts to the 1/4th and 2/4th Battalions.

It would be impossible here to give an adequate account of the 1/4th and 2/4th Battalions' exploits overseas. Let it suffice to mention such engagements as Hohenzollern Redoubt, Ypres, 1917, Cambrai, 1917, Bailleul and Bellenglise which amongst many others must live for ever in the minds of the people of Leicester and Leicestershire. October 13th, 1915, was indeed a black day for City and County, the 1/4th Battalion took a glorious part in that memorable attack on the Hohenzollern Redoubt, with the loss of 20 officers and 453 other ranks.

At the end of 1919 demobilization was complete, and in the following year the Territorial Force was reformed, recruiting being opened in Leicester in March. Perhaps, not unnaturally, so soon after the war, recruiting was very slow, and when the time arrived for the Battalion to go to its first camp, there were 5 officers and some 60

other ranks under the command of Lt.-Col. Blackwall, D.S.O. At this time the Battalion's headquarters were at the Junior Training Hall, where they remained till moved to the Magazine in 1922.

In April, 1921, during the troublesome times of the Strikes, the Defence Force was formed, and a considerable number of the Battalion was transferred to this Unit, under the command of Major J. E. Viccars, D.S.O. In 1922 Lt.-Col. H. W. H. Tyler, M.C., took command, and the strength steadily grew. He was succeeded in 1930 by Lt.-Col. A. Halkyard, M.C., who in turn handed over to Lt.-Col. F. Mantle, T.D., in 1936.

During these post-war years the Battalion always received great help and encouragement from the Regular Battalions of the Regiment. The successes of the Battalion since the war have been in no small measure due to this assistance, which was always so readily given. This close liaison between the Regular and Territorial Battalions was very marked, and did much to promote that very keen regimental tradition which existed in the 4th Battalion.

In 1936 the question of the Air Defence of this country was receiving attention, and on December 10th, 1936, the 2nd Anti-Aircraft Division was formed, and the 4th Battalion ceased to exist, the 44th (The Leicestershire Regiment) Anti-Aircraft Battalion, R.E. (T.A.), taking its place. A large number, including all the officers, of the old Battalion transferred to the new unit, a Searchlight Battalion of the Corps of Royal Engineers.

In 1937 Col. J. E. Sarson, C.B., O.B.E., V.D., T.D., *D.L.*, retired from the position of Honorary Colonel, and thus ended perhaps an almost unique career, covering 75 years of active association with the Volunteers and Territorial Army. He was succeeded by Col. Sir Frederick Oliver, T.D., *D.L.*, *J.P.*, who thus returned to his old Battalion, although in the intervening years the title and role had completely changed.

SAPPERS AND INDIANIZATION.

ANONYMOUS.

THE present policy in the Indian Army is the Indianization of the equivalent of a cavalry brigade and a division of all arms. This entails Indianizing three Field Coys., one Div. H.Q. Coy. and a Field Troop. One Field Coy. comes from the Bengal and one from the Bombay Sappers and Miners, the remaining units are being found from the Madras Sappers.

To date, only the three Field Coys. have been affected. In the Bengal and Bombay Coys., one or two Indian subalterns have replaced British ones ; in the Madras Coy., Indianization is complete except for a British Coy. Commander and second-in-command, as there is yet no Indian senior enough to fill these positions.

Complete Indianization has meant a radical change in the organization of the higher ranks of the unit. Establishments " A " and " B " show the main differences between the non-Indianized and Indianized Coys. respectively.

ESTABLISHMENT " A."

The establishment of the non-Indianized S. & M. Field Coy. is briefly as follows :—

Four British officers
Two Subedars } Viceroy's Commissioned Officers
Four Jemadars }
Three British (R.E.) W.O's. or Serjeants

and about 320 rank and file, which includes a Coy. Havildar-Major and Quartermaster-Havildar. With these last two there are 15 " key-men."

The alteration in establishment mainly affects the key-men ; the number of the rank and file remains practically unchanged.

ESTABLISHMENT " B."

In the Indianized Field Coy. there are only 11 key-men.

Two B.O's. (ultimately to be Indian).

Four K.C.I.O's. or I.C.O's.

(The K.C.I.O. is one educated at the " Shop," Chatham and Cambridge, the I.C.O. at the Indian Military Academy, Dehra Dun, and the Thomason Engineering College, Roorkee.)

One Indian Warrant Officer (Class 1).

Two Indian Warrant Officers (Class 2).

Two Quartermaster-Havildars.

The essential differences are the replacement of six V.C.O's. and three B.N.C.O's. and the introduction of the Warrant Officer rank.

At the risk of boring thoroughly those well-acquainted with S. & M. organization, a short explanation of the roles of the key-men in the two establishments is as follows.

ESTABLISHMENT "A."

The senior Subedar really runs the Company, rather as the S.U.O. runs the "Shop."

The second Subedar runs the H.Q. Section and acts as Quartermaster.

The four Jemadars each command a Section.

The three B.N.C.O's. are only fully employed by the Company when away from Corps H.Q. One usually runs the unit workshops, one is in charge of the equipment department, and the third is a workshops trades instructor.

ESTABLISHMENT "B."

The four Indian subalterns command the four Sections.

The W.O. (Class 1) replaces the senior Subedar and the Coy. Havildar-Major.

One W.O. (Class 2) replaces the equipment B.N.C.O. and the Quartermaster functions of the second Subedar. In this dual role he receives more help and supervision from an officer than would have been possible in Establishment "A." The two Quartermaster-Havildars also assist him in running "Q" and "E" respectively.

The second W.O. (Class 2) runs the Coy. Workshops when away from Headquarters.

THE EFFECTS OF ESTABLISHMENT "B."

The effects on the unit may be broadly divided into three categories :—

1. Those due to the suddenness of the change at the start.
2. Those likely to remain as long as Indianized Sapper units are in the minority.
3. Those likely to be permanent.

The aspect dealt with throughout is the Field Coy. away from its Corps Headquarters.

Category 1.

On 1st January, 1938, four Indian subalterns started their new roles as Section Commanders at the same time. They were all junior and somewhat inexperienced, also they were not intimate with the customs and language of their men. The Madrassi's mother-tongue is Tamil, as different from Urdu as Russian from English.

Similarly three Havildars became Warrant Officers; independent positions carrying far more responsibility than those to which they had previously been accustomed.

In short, seven out of the eleven key-men are new to their jobs; a certain amount of dislocation is inevitable. Fifteen to twenty years of training and experience have disappeared with the V.C.O. The Indian subaltern is bound to be groping in the dark unless the section havildar can light the way.

Category 2.

While the Indianized units are in the minority, the supply of suitable Warrant Officers will not be easy. The good havildar will always aspire to Subedar and Subedar-Major in preference to Warrant Officer.

At first sight, suitable candidates for W.O. might be excellent havildars not educationally qualified for V.C.O. This is not so; each W.O. is employed far more in an administrative capacity than the V.C.O. was. The V.C.O's. were executive commanders, some of whom had a share of administration. The W.O. is not an executive commander; his work particularly requires educational qualifications.

W.O.2 might be considered as a stepping-stone to Jemadar for the good havildar. From the nature of the duties of the two W.O's.2, frequent change is most undesirable; this system would bring it about.

Category 3.

Changes which are likely to be permanent are as follows:—

1. In time, the training and administration of each Section, under an officer much more highly-educated than the V.C.O., should greatly improve.

2. The heavy burden of administration, which normally falls on the Coy. Commander, can be more easily decentralized amongst five other officers.

3. A link between the Coy. Commander and his men has been removed. The K.C.I.O. or I.C.O. cannot be completely in touch with the domestic details of the inner life of the Company; the V.C.O. could do this. The unit on its Indianized establishment much more closely resembles the British Field Coy. than before. There is, however, far more in common between the R.E. subaltern, his section serjeant and his men than there is ever likely to be in the Indian counterpart. It seems probable that frequently the officer will be of entirely different race, religion, language and customs from those of his men. The latter may be drawn from the following classes: Madrassi, Punjabi Musalman, Pathan, Mahratha and others; so far Indian Sapper officers have not largely been recruited from the above.

4. Continuity is more necessary in an Indian unit than in a British

one ; it was ensured by the V.C.O. It will be greatly decreased, as the Indian subaltern goes to M.E.S. or other jobs every five years or so.

5. The detachment of an officer from an Indianized Coy. is now the equivalent of removing a subaltern plus a Jemadar. The proportion of officers present with a unit will have to be greater.

6. The three B.N.C.O's. are all potential instructors in trades, even though not all used as such at the same time. The British N.C.O. tradesman is generally a higher class workman and instructor than the Indian N.C.O. Their places have to be filled by an I.W.O. and N.C.O's. The training of these trade instructors will take time and the supply is limited, as the Indian N.C.O. works little at his trade.

The W.O.2 (Workshops) must have a fair working knowledge of the major trades in the shops, *e.g.*, carpenters, bricklayers, fitters, blacksmiths, painters. His own work necessitates draughtsmanship and estimating. There is a trades havildar, but at least one other N.C.O. should have similar qualifications. Trades havildar will probably be a normal step towards W.O.2 (Workshops).

Active Service.

The possible effects when on Active Service are :—

1. The Indian subaltern is moved from one job to another far more frequently than the V.C.O. The responsibility for the correct functioning of petty detail and routine will devolve chiefly on the section havildar. In war, the less the officer is harassed by such matters the better can he think and organize and execute engineering work.

2. Provided that the Indian subaltern is as efficient as the British the working of detached sections should be easier. Each section can be provided with an officer of creative and executive ability. The V.C.O. is not always good at dealing with the unexpected. It will also be easier for the subaltern to deal with accounting and administration and with officers of other arms and the staff.

3. During the Great War, when heavy officer casualties occurred, the V.C.O., or I.O. as he then was, frequently found difficulty in working on his own initiative in the B.O's. place. A havildar will now have to replace an officer casualty.

* * * * * *

Whether it is peace or war the greatest difficulty is the loss of personal contact between officers and men which was maintained largely through the V.C.O. Until all V.C.O's. have faded away and Warrant Officers are promoted from the V.C.O. class, this personal touch is not likely to be regained.

A MEDIÆVAL MAN-OF-WAR.

By LIEUT. M. W. PRYNNE, R.E.

WHEN a south coast yachtsman decides to spend a night in the crowded Hamble River, he is mostly concerned with finding a space to moor. Least of all is he likely to stop and reflect that his boat is lying where vessels have sheltered since the earliest times. But this is so, and until the end of the fifteenth century, the river was one of the anchorages for the Royal Navy, or " King's Ships " as they were then called. And at the little village of Bursledon, where the

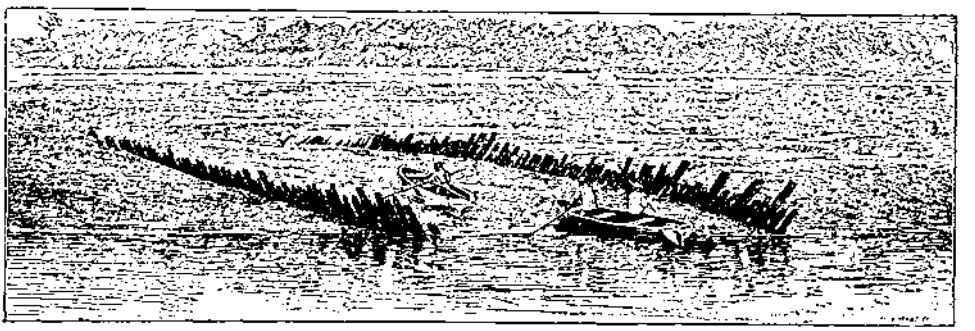


FIG. 1—The ship in 1875. Reproduced by permission of *The Graphic*, which has been incorporated in *The Sphere*, and by courtesy of *The Listener*.

river is first bridged, many fine vessels have been built and launched, including men-of-war in the seventeenth and eighteenth centuries.

About a mile above the bridges, where the river is a great deal narrower, lies the wreck of a very old ship. Only her bottom now remains, and most of this is sunk under the mud, with only the tips of the timbers and stem showing above the surface. Local legend had it that she was a Danish galley which had taken part in a raid on Botley. This ship was less fortunate than her companions and grounded while making for home, was fired, and burnt to the water's edge. This legend is " substantiated " by a ghost story which says that on certain nights a phantom galley comes down the river with great ceremonial. It is true some Danish raiders may have visited Botley in A.D. 871, but in spite of the fact that this wreck would have been easily the largest Viking ship remain in the world, nothing was done about her except to remove pieces of her timber for the manufacture of souvenirs. This was in 1875 and a picture from *The Graphic* of that time shows her appearance then. (Fig. 1.)

In 1932, the then head of the Shipping Section of the Science Museum, South Kensington, the late Mr. G. S. Laird Clowes, made a very hasty examination of the wreck. He observed that the closeness of her timbering at once eliminated any possibility of her belonging to the Viking age, and her shape seemed to indicate a much more recent date, as she is very much wider in proportion to her length than were the ancient northern ships. The very closeness of timbering which ruled her out as a Viking also placed the date of her building as either pre-1600 or post-1800, and from her general form Mr. Laird Clowes concluded that she was a merchantman of about 1840–50.

This identification caused much indignation among the local inhabitants, who were very proud of their Viking ship, though few of them had ever seen her. It was soon pointed out that the widest span of the old road bridge, recently replaced by a reinforced concrete structure, was about the same as the width of what remains of the wreck, and as this bridge was built between 1783 and 1800, the ship must have gone to her present berth before then. A mid-nineteenth century origin was also unlikely, as old inhabitants could remember hearing their parents speak of the ship as an antique.

In the spring of 1933, Captain F. C. Prideaux Naish, M.B.E. (late R.E.), a member of the Society for Nautical Research from its early days, persuaded Mr. R. C. Anderson, LITT.D., F.S.A., a vice-president of that society, to undertake with him an investigation to try and identify the wreck more certainly. I had thought out a method of feeling for the submerged portions of the ship under the mud with a probe, to discover the general shape and extent of the wreck, and hearing of their intention, I suggested that I should join the party and see what results I could obtain.

Access to the ship is not at all easy; for as well as being sunk in the mud, the remains are only partially visible for a short time at the bottom of the lowest spring tides, for an hour at the most on the day of the lowest tide of the year. The photograph (Fig. 2) shows the water very nearly as low as it ever goes. Any digging was difficult, as the mud was very soft and liquid and holes made during one visit were always found partially full again on the next. The only way of getting any results at all was to concentrate on certain local examinations at each visit and make fresh probing work such that it could be easily connected up with work already done.

The principle of the charting system was the measurement of the distance below a given line that the wreck lay, using a pointed metal rod, graduated in feet and inches, as a probe. This rod was made of ½-inch mild steel and the scale was cut on it with a file so that a quick wipe showed the figures quite clearly. This rod was plunged through the mud, as near vertically as possible, until it felt as if it had struck wood, and the depth recorded. Of course one could not

tell what the rod had hit, whether a rib, or whether the planking between two ribs, or whether one had merely struck a loose baulk of timber. But when a certain number of these depths were plotted out, with a certain amount of guesswork one could get a very fair idea of what lay below. To enable these soundings to be made at known distances horizontally, a cord was prepared with pieces of rag inserted at foot intervals, rather on the principle of a lead line. This could be laid on the surface of the mud, whereas a measuring tape would have very soon become unreadable. For laying off right angles a set-square with six foot arms was made; 3 : 4 : 5 ratio cords would

FIG. 2.—The ship as she is to-day. By courtesy of *The Listener*.

have done but the set-square was easier to manage, single-handed if necessary. A bundle of three-foot pegs, several reels of strong thread and a primitive clinometer completed the outfit.

First of all, pegs were driven in at intervals of about 20 to 30 feet down the centre line of the ship and thread stretched tightly between them. The elasticity in the thread itself enabled it to be stretched tightly enough to avoid a sag of more than ½-inch over any of the spans. Transverse lines were stretched across the hull at right angles to this centre line and adjusted so that they just touched it where they crossed. No attempt was made to level the threads, but their inclination to the horizontal was measured, within a degree or so, with the clinometer. The dimensions of the pegged out system were measured with a metallic wove tape. The threads had to be replaced at each visit, as once they had been wetted they sagged, but the pegs remained firm, so that it was possible to co-ordinate the various sets of soundings taken on different days. Afterwards the varying inclination of the threads was allowed for and the depths plotted were referred to a continuous plane. The line of the kelson, and the various sections shown in the construction plan were obtained in this way. Fig. 3 shows this plan, but the kelson is wrongly drawn, as later investigations have shown that it is 22 inches wide by 8 inches

A mediaeval man of war page 275

deep. Most of the internal longitudinal timbers have been omitted, too, as the soundings did not give enough data for them to be plotted.

Besides this general survey, detailed investigations were made, as far as circumstances would permit, of various features of the wreck. The mast-step, part of the kelson, the top of the junction of the stem and the keel, which is an important point when determining the size of the ship, and various pieces of the planking were uncovered and measured. Unfortunately, the length of the keel, the most fundamental measurement of all, was never accurately determined, owing to the difficulty of locating exactly its after end, which is 4 or 5 feet under water, and very muddy water at that, even at the lowest tide. Later in the year, when the river was warmer, I tried to investigate this by feeling for it, but I did not find out much except that it was covered with very sharp barnacles. Certain detached timbers were found during the work, and the importance of these is very great as it is only from them that we can form any idea of the construction of the non-existent upper portions of the hull. The sizes of the frames were mostly measured and the room between them. Since 1933, further local examinations have been made with a view to locating the internal longitudinal members of the hull, stringers and sleepers, and, while these have been found in several places, it is difficult to see exactly how these timbers were laid.

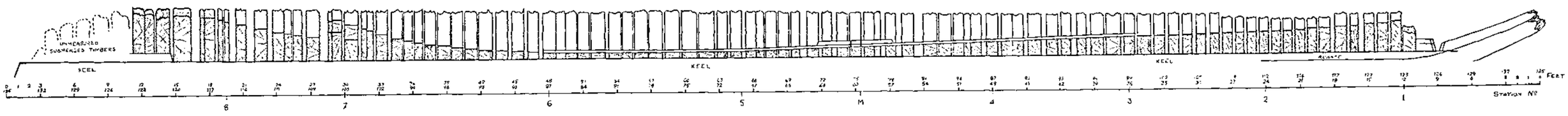
I think the results obtained were far better than any of us expected. The ship was identified without any reasonable doubt, and the conclusions reached were given by Mr. Anderson in a paper read before the Society of Antiquaries and in an article in *The Mariner's Mirror*. The most striking feature of the ship and one which was overlooked in 1932, is that she is clinker built. This means that her construction must date before 1550 and probably before A.D. 1500. From documentary evidence, Mr. Naish had for some time suspected that she was the *Grace Dieu of the Tower* of 1418, the greatest ship of Henry V's navy. While mentioning the name, it is worth pointing out that another ship of this name was purchased into the Navy about 1442, and lasted into the end of the century, and that very soon after her came the better known *Henry Grace a Dieu* of Henry VIII; the similarity of names often causes confusion. What is known of the 1418 *Grace Dieu* and her history fits in with the Bursledon wreck in the most convincing way.

She was built at Southampton and launched in 1418 by John Hoggekyns, the Master-Carpenter of the King's Ships. She is referred to in contemporary accounts as "the great ship" and is the only one to have that distinction, even though the *Jesus* was measured at 1,000 tons, which was a huge figure for those days, and another ship building for Henry V cannot have been less than 1,200 tons. Thus there is no reason to question the figure of 1,400 tons, which is one

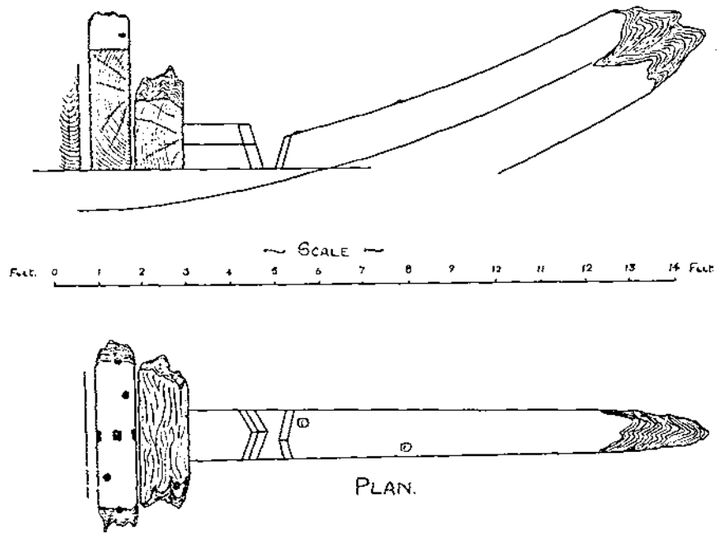
THE BURSLEDON SHIP

CONSTRUCTION PLANS

SECTIONAL ELEVATION DOWN THE CENTRE LINE



THE FRAMES.
TO THE SAME SCALE AS THE ELEVATION.



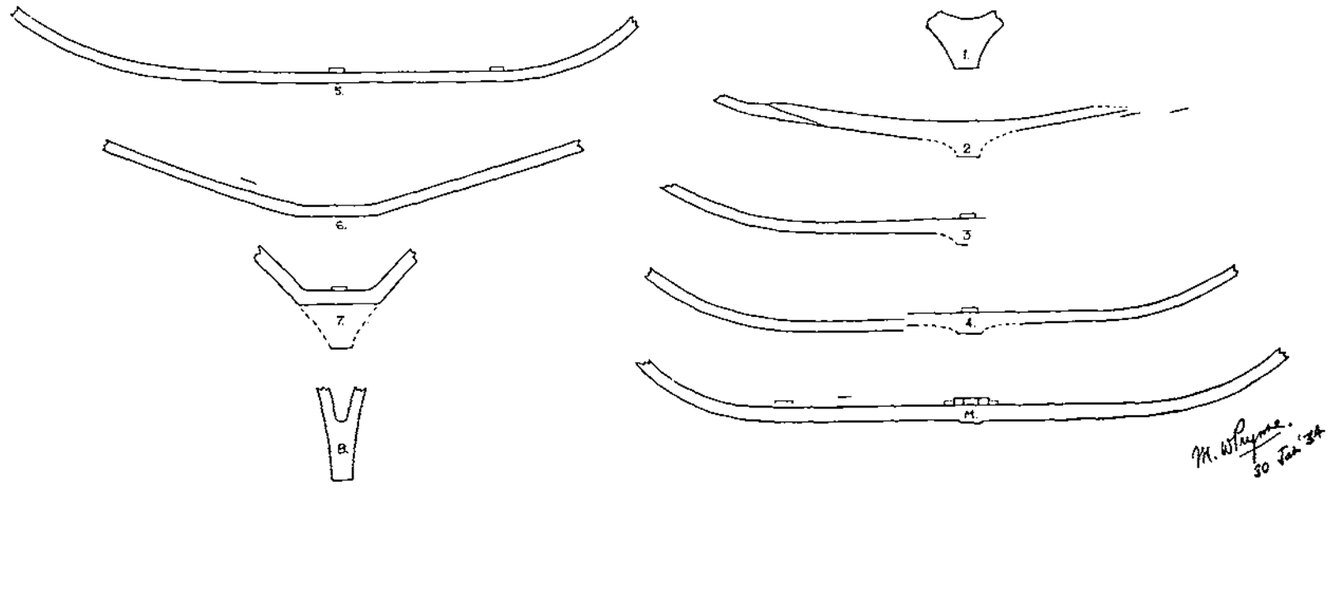


FIG. 3.—Plans resulting from the general survey. By courtesy of *The Mariner's Mirror*.

of the recorded tonnages for the *Grace Dieu*—the other being 400, a figure worthy of no special note. The dimensions of the wreck give a ship of about 1,400 tons, by the earliest English tonnage rule known, but it is right to point out that this rule dates from the end of the next century. The inventories show that the *Grace Dieu* had two masts certainly, and may have had three, and if so would be one of the earliest three-masters in this country. She was also one of the first warships to carry guns, of which she had three; no details are available as to where she carried them, but quite possibly they were in the main-top. She never took part in any action, and when she was docked she was reported weak; she had then been lying at moorings for over 12 years at Hamble and so this is not surprising. Nevertheless, she cannot be accounted a failure, for another great ship only 10 per cent. smaller was ordered by Henry V from Bayonne a year after she was built, and she was maintained as the best equipped ship in the Navy. Her chief claim to fame is her great size. Not only was she the largest ship afloat during her lifetime, but she was probably bigger than the *Henry Grace a Dieu*, the pride of Henry VIII's navy, or the *Sovereign of the Seas*, also the wonder of her age (Fig. 4). It is rather a curious thing that these last two ships built roughly a hundred and two hundred years later, should have been, in their turn, considered the greatest warships ever built in this country. In the case of the *Sovereign*, Trinity House felt constrained to send a memorial to Charles I, warning him against "these strange and large dimensions" and "that a ship of these proportions cannot be of any use." It is unlikely that the size of the *Grace Dieu* was exceeded until the latter half of the eighteenth century.

After Henry V's death, the Royal Navy was dispersed. Some ships were sold, but the larger ones, which may have been unsaleable, were laid up. In 1434, the *Grace Dieu* was dismantled, her mast—of which more later—unstepped, and she was hauled up into a mud berth near "Brisselden." Five years later she was destroyed by fire, and so she shared the same fate as the *Henry Grace a Dieu* and the *Sovereign of the Seas* already mentioned. Some fittings and ironwork were salved at the time, but it is this mishap that has preserved for us what remains of the great ship to-day. The wreck, as we found her, has clearly been badly damaged by fire. She is clinker built, her mast-step is empty, and her dimensions are consistent with those of a 1,400-ton ship. The general appearance of her outside planking agrees well with such representations as there are of ships of the period (Fig. 5). In fact, there seems to be no doubt that in the Bursledon wreck we have all that is left of the great *Grace Dieu* and the only actual remains of a mediæval warship ever discovered in this country.

Of all the specialized knowledge of the Middle Ages, very little

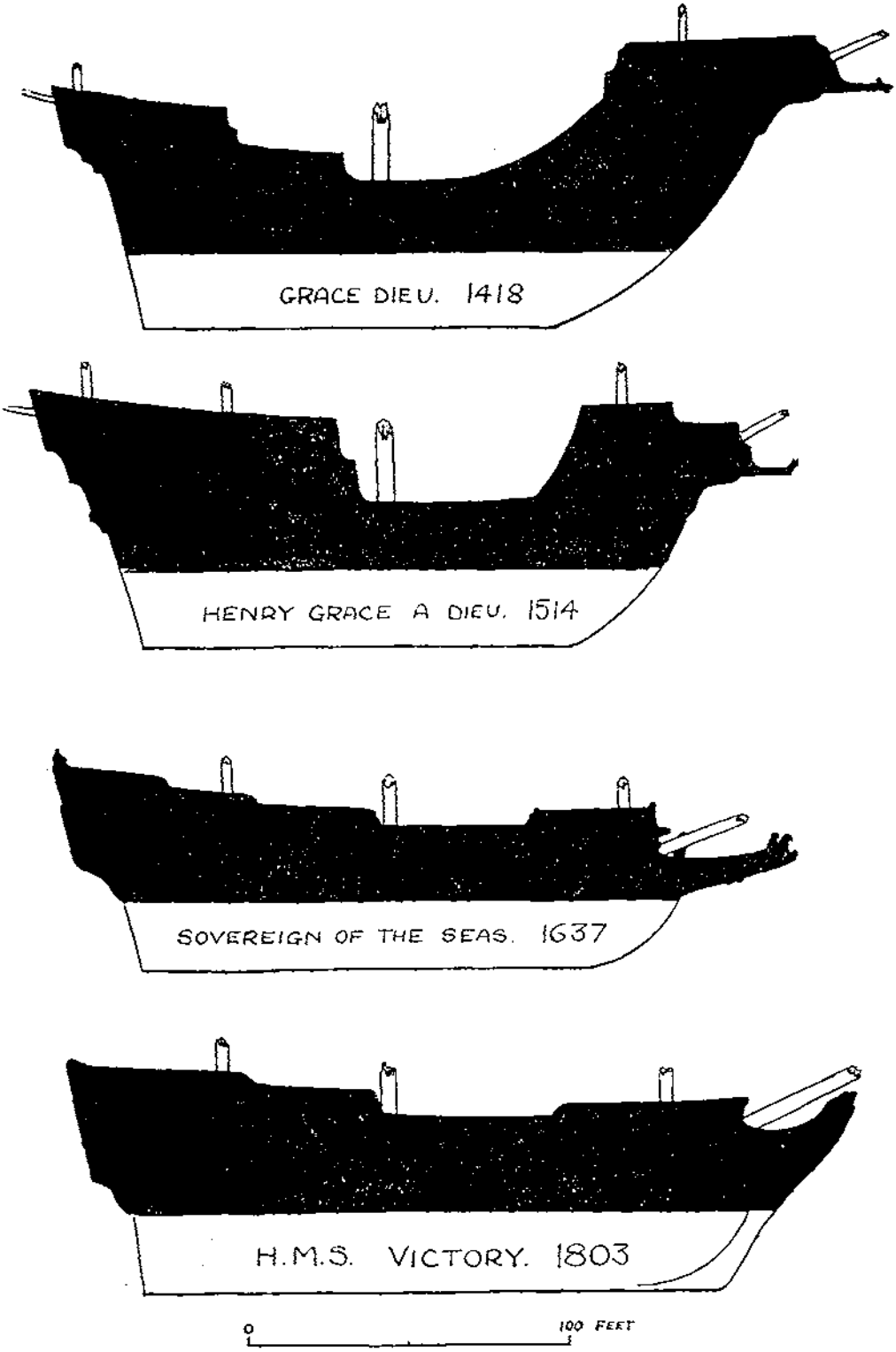


FIG. 4.—*Grace Dieu*, *Great Harry*, *Sovereign* and *Victory* compared. The two older ships are conjectural reconstructions, and the two lower have their works drawn in by eye, but the leading dimensions are to scale.

is in such complete obscurity as their science of naval architecture. The accounts and inventories survive in part but these seldom give

FIG. 5.—The outside planking compared with a seal of c. 1400. (From an Exhibit in the Science Museum, South Kensington.)

dimensions, and it is not even known how their tonnage figures were arrived at. Nor are there satisfactory pictures available. The

A mediaeval man of war page 279

earliest scale plans date from the latter years of Queen Elizabeth's reign and it is not until the middle of the seventeenth century that the details of ship construction are known. Viking ships are an exception owing to the buried remains found in Norway, Germany and elsewhere. For representations of English ships up to 1450 or so, we have to rely on tapestry, carvings, church frescoes, and illuminated manuscripts mostly of a religious character, and on seals. These seals are very important, because although the ships depicted are formalized and the shape has to fit in the confined space of the design, they can be dated from the documents to which they are attached. It is always possible that an archaic type of ship was portrayed deliberately; nevertheless, the development of certain features, details and fittings can be traced through them.

The knowledge that can be gained from the remains of the *Grace Dieu* fills an enormous gap in the history of English and North European shipbuilding. Here for the first time can be seen some of the details of construction at a time when the single-masted, virtually double-ended ship of the north was blending with the southern or Mediterranean type to produce the several-masted, square-rigged ship that was to hold the field for 450 odd years. There is far more difference between the ships of A.D. 1400 and the ship of 1600, than between the ship of 1600 and that of 1800. And there is very little fundamental difference between the ship of A.D. 1000 and the ship of A.D. 1400, beyond size, the rudder, and the superstructures added at each end of the latter. Fortunately, among the few dimensions extant for mediæval northern ships are a few of the large ship which was building for Henry V at Bayonne only a year after the launch of the *Grace Dieu*. Her keel was 112 feet to the *Grace Dieu's* 125 feet (about) and making the not unreasonable assumption that the two ships were fairly similar, approximate figures can be deduced for the beam, stem, stern-post, and length between posts of the *Grace Dieu*. By this method of estimation, she must have been over 200 feet between posts and 50 feet wide. When one takes into consideration the huge overhanging fore- and after-castles of the period her overall length must have been about 230 feet. The accounts kept during her construction give bulked quantities of timber, oak and elm, ironwork and other stores, also pay-lists and other interesting details, but unfortunately nothing from which dimensions can be deduced with any accuracy. They confirm, however, that the *Grace Dieu* was clinker built, as payments were made to "boarders, holders and clenchers." Mr. L. G. Carr Laughton, a vice-president of the S.N.R., has done a great deal of work in the Public Records Office, searching the contemporary documents; but although Robert Berd's account of the building runs to 6,000 words or so, it refers to books of detail which have not yet been found. It is hoped that these books of detail

would give more information about the construction and fittings of the ship.

It is clear from the remains that the science of construction had not kept pace with the great increase in tonnage. The *Grace Dieu* is possibly the extreme example of these "growing pains," for although she is comparable in size to Nelson's *Victory*, her construction has

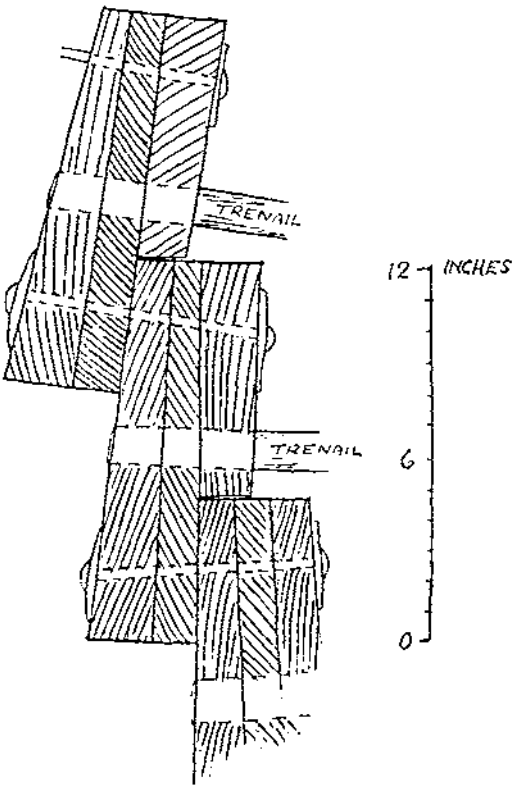


Fig. 6.—Section of planking.

many of the boat-like characteristics of the lightly-built Viking ships. The biggest source of her weakness was her clinker planking, but the builders had striven to overcome this by making it up of three skins, so that the total effective thickness was over 6 inches (Fig. 6). This is the only planking of its kind ever found. The planking itself was made up of short lengths scarfed together, and the spaces and joints were made watertight with moss caulking and Stockholm tar, and it is interesting to find that large quantities of these substances are mentioned in the building accounts. The planks were fastened with iron nails $\frac{5}{8}$-inch square at about $6\frac{1}{2}$-inch intervals with 2 by 3 inches rectangular washers inside and round roves outside (Fig. 7). Owing

to the corrosion of these nails, it was not possible to tell whether the round roves, which are about 2¼-inch diameter, were really the round heads of the nails, but similar nails with large round heads, and rectangular roves inside have been found in a Viking ship in East Prussia dating from before A.D. 1300. The washers inside indicate

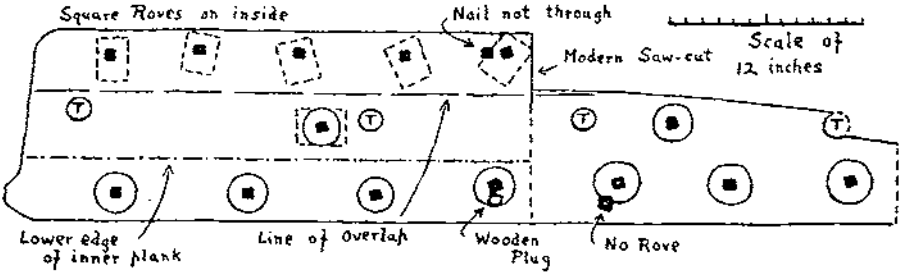


Fig. 7.—A piece of the planking—outside view. By courtesy of *The Mariner's Mirror*.

that the frames were put in after the ship was planked up, and the scarfing of some of the frames themselves confirms this (Fig. 8). This shows that the ship was built according to ordinary clinker building practice as in use to this day. The planks were fastened to the ribs with oak trenails and these may have been driven from the

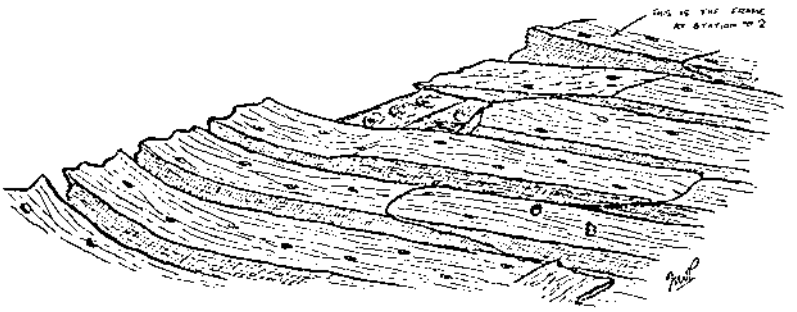


Fig. 8.—Timbers on the port side showing the scarfing. By courtesy of *The Mariner's Mirror*.

outside; certainly some of the holes were bored in this direction. The ceiling is light stuff, two inches and less in thickness. In an attempt to increase the strength of the ship, very close timbering was adopted, the average frames being 13 inches wide and 3 inches apart; but it must have been longitudinally that the ship was weakest. In all wooden ships of any size, the provision of sufficient girder strength to resist hogging has been a prime difficulty, and the factor that limited their length to about 250 feet. With her big end castles, and no heavy guns amidships, the *Grace Dieu* must have tended to hog more than most, and it is surprising to find the keel

has not lifted more than a foot or so in the middle above the ends. The kelson is 22 by 8 inches and the keel itself, where it joined the stem was only 1 foot 2 inches wide. Its depth was not measured but is not likely to be more than 30 inches at that point. Several timbers more than 12 by 12 inches in section have been found running longitudinally inside the frames, and these would help the strength a certain amount. Very little can be ascertained about the arrangement and details of the decks, but a curious timber found loose (Fig. 9) has grooves that suggest that it was a rider head and Fig. 10 shows how it may have been employed. A rider is a kind of additional

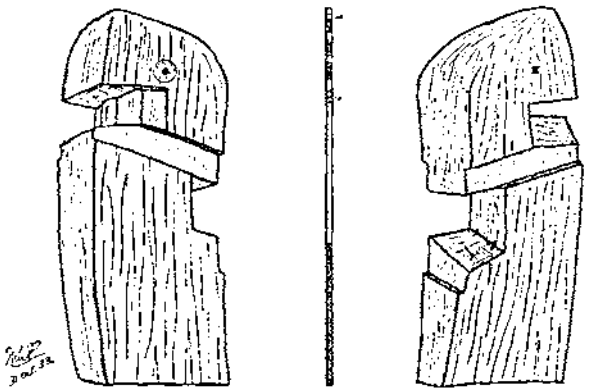


FIG. 9.—Head of a loose timber—perhaps a rider. By courtesy of *The Mariner's Mirror*.

rib fitting inside the frames of the ship, and where there was ceiling, this would come between the frames and the riders. It seems to point to very light construction at any rate for the lower orlop, which was probably near the water-line. It indicates a deck beam 12 inches wide by 8 inches deep and 2 inches deck planking. One should remember, when comparing these light scantlings with those of later periods, that the decks did not have to bear the weight of guns. The use of decks to strengthen the hull was not yet fully realized, and it is likely that they did not run continuously from end to end of the ship but that the level broke somewhere aft of amidships. The " lines " shown in Fig. 11 are corrected for the hog mentioned above, and also for the small amount of " winding " present, but the wreck is not nearly as distorted as one might expect.

The mast-step is surprisingly small (Fig. 12), for the mainmast must have been a stupendous affair. It was probably a built-up tree about 150 feet high, and five feet or more in diameter at the base. At all events, we know that its unstepping was an operation which called for the supervision of a Master Mariner of Sandwich, and how it was done at all is something of a mystery. The yard and sail, if

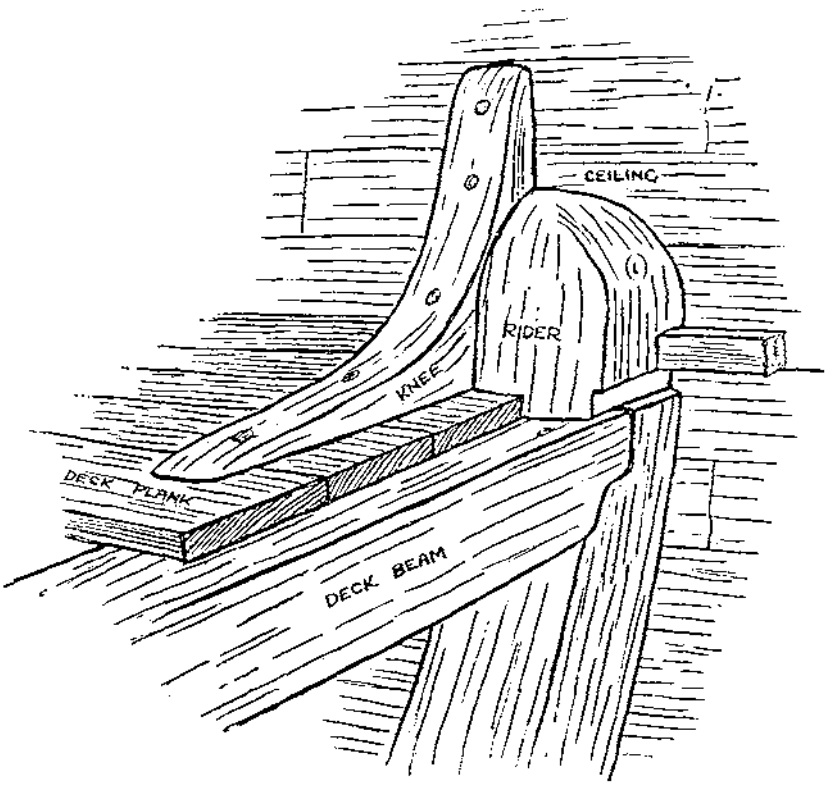


FIG. 10.—Conjectural reconstruction of the rider head.

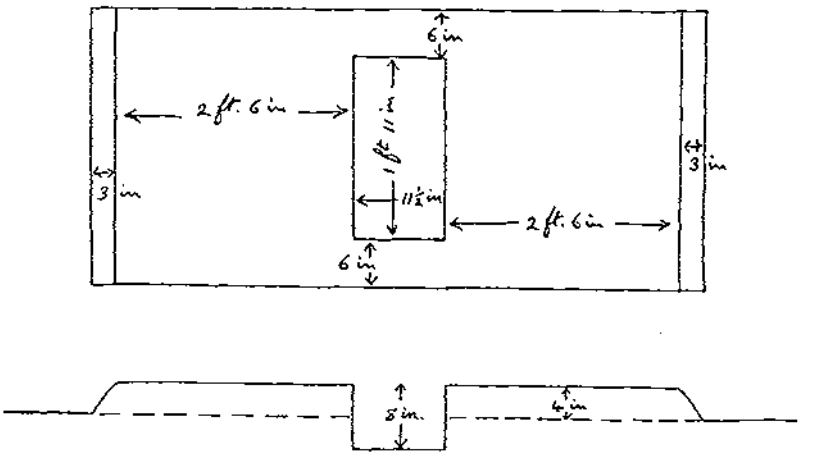
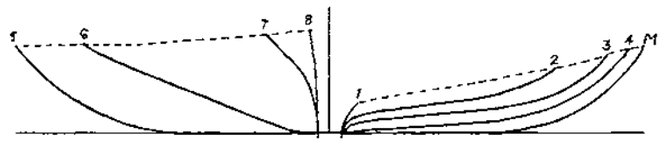


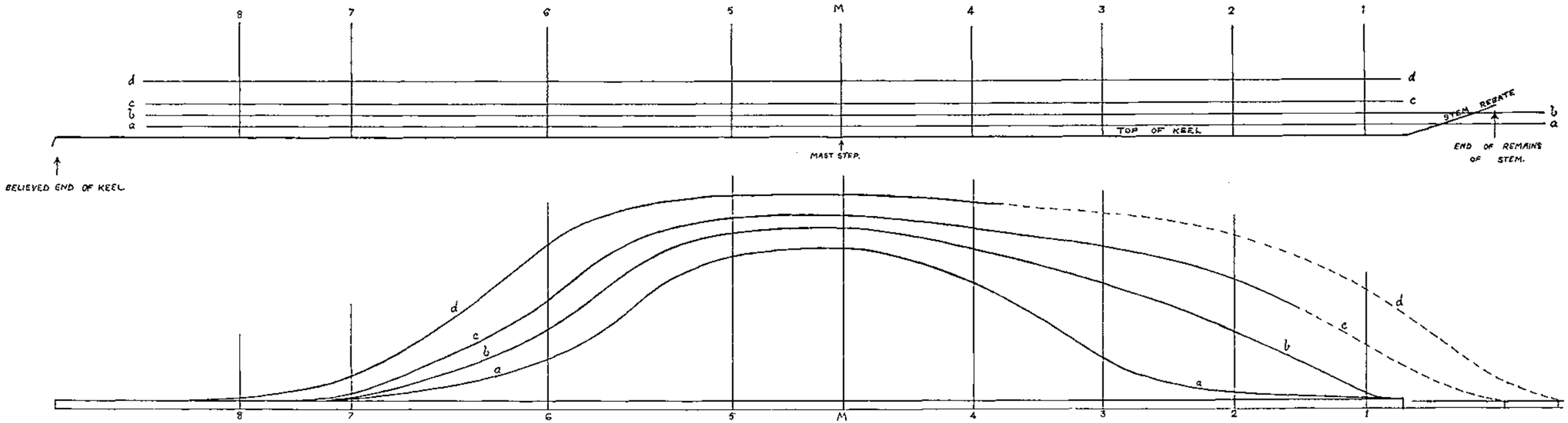
FIG. 12.—The mast-step. By courtesy of *The Mariner's Mirror*.

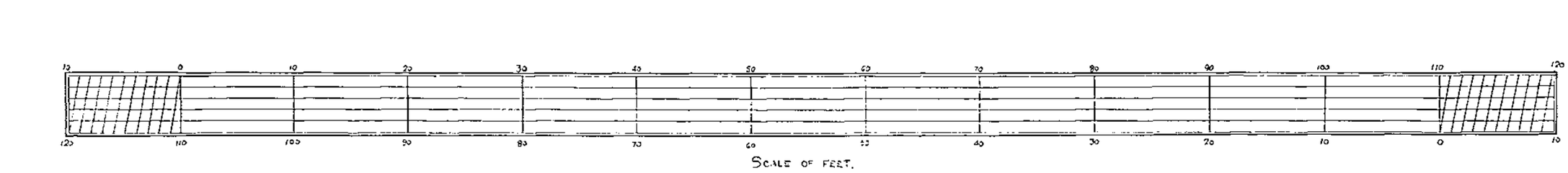


SECTIONS INSIDE THE PLANKING.

THE BURSLEDON SHIP

FAIRED LINES





SCALE OF FEET.

R. W. Paynne
Dec 1933.

FIG. 11.—The ship's lines, corrected as far as possible. By courtesy of *The Mariner's Mirror*.

they were made in the proportions usual for the period, were quite staggering, and a sailor of 1850 would probably have refused to believe that they could be handled. The mainyard would be 150 feet long, and the mainsail, half of which would be made up of detachable bonnets, about 20,000 square feet—the biggest square sail in history! But it must be remembered that the *Grace Dieu* would only go to sea when the weather was fine, as in anything of a blow she would be quite unmanageable.

No trace of any stern-post or stern-post knee was found, but some years ago the stump was still standing, and it is said to have been broken off by a barge hitting it. It is to be hoped that it is still lying somewhere nearby in the bed of the river.

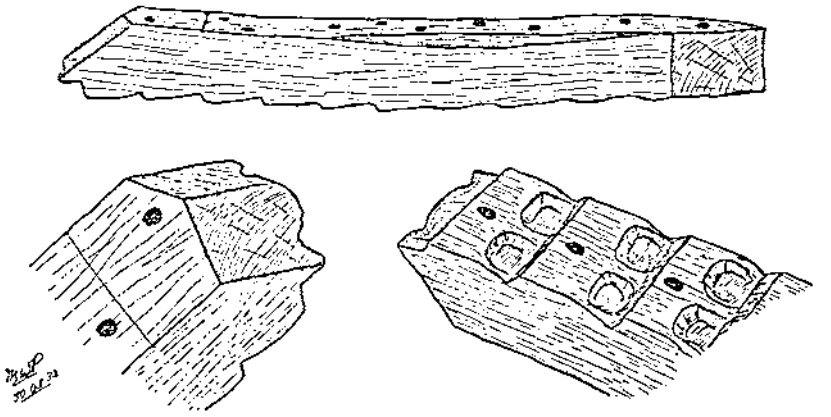


FIG. 13.—A loose timber, part of a frame. By courtesy of *The Mariner's Mirror*.

It will be noticed that where the stem joins the keel, there is a curious angular cut. This is so smooth that it was thought to have been made at the time the ship was built. I have since come to the conclusion that it was done in an attempt to cut off the stem with the aid of a chisel, probably in 1875. The shipbreakers succeeded in removing the false stem, of which only about 18 inches of the butt remains on top of the lower end of the true stem, but the stem itself although cut through, refused to be detached from the keel. This theory is borne out by the fact that the same angular cut is found on the end of one of the ribs, but with splinters of the detached piece left behind. Two pieces of timber found loose also had this blunt wedge finish on one end.

The frames were joggled to take the overlapping planking, and little hollows cut for the rectangular washers of the clenched nails. This is shown in Fig. 13, which shows a piece of loose timber that was once part of one of the frames. But in places where there was a reverse curve, as at places at the garboards, this was not enough,

and wedges were driven in between the planking and the frames where the trenail was hammered through (Fig. 14). The use of these wedges is a shipbuilding method that has not been met with before, and it is impossible to say how long it was practised. It died out, of course, with the disappearance of clinker building for large ships.

There is still a very great deal to be found out about the ship, which would add to the present scanty knowledge of mediæval naval architecture. The first thing that strikes one is that she should be raised, cleaned, repaired and restored as far as possible, so that she could be placed on public view. This is entirely a question of balancing the cost of doing so with the final result. All there would be to see is the bottom of a large ship, a wreck 135 feet long and 38 feet

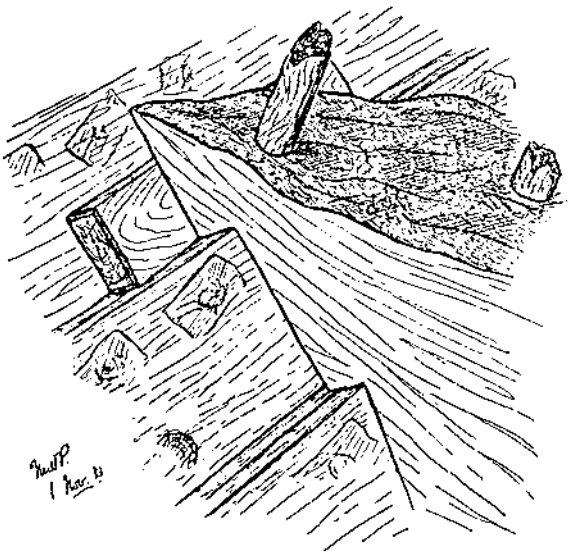


FIG. 14.—Details showing the use of a wedge between the timber and planking. By courtesy of *The Mariner's Mirror*.

wide from a hull 200 feet long and 50 feet wide. The question is whether any big expenditure is justified to salve what is left, and enable students and others to see first-hand and for the first time some of the methods of the Master-Shipwrights of the Middle Ages.

Germany and Norway have salved the remains of ships of the Viking period and housed them with great care at Kiel and Oslo, and to them we owe a great measure of the very detailed information we have of ships of that period. In Italy, too, the remains of Caligula's galleys, which lay at the bottom of Lake Nemi, have been salved, though they can only be called fragmentary, having been badly damaged during previous investigations.

Our *Grace Dieu* is quite unique, and, in my opinion, she would be

the object of great pride and interest, not only to those whose special study is ships and their history, but also to the general public, whose concern in maritime affairs is too often greatly underestimated. Interest would not be confined to this country, as the shipbuilding methods of the Northern European countries were similar in the fifteenth century.

A cheaper alternative to raising her, is to make a very thorough survey of her as she now lies. This could be done with a suitable party and proper equipment in two sets of equinoctial spring tides, provided that the whole business is very carefully organized. From this complete and exact survey it would be possible to construct a large-scale model, say quarter full size, which would show every detail of the ship's construction. Further, a committee of experts could plan a conjectural model of the ship as she was, and in this they might be greatly helped by any further loose fragments that may be found in and around the wreck. The ship herself, after the examination, could be covered up with mud again, as this seems to have preserved her to a great extent.

From a technical point of view the problem of raising her is interesting and not very difficult. She lies on a sloping gravel bed, about 7 feet higher at her forward end than aft, covered with mud to an average depth of 5 feet, and roughly at right angles to the line of the river bank. The after end is nearly in midstream. At low water ordinary spring tides, her highest point, the tip of the remains of the stem, is just visible, and at high water this is about 10 feet below the surface. Some kind of coffer dam would have to be built around her, to enable work to be carried on at all states of the tide; it would have to be about 150 feet long by 60 feet wide and its walls 22 feet high. Pumps and conveying machinery could be put in lighters moored alongside, as the water is sheltered and smooth. About 1,000 tons of mud and shingle would require to be excavated. All this would have to be carefully examined for loose pieces of the ship, then removed and spread over the neighbouring mud-banks. Two alternatives are then possible. The wreck could either be dismantled as she lay, or raised bodily and moved to dry land. I think the latter method would be better, as the bottom of the dock would not be a very pleasant place to work, and the process of taking the ship to pieces would have to be very slow and careful work demanding expert supervision. In addition, the pumps would have to be kept working the whole time and boats kept going to and from the shore. Before she was raised a temporary protecting frame would be built all round to prevent further damage or distortion. The remains weigh in the neighbourhood of 130 tons, and allowing 90 lb./ft. cube, this would mean about 60 tons to be carried if she were submerged during transit. Using the tide she could be landed at a specially prepared slipway and then hauled up.

Once high and dry, she could be dismantled and all the pieces numbered and cleaned. Decayed timber and trenails could be copied from the remains and used in the reassembly. It is probable that the iron fastenings would crumble away on exposure to the air; on the other hand, there may be some way of treating them that would prevent this. The woodwork would require special treatment to prevent warping and splitting as it dried out. Fortunately, the accumulated experience of the Germans, Norwegians and Italians in this matter can be drawn on, and there should be no difficulty in ensuring the proper preservation of the remains.

Where her final home should be is outside the scope of this article, but Southampton, where she was built, and Portsmouth, where the *Victory* now lies, have their claims. But owing to her unique interest, probably the best place of all is Greenwich, where there is the finest maritime museum in the world. It only remains to be seen if funds ever become available. If they do, this country will be able to show the only existing remains of a mediæval warship in the world, the greatest of her age and of three centuries that followed.

Acknowledgment. I have borrowed material freely from Mr. R. C. Anderson's article in *The Mariner's Mirror* and from notes by Capt. F. C. Prideaux Naish and Mr. L. G. Carr Laughton, and I am grateful to the two first-named for reading this article and their helpful suggestions. Thanks are due to the journals, by whose courtesy I am able to reproduce most of my illustrations.

Bibliography. For anyone sufficiently interested here is a list of various references made to this ship at various times since 1875.

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PROFESSIONAL NOTE.

Notice Boards at Lydd.

By T.T.B.

Notice boards in the open at the seaside when painted with ordinary W.D. paint usually deteriorate in one year, and all require repainting after two years. More than 200 Notice Boards and Danger Posts have recently been put up here; so careful consideration has had to be given to the cost of maintenance.

Some departure from the usual soft wood post fixed in the ground and the customary paint was evidently indicated, to reduce annual upkeep.

As other districts are no doubt having to erect a number of Notice Boards, new methods which show signs of promise after exposure here will be of interest.

An Imperial Chemical Industries synthetic paint DUIUX was selected for trial. The boards and posts were painted three coats: then one coat white lettering on a glossy red ground, covered by one coat of synthetic varnish.

No signs of weathering are yet apparent. It has, however, been discovered that with paint of this quality it is essential that the timber from which the boards are constructed should be perfectly seasoned. Timber kiln-dried at a temperature of 160° to 180° F. to a guaranteed moisture content of 16% to 18% is recommended.

To reduce deterioration of the posts at the ground-line, and to facilitate removal for repainting, the posts are bolted to stobs of pressure-creosoted timber in precast cubes of concrete. The Notice Board of kiln-dried timber in narrow widths should be flush clamped and mitred at the corners so that no end grain is exposed; this will prevent cracking and warping which, letting moisture into the wood, then blisters the paint.

A material recently put on the market by the Venesta (Plywood), Ltd., appears to be specially suited for notice boards. The plywood is glued together with a synthetic thermo-glue which is absolutely impervious to moisture and a coat of this is also given to the outside faces. Paint appears to adhere firmly to this and Shuttaply, as it is called, is being experimented with here.

Enamelled sheet iron notices, peculiarly susceptible to wilful damage, are expensive in first cost, and only suitable for those that will never be altered.

MEMOIRS.

BRIGADIER N. T. FITZPATRICK, D.S.O., M.C.

NOEL TREW FITZPATRICK was born on the 24th December, 1888, the son of Lieut.-Colonel J. F. Fitzpatrick, I.M.S., and was educated at Cheltenham College, where he distinguished himself as a swimmer and played in the football XV. He passed into Woolwich in 1907, became an "Under-Officer" and was commissioned in the Royal Engineers in December, 1908.

On leaving the S.M.E., he was posted to India and served in the Military works for four years, the last three of which were spent in the Zhob. There the war found him, but he was soon brought home and joined the newly-formed 106th Field Company of the 25th (New Army) Division.

The division crossed to France in September, 1915, and during 1916 fought on the Vimy Ridge and the Somme. "In July, 1916, I was appointed C.R.E. of the 25th Division" writes Colonel R. J. Done, "and found the field companies R.E., like the rest of the division, a good deal knocked about. The 106th Company had no major and the senior officer in command was one Noel Trew Fitzpatrick. I was greatly taken with him. Under the greatest difficulties he was putting up a good show: trying to reorganize the company in the midst of the Somme fighting and at the same time trying hard that the company should take its proper part in the battle. Before very long, with the local rank of major, he had his company reorganized into a first-class field company, R.E., and next year his company did excellent work in the attack and capture of the Messines Ridge and subsequent fighting." He had been awarded the Military Cross for "conspicuous gallantry, untiring energy and splendid example" in the Somme fighting and received a brevet majority in January, 1917.

In October, 1917, the command of the 6th Battalion South Wales Borderers, the pioneer unit of the 25th Division, fell vacant and Fitzpatrick, who already knew the battalion well, was selected to fill the vacancy. "This proved," writes one of his officers, "a very happy choice for the battalion and he soon became deservedly popular with all ranks." "He had," continues his C.R.E., "all the attributes of the good soldier, fearless, of untiring energy, absolutely fair and just, with exceptional powers of organization, always cheerful, always good-tempered, with a charming manner to all ranks

Brig Noel T Fitzpatrick DSO MC

and withal a good engineer. A fine leader of men." "He was outstanding," writes another officer who served with the battalion, "in his leadership, in his quiet courage and remarkable cheerfulness, remarkable in that, no matter how tired he might be or how severe the strain, he was always the same—cheery and full of optimistic encouragement. The units of the battalion felt more confident and safer from the mere fact of his presence."

The German offensive of March, 1918, found the battalion in reserve near Achiet le Grand. It was put in to stop the German advance at Bapaume and fought a series of rearguard actions. It was then transferred to the Lys and, between April 10th and 14th, it was heavily engaged between Ploegsteert and Neuve Eglise in delaying the German advance.

On the 14th April, Fitzpatrick was severely wounded while going up to encourage his battalion during an enemy attack. He had been awarded a D.S.O. in January, 1918; he had four "mentions" to his credit; and, but for his wound, he might well have been selected for a brigade command for which his name was noted.

He did not return again to France, but, after a spell of light duty at home, took over the 7th Field Company on the Rhine. For four months in 1922 we find him as C.R.E. in Upper Silesia, earning the praise of his G.O.C. and of commanders of units for his energy, charm, and helpfulness in most difficult circumstances. A short spell at the War Office was followed by two years at the Staff College, a year at Aldershot, and two years as Brigade Major, S.M.E., during which he was promoted Brevet Lieutenant-Colonel. His heart was, however, always with the troops and he was delighted in March, 1929, to find himself selected to succeed Martel as commander of the 17th Field Company, at that time the Experimental Mechanized Unit.

No better choice could have been made for, although not a great mechanic, he possessed unusual originality of mind and a remarkable power of getting the best out of everybody. His methods of training were vigorous and refreshing. He seemed always to be able to find a job of real responsibility, even for the junior N.C.O's, and to ensure that every minute was filled with work or training of real value.

"He had a sharp tongue for a malingerer" writes one who served under him as a section serjeant, "but a wide and sympathetic understanding of human nature, and the men felt that they could go to him with their worries and get a most sympathetic hearing and advice. On the works he had a genial word and smile for us all, always ready to discuss our work with us, to ask our opinion and even our advice: this, of course, brought out a desire to please him and to produce the high standard of work which he demanded. When he gave one a job of work there were never any strings tied to

it, his attitude was—do the job in your own way, use your initiative, but produce a satisfactory result."

The writer of this memoir can testify that the 17th Company never failed their commander. "Fishpat," in his turn, was charmingly and unashamedly proud of his company, and nothing delighted him more than to see its work recorded in the pages of *The R.E. Journal* —a record of real value to other company commanders.

In February, 1932, he took up the appointment of C.R.E., Gibraltar, and was promoted substantive Lieutenant-Colonel in December of that year. To be C.R.E. of a division at Aldershot was, however, his real ambition and this ambition was fulfilled when he took over the 1st Division R.E. in April, 1933. He at once threw himself wholeheartedly into his duties not only in the training of his units, but on the works side, which was then becoming particularly heavy. Though not an experienced works officer, he had that most valuable of all traits in a C.R.E., an intimate knowledge of the troops and a wholehearted desire to be helpful: it was not long, therefore, before he gained the confidence and affection not only of his divisional commander but of all units of the division. As regards those under his own command, no trouble was too great where their welfare was concerned and his appreciation of their efforts was unstinted.

The summer of 1935 brought the first warning of trouble to come: overstrain of the heart was the diagnosis and several months' rest the remedy. It was a blow to one who was most honourably ambitious to rise in his profession. Back at duty, he was selected in October, 1935, to be G.S.O.1 of the Northern Command. But he was not a fit man and in August, 1936, an operation for appendicitis again put him on the sick list.

He became Chief Engineer, Eastern Command, in February, 1937. Reconstruction schemes were at their height, and, though cheery and charming as ever, he was far from being his old vigorous self. He came to the S.M.E. for a short course of instruction in January, 1938, looking far from well, walked out of the lecture-room "to get a dose" and a few hours later was operated on for severe peritonitis, the result probably of his old wound. From the first there was little hope and on the 20th January he died.

So untimely passed a first-class soldier, a fine sapper, a simple and great-hearted gentleman and, for all who knew him, a most loyal and well-loved friend.

He married in 1915, Marjorie, daughter of Lieutenant-General McCausland, Royal Marines, and leaves a widow and a son of 17.

L.V.B.

COLONEL DUDLEY ACLAND MILLS.

DUDLEY ACLAND MILLS was the son of Arthur Mills of Efford Down, Bude, Cornwall, at one time M.P. for Exeter, and Agnes Lucy, his wife, who was the daughter of Sir Thomas Dyke Acland of Holnicote, Devon. He passed from Eton into Woolwich and was commissioned in the Corps on the 18th December, 1878. He was then given leave to take advantage of a favourable opportunity to visit New Zealand and so the beginning of his course at the School of Military Engineering was postponed till 1880. After the completion of that course and a few months' service at Manchester, he joined the 28th (Submarine Mining) Company at Gosport, thereby commencing a long association with the submarine mining activities of the Corps. He served at Gosport and Pembroke with the 28th Company (1882–3), and at Hong Kong for four years (1883–7), and again on the Solent with the 33rd Company (1887–8). For short periods in 1888–9, he was first at Cork Harbour and then attached to the Elswick Works at Newcastle. He was promoted Captain in April, 1889, and from 1889 to 1893 commanded the 39th (Submarine Mining) Company at Sheerness. In November, 1893, he went to Halifax, Nova Scotia, to command the 40th Company. There in the following year he married Ethel, daughter of Sir Henri Joly de Lotbinière, Lieut.-Governor of British Columbia. On returning to England in 1895 he served as staff officer to the C.R.E., Western District, at Devonport. He was promoted Major in July, 1897. In January, 1903, he went back to Halifax to command the 40th Company, and after promotion to Lieut.-Colonel in July, 1904, became C.R.E. in Jamaica (1904–6), Plymouth (1906–7) and Jersey (1907–9), successively. He was promoted Brevet Colonel in October, 1909, and retired in October, 1909.

By that time he had three children, two girls and a boy, and after a short residence near London he determined for their sakes to settle down in the New Forest. There he built a house near Buckler's Hard, in which he resided until the outbreak of the Great War. He then rejoined the R.E. at Longmoor camp and presently found himself in command of the 10th Duke of Cornwall's Light Infantry, a pioneer battalion raised among the Cornish miners and clay-workers. He took it to France in May, 1916. Later, he commanded the 12th (Labour) Battalion D.C.L.I. till December, 1916. In the last year of the war and for some months in 1919, he was employed under the Admiralty at Sheffield in connection with the testing of steel. Then he returned to his family in the New Forest. In May, 1926, he met with an accident, being knocked down by a

bicycle, and was laid up for some months. Two years later he thought it would be in the interest of his children, now grown up, that he should live in London where, after one or two changes, he settled down in Earl's Court. There he pursued his leisurely studies and enjoyed the society of his family and of their friends and of his own, until his death on February 22nd, 1938. He had then been a widower for a couple of years.

A result of the postponement of his Chatham course already mentioned was that he went through it in 1880–2, with the writer of this memoir, whom he taught to think and to row, the instruction often being given at the same time. Thus began a friendship which lasted 58 years and a correspondence that extended over nearly as long a period. From this correspondence and personal recollections it is possible to amplify the short epitome given above with some indication of his interests in life, of what he did in pursuit of those interests and of what he was, which was of much greater importance than what he did.

Though he did his duty in the service conscientiously and intelligently and had an attachment to the Corps in which were his two de Lotbinière brothers-in-law and from which he chose some of his closest friends, it would be vain to assert that he had the tastes or the outlook of a keen soldier. Neither militarism nor the business of soldiering were to his liking. He held that " to the decent British mind, war is offensive and disgusting, not because of its blood and tears but of its intense stupidity and unbusinesslikeness." He sympathized with the French soldier guide to a battlefield who told him of the many killed there and added, " Et pourquoi ? " He objected to trade in peace being restricted for reasons of war and long ago, in 1898, ridiculed the opposition to the Channel Tunnel. He liked the outdoor life and the ship and boat work of submarine mining, in which he spent much of his service, more than the office work he was employed on for some years. His experience of army administration did not impress him and possibly the senior officers under whom he passed some of his early service were not such as to raise it in his estimation. He thus described 55 years ago his C.R.E. in Hong Kong, " a very stout old gentleman with large square face and long black beard, always smoking, never unless unavoidably so in uniform, learned in stocks and shares and political movements, an ardent China-maniac, fond of chess, croquet and gardening, content after being C.R.E. on and off for 25 years to superintend generally and not meddle with subordinates unnecessarily and in short, a model C.R.E." In contradistinction to this model C.R.E. it was his fate to come across one who was of a type, now no doubt unknown, afraid of his seniors and determined to make his juniors afraid of him. In the latter part of his service he was more fortunate but he had no admiration for the various administrative changes

Colonel Dudley Acland Mills

being carried out by the War Office in the Western District in 1897 and noted the lesson of history that great naval and military commanders failed when tried as administrators. He held definite views on the need of an army policy which should lay down clearly the political and military requirements of the country and a scheme to meet them. He was troubled that districts were insufficiently taken into the confidence of the War Office and not told the conclusions, in so far as they affected the defence work on which he was then engaged, come to by the various committees then furnishing reports. He hated "red tape" which delayed the execution of decisions and his sense of humour was excited by the nonsense often to be found in allowance and other regulations.

His experience of active service in the Great War was to his liking and in May, 1916, he wrote, "If you can get a job like a labour battalion you will never regret it. I have a splendid time. It is healthy outdoor work, bumping about in a small car over roads which are going to be mended." But he recognized that most of the work fell on the French department of the *Ponts et Chaussées* and that the C.O. Labour Battalion had no very strenuous job and could devote himself to the study of local conditions.

The subjects of some of our early letters were the philosophy in which he had done some desultory reading while still at Woolwich and on his S.M.E. course, and the crude doubts that arose from my own early reflections as I expounded them to him. He had read T. H. Green on Hume, some J. S. Mill, Herbert Spencer and Butler and looked on his philosophical opinions as an organic growth necessarily differing from mine. "Therefore one cannot expect unanimity even as regards things plain to one as a pikestaff and obscure to the other as a W.O. memo." He wrote to me of cause, time and space as *a priori*—as ideas of the mind, and that the absorption of this truth made "here and there" "then and now" as but the colours through which alone one can look at the non-ego. The mind may get coated over but "to me actually it is true philosophy to hold that the highest moments of inspiration are the moments when we see things in their truest light, that is in the nearest approach to truth we can get." "The business of moral philosophy, dialectic, metaphysics, etc., is to see that our intellects do not obscure by intellectual excess the visions granted to our souls." Presently he advised me to read Seely's *Ecce Homo* with which he agreed with one exception, which, however, was an important one. Later he tried Martineau. "It is the philosophy I learnt from T. H. Green, 1881–2, put into religious garb. I believe he is a great power in some religious circles."

His philosophy was in contrast to the religious atmosphere in which his youth had been passed. His mother used to say that her husband was broad-church, her eldest son high-church and her

other son no-church. But he was keenly interested in religion and in religious movements and their leaders. He wrote in 1894, that he had certainly absorbed Froude's views and quoted with admiration Froude's well-known reference to the siren's song in his reply to a passage in Newman's *Apologia*. Newman's prose was of course a joy to him which he imparted to me and the circumstances of the writing of "Lead Kindly Light" fascinated him. Somewhat later (in 1896) I remember his taking me one Sunday morning down to St. Botolph's in the city to hear Jowett's funeral sermon on William Rogers whose outburst, securing for him the nickname of "Hang Theology Rogers," appealed to Mills' dislike of theological trammels to intellectual progress. He was essentially tolerant of other people's views and was not troubled by his wife's Christian Science nor, as I have indicated above, by my own beliefs nor by those in which I had been brought up. It was in jest that he wrote that what with Christian Science now all-pervading and Tariff Reform "there will soon be no area left for dry common sense to live on."

He was a Liberal in politics, being opposed alike to Tariff Reform and Nationalization. He had a growing dislike of Imperialism, was against Chamberlain's *Zollverein* in 1896 and 10 years later wrote "Socialism makes me unhappy and Imperialism makes me sick." This did not prevent him from taking the greatest interest all his life in Imperial problems. He followed the Russian advance in India in the years when it was a burning question, but in 1898 he wrote "Is it worth while to fight periodical Crimeas, the effects of which vanish in a generation?" He deplored the anti-British feeling which he believed was being created among the people of India and spoke from his Jamaica experience of the same thing happening in the West Indies. He was enthusiastic for Lugard's policy of indirect rule in Africa and for the exposition of it by his "new brilliant Professor friend—Marjorie Perham."

After his early foreign service in Hong Kong he always took keen interest in China and looked back with pleasure to his wanderings in Kwantung and other parts, which he had done in Chinese dress so as not to be conspicuous. In 1889, when stationed at Newcastle, he prepared and published a map with statistical notes to illustrate the famine districts of China for which a Mansion House fund had been started. It was nearly 10 years later that his local knowledge assisted me in drafting a memorandum for the Colonial Defence Committee on the territory which it was proposed should be leased from the Chinese Government. He volunteered, but was not taken, for employment on the expedition that took part in the suppression of the Boxer rebellion. He was strongly averse from the importation of Chinese labour into the Transvaal after the Boer War and wrote in 1906, "I dislike exclusion of Chinese anywhere. I think all indentured labour unsound. The ordinance was a bastard growth

from two things I dislike, viz.: the anti-Chinese prejudice of white labourers, and the labour-exploiting device of capitalists."

He had a good knowledge of and admiration for the Chinese people. In July, 1900, when they were much under discussion, he thus wrote with regard to two leading fallacies. " (1) The ' yellow peril '—German Emperor, Wolseley, Charles Pearson, *Spectator*—theory, which asserts the latent military capabilities of the Chinese. Such a theory is based on ignorance, love of sensation and rhetoric. (2) The opposite but equally dangerous theory that Chinese are easily governed. This theory is the more dangerous as it is held by some people who know a good deal about the Chinese. . . . I think they are led into error by the ease with which Chinese coolies can be organized and disciplined. But the records of Hong Kong and Singapore will show, I believe, if properly studied that the political government of the Chinese is not at all an easy matter."

An indirect result of his two tours in Halifax, Nova Scotia, was the prolonged study of the British frontier with the United States. He greatly admired Shelburne, who conceded American independence and was one of the most unpopular statesmen of his time. For the first part of 1914 he was studying the circumstances that led up to " the tragedy of errors, the war of 1812–14 " and the treaty of Ghent that concluded it. In the following year a paper by him on the subject appeared in the *Positivist Review*. He had long before, in August, 1902, been investigating the Alaska boundary question " now happily slumbering but liable to resurrect." In May, 1921, he was " deep in ' Oregon ' to be an item in ' Canadian boundary disputes ' for a lecture to a summer school of geography at Oxford in August." He had a theory that in the matter of the Oregon boundary " U.S. forced the pace and lost the race. . . . An expansionist move came on in the '40's and the Oregon question got into party politics ' 54° 40' or fight ' being the famous cry, so it became urgent for G.B. and U.S.A. to come to terms, which they did on June 15th, 1846, by adopting the 49th parallel to the sea, Vancouver Island passing wholly to G.B." But the work long looked for by his friends on the history of the Canada-United States boundary never appeared.

Soon after he arrived in Jamaica he described himself as " plunging into drains." To help his consideration of the sanitation problems in the Island he wrote to me, then in Hong Kong, for documents showing schemes for the latter colony. He was again, as in his Western District days, anxious to see greater dissemination by central authorities of information useful for local executives. He had also " been thinking (I admit only thinking but is not steady thinking the crying need of the age?) of a diagram " illustrating the history of Jamaica, with stress on columns showing the " Introduction of plants and animals " and " Politics, Disturbances, etc."

of special interest in that colony. He tried to help the library there and the librarian with whose services local authorities, ignorant of their value, wanted to dispense " and I suppose burn the books like the Emperor Tsin did."

In the various colonies in which at different times I was working he took a vicarious interest. He was well versed in the old Colenso controversy in South Africa which had an echo in 1908–9, in the championship by the daughters of the former bishop of the rights of the Church of England in South Africa and for the heir of Cetewayo. He got for me books on the old quarrel and offered to keep them for me till I should be " impeached or otherwise returned to London." He read the blue books on the Dinizulu rebellion and thought little of the Premier's " Damnable Interference speech (Interventio Damnabilis would have been its title as a Pope's Encyclycal)."

Mills had a fine collection of old-world maps and of Chinese maps and books. Of the Chinese maps he said in 1926, " I got them in 1888. I meant in those days to continue the study of China but never did so." He thought at one time of writing the history of British wars in China and though he did not carry out his idea he was anxious that some student should undertake the task to show that "the prevailing idea that Great Britain (though well-intentioned now) used to bully China, is not true." All his maps and many of his books he first lent and afterwards gave to Manchester University, whither his great friend, H. W. Barker, went from Southampton as Professor of Geography. Partly in Barker's time and partly in 1935, when Barker had died and Professor Fleure had followed on, he worked at a catalogue of the University maps. The Story of Exploration or Historical Geography, as embodied in maps, was probably his keenest interest in the last 30 years of his life and the theatre of his greatest achievements—not so much by his own discoveries in this field as by stimulating others to enter it. A lecture to the *Société Jersiase*, in 1907, was the first of many occasions in which he exhibited sequences of maps illustrating discovery. Others were at the Colonial Institute in 1911, and, after the war, at Sheffield, in London at King's College and elsewhere, at Eton College, at Manchester University and at Winchester. He circulated descriptive catalogues and gave verbal explanations at these exhibitions while avoiding the formal lecture. Maps were to be looked at and not heard about and his ideal was at King's College when he and two other geographers " split the congregations into grouplets and gave each grouplet a lecturette on maps in succession —finger on map, eye on grouplet." His enthusiasm for the story of discovery thus illustrated, lasting long years and radiating from various centres, cannot have failed to have interested many students and to have excited kindred spirits. Two addresses on historical geography to the Royal Geographical Society of Australasia in

1921 and 1922, owed their initiative and part of their matter to him. He loved diagrams, not only those illustrating geographical discovery and historical synchronism, but also those picturing more abstract ideas such as the waste of parliamentary time and the domination of one human quality by another.

A very definite personality himself he enjoyed meeting other personalities and, whether they were famous or not, seizing their leading characteristics. Of Roosevelt, who was afterwards first President of that name, he wrote on reading a book of his essays in 1898, " He is standing for New York State and means to be President, U.S.A., conquer the whole of the two Americas, influence the world generally à la Bismarck, etc." He met Oliver Wendel Holmes at Boston in February, 1894, and found that he talked like his books. He appreciated A. J. Balfour, if not for his political principles at any rate for his political sense. He had met him at his father's house when he was about 16 and, his father having told him that Balfour meant to become Prime Minister, he had for the next few years looked with interest at *Vanity Fair* and other cartoons of " Miss Clara." He told me several anecdotes of Balfour, one of which " is very likely nowhere recorded except in my memory and perhaps in Mrs. Dugdale's." It is unfortunately too long to quote here. He followed with interest Ramsay Macdonald's career as a labour leader though he did not think greatly of his literary efforts. In 1908 he heard him " make a most sensible anti-socialist speech " against a proposed legal minimum wage scheme. Travelling in Norway the year before the war he met Knudsen, the Prime Minister, " a well-to-do shipowner, landowner, manufacturer, etc. . . . reputed very extreme in his taxation principles " and discussed with him the avoidance of income tax—of special interest to me, then at the Inland Revenue. In Norway the tax was in some places as much as 25% and was on total income, which had to be declared whether derived from property or investments at home or abroad, whether used or unused. This severe minister " was the most comfortable, good-natured, bourgeois-looking person." I do not think Mills had any great admiration for Cecil Rhodes though he was influenced, as many of us were, by the fine men (in his case his special friend Hubert Harvey) who knew Rhodes and admired him. When Mills thought, however, that Lord Selborne had attributed to Rhodes the saving of Bechuanaland by the Warren expedition, he recalled that Rhodes was then leader of the Bond and told the Cape Parliament in July, 1884, that " first and foremost they should try and remove the Imperial factor from the situation." Sir Charles Warren, of course, Mills knew well and it was with dismay that after Spion Kop he wrote " what is Warren doing? " though later he thought he had been made a scapegoat for his senior officer. He was instinctively on the side of the R.E. officer publicly attacked

and after the Nile campaign of 1884–5 he wrote with some indignation at the suggestion that prompter action by Sir Charles Wilson would have saved Gordon at Khartoum.

Incongruous happenings to and sayings by notable persons amused him and he quoted in his letters stories of a king, ruling by divine right, who deplored being left to extricate himself from a difficult situation with the assistance of Divine Providence; of a Prime Minister in 1841, giving a correct but mortifying reply to a complaint by the Rothschild of the day of Mississippi State not paying a dividend due; of a Colonial Under-secretary (Mr. Mother-Country Steven) who was masterful and hardworking, ascetic and talkative; of a Turkish ambassador at Florence in 1868, offering to protect an Armenian patriarch—subject of the Sultan—from the anger of the head of Christendom to whose authority in General Council he had yielded imperfect obedience; of an English High Court judge who in recent times referred in a judgment to "certain circumstances when the laws of gravitation acted"; of an Australian Chief Justice talking down a distinguished naval officer "who is a great and self-important conversationalist."

Just as he was wont to give in a few words the characteristics of people he knew personally or from his reading, he described the places he visited in his distant journeyings or continental travels. The latter were nearly annual in the years he was quartered or residing in England. He knew well-how to get the most from these travels. In the winter of 1893–4, he went, accompanied by myself, to the little republic of Andorra, crossing the Pyrenees on foot, getting information from all he came across—from the peasant talking a Basque patois and from the deputy to the Bishop of Urgel whose attitude was "*l'etat c'est moi*," enjoying strange customs and sights and queer food. Then in Spain, among the beauties of nature and art, he derived amusement from the animated though little understood conversation and the more intelligible gestures of good-looking country people crowded in a third class railway carriage; from the bearded old doctor, called in to attend me, who seriously wrote out a prescription for a bottle of citrate of magnesia; from the Madrid hotel manager who hastily explained that, since the suicide in the hotel of the libeller of Parnell, a new owner had come under whom such things could not happen; from the characteristic way in which the young Englishmen on the Embassy staff disassociated themselves from their Spanish surroundings. It was in the same spirit of humorous observation that in later years, accompanied by his wife, he visited Norway and Sweden, Belgium, Switzerland, North Italy and most frequently different districts of France and Paris. Once they were on the Riviera and stayed for a night at a large hotel at Mentone where he found "the usual terrible accompaniments of British bourgeois civilization."

He read much and in many directions—books on philosophy, religion, geography, history and biography; but he had no use for men, women, or books that seemed to him morbid and wrote once with quaint exaggeration, "Now geniuses I can stand; Gordon and Newman I love; Napoleon I hate but acknowledge his fascination, etc., etc. But morbidities—Shelley, Swinburne and broadly nearly all novelists are people whose existence now, or heretofore, or even hereafter is, has been, or will be, regrettable."

Whether he was or was not a Latin scholar I am incapable of judging, but a number of amusing Latin rhymes with myself as subject are scattered among his letters.

He thought much on the subjects of education—"of the *de facto* uselessness of education as now carried on in most cases," quoting his own experience at Eton in 1873–5, and his son's at Bradfield in 1922–6. "Neither boy benefited much by either education. I was by nature (and still am) very inquisitive, and this inquisition is often called a thirst for knowledge. It caused me to read in various directions and make impressions on others, but only 'up to a certain point.' Mordaunt is very keen in observation, and in various ways—also very industrious in things he cares for; but he has a high resistance to all organized knowledge, especially that on the printed page." In the same letter he quoted a friend with long experience on a County Education Committee "that the real benefit of the 14–16 extension is the discipline to the youths—the intellectual progress quite secondary." "The Mordaunt problem" referred to in this letter had been preceded by that arising from his elder daughter's reaction to the idea of the university education he had designed for her. He seemed to think more of a university education of which he had no student's experience than of the school education of which he had. He considered "that for girl as well as boy a university education is a splendid thing. The fact that it gives you a wider choice if some day you have to earn your own living is only one element. It also gives you friendships and acquaintance with the varied views of intelligent people and not merely the narrow views of cliques, and it fills up your life between 19 and 23; that is in itself a great thing if you are not going out as a housemaid at once." For his younger daughter he was "not at all sure the university would be such an advantage. For her I should like some specialist study on leaving school—possibly art of some kind." He wanted his girls "to make themselves independent and interested. Then let marriage come to them like it comes to a man, more or less by accident." Neither his son nor his elder daughter went to the university nor did the younger take up a specialist study but he and his wife had the great joy of seeing both girls happily married and their son create for himself a good business through his observation, skilled craftmanship and well-directed energy.

Though he had a humorous contempt for sentimentalism he was a man of keen affections, delightful to watch with his old parents as a young man, with his children as an old one and with his wife through their long and happy joint life. In return his family delighted in him. He made many good friends—at Eton and Chatham, among young enthusiasts he came across in his years of service and among university professors and Athenæum members with whom he mostly associated after his retirement, and he kept the friends he made. They loved his well-stored mind and the knowledge made available by his retentive memory, his right sense of proportion and his absolutely frank and unselfish nature.

M.N.

All Reviews of Books on military subjects are included in the provisions of K.R. 535c (*1935*).

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library, Horse Guards, Whitehall, S.W.1.)

HISTORY OF THE GREAT WAR.

TRANSPORTATION ON THE WESTERN FRONT.

By Colonel A. M. HENNIKER, C.B.E., R.E. (ret.).

(H.M.S.O. Price, with volume of maps, £1 1 0 net.)

The author of this work had exceptional opportunities of watching the growth of the services, comprised in the general term "Transportation" from the commencement of the war till the Armistice was signed. Although he explains in his prefatory notice that in the volume of over 500 pages he has had to omit much detail, he has succeeded in compiling a record, which is not only valuable as such but is worth the careful examination of any student of war.

The introduction to Colonel Henniker's compilation, written by Brig.-Gen. Sir J. E. Edmonds, is, in effect, a general review of the volume. This introduction affords a useful summary of the record and invites the reader to a further perusal thereof.

The headings to chapters are sufficiently descriptive to permit of easy reference and enable a critical reader to examine any particular issue without waste of time.

It would not be possible to write a comprehensive appreciation of Colonel Henniker's work without presenting a document of great length, but a few observations may be offered as to the lessons to be learnt from the record of the past. It is not sufficient to hug ourselves with the belief that there can never be another war involving the transport of such immense quantities of supplies and ammunition. It will be idle to assume that we shall never again mobilize sixty Divisions for service on a single continuous front; nor may we hope with any prospect of fulfilment that we shall enjoy the same advantages as those nations which recognize that a system of universal military service is essential. Moreover, although the rapid advance of science continually imposes new methods on the art of war, the movement of troops and their supplies and ammunition by sea, rail and road will still have a marked influence on the success of any military operations.

A close study of Colonel Henniker's record of transportation on the Western Front will, it is believed, provide a basis for the construction of a system of organization in peace, which will be adaptable to the varied and constantly varying conditions of war. Such a study is particularly of value to officers of the Corps, on whom the main responsibility for maintaining the Army's communications will fall under all circumstances.

In the theatre of war the responsibility for plans of operations rests with the General Staff, who must consult the Q.M.G.'s Branch as regards all questions of movement. The determination of such questions depends and will continue to depend on a proper appreciation of the possibilities and limitations of railways. It is quite clear, therefore, that the organization in peace should be such that expansion to meet

the needs of any plan of operations in war is provided for. It follows that the peace organization should ensure that personnel can quickly be available to augment existing regular troops and definite arrangements should be made to obtain railway material, locomotives and rolling stock from British railways or from railways in the Dominions or Colonies. The drafting of civilian railwaymen into the army without giving them any military training is open to many objections. Apart from the importance of inculcating a spirit of discipline and of imparting some knowledge of the handling of arms, there are two things which the civilian, however experienced in railway construction and operation under peace conditions, can only learn by direct training and contact with troops. These are that the best and accepted methods must frequently be subordinated to the practical military needs of the moment, and further, the strength, organization and equipment of the various arms constantly change and a working acquaintance with such changes is essential.

One last word. However carefully considered may be the plan of operations laid down, force of circumstances will inevitably involve quick changes and these will usually demand a greater strain on the Transportation Services than originally foreseen.

All this and more emerges from a scrutiny of Colonel Henniker's record and all those likely to play an active part in the next war will be amply rewarded by reading and re-reading the volume.

H.F.E.F.

SEBASTIEN LE PRESTRE DE VAUBAN.

By SIR REGINALD BLOMFIELD, M.A., R.A., F.S.A.

(Methuen & Co., Ltd. Price 15s. Illustrated.)

An original life of Vauban in English is long overdue and very welcome and provides a subject worthy of its distinguished author. In Sir Reginald's view—which it would be an impertinence to criticize—Vauban was a magnificent engineer, none finer, but no architect. Much of his work has, of course, disappeared, superseded by later methods or yielding to the advance of the speculative builder. Here and there Nature has hidden it with trees and brambles. For these reasons, and on account of his evident admiration for Vauban himself, Sir Reginald has written this excellent study. In it he deals with the past developments of fortification and the military conditions of the time fully and clearly enough for one to visualize many of the problems as Vauban saw them : herein lies much of the value of the work to military readers.

To overlook the lessons of the past is to place oneself at a disadvantage when attempting to recognize current tendencies or to foresee future developments. Engineering science to-day is being pressed as never before into the service of every branch of military activity. Vauban, in his turn, strove hard to save time and human lives by the adoption of up-to-date methods.

He was a simple, hard-working man, possessed of a strong sense of duty and exceptional personal bravery. He succeeded because he combined technical ability with great breadth of vision : he was, in fact, the exemplary " soldier and engineer." He understood the weapons and tactical methods of his day and was therefore able to apply his skill usefully to improving both. He took the greatest care of his men at all times and was at constant pains to avoid unnecessary loss of life. To this end he gave much thought to methods of obviating the customary direct or ill-prepared infantry assaults.

To him the *Corps du Génie* owes its origin and among his other activities was an original and comprehensive scheme for the defence of France as a whole, a remarkable conception when considered against the background of contemporary military

thought. It must be admitted that his name is usually associated with defence; in fact, he has been credited with various academic "systems" of fortification. This is doubtless the reason for his comparative obscurity as a soldier. And yet his defensive measures were bound by no rigid systems; he was acutely aware of the value of ground and realized that no two problems were alike. "One does not defend with systems," he would say, "but with common sense." But perhaps the greatest contribution to the art of war of this Marshal of France was his successful development not of the defence but of the attack. "*Ville assiégée par Vauban, ville prise*," ran the saying.

Who is to be the next to restore the superiority of the attack?

I.S.O.P.

ALARMS AND EXCURSIONS.

Reminiscences of a Soldier.

By Lieut.-Gen. Sir Tom Bridges, K.C.B., K.C.M.G., D.S.O., LL.D.

With a Foreword by the Rt. Hon. Winston S. Churchill, *P.C., C.H., M.P.*

(Longmans Green and Co., London, 1938. Price 12s. 6d. net.)

It is fortunate for us that the author of these reminiscences can wield a pen as well as a sword, for here we have a good book, full of humour as well as sound sense and valuable criticism—to say nothing of history that is little known to many of us, especially as to events in South-East Europe after the Armistice—written in a style that suggests a literary education or inherited talent. "Tom Bridges" is the nephew of Robert Bridges, Poet Laureate, to whose memory he devotes a chapter at the end of his book. Their friends must have recognized many points of similarity in the characters of the two men. We read: "Robert Bridges was a fine figure of a man. "He was gay and companionable, but fierce in argument. He loved real friends, good "talk, good wine. He worshipped beauty. . . . He was shy and modest." The uncle's reluctance to receive the newspaper men during a visit to the United States was summarized by the Press: "King's canary refuses to chirp." Mr. Winston Churchill confirms the modesty of the nephew in the final words of his Foreword—"Here then "is this gay story of grim events, told with modesty and yet with feeling, a wide "public may find both pleasure and instruction."

For the soldier, there is certainly plenty of both. After idling away two years at "The Shop," Lieut. Bridges was posted to a garrison battery quartered in an old fort at Delhi, and carried out his first annual practice (in 1893!) with muzzle-loading smooth-bores firing round shot. Had it not been for his innate love of sport, of which fortunately there was plenty of all sorts in the neighbourhood, he might easily have gone mad or died of drink. But the shock of the 64-pounders and the fate of his captain and major must have set a light to a spark of ambition lying dormant in his breast. Within five years he had been given his jacket. Ambition now fully roused, he seems to have adopted three rules of life. The first, that soldiering and sport can go hand in hand: the second, that a soldier cannot wait for opportunities to come along unsought, he must make them: the third, that if he wants anything, he must never be afraid of asking. He was ahead of his time in the old army, when all initiative was apt to be frowned upon, especially if the superior happened to be a crusty bachelor major! A Horse Artillery jacket was not wanted on the N.W. Frontier, and Lieut. Bridges must have scented war, and more scope for a horse-soldier in Africa; for thither he made his way. Disappointed again in getting on active service, he took French leave, got all the fighting he wanted in the reliefs of Ladysmith and Mafeking, and was forgiven—after a severe wigging—by Lord Roberts, who told him that "He had done what his father would have done in his place," and took him to lunch. Not the first or last time that "Tom Bridges" got away with it! The story of his fighting career

as a commander of irregular troops in South Africa and later in Somaliland is modestly told—much too modestly in the case of his share in the fighting which led to the complete discomfiture by General Plumer of De Wet's attempted invasion of the Cape Colony in February, 1901. In Somaliland he raised and commanded a 4-gun camel battery for three years, and was very severely wounded in the smashing victory of Jidballi, which ended that campaign and dispersed the followers of the Mad Mullah, for some years at least. Having been transferred to the cavalry, *after* being Commandant of the Cavalry School at Netheravon, he accompanied the B.E.F. to France as a squadron leader in the 4th Dragoon Guards, was given command of the 4th Hussars after the Battle of the Marne, and then hurried off by car *via* St. Omer and Ostend (there were Uhlans already in Lille) to Antwerp—completing the journey of over 500 miles in one day. After Antwerp, La Panne; and then the command of the 19th Division. "La Division Papillon" covered itself with glory at La Boiselle on the Somme, and Bridges was in 1916 promoted to Major-General at the age of 45. Then followed the Ancre. But prior to all this, he had been designated to take charge of the campaign in East Africa, and sent home to prepare the plan of campaign, General Smuts having already refused the job.

Someone at the War Office suddenly discovered that he was only a temporary Major-General, and so General Smith-Dorrien was appointed to command with Colonel Bridges as his second-in-command, and potential successor. This did not suit the author, who requested and obtained permission to rejoin his Division in France. He does not relate whether he regretted his decision in view of General Smith-Dorrien's breakdown at Cape Town, but he writes as follows: "The campaign would have "been shortened, for in my original plan, which was based on the advice of experts "with great local knowledge, I had stipulated on a rest period of four months during "the rainy season. The neglect to adopt this—by General Smuts, who eventually "conducted the campaign—led to heavy wastage in men and transport, and im-"mensely increased the cost of the campaign."

In 1917, while Major-General Bridges was preparing his division for the Messines offensive of the Second Army, Mr. Asquith one day dropped into his headquarters in the Scherpenberg Hill. Bridges lived in a tent on the hill-top. Mr. Asquith's climb to the top was interrupted by meeting Poilu* face to face. "I may be wrong," he said, "but did I see a lion in the path?"

Before Messines was fought, Major-General Bridges was sent to the U.S.A. as military member of Mr. Arthur Balfour's Mission. He writes, "Arthur Balfour was a success from the first." If the reader will glance at pp. 169–190, he will probably agree that General Bridges had no small share in one result of the visit, in that the Americans changed their minds and adopted conscription in lieu of voluntary service.

On his return he had to prepare for Passchendaele. On the subject of this offensive he has some trenchant remarks to make, but it must be remembered that he had always cherished the idea that the capture of Ostend would have been comparatively easy in 1915. He concludes: "If the great mass of British Troops had been put in "somewhere on dry land in July, 1917, it would have been of more use to the French, "for whose benefit, it was afterwards said, the offensive was chiefly planned." General Bridges, who knew the French well, considered that the British were always too ready to defer to the judgment and wishes of French G.Q.G., even after they had become the preponderant partner of the alliance.

On September 23rd, 1917, Major-General Bridges was hit by the fragments of a German shell not far from his divisional headquarters, south of Ypres, whereby hangs another tale of Poilu which the reader must find for himself. When he had recovered from his operation he was asked by Mr. Lloyd George to join Lord Reading's Mission to the United States. "I am not at all sure," he writes, "that the astute little

* Poilu was the name of a lion-cub which Bridges had won in a raffle at a Red Cross bazaar in Paris and made the mascot of his Division.

" Welshman did not select me for this job knowing that with a pain in my leg, and " coming straight from the centre of anxiety—over the question of man power and " the delay in the arrival of the Americans—I would boil over and cut through " diplomacy rather than not get the trooping programme fulfilled."

On his return, with a disappointing report as to progress, he was sent to see General Pershing in France—" who," he writes, " had a good grasp of the situation, though his " solution of it was coloured by his avowed intention to have the whole American " Army in line under his command, rather than by the desire to finish off the war as " speedily as possible. . . . The short cut to victory would have been to keep the " American troops brigaded with the Allies in small or large units and to have made " use of all the staff machinery already existing. . . . His main attack in the " Argonne, though outnumbering the Germans by the unusual odds of about ten to " one, and supported by 2,700 guns, was held up after the first day and failed. . . . " The Americans had lost 100,000 men, and were said to have 100,000 stragglers, " which in the circumstances was not surprising." So much for untrained staffs and untrained officers and men.

Major-General Bridges' remarks on pp. 67–69 of the book should be read in this connection, and also a paragraph at the top of page 58.

Chapters XI and XII dealing with events at Salonika and leading up to the collapse of Bulgaria on September 30th, 1918, and Chapter XIII dealing with the Bosphorus, contain matter known to few who did not take part in the operations on the spot. Chapter XIV deals with South Russia and Denekin. Chapter XV describes the Greek fiasco, and Smyrna. They all furnish most interesting reading, and draw strong criticism from the author on the general conduct of affairs by the Allies after the Armistice.

Reference has already been made to the chapter on Robert Bridges. The book ends with a chapter on Australia, to which continent Lieut.-General Sir Tom Bridges proceeded after the war as Governor of New South Wales, on the recommendation of the Secretary of State for the Colonies and Dominions. Mr. Winston Churchill's words shall end this review:—" As anyone can see from reading this book, His " Majesty's representative had—as was proved—all the qualities and personality, " all the comprehension and knowledge of men and affairs necessary for the discharge " of so important a task."

Which reminds the reviewer that he has omitted to mention Bridges' fourth rule for a soldier's life—Don't be afraid of asking for leave. You may get it (see p. 341), and the world will still be going on quite happily when you return.

H.B.W.

SUPPLY IN MODERN WAR.

By Lieut.-Colonel G. C. Shaw, R.A.O.C.

(Faber & Faber. Price 12s. 6d.)

Whether one agrees with his views or not, Colonel Shaw has made an interesting and praiseworthy attempt to analyse the difficult problems of supply of armies under the new conditions of mobility and in face of air attack on communications.

His main contention is that it is no longer possible to ensure the continuous flow of supplies, from rear to front, on which great man-power armies have depended since the system was introduced by the Prussian Staff in 1866. Continuity of flow is liable to be interrupted, and, in any case, delivery cannot keep pace with the requirements and movements of mechanized or motorized formations if their potential mobility is to be exploited.

In his search for an alternative system he reviews, in his earlier chapters, systems employed before railways made the continuous flow of supplies from rear to front

practicable. The self-sufficiency of the Roman legion, achieved by exploiting the carrying-power of the men and their frugality, produced a formidable fighting force of great mobility and he accepts it as a suggestive model. The Napoleonic system of "living on the country," which also conferred mobility, being no longer practicable in view of the nature of modern munitions and motive power.

How under modern conditions is something of the self-sufficiency of the Roman legion to be achieved? Primarily, Colonel Shaw argues, by following the lead of industry in making the machine do the man's work and thus reducing numbers. He therefore finds himself in agreement with the advanced advocates of mechanization who hold that armoured fighting vehicles should be the main instruments of war, with motorized man-power playing a subsidiary co-operative part.

Motorization, which merely places man-power on wheels and only employs mechanization as a powerful auxiliary, he condemns, and considers it a phenomenon of a period of transition—an attempt to adapt the man-power army to modern circumstances.

He admits, however, that as European armies are reorganizing on the basis of motorization instead of full mechanization, supply systems must for the present cater for both.

What he advocates, especially for mechanized forces is, I understand, an intermittent as opposed to a continuous flow of supply. Fighting formations to be reduced in size and to have with them supplies sufficient to give them extended radius of action and independence for a limited period; but not so much as would make them cumbrous. Replenishment to be by convoys, dispatched as required, and working from advanced mobile bases, which in turn would be replenished from a main base far in rear.

Such a system, if feasible at all, is obviously more applicable to mechanized than to motorized formations with their higher proportion of man-power and need of powerful supporting weapons.

On the whole, Colonel Shaw's picture is too futuristic for his suggestions to be of immediate value, but one may agree with him that supply procedure is liable to become stereotyped, and to seek to meet its difficulties by additions to a system based on out-of-date experience instead of aiming at flexibility. On occasions a breakaway from normal routine will be necessary to allow mobile forces to be used to the best advantage.

The difficulties of the supply problem are great, but it is comforting to think that they will be much greater for the large armies of the Continent than for our small army. Such alterations of system as may be proved necessary in war would be easier for it to carry through. Moreover, we are likely, initially at least, to have the advantage of operating in a friendly country and without the added difficulties created by protective demolitions.

C.W.G.

THE HISTORY OF THE BOMBAY ARMY.

By SIR PATRICK CADELL, C.S.I., C.I.E., V.D.

With a Foreword by the MARQUESS OF WILLINGDON.

(Longmans, Green & Co. Price 18s.)

This book fills a long-felt want; as the author points out, while there are well-known histories of the Madras and Bengal Armies, there has hitherto been no general history of the Bombay Army, and the great achievements of that Army make the omission the more remarkable.

The Bombay Presidency was the oldest of the three, and it was the first to raise troops, both European and Indian, but the development of its Army soon lagged

far behind those of Madras and Bengal. Confined chiefly to a small island, with the mainland held by the most formidable native power in India, the Bombay Government had neither the opportunity to intervene in the quarrels of local rulers, nor the recruiting facilities of the other presidencies, while the cheese-paring policy of the East India Company and of the local Council kept the Army at a low level of numbers and organization. The first five chapters of the book, dealing with the period up to 1768, form a dismal record; on service, the troops sometimes did very well, sometimes very badly, though, when sent to assist other presidencies, they always earned praise.

It was not till 1768 that the troops were properly organized and officered, and at this date commences the story of the Bombay Army as a real fighting force; and the next hundred years proved its worth. The disaster of Wadgaon in 1779 was due to bad leadership and brought no discredit on the regiments; and there followed an unbroken period of success. The record of the Bombay Army in the Mysore Wars, the second and third Maratha Wars, the first Afghan War, Sind, the second Sikh War, Persia, and the Mutiny is a fine one, and there is little doubt that, at the latter end of this period, it was the best of the three armies. The author quotes the opinion of Herbert Edwardes on the superiority of the Bombay over the Bengal troops at the time of the second Sikh War; he might have added that Edwardes was much perturbed on finding that in the Bombay Army the sepoys were promoted for efficiency and not simply by length of service; he feared this would produce an Indian Army capable of fighting the British; but in 1857 it was the aged Bengal native officers who could neither keep their men loyal nor lead them against us, while the Bombay Army remained almost entirely loyal, and carried out the Central India campaign, which, though overshadowed by Delhi and Lucknow, was scarcely less arduous or important. It should be noted that a large proportion of the Bombay sepoys came from Oudh, and the Marathas had just as much incentive to disaffection as the Bengal Army.

The reputation of the Bombay Army was maintained in Abyssinia, but in 1880 it crashed at Maiwand—the author believes undeservedly. A force of about 2,500 men, after a march in the hottest season of the year, attacked an army ten times its size; it was badly led and heavily defeated. There were two Bombay infantry regiments present; one recruited entirely from the North broke first; the other, a down-country regiment, stood longer and only broke after heavy casualties and was still able to contribute to the stands that checked the pursuit. Maiwand in itself was scarcely enough to damn the Bombay Army, but the disorganization during the retreat and the dejection of the troops in Kandahar were more serious, though Sir Patrick rather discounts the latter. Although a few years later, the 28th Bombay Infantry shared with the Madras Sappers and the 15th Sikhs the Indian honours of Tofrek, the reputation of the Bombay Army did not recover; it may be that this had little to do with Maiwand. The Punjabi and Gurkha regiments which now dominated the Indian Army had a poor opinion of all the down-country regiments, whether of Bombay, Madras or Bengal, and they did not extend this prejudice to the five Bombay regiments recruited up-country, one of which had failed at Maiwand; but the stigma of that day remained with the Bombay Army till November, 1914, when the Bombay units of the Poona Brigade swept into the Turkish trenches at Sahil. Shaiba, Es-Sinn, Ctesiphon and the Defence of Kut followed and restored to the Bombay Army its reputation of earlier days.

The author notes that the first V.C. won by the Indian Army was awarded to a Bombay cavalry officer in Persia, and the first V.C. won by an Indian was awarded to a sepoy of a Bombay regiment (in this case a Punjabi Mussalman) in France. It might be added that the longest roll of Battle Honours in the Indian Army is held by the Royal Bombay Sappers and Miners, and that, prior to their disbandment in 1932, the longest roll outside the Sappers was held by the Bombay Pioneers.

Nevertheless, in post-war reorganizations, the Bombay Army has fared badly, and, though in the present Indian Army, four cavalry and four infantry regiments are of

Bombay origin, only one—the 5th Mahratta Light Infantry—is recruited in the Presidency.

The book is full of interest throughout and the narrative is clear and concise. So much history has had to be compressed into 300 pages and a few appendices that much has inevitably been omitted. A few fights only are described in any detail—Koregaon, a real epic; Kirkee, whose importance, like Plassey, is out of all proportion to its magnitude; Meanee and Hyderabad, predominantly Bombay Army battles; but one may regret that Es-Sinn and Ctesiphon did not receive equal treatment; in fact we may suggest that the doings of the Bombay units in Mesopotamia—from the standpoint of this book by far the most important of the campaigns of the Great War—might have been dealt with much more fully. The maps are adequate, though that of Kirkee is overloaded with symbols and is not easy to follow, especially as the village of Kirkee appears to have been a long way from the present site; while it is a fair assumption that the "sketch by Lt. M. Talbot, R.E.," on which the plan of Maiwand is based, included a scale, which the plan does not. These, however, are minor criticisms. The book generally is excellent and should be read by all who are interested in the Indian Army.

Sappers may perhaps regret that comparatively little mention is made of the Bombay Sappers and Miners; their presence is mentioned frequently, but little of their doings is recorded; and there is so much that might be. In Appendix I, a list of campaigns with the units engaged, they are not mentioned; in Appendix II, a list of units, with their campaigns, we find against them: ". . . Beni-Boo Ali, all "subsequent campaigns in which the Bombay Army participated with exception of "Sind, 1843." While this may not be strictly accurate, as there were a few minor campaigns in which the Bombay Sappers did not take part, it is not a bad substitute for the *Ubique* of the Royal Engineers.

E.V.B.

HISTORIQUE ABRÉGÉ DU CORPS DU GÉNIE.

By LT.-COL. DRECQ AND CAPT. WEIL.

This little brochure of some 85 pages is a short history of the French Corps of Engineers by the Director of Studies and one of the Instructors at the School of Military Engineering. It consists largely of short biographical notes of the principal figures, from Vauban to the present day, with an historical basis for each chapter.

The French Engineer Corps has as varied a story as our own. The development of France's African and Asiatic possessions has yielded a long line of celebrated Engineers—among them Faidherbe and Joffre—the foundations of whose careers were laid in colonial service much akin to ours.

Vauban is, of course, the principal figure in the gallery. His achievements as a military engineer are perhaps too little appreciated abroad; his character and his grasp of all subjects of national importance in his time mark him as something more than a great soldier.

The engineer work in the Great War and the leading figures are sketched in a few paragraphs. As in our own armies, the number of engineer units had to be greatly increased: the 100 companies of August, 1914 grew to 800, besides some 400 specialized units. The casualties amounted to nearly 19,000 killed.

A short reference is made to the work of the Engineers in the new fortifications of the frontiers. In the Colonies, since 1919, there have been many examples of notable engineer work.

W.H.K.

IF WAR COMES.

By R. Ernest Dupuy, Major, Field Artillery, U.S. Army, and George Field Eliot, late Major, Military Intelligence Reserve, U.S.A.

(Macmillan Company, New York, 1937. Price 12s. 6d.)

The authors of this book in their introduction state that their object is neither to produce a prophecy nor a professional treatise, but that it is an attempt to examine and co-ordinate the lessons to be learned from the Spanish and Ethiopian campaigns. From a study of the progress of military art and scientific research in the world generally, they hope to lay bare the characteristics of the next war, if it comes. They add that the book is primarily for the civilian reader.

The reviewer is of opinion that the authors have produced a book which will be valuable to soldiers as well as civilians, not so much because of its comments on the Spanish and Ethiopian wars, which in fact are hardly referred to after the opening pages, as for the impartial treatment of a number of subjects which, to the student of war, are still complicated and controversial. The book certainly contains a considerable amount of undisputed data which is more for the civilian, but it holds as well, and usefully assorted, a great many facts as regards the three Fighting Services which must be useful to officers studying their profession. The book was published in July last, much too early for final comments either on the Spanish struggle or on that taking place in China.

As to some of the conclusions, the authors draw attention to the failure of air power to reach a decision as they consider in Spain, and they stress the great effect which the existence of Franco's trained Army of Morocco, some 30,000, had on operations otherwise conducted between sides of hastily-raised civilian armies. In their judgment of the value of air power here, one is bound to observe that neither the scales of attack nor defence in Spain seem comparable with those which may appear in war between Great Powers and the conclusions may be premature.

One chapter discusses the principles of war. While classified somewhat differently to our own, their treatment here is extremely sound. This chapter is commended to those who are in doubt as to whether war is an art or a science.

The authors attempt to forecast what war will be like in the air, on land and at sea. No very new conclusions have been arrived at. The writers emphasize the great value of training. They consider that air attack on civilians will not prove worth while. They accept on behalf of their air force a very extensive low-flying role, not only low-flying in conjunction with army attacks, but low-flying attack during high-flying bombing.

As regards military operations, the views expressed seem somewhat contradictory. Thus in one place it is clear that big armies in the future are not visualized, yet the writers consider that reserves on land must decide the issue and they ignore the actual size of many armies in Europe at the present time. In their judgment of the course operations may take, it would seem that the power of the defensive has been overlooked, especially in the discussion of land advances of 250 miles at a time. As regards defensive systems, the book says " whether it will be possible for armies to " take up and organize deep and defensive positions of great strength in the face of " air power and armoured troops is a question which only the future can answer." They go on to show that lack of man-power will be a governing factor in preventing such defensive systems arising. The obvious need for more troops to provide reserves and adequate defences would seem to counter the theory of small armies.

In dealing with naval questions, the book gives a good account of the functions of various forms of naval forces and produces excellent reminders on the parts to be played by all three services in the maintenance of sea power. There are full discussions on the situation of all the naval bases of the world.

There is a short, if orthodox, chapter on gas warfare. To us it would seem that

the authors have overlooked the crippling effect on mobility if an army has to provide itself extensively with the means of defence against the wide use of persistent gases. The drain on effectives subjected to the casualty-producing effects of persistent gases is also not mentioned.

In the last quarter of the book, a rather sketchy review is given of the military problems facing the principal Powers in the world, too sketchy in fact to be of great value. Some interesting points, however, which are mentioned are :—

(*a*) The great strength of Italy in small naval ships.
(*b*) The suggestion that the Japanese methods of gaining control over successive provinces on the mainland are closely comparable to British methods adopted in the last century in India.
(*c*) The Russian plans in Siberia for meeting their problem with Japan.
(*d*) The authors' opinion on the probable role of the British Regular Army.

In this latter connection, the following quotation shows us as others see us : " We " may see a small but highly-mobile British Army employed directly in defence of " the Low Countries in co-operation with the forces of those Kingdoms ; or employed " in Portugal as a spearhead for a Portuguese advance against a Fascist Spain in the " Peninsular tradition of 1808–18 ; or forming the nucleus of an Entente " expeditionary force against Sardinia ; or co-operating with the French Armies " against a Continental foe."

In conclusion, it is a pity that the authors did not confine their studies to the events of the wars in progress at the time, and to the application of the facts learned to present theories of warfare. Such a line, however, could not have made much appeal to the civilian public which they attempt to attract. Nevertheless, this book is one which should be held in Service libraries, if only to compare and check up our own ideas on a variety of subjects.

B.C.D.

MATERIALS AND STRUCTURES, VOL. II.

By E. H. SALMON.

(Longmans, Green & Co., Ltd. Price 32s.)

This volume is intended to deal with the theory of structures and its application to practical design. It is described in the preface as a textbook for students who are preparing for theoretical examinations at Universities and elsewhere, and also for the use of those engaged in the practical design of engineering structures. It is difficult to cover such a wide scope in the space of a single volume, and for that reason, probably, the general arrangement of the book appears somewhat peculiar.

The first seven chapters are devoted entirely to mathematics and theory, and are supported by examples which are no doubt excellent practice for the type of question set in examinations. This is followed by several chapters on design of steel members, which should prove useful to the practical engineer.

Subsequently a chapter on building materials, viz. timber, stone, cement, etc., which seems strangely inappropriate at this stage of learning. Next a chapter on reinforced concrete, which is insufficient and too theoretical for practical purposes, finishing with chapters on foundations and masonry structures.

For the University student who requires a complex textbook this may prove useful, but for the practical engineer something less elaborate and more simple is required.

C.D.R.

NOTES ON THE MAKING OF PLANS AND MAPS.

First Edition, 1937.

(H.M.S.O. Price, 17s. 6d.)

Surveying, in one form or another, may confront any R.E. officer in peace or in war. When it does so the natural impulse is to turn to the notes upon which S.M.E. instruction was based—in the first instance at any rate. It is the object of the book under review to collect all S.M.E. survey notes into one volume. The S.M.E. course is designed more for general engineering (and railway) surveys than for the specializing map maker, and these "notes" illustrate the fact by dealing mainly with large scales and with a flat earth. They gain greatly by detailed and excellent descriptions of really modern theodolites and levels. If rural district councils are still content with the dumpy levels and vernier theodolites of their forebears, that is no excuse for wasting the time of the Corps.

After enunciating certain obvious principles the author turns to triangulation, and naturally has to deal with it for a number of officers, under hasty instruction, and all to be kept busy somehow. We start here, as in other chapters, with insistence upon a reconnaissance forbidden to most of us, in actual fact, by the act of God or the hand of the King's enemies. Existing maps, however bad, what we can see from back stations, and the invaluable plane table generally have to suffice. But it is an excellent precaution whenever possible. It is, I think, a pity that there is no word of spherical excess, or of the fact that the station angles must close to 360°. To leave adjustment and solution of triangles to the simple, if valuable, hint that the angles of a triangle, for solution purposes, must add up to 180°, would not relieve the perplexities of many an engineering survey. A little perplexing, too, to find that an "intersected point," so often an essential rivet of one's hastier triangulations of the past, should never be used for such a purpose.

After an excellent chapter on theodolites and a good one on traversing (but it would have been better to add word as to computing the enclosed area) we come to the plane table. Like "triangulation" this subject has had to be suited to a mass instruction. In later life the R.E. officer is concerned principally as the O.C. of a plane-tabling unit. His general duties lie in superintendence, in supplying the control, in siting camps, and in struggling with transport. But he will have to compare the edges and not leave that to "both parties to the common line." The less they see of each other the better, and the guide here is not the text but that excellent graticule, in a pocket in the cover, which was reproduced originally as an illustration to an Ordnance Survey pamphlet.

"Levelling," "Chain Survey," "Subtense and Tachymetry" are sound guides to their subjects.

In "Road Survey" we come to the swan song of that excellent R.E. unit—the Temporary Roads Department of the Gold Coast. As a unit—now, alas, defunct—it left golden opinions, and a really practical useful procedure, behind it. Its methods may still be invaluable to the Corps.

A good chapter on curve ranging is followed by draughtsmanship, which is equally good until one is brought up—all standing—by the commandment "Capitals and small letters must never be mixed." How else shall we write "War Department Property"?

Chapter XIII is, not inappropriately, on Projections. Questionable, I think, when so much else of immediate practical value such as Photogrammetry (ground or air) is omitted.

Under the normal, but unfortunate, title "Reproduction Processes" we come to lithography and map printing. It is good as far as it goes, but it would have helped many a C.R.E. and D.O. of the future if it had had reference to the special difficulties of keeping up to date and then reproducing skeleton record plans, and the many others (at scales varying from 1/20000 to 1/96) which are in their keeping. These

include architectural plans. The Ordnance Survey is constantly called upon for advice on this subject.

The last chapter is on the level in earthworks, and is followed by good tables and excellent illustrations.

It is a tribute to the interest of surveying that so many excellent books and manuals have been written about it. To many of these, R.E. officers must eventually turn, and it would have added much to the value of these "Notes" had reference been made, at the end of each chapter, to the titles, authors, publishers, and prices of these authorities.

H.St.J.L.W.

"TO HORSE."

By CAPTAIN F. C. HITCHCOCK, M.C.

(Hurst & Blackett. Price 10s. 6d. net.)

The author endeavours to cover a great deal of ground in the volume. There are chapters dealing with Points of the Horse, his history and breeding, stable management, the training of the horse and man, and some common ailments and their treatment. To do this a certain amount of detail has had to be omitted.

The chapters on the Evolution of the Horse are interesting, and the points of the horse well described.

The detail of stable routine refers more to the racing stable than the hunting stable, but the principles governing both are the same. Although it is common practice to use a dandy brush to clean the horse's tail, this is a very bad one, and usually ends in the horse having few hairs left below the dock. Clipping should only take place when the horse's winter coat is "set" or when the horse is losing condition from excessive sweating.

The chapter on Seat and Hands is orthodox and has some useful hints as to leading horses, securing reins, etc., which are not usually explained.

The elementary stages of training the young horse are well explained and the method of long reining is illustrated by some good diagrams. When passaging to the right, however, the lively rein should be the left rein, used to indicate the pressure of the horse's leg, and not the right, as stated. The use of an assistant is not very clearly explained, although one is essential in training the horse to obey the voice.

In the chapters on Teaching the Young Horse to Jump, the early stages are clearly explained. The first lessons in mounted jumping are, however, rather glossed over. This should always be done at the trot, the rider making full use of a neck strap and riding as far as possible on a loose rein.

The Continental or Forward Seat is rather summarily dealt with. This seat requires a special type of saddle and much practice and hard work are necessary before the rider can adopt it. Its advantages have been fully proved abroad and there is no doubt that in time it will be used more extensively in this country. At present, however, there are few people capable of demonstrating it, and there is a great deal of ignorance and misapplication with regard to its use.

The question of balance, flexions, and collection is not very clearly explained, with the result that the chapter on Bitting leaves one with the impression that the whole solution lies in finding the correct bit. In point of fact, the correct way more probably lies in a certain amount of re-training and teaching the horse to obey the bit. It is perfectly true that this instrument should suit the horse's temperament and mouth.

There is a useful chapter on Saddlery, although the value of a string girth for preventing girth galls is omitted.

The book concludes with some valuable hints on common ailments and an Appendix giving the syllabus of the examination for an Instructor's Certificate.

Although there is nothing new, the subject matter is clearly put and well illustrated, the principles laid down are orthodox, and the book is written in an interesting style.

D.W.A.C.

HOW TO LIVE IN ENGLAND ON A PENSION.

By "MAUSER."

(Third edition; revised and enlarged.)

(Oxford University Press. Price 3s. 6d.)

This is a new edition of the invaluable little book reviewed in *The R.E. Journal* of September, 1934. It has been revised up to date and appendices have been added.

It is the most practical manual that those about to retire could wish for. Written in an easy style, it deals with the very problems which beset so many officers of all Services, and points out the many difficulties which are bound to be met with and the way to meet them. The chapters on buying a house and furnishing it are alone worth the modest sum at which the book is published, but above all, the friendly spirit of encouragement from one who has himself experienced the problems leads one to read the book through and through.

The prospects of retirement are perhaps too often passed over without much thought until the day comes. There are ways of preparing for it which "Mauser" describes fully. Fortunate are those who are able to read, mark and learn all that he says, before the great change comes from active military life to obscure retirement. Many disappointments will be avoided if this book be carefully studied.

The practical impossibility of finding a "job" in civil life on retirement leads the author to discuss "making one's own job," and among the ways of doing this he describes at length the prospects of apple-growing on the cordon system, of which he himself has practical experience. There are many deceptive pitfalls in the enticing advertisements offering to do all the work on a fruit-growing concern in return for capital invested. "Mauser" has his word of warning against them. If the "back to the land" idea appeals, it is the owner-worker who will reap the benefit.

Other ways of supplementing the pension are described.

On the financial problem, a specimen budget is detailed, based on the expenditure of a family of four and a maid. Every reader will have his own opinions on this subject, and "Mauser" wisely refrains from dogmatizing. He is compelled to argue a specific case for clearness' sake. As he says in his preface, "he is not out to put the wind up anybody." He has "arrived at his solutions by a succession of bumps and jolts," and he is rendering valuable service to his fellow-officers by writing down his experiences in this attractive manner.

A chapter on hobbies has many home-truths. When it is remembered that the majority of retiring officers are still full of active vigour, the necessity of keeping fit —mentally as well as physically—and of keeping up the liveliest interest in at least *some* subjects, will be obvious. There are many ways of doing this.

The author does not minimize the difficulties; but he does not forget that he is writing for a class who are accustomed to facing emergencies and to come smiling through.

"Mauser on Pensions" should be one of the first investments made by those within sight of retirement. His advice will be equally valuable to members of the Civil Services.

W.H.K.

THERE'S A DEVIL IN THE DRUM.

By JOHN LUCY.

(Faber and Faber. Price 8s. 6d.)

This is the autobiography of a South Irish lad of fair education from the time that he enlisted in the Royal Irish Rifles in 1912, till he got his commission in the same regiment in 1917. While his description of barrack life is interesting, the most

engrossing chapters are those dealing with the war. One may suppose a certain haziness in his recollection of great events of which he could only see a small part. But the book may be held to give an accurate account of the doings and thoughts of an intelligent young N.C.O. during the fearful strain of the first year of the war. While there was much he disliked in the Army, his pride in his battalion runs through the whole story, which brings out well both the qualities and limitations of the men of the old Army.

It is coloured by the divided loyalties of an Irish Nationalist serving the King.

E.V.B.

SCIENCE AND MECHANIZATION IN LAND WARFARE.

By LIEUT.-COLONEL D. PORTWAY.

(W. Heffer & Sons, Ltd., Cambridge. Price 6s. net.)

This book serves a very useful purpose in that it draws attention to the vital necessity for a groundwork knowledge of science and engineering among those who are responsible for directing the defence forces of the Empire. This naturally does not mean that those concerned should possess detailed knowledge in any one direction, but the almost total absence of any general knowledge of this kind in the past has seriously retarded all progress and reduced efficiency.

We are now at last starting on a proper system of education so that officers who may later be at the head of affairs may have at least some of this necessary groundwork knowledge and the book shows clearly the necessity for progress in this direction.

The book starts with some fundamental scientific principles which are clearly set out and easy to follow. They are elementary but of interest even to a scientific corps. Then follows rather a long chapter on railways, which gives a good précis of railway work in war during the past century. No one will deny the importance of railways, but present trend of progress in war would seem to point to somewhat smaller and well-equipped forces in the future rather than the very large man-power armies of the last war, so that the importance of railways is not likely to increase. The capacity of modern mechanical transport is perhaps a little under-rated by the author, and it is well to remember that air action may put a railway out of commission, whereas the air can usually only reduce the volume of transportation by mechanical transport. It should also be remembered that most modern mechanical transport has some degree of cross-country performance and there have been cases of special lorries taking as much as 40-ton loads cross-country for civilian purposes.

The chapters on mechanization and chemical warfare are rather short for such vast subjects, nevertheless they put the case clearly and fairly and will undoubtedly give the reader a good groundwork knowledge on which to base further studies.

The discussion on weather problems and the stratosphere is very interesting and useful, and the author is undoubtedly right in stressing the importance of a study of these problems, and of their value in war. Then follow two very general chapters on the Corps of Royal Engineers and the Royal Signals, which give a useful bird's-eye view of the activities of these two Corps.

The book concludes with an account of artillery survey and then deals with some problems of personnel and recruiting.

Although the author has touched on controversial points at places, he has succeeded in steering the middle course, which is generally accepted, all through. Although the book is intended primarily for students at Cambridge University, it will certainly be of interest to officers generally; there are few who will not find some new and valuable knowledge to be gained by reading this book.

MAGAZINES.

RASSEGNA DI CULTURA MILITARE.

(Formerly "Rivista di Artiglieria e Genio.")

(*January*, 1938.)—The *Rivista di Fanteria* and the *Rivista di Artiglieria e Genio* have now been combined, and, commencing with this number, will appear as one journal, but the parts dealing with general military matters and those relating specially to artillery and engineer subjects will be kept separate.

La guerra e la pace.

General Corselli gives his views on war and peace. The history of the past 3,400 years shows that war is inevitable. Human passions and national interests will, in the end, triumph over reduction of armaments, compulsory arbitration, and all pacts designed to prevent war.

The writer goes on to quote the "Duce" that war is not entirely an evil—it is a kind of social tonic that stimulates the energy of a race and the national virtues—and pacifism is not entirely a blessing. Modern warfare is totalitarian in character, hence the necessity for the entire nation being prepared for war.

L'anno 1937—XV *in una rassegna panoramica.* By Dr. Furitano.

A résumé of the chief events of the past year in Italy and abroad. Progress in Italy has been marked by a balanced budget, by continuing to make the country independent of foreign imports, by increases and reorganization in the army, navy and air force. Abyssinia, naturally, also figures largely in the picture.

L'attuale corsa agli armamenti navali e le caratteristiche delle flotte del futuro. By Consul-General Ginocchietti.

A review of the comparative strength of the six principal naval powers, and of the lines on which their navies are being developed. The writer does not think that the navies of the future will differ fundamentally from those of the past half century. There will be a group of battleships forming the main nucleus; a large number of more or less protected cruisers; a very large number of destroyers and many submarines. There will only be a few aircraft carriers.

La guerra cino-giapponese.

Colonel Oxilia gives a first instalment of an account of the Sino-Japanese War. He traces the history of the struggle back to the Sino-Japanese War of 1894, which ended with the conquest of Korea by the Japanese.

In the Great War both China and Japan were on the side of the Allies. Subsequently internal disorders in China gave an opportunity for Communist penetration from Russia. In 1925, came the rise of Chiang-Kai-Shek, who had to manœuvre between Russian pressure on her borders and Japanese expansion in North China. The present war is, fundamentally, a struggle between these two influences, and has many points of similarity with the present situation in Spain.

Japan's enormous commercial expansion during the past years has been due to organization of production, to dumping and to low wages. She requires a market for her goods, for which China is the main outlet, as well as coal and iron mines, oil and cotton, which are essential to her industries.

La guerre di Spagna. By Captain Mele.

The first instalment of an account of the civil war in Spain. The Nationalist revolt began in Morocco in June, 1936. General Franco, ex-commandant of the Foreign Legion and Governor of the Canary Islands, placed himself at the head of the

Nationalist movement. From Morocco Nationalist forces landed in various parts of Spain.

By the beginning of August, the greater part of the army had gone over to the Nationalists; the navy, with the exception of one battleship and four cruisers, remained loyal to the Government.

The main events of the war were as follows:— Tolosa and Irun were taken by the Nationalists in August and September. Soon afterwards the Nationalists captured San Sebastian and Toledo; in October, Oviedo was relieved by the Government forces after a prolonged siege. In that month the Nationalists marched on Madrid, and a prolonged struggle began round the capital. In November, Franco began a blockade of Government harbours, and this led to a series of incidents with the powers concerned. Desperate fighting continued west of Madrid well into January. Malaga was captured on the 8th February.

I reparti del genio della divisione alpina nella guerra di movimento. By Lieut.-Colonel Cappuccini.

After a dissertation on mountain warfare in general, the writer points out how very inadequate the proportion of engineers allotted to an Alpine division is. It is only 2 per cent. of the whole strength, as compared with 6 per cent. in an ordinary infantry division.

The engineers of an Alpine division consist of a company of 5 platoons, with about 200 specialists and 150 drivers, etc. Their equipment is a light mountain bridge, two park sections, 30 km. of wire, 3 searchlights, 12 radio stations, etc. There is no commanding engineer.

After discussing the work that engineers may be called upon to carry out in an Alpine division, the writer suggests the following organization:—

One commanding engineer.

Two companies of artificers specially trained for mining work, work with rock drills, etc.

One signal company with more than 30 km. of telegraph wire and radio equipment. Mountainous country is not ideal for wireless work.

One searchlight section, with six searchlights, of which two should be of extra power.

Le teleferiche militari con funi ancorate ad entrambe le estremità.

Lieut.-General Bellusci continues his article on anchored wire ropeways. In this instalment he shows how the motor power is determined in the " to and fro " system for ascending loads, and the braking power for descending loads. He also explains how the parabola is worked out for the carrying and hauling ropes over various spans.

(*February*, 1938.)—*Una cronaca portoghese sulla spedizione di Don Cristoforo da Gama in Abissinia.* By Prof. Naldoni-Centenari.

The first instalment of an account of a Portuguese expedition under Don Christopher da Gama that took place between June, 1541 and February, 1543. Da Gama, whose brother was Governor of the Portuguese East Indies, landed at Massowa, on the Red Sea, with a force of 400 Portuguese to help the Negus of Abyssinia against the King of Zeila.

The account is interesting from an Italian point of view, as a good deal of the country traversed is identical with that of the Italo-Abyssinian campaign several centuries later.

La guerra cino-giapponese.

Colonel Oxilia continues his account of the Sino-Japanese War.

After a brief description of the country of China, and a summary of the military peace organization of the two countries, the writer gives an account of the immediate causes of the conflict. The presence of Japanese troops in China was a direct conse-

quence of the Boxer Rebellion. After the establishment of Manchukuo, strong anti-Japanese feeling in 1935 led to incidents between Chinese and Japanese troops, and attempts to localize the quarrels failed.

In the present state of our knowledge the writer finds it difficult to define the Japanese plan of operations. It appears to be: to cut off all contact between Russia and China across the interior of Mongolia and Suyuan, to occupy the Shantung peninsula and so ensure free navigation in the Gulf of Pechili, and to occupy the provinces in North China of Hopei, Char, Suyuan, Shansi and Shantung.

The Chinese plan is still more difficult to follow. It first appeared that the operations on the Shanghai front were a diversion desired by the Chinese, in order to split up the Japanese forces. Now it seems that they have assumed greater importance.

Strade e motori: mentalità della motorizzazione. By Lieut.-Colonel Di Marco.

A study of roads in relation to motor traffic and their military value. Many roads in Italy are not up to the standard of modern requirements. Curves are too sharp, roads are too narrow. Cross-roads should be eliminated as far as possible. The writer goes on to discuss various points, such as wear and tear, the colour of the surface (white roads stand out clearly when viewed from the air), resistance to chemicals, resistance to projectiles, dust, etc. Stress is laid on the value of roadside trees, to conceal the movement of military formations. In Italy the plane tree is considered the best for avenues.

Note Palestinesi.

Lieut.-Colonel Micaletti discusses the problem of Palestine, and the attitude of Jews and Arabs towards the British administration. He points out that Italy cannot be disinterested in the question, as she has political and economic interests as well as spiritual rights.

La guerra di Spagna. By Captain Mele.

An account of the more recent developments of the civil war in Spain from the Nationalist point of view, with a eulogy of the Italian troops and airmen.

La valorizzazione dell'impero.

Captain Lucca discusses the economic value of the Italian empire, *i.e.*, Abyssinia and Italian Somaliland, and suggests how the country could be developed by constructing railways and roads.

The railways that he proposes are the following:—

(1) From Assab to Dessie, eventually continued to Lake Tsana.
(2) From Tigrai to Massaua, with prolongation to Addis Ababa.
(3) From Mogadiscio to Dolo, with prolongation to Addis Ababa.
(4) Prolongation of the Jibuti-Addis Ababa line to Gimma.
(5) Prolongation of the Massaua-Asmara line towards Tessenei and Gondar.

La nostra artiglieria nel 1915. By General Ago.

Italy entered the war in 1915 with a great shortage of guns and munitions. This shortage hampered General Cadorna enormously in his strategy, who, in order to back up the Allies, took greater risks than he should have done, with the disastrous consequences of 1917. What placed Italy in a position of disadvantage was the shape of her eastern frontier, fixed in 1866. The Austrian salient of the Trentino left a very narrow link between the Venetian provinces and the rest of Italy.

General Ago considers that, in the circumstances, General Cadorna's strategy was correct, but he goes on to point out how the problem should have been tackled if Italy had had the requisite number of guns and supply of munitions.

Ascoltazione sotteranea.

Major Memmo describes three types of apparatus in use by the engineers for underground listening. They are known as the (1) Geophone, (2) Telegeophone, (3) Seismomicrophone. The two former are mechanical, the latter electrical. Sound travels underground with a velocity depending upon the nature of the ground, and varying between 3,000 and 4,000 metres per second.

These instruments will enable the listener to locate, not only the topographical position of the origin of the sound, but also its depth below ground surface.

Le teleferiche militari con fune ancorate ad entrambe le estremità.

This is the fifth chapter of Lieut.-General Bellusci's treatise on wire ropeways anchored at both ends. In it he deals with the profile of the different standard types of ropes. Calculations are given showing how the mean height of standards is worked out. The mean distance between standards is taken as 80 metres; the maximum sag in such a span is 2·5 metres, in which case the height of the standards (*i.e.*, of the points of support of the carrying-ropes above the ground) works out to 6·6 metres. The average height of the hauling rope, at the points of support, above the ground is taken as 5 metres.

The next point to be determined is the number of standards required according to the section of the ground. The method of working this out is explained.

The distance of 80 metres between standards can be varied to a certain degree. There is a minimum distance between them, which varies according to the type of ropeway. For large spans, such as may occur in crossing a deep valley, special precautions will have to be adopted.

In extra large spans, *i.e.*, exceeding 800 metres, the carrying ropes must be kept 5 metres apart, to prevent them riding in a high wind.

A.S.H.

REVUE DU GÉNIE MILITAIRE.

(*January–February*, 1938.)—*Les téléferiques de campagne.* By Captain Bar. A descriptive article on cable-ways for use in the field. Three normal types are described: average, light and improvised. The first class includes those of a length of about 2,500 metres, running loads equivalent to six tons per hour; the second, those of lengths up to 1,800 metres, and loads equal to three tons per hour; and the third comprises the improvised field variety working loads of 250 kilogrammes. The details given of each class are sufficient to show their limits of capacity, and clear photographs are added of different stages in the erection of pylons, etc. The utility of this system of transport in mountainous country is obvious, and the French engineers have plenty of opportunity of practising with it. Not only is it time-saving, but it is to a great extent independent of weather; and its vulnerability to air attack is almost negligible.

Les obstacles dans la guerre moderne. By Captain X. Based on several recent articles in the German military Press on the use of obstacles to retard an advance. The growth of mechanical transport, necessitating better roads and stronger bridges, has increased the importance of the subject of demolitions in a retreat, and further, the use of tanks and other cross-country armoured vehicles has opened up a new interest in land-mines and anti-tank obstacles. The equipment of engineers with mechanical transport and mechanical tools is discussed, and estimates of work involved in mine-laying are given. An engineer company of 150 men is considered capable of laying 900 mines covering a front of 600 metres (in three successive lines) in one hour.

Reference is made to the English anti-tank exercises of 1935. The bulk of the article is devoted to German views recently expressed, and is illustrated by two concrete examples, one located in a district of Northern Germany, and the other a discussion of what might have been done with modern resources in closing the gap between the German First and Second Armies on the Marne on September 6th, 1914. Here was a case for delaying tactics on a large scale, and it affords an interesting example for modern study.

Charles-Augustin de Coulomb, officier du Génie. By Lieut.-Colonel Metz and Captain

Fadheuille. The second centenary of Coulomb's birth was celebrated on November 7th, 1936, by the sister societies of physics and electricity. Coulomb was an engineer officer. After some eight years spent in the construction of fortifications in Martinique, he returned to France in 1772 and began a long series of investigations into scientific problems, the results of which he published in many pamphlets, and which earned him the recognition of the Academy of Sciences. About 1789, he turned his attention to electricity and magnetism. He retired from the army in 1791 with the rank of major; but his health had been undermined in the West Indies, and although he lived to seventy years of age, his retirement was affected by ill-health. He died in 1806, as Inspector-General of Public Instruction. He invented the method of measuring the quantity of action, and from it deduced the fact of electrical attractions and repulsions. His own torsion balance was his principal means of discovering these phenomena.

Quelques opérations du Génie Belge pendant la guerre. By Colonel Rousseau. A few notes on some typical works executed by the Belgian engineer units during the war, taken from a lecture by Lieut.-General Giron to Belgian reserve officers. General Giron commanded the engineers of the 5th Division, and his experiences therefore were those of a divisional C.R.E.

A noteworthy remark is that of the use of mining frames of trapezoidal instead of rectangular shape. They were said to withstand shocks more successfully, in the case of shallow galleries.

Note sur l'emploi des containers pour la ravitaillement des grandes unités. By Lieut. Gauthier. The competition of rail with road transport has led to the extension of the use of " containers " of various kinds—familiar to us in the shape of meat and fruit vans lifted from ships and loaded on railway trucks or road trollies as necessary. For military purposes, there is a wide scope for these transport elements; and much time and labour could be saved by their adaptation. Trollies suitable for carrying containers are also suitable for other stores.

W.H.K.

REVUE MILITAIRE GÉNÉRALE.

(December, 1937.)—Choix et instruction du personnel nécessaire à la défense antiaérienne. By General Niessel. The training of anti-aircraft personnel has now become an urgent matter for all nations liable to aerial attack. Not only must the military units be fully trained and provided for, but a large measure of assistance must come from the civil population. General Niessel deals separately with the active means of anti-aircraft defence—fighting the enemy and inflicting losses on his craft—and the passive means—the minimizing of losses in personnel and property. The former measures comprise pursuit by aircraft both by day and by night, anti-aircraft artillery, searchlights, machine guns and balloon barrages. These services are manned by military units. The passive measures are the sheltering of the civil population, special precautions against gas, organization of services to fight the fires caused by incendiary bombs, ambulance services and de-contamination work. The measures hitherto taken in France to organize these precautions apparently lag behind those adopted by her neighbours. In view of France's geographical position, the author urges that no further time should be lost in dealing with this vital matter.

Comment s'adapter aux possibilités de l'armament actuel. By Colonel Chiavarini. The author takes up the theme " How would Napoleon have fought the battle of the Marne ? " He would, it is certain, have avoided the " war of attrition," but he would probably have gone " all out " in doing so. In Napoleonic days, the destruction of a field army did not mean the ruin of the whole population, and the devastation of a country-side. The issue of a campaign was often decided in a single day; and man's brains, not mechanical power of weapons, settled the result.

The article then goes on to calculate the actual number of hectares of damageable targets there would be in France to an aerial attack. He concludes that a force of 4,000 aeroplanes coming from, say, Germany could destroy all those targets and be back again in Germany in a few hours without re-fuelling, or they could cross to Spain, re-load with bombs there and make the return journey with a fresh discharge. Would reprisals on a similar scale be a sufficient deterrent?

" L'Air Control " est-il possible en Afrique noire? By F.H. The author, evidently with local knowledge, considers the question whether the French territories of Niger and Tchad would be better controlled by the Air Force or by the usual system of military posts and garrisons of native troops. He refers to England's attempts to administer her mandates in Palestine and Irak by air control, and observes that in Palestine we have reverted to the military form of control. The chief disadvantage of air control in French West Africa is that France herself would derive little help in time of war from the air squadrons maintained there, whereas so long as the native military units are maintained, she has the nucleus of considerable military reinforcement in the background.

L'Infanterie " puissante motorisée." By Commandant Drumillon. The trials of a new rifle called the Halger-Ultra, a German invention, in 1931, which has very high armour-piercing properties, has led the author to consider the creation of a new type of infantry armed with even more powerful automatic weapons than those of the present time. It seems likely that in the race between offensive weapons and defensive armour the former will outstrip the latter, because the limit of weight is reached more quickly in defence than the limit of propellent power and armour-piercing power is reached in the opposition. The author considers that the French infantry at present can only fight a defensive battle in a prepared position and covered by an obstacle impervious to tanks. He wants a much more powerful infantry—shock troops *d'élite*, so to speak. Not all the infantry divisions need be so organized and equipped, but a large proportion of them. He goes into great detail in describing the armament of such a force, following the general lines of most of the contributions to this discussion. He is dealing with the type of infantry required to attack a fully-equipped enemy not actually in a fortified position; the latter situation has, of course, to be met by methods of siege warfare involving heavy artillery.

(*January*, 1938.)—*Le but et le développement de la " Revue Militaire Générale."* By General Azan. The Editor reviews the first year's results of the new form of the Review.

Notes sur la Conduite Supérieure de la Guerre de 1792 à 1797 et de 1914 à 1918. By Marshal Franchet d'Espèrey. A comparison of the methods of the Higher Direction of War between the system under the National Convention, and later the Directory, of the French Revolution, and the system during the Great War. The former methods of controlling the operations of the army under Committees responsible to the Government, and Carnot's methods before Napoleon took charge, are described in this first instalment. The comparison is deferred to the subsequent instalment.

The succession of committees of the revolutionary period would never have worked satisfactorily had it not been for Carnot's superior management. He was the real director of the military campaigns of that period.

La Défense Nationale. By Jean Fabry, a former Minister of War. National defence, the author emphasizes, is no longer only a military problem; it is the business of the whole Government. The more deeply the public safety is involved, the more serious must be the study of the problem. The old adage, " the State must have the army of its policy," no longer holds good. The army—that is to say, National Defence, must be the maximum instrument of which the nation is capable. Its value, however, depends on varying political conditions.

France, faced with a diminishing population, must lean more and more on the assistance she expects from her great African possessions. The battle front must be complemented by a " factory front," on which the whole nation must exert itself.

As regards the question of the unified control, M. Fabry says that both the Ministry and the Minister of National Defence already exist; the former is the whole Government, the latter is the President of the Council. The appointment of a sole commander of the three forces is urged, if only for the beginnings of the conflict.

Composition et Puissance de la Flotte. By Vice-Admiral Darlan. A brief review of the chief characteristics required of a modern navy, and especially of the French Navy. The author strongly supports the view that the Fleet Air Arm must be separated from the main Air Service; it is a special arm. The United States, Japan, France and now Great Britain, have all recognized this necessity.

Sécurité aérienne et offensive aérienne. By General Armengaud. The results of the Damascus-Paris air race and of the French air manœuvres last summer give rise to new thoughts on the range and power of bomber-planes. It is as well for each European country to reckon on being totally within reach of the most powerful bombing machines. France, especially, has to maintain the closest watch on developments, and on the possibilities of a sudden air attack in mass. More pursuit planes are needed by France. The power of striking back is as important as the anti-air defences, and although the advantages of surprise and the initial blow lie with the aggressor, the retaliation can be swift and thorough.

These are some of the points of this topical article.

Une page de la Guerre d'Espagne. By General Niessel. Describes the battle of Brunete (July 7th to 26th, 1937), in which the Spanish Government carried out a very successful surprise attack, but was unable to make a decisive breach in the insurgent lines for want of reserves and artillery. The insurgents, outnumbered at first on the ground and in the air, were able to bring up reinforcements, and especially aeroplanes, and restore the situation. The Government tanks were not closely followed by infantry. The Nationalist leadership was superior.

La Campagne d'Éthiopie. By General Rouquerol. A rapid review of the campaign, considered as a feat of planning and organization. No reference is made to the fighting. The triumph of the Italian national preparation for the campaign is the principal lesson; and the author re-affirms the necessity of concentrating the whole of the means and material required for any offensive.

L'Officier dans la Nation. By Major Dassonville. Based on an article written by Captain Lyautey (afterwards Marshal Lyautey) in 1891, which appeared anonymously in the *Revue des Deux Mondes*, and created some stir at the time, on account of the novelty of its ideas. Lyautey was in advance of his time.

(*February*, 1938.)—*Notes sur la Conduite Supérieure de la Guerre de* 1792 *à* 1797 *et de* 1914 *à* 1918. By Marshal Franchet d'Espèrey. The author concludes his comparison between the higher direction of war as conducted by the Committee of Public Safety, represented in Carnot, and the direction during the Great War. At first, the commanding figure of Joffre appeared to embody the supreme control, but Joffre himself never aspired to more than the supreme command of the armies; the direction of the war itself, involving the whole nation, was always the affair of the Government. Various War Ministers tried to encroach on the Commander-in-Chief's powers, but while Joffre lasted, he preserved his full authority. Gallieni worked hard for Joffre's resignation, but his health gave way before he could encompass it. Secret intrigues against Joffre were constantly in motion. It was felt that he had too much power; yet he was a firmer rock than the successive War Ministers who felt it was their business to try and remove him.

Under Gallieni, a system of " Commissars " was authorized; commissioners who were allowed to circulate in the zone of the armies without permit from the Commander-in-Chief. The collapse of Nivelle was largely due to parliamentary interference. Hence the cautious policy of Pétain.

Among the Allies, the author refers to the Inter-Allied War Council, its abortive plans, and the final appointment of the Generalissimo.

Tactique d'hier et de demain. By General Velpry. An interesting comparison of

the tactics of the Great War and the doctrine of to-day. The author, a strong advocate of the tank, claims that it was the tank which overcame the machine-gun and won the war. The pulverizing of a defensive position by masses of artillery made it impossible to get over the stricken ground in time to prevent the preparation of a fresh position; when the artillery could be moved forward, all had to be begun over again. The successes of November, 1917, July 18th, 1918, and August 8th, 1918, are cited as examples of the correct use of tanks. But in those days the anti-tank defence was almost non-existent. The author fears that the teaching of to-day is losing sight of the immense advantages of the tank as used in the closing stages of the war.

L'Évolution du rôle militaire et maritime de l'Empire Colonial Français. By Commandant Regnault. A résumé of French colonial acquisition, and the military effort expended in acquiring it, from the beginning of the seventeenth century. After the Napoleonic wars, most of the French empire had been lost, but the new empire built up between 1815 and 1900 is much greater and is of infinitely more value to France. More and more does she rely on the man-power of her African Empire.

Organisation des liaisons dans la mise en œuvre des destructions. By Colonel Rousseau. A short article on the necessity for close liaison between the Command and the technical troops responsible for carrying out demolitions. The preparations for the demolitions must be made in advance by the Army or Corps authorities; the actual destruction can only be effected by the divisions or brigades. The contrast between the haphazard demolitions of the retreat in 1914 and the systematic destruction of 1918, shows the value of pre-arranged schemes. The article is in very general terms.

(*March*, 1938.)—*Organisation de la défense nationale.* By the Editor. A short reference to two recent decrees signed by the President in January, 1938, relating to co-ordination of national defence. M. Daladier, who combined the offices of Minister of National Defence and War Minister, and who was responsible for these decrees, has achieved a closer co-ordination by their means. The permanent Committee of National Defence was instituted in 1936, and is presided over by the Minister of National Defence. The Committee also has the assistance of the Chiefs of Staff of the three services, one of whom is delegated as Chief of Staff of National Defence. General Gamelin, the present Commander-in-Chief designate, holds the latter post.

La Guerre d'Espagne. By General Armengaud. The author, who has recently been in Spain studying the war from the Government side, writes on the combination of the air forces with the naval and military forces on both sides. He remarks that the Government side has neglected this action since the war began. The Government naval forces are practically equal to those of the insurgents; but the latter have the assistance of other powers whose means of supporting them are ready to hand. The naval air bases in Majorca and Iviza are very favourably situated for General Franco, and even if the Government had wished to secure these for themselves, the pressure and active intervention of Italy would have prevented it. The attack by the Spanish Government air forces upon the German battleship *Deutschland* at a comparatively low altitude, was successful, but was visited with such swift and terrible retribution on the open town of Almeria that it was never repeated.

On land, there has not been the same disparity, and air forces have figured very largely in the principal fighting, notably at Brunete and Belchite. On either side, the air forces act as a general reserve of artillery, and most of the casualties in recent battles have been due to air bombs or machine-guns from aeroplanes.

The author praises the efforts of the Government air forces, which are being developed with all the energy which their limited means permit, and are manned by a courageous personnel, but he thinks that these efforts are on too small a scale to bring about the decision. The Balearic air bases are too much of a weight against the Government, which does not possess the means of destroying them.

Infanterie et Cavalerie. By Captain Vernier. A new edition of the Cavalry Regulations is shortly to appear in the French Army, and the author takes the opportunity of analysing the points of difference between the present cavalry and infantry

regulations. For it is clear that the more complete the disappearance of the horse, the closer to infantry will the cavalry tend, until it will be difficult to see any difference. But the Germans, for reasons connected with warfare on their eastern frontier, are not going so far in the removal of the horse, and the French do well to remember this. That there should still be considerable difference in the methods of employment of cavalry and infantry is the reason for this article, written by a cavalryman.

Tendances Générales de la construction automobile. By Captain Bouley. Reflections on the tendencies observed at the 1937 Motor Show in Paris.

Il faut creuser le canal des Deux Mers. By Captain Tourte. A plea for the immediate construction of the long-projected great ship canal from the mouth of the Garonne to the Mediterranean at Narbonne. This project dates from Louis XIV's time, and has been revived on many occasions. The new situation created by the rise of Italy and the Spanish Civil War makes this canal of the highest importance. England, the author reminds us, would benefit very largely from it, if the Straits of Gibraltar were closed. It would neutralize hostile occupation of Spain. It would shorten sea communications. An unusual argument in its favour is added: the journey through the fresh water of the canal would clean off the barnacles from the ships' bottoms.

De l'homme au chef. By Captain Manie. A psychological study involving the conscious and sub-conscious minds; perplexing and introspective.

W.H.K.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(*January*, 1938.)—*Histoire de l'Inspection Générale de l'Armée et des Centres d'Instruction Belges pendant la Guerre Mondiale.* By Lieut.-General de Selliers de Moranville. The first instalment of a very detailed account of the work done in rear of the Belgian Army in building up the reinforcements and training them for the field. Lieut.-General de Moranville was Inspector-General of the Army and Commandant of the Schools of Instruction throughout the whole war, and kept careful records of his work. The exceptionally difficult circumstances under which the Belgian forces had to be organized, recruited and supplied add interest to this account.

When the withdrawal of the Belgian Army from Antwerp became necessary, in October, 1914, the author was invested with the command of some 18,000 recruits and charged with organizing their training in camps of instruction in France, placed at the disposal of Belgium. At first these recruits, amounting to 3,000 for each of the six divisional depots, were sent to Belgian towns, but as the battle front approached these the men were taken round to Cherbourg, Dieppe, and Fécamp, and fresh depots were formed in various towns and villages in Normandy, with headquarters at Rouen.

Une Année de Guerre en Espagne (*July*, 1936—*July*, 1937). By Major Wanty. This concludes Major Wanty's account of the Spanish Civil War down to July 31st, 1937. The most interesting part of the article is the author's conclusions and deductions at the end.

All published versions of the numbers engaged on either side are open to criticism, and the true facts will not be known for a long time. The Government, according to Major Wanty, had superior numbers, but the Nationalists had far better material and a much greater number of trained officers.

The huge area of operations, and the comparative smallness of the armies have given rise to a series of manœuvres and local thrusts, without very decisive results. The manœuvre tactics of the Nationalists seem superior; and the manner in which they retrieved their tactical situation after the Government success at Brunete in July last was very creditable to the insurgent command. Tanks have not proved so influential as was expected; probably for want of infantry to follow them up.

Many tanks have been destroyed or put out of action by being smothered with flames from petrol bombs. Motorized columns, *à l'italienne*, did not have things all their own way; a mishap at the head of a column would immobilize all the rest; and aeroplanes took toll of the helpless transport. As to aerial bombardment, the Douhet theory of national terrorization has proved illusory; the Spaniards have withstood terrible punishment. The hatred of such tactics appears to consolidate the popular resistance to the vile abuse of aerial weapons.

Une exposition de perfectionnement culturel ainsi que d'organisation des loisirs du soldat. Anon. A description by a regimental commander of the education and vocational training of the Belgian soldier; his classification into trades, and the facilities given him for pursuing his training in them during his service. The article is written in French and Flemish side by side.

(*February*, 1938.)—*La Défense de Dixmude* (1914). By Major Wanty. This second instalment continues the story of the defence of Dixmude, and explains the importance of this defence in the general battle of the Yser. The Germans made continuous efforts to capture the town, which was a focal point of the road and railway systems of that part of Belgium. The operations now described are those of October 20th to 22nd, 1914, when the Dixmude bridgehead was defended by General Meiser's brigade. Later, in the evening of the 21st, Meiser's brigade was placed under the orders of Admiral Ronarc'h, whose French Marine Fusiliers played so gallant a part in the defence. The account of the fighting is clearly described and is well authenticated.

Histoire de l'Inspection Générale de l'Armée et des Centres d'Instruction Belges, 1914–18. Lieut.-General de Selliers de Moranville continues his detailed account of the raising and training of men for the Belgian Army during the war. The rapid over-running of Belgium after the fall of Antwerp made the withdrawal of the available recruits a matter of the greatest difficulty, not diminished by the necessity of seeking transport facilities from the French at Dunkerque, who were already absorbed with the task of getting reinforcements round to Flanders. British vessels assisted in the transport of these men from Dunkerque to Cherbourg and Rouen.

Once the divisional training centres had been safely distributed in towns and villages of Normandy, the training of further large numbers of recruits was arranged with the willing help of the French Government. Some 40,000 men—15,000 recruits of the classes 1899–1913, and 25,000 of the 1914 class—were prepared for; and their feeding, clothing and administration are described with full details.

La Révolution Brabançonne dans le Duché de Limbourg, 1790–1794. By M. Leconte. The fifth instalment. Gives details of the medals and recognitions awarded to the volunteers after their efforts in 1790–91; even mentioning several individuals by name.

(*March*, 1938.)—*Dixmude, 17th October–10th November*, 1914. By Major Wanty. This third instalment covers the fighting from October 22nd to 25th. The lack of reserves threw a great strain on the troops, both French and Belgian, but especially upon the latter, who were unable to organize even the short system of reliefs which the French adopted. The machine-gunners had no respite, day or night.

There was comparative calm from October 22nd to October 24th, but on the latter day, the German attacks were renewed, and pressure on the north of Dixmude made the situation in Admiral Ronarc'h's bridgehead most perilous. But the resistance was grand, and very heavy losses were inflicted on the Germans, who were mostly young men of the new Reserve Corps. The Higher Command decided that Dixmude must be abandoned. But the moment was still postponed.

The steadfast attempts to hold the position are very clearly described, with a wealth of detail.

Histoire de l'Inspection Générale de l'Armée pendant la Guerre Mondiale. By Lieut.-General de Selliers de Moranville. The author continues his account by giving a synopsis for each six-monthly period from January, 1915, to February, 1919, of the chapters of his main history. The headings only are given.

La Révolution Brabançonne dans le Duché de Limbourg, 1790–1794. By M. Leconte. The sixth instalment. A very detailed account of the re-constitution of the companies of Limbourg volunteers for the defence of their country against the French in 1792. No account of any operation is given, but minute details about pay, clothing, medals, etc.

W.H.K.

REVUE MILITAIRE SUISSE.

(*December*, 1937.)—*La fatalité des fronts continus.* By General Rouquerol. This well-known writer discusses the question "shall we revert to trench warfare in the future?" He points out that the deadlock arrived at in 1914 was foretold as far back as 1891, by Lt.-Col. Mayer, the Swiss writer. The increasing power of the defence, coupled with the enormously increased number of men put into the field, caused the race to get round the flanks. Are not these same factors at work to-day? The rise of new offensive weapons—tanks, aeroplanes, gas—and the increasing motorization of war, have been met by defensive counter-measures, which still give the defensive great power. "Offensives against a front organized in depth, even at short notice, were so ruinous in the last years of the war that their interruption proved actual victory for the defenders." General Rouquerol concludes with his opinion that a future great war will rapidly turn to stabilization and attrition.

Who will be the gainer from such a catastrophe?

Notes de tactique à l'usage des futurs capitaines. By Colonel Lederrey. This instalment concludes this useful compendium of modern tactics for junior officers.

Les materiels aéronautiques. By Captain Schlagel. Notes on two recent models introduced by the Belgian and British Air Services respectively. The former, a Renard one-seat "chaser," achieves a speed of more than 310 miles an hour at 4,000 metres. The latter is the Fairey light "bomber" of the Battle type. Photographs and performances of both types are given.

(*January*, 1938.)—*L'Immobilisation des fronts.* By Lieut.-Colonel E. Mayer. Last month's article by General Rouquerol, which quoted an article written by Lieut.-Colonel Mayer in 1891, forecasting the deadlock arrived at in 1914, has led to an explanation by the latter, who does not wish to be taken too literally. Stabilization can only take place if the flanks are unassailable. In 1914, both sides found themselves running out of munitions at the same time, and both had to pause to recover breath; the Germans had also to look to their eastern frontier. Stabilization in the future is just as uncertain as ever; more so, in fact, since air warfare must necessarily play a principal part in the opening moves.

Impressions et expériences de la guerre d'Espagne. By Captain E. Bauer. A further instalment of Captain Bauer's interesting notes from Spain. He writes chiefly of the Nationalist side, and is full of praise for the discipline and military regularity of Franco's troops, whether Moors, foreign legionaries or new levies. The courage and fighting qualities of the Spanish troops have been evenly matched on both sides. General Franco is almost a legendary hero to the Moors. Whichever side wins the war, the Spaniards who have fought through it will form a very considerable army of patriots, inured to hardship and of proved courage: they will be capable of defending Spain against foreign intrusion.

The author gives much praise to the engineer units. Their rapidity and skill are remarkable. Roads and bridges are rapidly repaired; field improvisations are replaced by permanent concrete structures, and mountain roads are turned into good lorry routes. The trenches are clean and kept in good order; concrete is largely used. The Government side has excellent engineer material in the Asturian miners. Motor transport is, of course, of all kinds, with Italian makes predominating. There

is little marching of columns. Food supply is good and regular; the writer heard of no complaints about the rations from any quarter.

Notes de tactique à l'usage des futurs Capitaines. By Colonel Lederrey. Some appendices to the previous series of articles already published in this review, dealing with the conduct of exercises.

La fourniture des chevaux dans notre armée. By Lieut.-Colonel Muller. The future supply of horses and mules for the Swiss Army is exercising the Federal authorities, and the importations from abroad are costing more than is desirable.

(*February*, 1938.)—*De l'influence exercée sur notre tactique par l'introduction en masse d'engins motorisés et blindés.* By Lieut.-Colonel Montfort. What is to be the action of a non-motorized army like the Swiss, against an army mechanized to the full? Several factors are, of course, affected by the mechanical changes brought about in modern warfare, and the author deals with them in turn, beginning with the transmission of information and orders. The time factor is one of the principal elements which have been affected; and this in turn affects all the operations of war. Colonel Montfort takes each operation in turn and analyses these effects. Tactical situations brought about in present-day conditions defy any convenient method of depiction, and so uncertain must be the results that illustrative diagrams must remain diagrams only. A motorized force, 60 miles distant, which can arrive at an exposed flank or a thin spot within two hours without appreciable physical exhaustion is not easily dealt with, even in paper solutions.

It would appear that the Swiss have more assistance from nature than most other military nations; but the article urges that more attention be paid to the menace of mechanical invasion.

L'Armée Allemande en 1937. By Colonel von Xylander. A review of the chief military events in Germany during 1937. The manœuvres in Pomerania in September gave opportunity for the trying out of the organization of the new army which has been forming since Hitler threw off the restrictions of the Peace Treaty. The two-year service men were tried for the first time. Other military events of the year are described, chiefly with reference to the effect of new recruiting regulations, and the training of young officers. No details are given as to new formations, or the present strength of the forces.

Impressions et expériences de la guerre d'Espagne. By Captain Bauer. The conclusion of Captain Bauer's articles. He refers briefly to the effects of air operations and mechanization on the war. Almost all the Spanish air units, except those stationed in Morocco, fell into Government hands at the beginning of the insurrection. The Nationalists were furnished with large numbers of German and Italian machines, while the Government received them principally from France and Russia. The bombardment of towns has been a feature of the warfare on both sides. Reprisals follow reprisals. The Nationalists have paid more attention than their opponents to the bombing of communications and concentrations; while it was the Government use of aeroplanes which shattered Franco's motorized drive against Madrid in March, 1937.

The tanks have not had everything their own way. Once their surprise effect is over, they fall victims to artillery fire or petrol bombs and hand grenades thrown by the infantry. This latter form of anti-tank defence has been much used. The fast light tanks of German or Italian make have not proved so efficient as the somewhat heavier Russian type (6 ton), armed with a single 45 mm. gun and a machine-gun. Great speed in armoured vehicles has not proved advantageous; the tanks must operate in close liaison with other arms. Attacks by aeroplanes on tank concentrations have proved successful.

(*March*, 1938.)—*Les débuts de la guerre mondiale d'après un livre récent.* By Lieut.-Colonel E. Mayer. The author says he disagrees with some of the conclusions arrived at by General Duffour in his recently published book, *Joffre et la guerre de mouvement*, but it is not clear which of the conclusions he questions. Colonel Mayer remarks on

the failure of the French Command to profit by the victory of the Marne in 1914; and adds comments of his own on these early days, but he does not give the corresponding views of General Duffour.

Instruction militaire préparatoire ou éducation nationale. By Captain Schenk. A plea for a more regular national education to counteract the deficiencies of the primary school system and of present-day parental influences. In Switzerland there is a gap of four to six years between the youth's release from school and his assumption of manhood's rights and duties. The falling-off of parental control, due to the crowded pace of modern life, and the cramming of too many subjects into the school curriculum, throws the youth of fifteen into confusion and perplexity. He has to make his choice of a career in the midst of conflicting influences, and he falls a prey to subversive doctrines of which there are so many to-day. The author wants the preparatory military instruction to be obligatory, not left to private bodies. He wants a longer school training, up to 17 or 18 years, and the military training to follow without interval.

The Federal Military Department has such a scheme under consideration.

The problem of the training of youth for the service of the State is not confined to Switzerland.

Quelques tâches des armes lourdes d'infanterie dans la préparation d'une position défensive. By Lieut. Gaberell. A few remarks on the tasks of the infantry anti-tank gun and the trench-mortar.

Feu la 1re Division. By Colonel Tardent. Recent changes in organization have considerably altered the composition of the 1st Division, and its chief staff officer gives a nominal list of all the Divisional, Brigade and Regimental commanders from 1925 to 1937.

W.H.K.

MILITÄRWISSENSCHAFTLICHE MITTEILUNGEN.

(*January*, 1938.)—The first two articles commemorate the eightieth anniversary of the death of Field-Marshal Radetzky and the death of General Ludendorff respectively.

The Conflict in East Asia. By General Wiesinger.

The account of the Sino-Japanese conflict is continued from the November number.

In order to appreciate the present state of affairs correctly, it must be realized that the Japanese victory at Shanghai early in November has completely altered the situation in China. The Japanese have attained most of their military objectives in North China. On the 13th December a "Provisional Government of the Chinese Republic" was set up at Peking. A second autonomous state is in process of formation in Inner Mongolia, under the name of Khokho, and consists of the provinces of Chahar and Suiyuan.

After describing the political and military situations in Japan and China, the writer gives an account of the operations that have taken place in (1) Central China and (2) North China respectively.

After heavy fighting round about Shanghai throughout October and early in November, the Japanese effected a surprise landing in Hangchow Bay, south of Shanghai, which threatened an encirclement of the Chinese forces. The Chinese were driven back out of the successive positions they held between Shanghai and Nanking. By the middle of December the Japanese were in occupation of Nanking.

In North China two Japanese armies carried out operations in Hopei, and a Japanese force occupied Suiyuan, but the most important events took place in the province of Shansi. At the beginning of October the Japanese north-west group crossed the high mountain range in the north of Shansi, where the Chinese were

holding the inner Great Wall, and, after fighting several battles, the Japanese occupied Taiyuan on the 8th November.

A series of sketches show the position of the opposing forces at various times, as far as they can be ascertained.

Political and Military Review.

Major-General Paschek reviews world affairs during the second half of 1937. The account is interesting on account of the writer's impartial point of view.

(*February*, 1938.)—*A 58-year-old Military School.* By Lieut. Field-Marshal Klepsch-Kirchner.

On the 1st November, 1937, the Vienna Military School celebrated its fifty-eighth anniversary as a training school for the Quartermaster-General's Staff of the Imperial army. It was closed down on the outbreak of the World War, but was restarted for short courses in 1917. On the conclusion of the war its development was hampered by the conditions of the Treaty of St. Germain. In the year 1925, the course lasted one year, from 1926 to 1930 two years, and since 1930, three years.

Motorization and Manœuvres. By Captain von Binzer.

It is one of the most astounding facts in military history that in the last war armies of millions fought, with unlimited materials, for four years on the western front without achieving a definite result.

In 1914 the balance in favour of the attack was upset by the machine-gun: the ideal weapon of the defence. The length of the fronts made outflanking movements impossible. Both combatants looked for a solution in the artillery battle—the ideal weapon of the attack. But an artillery attack required a change of position after a time, and attacks were eventually held up by fresh reserves brought up by the defence. The tank was a partial solution of the problem.

Every form of attack can be countered by a form of defence. The writer gives it as his opinion that stabilized warfare is a thing of the past, and that, thanks to motorization, the next war will be one of manœuvre.

Cartography in three Dimensions.

Captain Knapp explains how a stereoscopic effect can be obtained in coloured and contoured plans by the use of spectacles with one blue and one red eye-piece.

Political and Military Review.

Major-General Paschek continues his review of the general political situation, up to the state of affairs on the 10th January, 1938. The main points dealt with are: The League of Nations, the grouping of the European powers, the Sino-Japanese War, the British Empire, America, the Brussels Conference, Trade and Commerce, and questions of rearmament.

It is interesting to note that, in the writer's opinion, Great Britain was never in a more critical situation, not even in the days of Napoleon, nor during the World War.

A tabulated statement accompanies the article, showing the strength of the army, navy and air force of all important nations.

The Civil War in Spain.

General Wiesinger gives a fifth instalment of his account of the Civil War, dealing with the quarter ending 15th January, 1938.

General Franco's operations in Asturias continued throughout September and October. The town of Gijon, on the coast, was occupied by the Nationalists on the 21st October, and Aviles and Oviedo fell into their hands shortly afterwards.

The occupation of Asturias gave the Nationalists possession of all the harbours on the Atlantic Ocean and those between Algeciras and Malaga, the Balearic Islands (with the exception of Minorca) and the Morocco Protectorate. The Popular Front is limited to the rest of the Spanish coast.

The Asturias victory is of great importance for Franco; besides giving him a large number of prisoners and captured material it now leaves a single dividing line between the two opposing armies, it also enables him to reorganize his forces.

By the middle of December, Franco had made his arrangements for an attack on Madrid, when the Government made a counterstroke against Teruel. Teruel itself is of little tactical value, but its capture has put heart into the Government troops, and has postponed Nationalist operations against Madrid.

(*March*, 1938.)—*Can Methods of Warfare be restricted ?*

A translation of an article by Major-General Sir H. F. Thuillier in the *Journal of the Royal United Service Institution.*

The editor makes the following comment :

" We have taken this article from the leading military monthly magazine of the " British Empire, together with a portion* of the discussion that followed the lecture. " It relates to a question—really a military one—but one that concerns the whole " human race, including women, children and old men, since it affects them and the " fate of their families.

" The dispassionate judgment with which the question is handled in concise " sentences, with convincing logic and startling simplicity, is a token of the wide " view taken by a high officer of the Empire, and of his sense of justice even in " criticizing his own country.

" The lecture is also a study of the question whether wars are caused by soldiers."

Air-Raids and their Effects. By Colonel Schöbel.

In introducing the subject, the writer points out that Austria had practically no experience of air-raids in the World War. The only air-raids carried out by the Italian air force were on a very small scale, and Vienna was not touched.

Colonel Schöbel describes the various types of bombs in use, of which the main kinds are : high-explosive (with contact or delay-action fuse), incendiary, and gas ; this being the order of their destructiveness. He gives details of past air-raids and points out that far more serious damage and many more casualties must be expected in the future.

In describing the effect of air-raids, he quotes General Fuller and other British, as well as German authorities. The Italo-Abyssinian War can only be taken as an example if the scarcity of targets and the absence of towns is taken into consideration. To some extent the Spanish Civil War is misleading. Madrid has only suffered slight damage, but this is because Franco, as a Spaniard, wished to spare the main buildings of the capital.

Both in Spain and in China air-raid damage has been mainly caused by high-explosive bombs ; gas bombs have hardly been used at all. It is possible that, in view of their comparatively slight effect, they may eventually cease to be used altogether.

In conclusion, the writer points out that suitable measures of protection can be taken against all but heavy high-explosive bombs. Even against the latter, steps can be taken to minimize their effect. But the main thing is to be prepared and to take all necessary precautions in good time.

Anti-Aircraft Weapons and their Employment. By Major Krziwanek.

Anti-aircraft weapons are of four kinds : A.A. guns, heavy A.A. machine-guns, light A.A. machine-guns, and searchlights.

A.A. guns are classified as (1) light (up to 8 cm. calibre), (2) medium (up to 10 cm. inclusive), (3) heavy (over 10 cm.). The heavy guns are mounted on rails, the others are either motorized (towed by a vehicle), or mechanized (mounted on an armoured car or tank).

Heavy machine-guns are ordinarily of calibres from 2·5 to 4 cm. A direct hit with a 3·7 cm. or 4 cm. explosive tracer-shell will bring down an aeroplane, smaller shells cannot be counted upon to do so.

Light A.A. machine-guns are of 12·5 to 20 mm. calibre and are specially useful against low-flying aircraft.

* Remarks by Admiral Earl of Cork and Orrery.

The article goes on to deal with ammunition, the employment of the different types, and direct and indirect fire.

Air Protection and the Means of ensuring it.

Lieut.-Colonel Punzert mentions the probable main objectives of an air-raid, and the means of combating it, or of rendering it as little efficacious as possible.

Experiences in Air-Raid Protection. By Lieut.-Colonel Trimmel.

The experience of the civil population in the World War, as regards air warfare, was practically nil. In the next war the state of affairs will be very different.

The experience gained in the war at the front will be useful. Practically all that is to be known about poison gases is now common knowledge, and, given timely preparation and instruction, adequate protection against gas attacks can be ensured.

On the other hand, very little is known from practical experience of the effect of incendiary bombs and shells. They were used on a small scale in the bombardment of Reims, and the fires that they caused were easily extinguished. The effect of the incendiary chemicals since employed has yet to be learnt.

Exercises in Air-Raid Precautions.

Captain Larisch mentions a number of exercises in air-raid precautions, some of which are for private individuals and others for public organizations. He stresses the importance of discipline in the civil population, if it is not to be demoralized by air-raids.

Screening and Darkening.

Lieut.-Colonel Schörgi mentions some of the principles of camouflage, by which buildings, roads, etc., are rendered less conspicuous to observers in aeroplanes. Natural methods ordinarily used consist of planting trees or covering with greenery; artificial means are the correction of the shadow outline and the use of screening nets and artificial fog. Roads and roofs should be dark in colour, and bright tints should be avoided. For protection at night, complete darkness or the maximum screening of unavoidable light is essential.

Fire Precautions in Air-Raid Measures.

Major-General Zar invites attention to the danger of storing inflammable lumber in the attics of houses. Incidentally, this is forbidden by law in Vienna. He describes the organization of the Vienna fire brigade, arrangements for water-supply, etc.

Gas Precautions in Air-Raid Measures. By Major Hirsch.

Gas attacks from the air may be effected by (1) dropping gas bombs with contact fuses or adjustable time fuses, (2) by spraying or pouring the chemical from aeroplanes.

It is hardly within the region of possibility to extend a gas attack over the whole of a large town. A gas attack is most likely to be used as a sequel to an attack with high-explosive or incendiary bombs, to prevent or interfere with salvage work.

The latter part of the article is devoted to the use of gas masks, the work of decontamination squads, etc.

Poison and other Gases and their Physiological Effect. By Surgeon Lieut.-Colonel Mader.

A description of various gases in use in chemical warfare and their effect on the human system :—

Lachrymators : *e.g.*, xylyl bromide.

Blue Cross Gases : (sternutators).

Green Cross Gases : (acute lung irritants), *e.g.*, phosgene.

Yellow Cross Gases : (vesicants), *e.g.*, mustard gas.

Gas Protection of the Civil Population Abroad.

Major Hirsch describes the air-raid precaution measures taken in most European countries and the type of gas mask adopted in each.

No air-raid precaution laws have yet been passed in Austria, nor has a type of

popular gas mask been adopted. This has its advantages, as Austria will be able to profit from the experience of other countries.

Major Hirsch suggests the Swiss C mask, and some of the Czechoslovak masks as suitable types for the active population; for the passive population, the German VM 37, the Italian, and the Russian GT 6 masks are suitable.

A point emphasized is that, once gas masks have been fitted, they should be retained by the owners, and not returned to store, where they might not be available in time for a rapid issue in an emergency.

Anti-Air-Raid Building Construction. By Colonel Bodenstein.

Among the many suggestions for making towns and buildings less vulnerable against air attack are the extension of open spaces and the laying out of garden cities. Roofs should be made of reinforced concrete, or, at any rate, of non-inflammable material, as a precaution against incendiary bombs. A steel frame building, with reinforced-concrete panels, is a good form of construction. Refuges in suitable places are necessary.

Air-Raid Shelters. By Major-General Palla.

Air-raid shelters should ensure protection against:

(1) the distant action of high-explosive bombs;

(2) the penetration of gases;

(3) the effect of incendiary shells.

Shelters will, as a rule, be built in basements, and, if possible, completely underground. No shelter should be designed for more than 50 persons. Each person should have an air space of 3 to 4 cubic metres (105 to 140 cubic feet) and a floor space of 0·6 square metres (7 sq. feet). The necessary thickness of walls proof against splinters is given; also suggestions for the design of a shelter and for its ventilation.

Principles of Self-Protection for the Civil Population in Air-Raids. By Lieut.-Colonel Diakow.

Suggestions as to the ways in which private persons can help themselves and each other in making preparations against air attacks.

Visit to a Gas Mask Factory. By Marcel Grund.

A description of the process of manufacture of gas masks in the Lichtenwörth factory in Wiener-Neustadt.

A.S.H.

WEHRTECHNISCHE MONATSHEFTE.

(*December*, 1937.)—*Mountain Artillery.*

For 15 years the 7.5 cm. M 15 mountain gun, manufactured by Skoda, Schneider and Creusot was unsurpassed and is still in use in Austria, Italy, and several other countries. It had a range of 7,000 metres and formed six mule loads.

It has recently been improved upon in America by the 75 mm. mountain howitzer, Mk. 1, and by the new Swiss 75 mm. mountain gun on the Bofors system. The American howitzer forms six mule loads and has a range of 8,400 m.; the Swiss gun forms nine mule loads and has a range of 10,500 m. The latter is a powerful but very heavy weapon.

The modern tendency appears to be to make less distinction between howitzers and guns.

Bronze and Steel as Raw Materials for Austro-Hungarian Ordnance. By Major-General Reutter.

Prior to 1874, the Austrian field and mountain guns were made of ordinary bronze. In 1874, Major-General Uchatius introduced a new process of manufacture which greatly increased the strength of the material. He called it steel-bronze. His

successor improved upon it by adding phosphorus to the bronze, and this material was known as forged bronze.

Bronze guns were in use during the World War and rendered good service. They were less liable to corrosion than steel guns, but they could not resist the high pressure of modern charges, and had, for several years before the war, been gradually replaced by steel guns.

During the war the shortage of copper put a complete stop to the manufacture of bronze guns. Shortage of nickel made it necessary to reduce the amount of nickel in steel guns, and finally eliminate it altogether.

Japan's Provision of Coal, Iron and Oil against the Risk of War. By Dr. Ruprecht.

Old Japan's supply of bituminous coal is estimated at 8.5 milliard tons, practically enough to cover her home consumption. But only 5 per cent. of her requirements of br own coal are mined in the country, the rest comes from Korea and Sakhalin. Ho wever, her position is not as favourable as it might at first appear: her bituminous coal is of inferior quality, and her mines are difficult to work, owing to saturation by water and the presence of volcanic gases. She is obliged to fall back on Manchukuo to supplement her requirements.

As regards iron ore, there are a few iron mines in Japan; a very small amount of ore comes from Korea; the largest proportion comes from Manchukuo. It is of poor quality, and only has just enough iron in it to be workable. To obtain her requirements, Japan has acquired mining rights in three islands north-west of Australia, in the Cape York peninsula, the Malay States, the Dutch East Indies and an island on the coast of British Columbia.

Japan's position with regard to oil is less favourable. She can only obtain about a quarter of her annual requirements from Japan itself, Manchukuo, and Sakhalin. Her government has worked out a seven-year plan for increasing the oil supply by the liquefaction of coal, by synthesis, and by low temperature distillation. But, even so, she is still largely dependent upon foreign sources of supply, and she has admitted that she dreads nothing so much as a blockade.

The Artillery of Czechoslovakia. By S. H. Kocab.

At the close of the Great War, Czechoslovakia took over not only a very large portion of the artillery of the former Austro-Hungarian monarchy, but also several of its main munition works, notably the famous Skoda works at Pilsen in Bohemia.

During the last three years she has been spending very large sums of money on special equipment for artillery. According to the writer, the artillery, particularly the medium and heavy guns, is out of proportion to the other arms of the service. Czechoslovakia has vastly increased her anti-aircraft artillery. She is now in a position to place a modern gun—out of her peace equipment—every 900 metres along the whole of her German frontier.

(*January, 1938.*)—*Space, Raw Materials and Race.* By Captain Dr. Steinbrecht.

Space, raw materials, and race are the foundations of a country's strength. The writer points out how the population of Germany has expanded during the past century and how greatly it is cramped for space. There is an ample supply of raw materials in the world, but their distribution is most unfair.

As regards race questions, he dwells on the danger of the predominance of the yellow and black races. The Japanese are pushing out European trade everywhere. The war cost the white race about ten million of their best men in dead, and taking into account the children of these ten million, it meant a loss of perhaps thirty to forty millions. The proportional birth-rate to-day is estimated to be: two Germans, three Japanese, seven Russians, twenty Chinese.

Readjustment in Armament Factories.

Dr. Leonhardt draws attention to the disorganization likely to be caused in armament factories on the outbreak of war, owing to the workmen being called away to serve with the colours, and makes suggestions for getting over the difficulty.

Wood Fighting and Weapons suited to it.

General Ludwig describes some of the wood fighting in the Argonne in the autumn of 1914 and discusses the most suitable weapons for this type of warfare in future.

He considers infantry mortars, light machine-guns, machine pistols, flame-throwers, and light tanks, working singly, to be effective in wood fighting.

Armament Industry before 1914.

Lieut.-General Marx points out the difficulties encountered by the German Chancellor and the Prussian Minister of War in former days when matters concerning the army had to be referred to 23 separate governments and three other war ministries. Many ministers broke down under the strain of the work. The abolition of the smaller states has greatly improved the efficiency of the army and the armament industry.

Poland's Industry from a Defence Point of View. By Captain Ruprecht.

Poland is almost entirely an agricultural country: only 15 per cent. of her inhabitants are employed in industry. She has a very long frontier to secure, devoid of any natural defences, and, in the event of war, she is likely to find herself in the same position as Russia during the World War, with a shortage of skilled labour to maintain her armament industry, and to make good her material losses in an army of 3·6 millions, with 1,500 aeroplanes, 600 tanks, 11,000 machine-guns and nearly 1,800 guns. To remedy the deficiency, it has been decided to start a large industrial centre in the neighbourhood of the town of Sandomir, south of Warsaw. It will take ten years to carry out this plan.

Portable Radio Stations and their Employment. By H. Neumann.

A description, with photographs, of various types of portable wireless sending and receiving stations in use in the German service. An important point about such instruments is that it should be possible to change over rapidly from telegraphy to telephony and vice versa.

German Practice Aeroplanes for Military Purposes. By Wowa.

A description, with photographs, of various aeroplanes used for instructional and practice purposes.

(*February*, 1938.)—*The 2 cm. Machine-gun.*

A detailed description, with 15 photographs, of the 2 cm. machine-gun. The various illustrations show it (1) mounted on wheels, with tripod trail, (2) in sections, packed for animal transport, (3) with limber, for horse draught, (4) with disc wheels and pneumatic tyres, (5) for man haulage, (6) on a pedestal mounting.

The Cost of Petrol produced by the Liquefaction of Coal. By Dr. Ruprecht.

The only two countries to use synthetic petrol in 1936 were Germany and Britain, to the extent of 280,000 and 70,000 tons respectively. This represents only a small fraction of their total petrol consumption, and the cost of production is about three times that of petrol derived from natural oil. In Great Britain the extra cost is met by the imposition of a preferential duty.

Other countries have taken up the question, *i.e.*, France, Italy, Japan, and others, and they have adopted various methods of meeting the cost.

Australia is one of the few countries, poor in oil, that does not intend to proceed with the liquefaction of coal. She believes that, in the event of war, she would still be able to obtain supplies of natural oil from the United States of America and the Dutch Indies.

The Officer as a Mathematician. By Horst Herrmann.

A comparison between German and French officers with regard to their knowledge and study of mathematics. The reference is mainly to artillery officers, and, in the writer's opinion, the average German officer does not take the same interest in mathematics as his French confrère.

The Corps of Ordnance Officers in the U.S.A. By Major Engel.

A description of the organization and work of the American Ordnance Corps, taken from articles that have appeared in the publication *Army Ordnance*.

Is Anti-Tank Defence predominant nowadays ?

A reference is made to an article that appeared in *La France Militaire* on the 24th November, 1937, entitled *Les Chars dans la Défense*, in which the writer expressed his doubts of the probable success of a tank attack on account of the many methods of anti-tank defence now in use. The conclusion arrived at is that in certain circumstances tanks may prove extremely valuable for purposes for which they were not originally designed, namely, in the defence.

(*March, 1938.*)—*The 3·7 cm. Machine-gun.*

A description of the heavy automatic 3·7 cm. machine-gun, manufactured by the Rh.-Borsig Company, with a series of photographs showing the different types of mountings used in connection with it. It is intended for use against aircraft or tanks.

Some Recent Alloys in Cast Metal and Steel Materials and their Importance for Armament Work. By Dr. Karsten.

Two elements, molybdenum and vanadium, when used as alloys with cast metal and steel, give to these substances certain properties that are perfectly astounding in view of the small quantities used. The writer gives a number of instances showing how a very small addition of these elements will increase the strength of steel or other metal by a very large percentage.

These discoveries are of value in helping the country to become independent of foreign raw materials in its metal industry.

Time required for the Reconstruction of Bridges. By Major Reiss.

Time is money in peace time—time is victory in war. The writer points out how much valuable time can be saved by using suitable mechanical means for the repair of bridges and tunnels. He quotes instances of the time taken for the repair of bridges and tunnels during the war, and works out from them a general rule that, taking an engineer company as the unit of work, the time taken to repair a bridge over 50 metres long will be one and a half days for every 10 metres of length. In unusual circumstances, or in the repair of shorter bridges, the time taken up with preparatory work will lengthen the time of construction.

Bridges were usually repaired with wooden framed trestles carried on piles. This was, as a rule, the quickest method. In some cases, where the river bed was suitable, damaged girders were hoisted on piles of sleepers as a temporary measure. On the eastern front 180 bridges, and on the western front about 45 railway bridges, were repaired or rebuilt. Credit is given to private contractors for some rapid reconstruction work that they carried out.

In the case of tunnels, obstructions caused by derailing or by the collision of engines and waggons were soon repaired ; damage caused by masses of earth brought down by explosions, especially if aggravated by inrushes of water, was difficult to repair. Demolitions in the middle and at both ends of a tunnel were the most troublesome to deal with. If the hill through which the tunnel passed was of no great height, it sometimes paid to repair the tunnel by excavating from the top, or to convert it into a deep cutting. In another case the line was diverted round the hill.

In any case, the first thing to do in repairing a tunnel is to get one line open for traffic as soon as possible.

Apprentices in Armament Work.

Dr. Leonhardt discusses the problem of finding substitutes for the 6 – 700,000 skilled workmen employed on armament work who are likely to be called up for service on the outbreak of war. His proposal is to employ a number of apprentices who will undergo four years' training. On the outbreak of war, the two senior batches of these will be taken over as skilled workmen. They will fill about 300,000 vacancies.

The writer considers the system adopted in the British Air Force of enlisting apprentices as well as boys (the latter between 15½ and 18½ years of age) to be worth study.

Rationalization of Industry and Armament Work.

Dr. Ruprecht compares the rationalization of industry with that of armament work and shows how they differ from one another.

Defence Policy and Machine Construction. By Prof. Woldt.

Modern war is a war of machinery, and a fighting army must be equipped with machinery of every kind. All technical progress and improvements must be carefully noted by the supreme army command.

Wind Power and Land Defence.

Wind is an inexhaustible source of power. This article explains a proposal to utilize it when existing coal measures are exhausted, or when coal is only obtainable at depths at which it is no longer economical to work it. Ingenieur Honnef's proposal is to utilize wind power, which is continuous at a great height, by erecting some 6,000 wind towers all over Germany. The towers will be from 200 to 400 metres high and they will be furnished with wind-wheels of 100 to 160 metres diameter. With the larger diameter and a wind velocity of 15 metres per second, each wheel would develop 27,200 h.p. or 20,000 kilowatts.

Visibility at Night.

Dr. Löhle deals with the technical aspect of visibility at night, such as might affect an observer at a height of 6,000 metres. He confines his study to the conditions prevailing on a clear, starlit, cloudless night.

It is an established fact that visibility can be increased by the use of field-glasses. By day an object subtending a visual angle of one minute will stand out clearly, whereas by night a visual angle 100 times greater is necessary for visibility. Light at night is made up of starlight (direct and diffused) and sky-light, the source of which is a matter of conjecture, but which may be of five times the strength of starlight.

(To be continued.)

A.S.H.

VIERTELJAHRESHEFTE FÜR PIONIERE.

(February, 1938.)—Reflections on recent Land Fortification, by Colonel Dittmar.

This article begins with a review of an article by Lieut.-Colonel Montigny that appeared in the *Revue Militaire Française* of December, 1935, entitled *Les systèmes fortifiés dans la défense de la France depuis 300 ans.* (Already reviewed in *The R.E. Journal.*)

As the result of the experience gained in the World War, the French have adopted a system of *régions fortifiées*, in which reinforced concrete and armour are extensively used. Each individual *région fortifiée* must comply with the following conditions:—

(1) The extent of the front must be such that the attacker cannot go round it, and the enemy's fire from the flanks must not be able to prevent movement within the *régions fortifiées.*

(2) It must have strong and extended flanks. These can rest upon natural features or open "deep positions" whose flanks are similarly denied to the enemy.

(3) The front must have free communication with the rear.

(4) The front must have a net-work of communications ensuring rapid and safe movement.

(5) The front will consist of one or more dense, deep, interconnected firing-lines, fully protected and strengthened by natural or artificial obstacles.

(6) Living quarters must be provided and comparative comfort ensured for the garrisons both during the fighting and in periods of rest.

Colonel Dittmar goes on to discuss the relationship between the field army and the system of fortification adopted. In former times the fight for a fortress was not merely a tactical operation, but a question of honour. Many sieges have become examples of national glory, whereas they have actually caused heavier losses than many a battle lost in the field.

It is important to look upon fortresses as parts of a system, and not on their individual value. There are times when it is correct to abandon a fortress. Instances are quoted of the abandonment of Reims and La Fère by Marshal Joffre before the first battle of the Marne, and the abandonment, by Hindenburg and Ludendorff, of the fortress of Lötzen before the battle of Tannenberg.

In conclusion, the writer points out that the land fortification of to-day offers far more possibilities than the fortresses of the old type possessed or could possess. In the fog of uncertainty of war, an attacker must not only consider the strength and the garrison, but also the role that a fortress may have to play in the projected operations. Military history teaches that it is not the strength of a system of fortifications that is decisive, but the impression that it makes upon the enemy and the effect that it causes to his plans. Uncertainty in regard to the result of an attack on modern fortresses has never been greater than it is to-day.

Colonel Unverzagt, Commander of the Engineers of the VIII Reserve Corps, By Major Günther. An account of the part played by a distinguished engineer officer when in command of the 35th Fusilier Regiment in the battle of Champagne in August, 1915.

The Training of Engineer Leaders and Men.

(1) *Engineers in an Advance through close Country*, by Lieut.-Colonel Dinter. An account of some tactical exercises carried out by the 22nd Pioneer Battalion in the country N.E. of Bremen, an area largely intersected by water-courses.

(2) *An attack across a River*, By Colonel von Schaewen. A similar account of a tactical exercise carried out with its bridging equipment by the 19th Pioneer Battalion, without the assistance of troops of other arms.

Laying River Cables in the Rhine, by Captain Schroeder. The reconstruction of the bridge over the Rhine at Constance necessitated the relaying of the telephone cables, which had been laid under the road surface of the old bridge. It was decided to keep up telephone communication by means of cables sunk in the bed of the river. The cables in question were five of 9 cm. diameter and one of 6 cm. diameter; their combined weight amounting to 260 kg. per metre run. In order to protect them from injury, the cables were to be sunk in a trench one metre deep, cut across the river by dredging.

Two methods of carrying out the work suggested themselves:—

(1) Constructing a pontoon bridge, laying out the cables on the aft gunwales and sinking the bundles of cables by heaving them overboard simultaneously on the downstream side.

(2) Constructing a pontoon bridge, laying the cables out on the bridge deck, and sinking them gradually by passing them over a drum, while dismantling the bridge, bit by bit, from south to north.

It was decided to adopt the second method.

A difficulty that presented itself was that of getting the heavy sockets that bound the cables together over the drum. The solution arrived at was to fix the sockets to the cables, after they had passed over the drum, and before they had reached the water.

The article, which is illustrated by a plan and cross-section and seven photos, gives full details of the execution of the work, which was carried out by the 3rd (motorized) Company of the 5th Engineer Battalion, reinforced by two sections. The length of the bridge from bank to bank was 159 metres.

New Methods for Crossing Rivers by Motorized Units, By Major Hartung. This article is written in continuation of one that appeared in the same magazine for November, 1936. A translation of the first article, under the heading of " Wire Rope Bridges for Motor Vehicles," appeared in *The R.E. Journal* of March, 1937.

The writer's original idea was that of a bridge consisting of two steel-wire cables, on which motor vehicles could ride if provided with a special device attached to the outside of each wheel. The anchorages consisted of hand-driven pickets, and the span was limited to 40 metres.

In the present article, he has carried the same idea one step further, so as to deal with bigger spans. He makes use of two amphibious tanks, each of which carries a drum, round which the cable is wound. The drums are actuated by the tank engine, and the cable can be paid out or wound up mechanically. The tanks take up their position on opposite sides of the river, with the two cables stretched out from one to the other. The tanks form the anchorages; they are secured to the ground by means of steel piles driven through openings in the floor, and they are further supported by struts. (These openings would appear to be one of the weak points of the scheme.)

In other respects, the general idea remains much the same as in the original scheme. But it does not appear to have been tested in practice, and it remains to be seen what modifications will have to be made before satisfactory results can be obtained.

Suggestions for Target Practice for Engineers. Captain Meltzer puts forward some ideas for training Engineers in field firing.

A.S.H.

THE INDIAN FORESTER.

(*January*, 1938.)—This number begins Volume LXIV.

There is an article on the standardization of wood pole sizes for overhead electric transmission supports. Timbers are classed according to strength, and it is rather astonishing to find teak and benteak in the second class only, inferior to sal and others. The breaking load for teak is given as 3,700 lb.

An extract later on states that palmyra poles from Cuddapah in the Madras Presidency have been tested and found as strong as sal, in spite of their hollow interior.

(*February*, 1938.)—In " The financial possibilities of plantations," Mr. B. E. Smythies aptly compares expenditure entailed on afforesting areas in N.W. India, in order to prevent erosion, with that incurred in building a large bridge for military or strategic purposes.

The romance of forestry is well expressed in a broadcast talk, " Forests and Man " by Mr. Garland.

" Bush treatments with wood preservatives " emphasizes the comparative uselessness of merely smearing preservative on to wood, for outdoor work or in exposed positions. Powderpost beetles and pinhole borers will get into any timber so treated. Unfortunately, the alternative is a plant to treat wood with preservative under pressure, and that is a matter of considerable expense.

The report on the forest administration of Kashmir records a trout weighing 13 lb. 6 oz. taken from the middle Bringi.

The *Scotsman* is quoted as recommending the afforestation of the catchment area of the Thames, as a guarantee against floods and drought. It would be as well if mankind in general sat up and took notice of the inter-relation of deforestation and floods. The Mississippi catastrophe of last year is an outstanding example.

(*March* 1938.)—Everyone who has been in India notices the meticulous care with which the villager erects bunds across watercourses to conserve the soil. An article with photographs shows good and bad ways of making them; the bad ones show the heaps of stone into which they have collapsed; the good have lasted for fifty years. The article gives useful hints on design, one being that the level of the centre of the sill of the bund should be slightly lower than that of the sides.

Mr. Garland's broadcast talk on "The Future of Forests" stresses the importance of the utilization of forest resources. In Japan, we are told, the third most densely populated country in the world, which cannot be accused of neglecting to develop its industries, a very much larger proportion of the country is under forest than in India, with her comparatively small population density.

An extract from *Indian Engineering* on the Indian timber industry shows what a lot has been done towards the more scientific treatment of wood in structural design, particularly in the making of joints. Some extracts may be quoted. "A too high or unscientific factor of safety was used in deriving the working stresses of Indian timbers. The fact that no impact allowance (for impact even up to 100 per cent. of loads figured) need be applied to working stresses for timber was not appreciated. It is hardly known to engineers that the strength of round timber is greater by about 18 per cent. than that derived by ordinary engineering formulæ." "A 60-foot Fink type of roof truss built up with modern connectors using chir pine, weighs about 2,700 lb. A steel truss of the same span, rise and loading, weighs 2,800 lb." "In these days of extensive research, the economic or mechanical permanence of most structures cannot be reckoned to be much over 25 to 30 years, a period which usually synchronizes with the minimum life of properly treated timber under the worst conditions."

The fire-resisting properties of various timbers are discussed in another extract; teak has twice the resistance of oak, and four times that of Western cedar.

F.C.M.