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

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THE SURVEY OF PEMBA.

By Capt. J. E. E. Craster, R.E.

Pemba is a coral island some 400 square miles in area, lying 60 miles north of Zanzibar, and forming part of the Zanzibar Protectorate. Upon it is grown more than half the world's total supply of cloves; a very valuable crop, upon which the Zanzibar Government levies an export duty of 25 per cent. The clove plantations, which cover about a quarter of the island, are owned by Arabs, who until the abolition of slavery in 1897 employed nothing but slave labour. It is said that in the flourishing days of the slave trade 14,000 slaves a year were imported into Zanzibar and Pemba, of whom the majority died within a year or two.

The natives of Pemba are closely allied to the Swahilis of Zanzibar, and speak a dialect of the Swahili language. There are also in the island a considerable number of freed slaves, who belong to nearly every tribe in East and Central Africa.

Climate.

The temperature varies but little throughout the year. The minimum cold weather temperature at night is about 74° and the maximum day temperature in the hot weather 90°. Heavy rain falls throughout April and May, and there is a second rainy season in November. Showers are of almost daily occurrence during the other months of the year, and the air is always saturated with moisture.

Preliminary Reconnaissance.

In August, 1910, Pemba was visited by Major Gordon, R.E., who made a report, and an estimate for the survey. In April, 1911, a survey party consisting of Capt. Craster, R.E., Lieut. Kyngdon, R.G.A., Lance-Corpls. Cager and Whitters, R.E., left England, and arrived in Pemba at the end of May.

Measurement of a Base.

The island is about 40 miles long, and 6 to 12 miles wide. Some 2 or 3 miles off the western coast lies a chain of small islands, and on the eastern shore of the largest of these a base had been selected by Major Gordon. Nearly the whole length of the base lay below high water mark, and the central portion below the low water mark of neap tides, so that the measurements could only be made at low water during spring tides. This involved a delay of 10 days between the first and second measurements. The measuring party were often working in water a foot, or more, in depth, but this caused little difficulty, and had the advantage of keeping the tape at a uniform temperature.

The base was measured with a 300-ft. steel tape, and the end of each tape length was marked by a steel toilet pin stuck in the side of a wooden picket, driven firmly into the ground. The tape was stretched with a spring balance to a tension of 20 lbs. This is as heavy a pull as can be conveniently applied by hand. If tapes longer than 300 ft. are used, a heavier pull is required, and it is desirable that some mechanical apparatus should be provided for applying it.

The first measurement of the base, after making the necessary corrections for temperature, etc., gave a value of 13817·343 ft., and the second a value of 13817·232 ft. The probable error was therefore 0·4 of an inch, or $\frac{1}{373000}$ of the total length.

During the measurement of the base the party was caught in a heavy gale while returning from the island. One boat was nearly swamped, and the other, though she weathered the seas better, had still greater difficulty in getting back. The following morning all the native boys except two deserted.

AZIMUTH OBSERVATIONS.

An astronomical azimuth was observed with a 5-in. micrometer microscope theodolite at Weti, a small town on the western coast of Pemba, from which both ends of the base were visible. Two pairs of east and west stars were observed, and the value found had a probable error of 0·5″.

PRISMATIC COMPASSES.

All the prismatic compasses were tested by the observed azimuth, and the magnetic variation of each noted. The compasses varied among themselves to the extent of 1° 50′. The firm of instrument makers who supplied them reported that, owing to the difficulty of making the central line of magnetization correspond with the long axis of the needle, variations of this amount were to be expected. It is therefore essential that the magnetic variation of each instrument should be determined.

The latitude of Weti was found from astronomical observations taken with a 5-in. theodolite. Four pairs of north and south stars were used. The latitude was found to be 5° 3′ 48″·3 with a probable error of 2″·9. This latitude agreed to within 1″·5 with the latitude as shown on the Admiralty chart. The latitude observations appeared to indicate that the refraction in the southern quarter of the sky was a good deal more than in the northern; the pairs of stars which transitted at the lower altitudes giving a greater value for the latitude than those which transitted nearer the zenith.

Considerable difficulty was experienced in making the astronomical observations, owing to the sky being generally covered with clouds or haze.

Trigonometrical Triangulation.

Trigonometrical triangulation was only possible between the chain of islands and the west coast of the main island. Very few points could be fixed inland, owing to the lack of any prominent hills, and the dense vegetation. A large amount of clearing was required at each trigonometrical station, and on the average it took one day to establish each.

During the clearing operations a large tree that had been cut, but which was still held up by rubber vines, fell suddenly and broke Lance-Corpl. Whitters' leg. A telegram was sent home to the Foreign Office asking for another topographer to take Lance-Corpl. Whitters' place. Lance-Corpl. McQueen was sent out, and arrived in Pemba about three months later. By that time Lance-Corpl. Whitters had recovered from his accident, and returned to work.

Some of the trigonometrical stations were established in mangrove swamps and below high water mark, no other site being possible. At one important point a dhow sailed into the trigonometrical beacon at high tide and carried it away; the mast of the dhow also went by the board. Fortunately all observations had been taken to and from this beacon before it was demolished.

The atmosphere was very thick, and great difficulty was found in seeing the trigonometrical beacons, especially when they were standing before a background of waving palms. Every form of beacon was tried, and the only one that proved to be visible was a straight pillar, a foot in diameter, and 10 to 15 ft. in height. These pillars were made of light wooden poles padded with grass or brushwood to the required thickness. If the background was dark, the beacon was covered with white cotton cloth, but if the background was sea or sky, the beacon was left uncovered. A large flag was placed on the top of each beacon.

Many beacons were destroyed by the natives as soon as they were erected, and the materials stolen. Native police were told off to protect the beacons, but no arrests were made. Eventually it was found that the best way of protecting the beacons was to slash the white cloth with a knife so as to render it useless for wearing purposes. An even more effective way would probably have been to splash the white cloth with red paint, which the natives would certainly have taken for blood. They regard a blood-stained cloth as "very bad medicine."

Compass bearings were taken from each new trigonometrical station to all stations visible from it, and noted in the angle books. Without this it was often found impossible for the observer to pick up the beacons with the theodolite telescope. The latter has such a small field that sweeping for beacons is a slow business, and the strain on the eyes of the observer is very great. If the compass bearing of the required beacon is known, no sweeping is necessary.

TREE STATIONS.

At three points tree stations were constructed. A large tree was cut some 20 ft. from the ground, and the top of the stem then formed an observation pillar on which the theodolite stood. The legs of the instrument were not used. Round the stem, and some 4 ft. below the top, a platform of sticks lashed with creepers was built for the observer.

It was found necessary to cut away all the branches from round the stem, otherwise the tree shook in the slightest wind. If a tree station more than 20 ft. high is required, a very large tree must be selected, or the stem will sway a little to every movement of the observer. No one but the observer should be on the platform while observations are being taken. The observer should note whether any alteration of his position causes the cross hairs of the theodolite to move off the object. If this is so, he must observe each angle separately, taking care not to move his position during the observation. By using the reflecting eyepiece, and turning it as required, angles up to 180° can be observed without the observer moving his position, but to read both horizontal microscopes he will often have to unclamp the lower plate and swing the instrument round.

THEODOLITE TRAVERSES.

When the triangulation had been carried as far as possible, Lance-Corpl. Cager began the topography of the western coast working north from Chake-Chake, the capital of the island. Capt. Craster and Lieut. Kyngdon proceeded to run theodolite traverses across the island from trigonometrical stations on the western coast.

The traverses involved very heavy clearing, and as the clove harvest was just beginning the labour supply was very limited. Consequently progress was very slow. At first the traverse lines ran through the clove plantations, and here great care had to be exercised to select the lines that involved least cutting, as heavy compensation had to be paid for each tree cut. After the clove plantation had been left behind, the lines entered thick bush with only occasional patches of cultivation. In the thicker parts of the bush, felling the trees was not sufficient, as they lay piled up to a height of 6 or 8 ft. in the traverse clearing. It was therefore necessary to cut up each tree and remove it piecemeal. This reduced the rate of progress to about 300 yards a day.

Over the trees grew in great luxuriance a creeper bearing a fruit like bunches of white grapes. The leaves of this creeper when crushed under foot gave out a strong aromatic scent that tainted the whole atmosphere in the neighbourhood, and affected even the native boys with a feeling of suffocation and giddiness. Another creeper bore pods covered with minute hairs that caused the pods to appear as if they were made of yellow plush. When the creeper was shaken, the air was filled with these tiny yellow hairs, which penetrated the pores of the skin and caused intense itching, and irritation.

On several occasions the traverse line had to be altered, to avoid disturbing the nests of wild bees. A professional honey gatherer accompanied the cutting party, to burn out and remove the nests, but when there were many nests close together even the professional could not tackle them.

It was not found possible to close the traverses on each other, as had been the original intention, owing to the heavy clearing that would have been required. The native boys also refused to do any more work in the dense bush belt that fringes the eastern coast of the island.

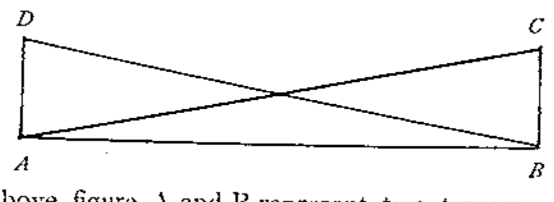
Each traverse point was marked with a permanent signal so that the topographers were able to identify it. Both forward and back vertical angles were observed with the theodolite from each traverse station, and the vertical height was calculated by the formula $h = c \tan S$; where S is half the algebraic sum of the angles observed from each end of the leg, and c is the length of the leg.

The magnetic bearing of each traverse leg was entered in the field book. This was found very useful as a rough check on the reduced bearing of the leg as calculated from the theodolite observations. If the ground had not a uniform slope between two traverse stations, a vertical angle was observed with a clinometer at each point where the slope changed, so that the taped measurements could be reduced to their true horizontal lengths.

Subtense Measurements.

When possible the length of the traverse legs was measured by subtense methods. This rendered the clearing of the line for tape measurements unnecessary, and reduced the amount of bush cutting to a minimum.

Only two signals were used in the subtense measurements. The first, distinguished by a flag, marked one end of the base and the traverse station, the second marked the other end of the base.



In the above figure A and B represent two traverse stations and AB the traverse leg. BC is the base measured at right angles to

AB and C is the subtense signal. The angle BAC was measured with a theodolite, two sets of five readings each being taken on each face. The length of AB was then worked out from the formula AB=BC cot BAC.

Before leaving A the observer measured a base AD at right angles to AB, and set up a signal at D. On reaching B, he observed the angle BAD, and found a second value for AB from the formula AB=cot DBA.

The mean value of AB was taken as the true value, but when the bases AD and BC differed greatly in length, the value of AB as found from the longer base was given the greater weight.

Subtense methods were also used for fixing prominent features which could be seen from one trigonometrical station only, and which could not therefore be fixed by triangulation.

Six theodolite traverses were run across the island. Their total length was about 40 miles and there were 218 traverse stations. The labour involved in calculating the co-ordinates and heights of the latter was very heavy.

PROJECTION USED.

The trigonometrical and traverse stations were plotted on the map from rectangular co-ordinates. As the end of the island is small no appreciable error was introduced by this method.

TOPOGRAPHY.

The island was surveyed on a scale of one inch to one mile.

Owing to the absence of prominent hills, and the density of the vegetation, ordinary plane table methods could not be used, and the following procedure was therefore adopted. Prismatic compass traverses were run between trigonometrical and traverse stations, so as to cut the country up into triangles of 3 to 5 miles side. These traverses were plotted on foolscap paper on a scale of six inches to one mile. The closing error of each traverse was distributed among the traverse stations, and the corrected co-ordinates of each station measured. The traverse stations were then plotted on the plane tables from their corrected co-ordinates, and the detail was plotted from the traverse field books.

The topographers subsequently took the plane tables into the field, and filled in all the remaining detail, and the contours, by plane table traverses run between the points already fixed. As these traverses were short, the closing errors were small, and could be adjusted in the field. The plane table was set by means of the trough compass.

As it was generally impossible to see more than 10 yards in any direction, a native boy was sent about 200 yards ahead to act as a point, and a compass bearing was taken,—or in the case of a plane table traverse, a ray drawn,—on the sound of his voice. At 200 yards the probable error in the bearing was found to be about 2°. The error however increased very rapidly with the distance, and at 400 yards it was about 5°.

Great difficulty was found in locating the point, if high ground intervened between him and the observer. The point was therefore instructed to halt at the top of each hill. It was found that a low pitched note was much more easily located than a high pitched one, and for this reason a boy with a clear bass voice was always selected as point.

Contouring was very difficult, as no observations of any value can be taken with a clinometer on the sound of a voice. Fortunately the valley bottoms though often swampy and impassable were fairly clear and their slopes very uniform, so that it was possible to determine their general gradient by a few clinometer observations. The topographers therefore mapped the main valleys as soon as possible and marked along them the heights as calculated from their general gradient starting from the high tide mark. The heights of the hills were afterwards fixed by reference to points in the valleys. The determination of heights by aneroid readings was tried but proved a complete failure owing to the atmospheric pressure being very variable.

The country offered many difficulties to the topographers. Steep razor-backed ridges about 200 ft. in height alternated with deep crooked valleys. The bottoms of the valleys were marshy and often impassable, and tidal creeks filled with impenetrable mangrove swamps intersected the country, so that long detours were necessary. Owing to the nature of the work the topographers could only survey half a square mile a day. Much time was also lost from wet weather.

The slow progress made by the topographers, and the urgent necessity of completing the work before the rainy season made it essential for the two officers to undertake a considerable part of the topography. In addition to running many of the prismatic compass traverses for the topographers, they mapped some 70 square miles of the island.

As a rule it is not desirable that officers should do topography, because it is work that can be done by non-commissioned officers and men who are of course on much lower rates of pay, and when an officer is employed as a topographer he cannot exercise enough supervision over his party. But owing to the heavy demands for trained topographers, foreign survey parties must generally be satisfied with the minimum rather than the most economical number.

The area of the island was originally estimated at 300 square miles, and the time allowed for the survey was eight months. An area of 300 square miles was surveyed within the time allowed, but the island proved to be about 400 square miles in extent, and the survey took $9\frac{1}{2}$ months.

NAMES.

Great care was necessary to obtain the correct names of the various districts and villages, as the common pronunciation often gave no clue to the spelling. Many of the villages had opprobrious names, such as "The Fools," "Fly Blown," etc., which the inhabitants would not admit, but which were used with gusto by their neighbours. One little congregation of poverty-stricken huts was endowed with a name which meant "Because I have nothing my brothers won't visit me." Lists of all names that would appear on the map were made out and forwarded to the Assistant Collector of the district who, after consultation with the headmen, wrote the correct form against each name.

LONGITUDE SIGNALS.

An attempt was made at the end of the survey to determine the longitude of Chake-Chake, the capital of the island, by wireless telegraphic signals from Zanzibar. The attempt failed owing to continuous atmospheric discharges, due to thunderstorms over the mainland of Africa, which made themselves heard on the wireless receiving telephone, and which were indistinguishable from the time signals. It often seemed as if the wireless signals themselves provoked atmospheric discharges, for the latter often came as an echo to the former. Perhaps it is possible that a cloud which is already fully charged may receive from the wireless signal an additional charge which is sufficient to break down the insulation of the atmosphere, and cause the cloud to discharge itself.

Even under the best conditions, the wireless telegraphic apparatus is not very suitable for longitude signals. It is almost impossible to send a short sharp signal, as the heavy currents used produce an arc at the contact points of the signalling key, and so prolong the signal for an appreciable interval after contact has been broken.

Chronometers installed in a wireless telegraph station are sure to be affected by the heavy currents, and strong magnetic fields, and cannot, therefore, be expected to keep a uniform rate.

INSTRUMENTS.

Two 5-in. micrometic microscope theodolites made by Messrs. Troughton & Simms were used during the survey. The sights on these instruments are rather crude, and at night it is difficult to align the telescope by them. In other respects the theodolites are very perfect instruments.

Four-inch prismatic compasses, graduated to 30′ and reading by estimate to 10′ were used. These were mounted on light tripod stands, and proved very satisfactory. The Indian clinometers which were of the standard pattern, gave some trouble, because they contained so much steel that they deflected the compasses if in their vicinity. The plane tables were 24″ × 18″ in size and mounted on heavier and more rigid legs than are usually supplied.

Two measuring wheels (perambulators) were taken out, but could not be used as the paths were too rough. The party was equipped with heliographs, but the cloudy weather prevented their use.

Great difficulty was found in preventing the steel measuring tapes from rusting. The only way to preserve them was to fill up the leather case with paraffin oil at the end of each day's work. It would be a great advantage in damp climates to have a small oil tank in which the tapes could be stored, when not actually in use.

Tools.

Axes and saws were purchased in England. Large bush knives were obtained locally in Zanzibar. When much clearing has to be done it is best to issue an axe and knife to each boy, and let him keep them till the work is finished. He then takes care of them, and keeps them well sharpened. For heavy bush clearing about one-third of the party should be equipped with felling axes, and two-thirds with hand axes. Axes to be used by natives should be of the lightest English pattern.

Much trouble was experienced in fitting new helves to the axes, as the sockets in the steel heads were very small, and the native wood helves had to be whittled away to fit the sockets. The new helves in consequence broke off at the socket after a few days' work. Spare ash helves were taken out, but these became dry and rotten before they were required for use.

Large cross-cut saws with teeth set very wide proved extremely useful, when once the native boys had learnt to handle them.

Many of the boys carried sheath knives with blades about 6 in. long. For cutting creepers and small brushwood these were much more handy than the large bush knives, and it would have paid to have equipped the whole party with them in the first instance.

Camping Arrangements.

Each officer and non-commissioned officer was equipped with a double fly ridge tent, camp furniture, cooking utensils, and a filter, so that he could camp alone if necessary. In addition there were two mosquito-proof houses ; one for the officers and one for the non-commissioned officers. The houses consisted of a mosquito curtain 8 ft. × 8 ft. × 8 ft. in dimensions. A small sheet 12 ft. × 12 ft. × 8 ft. thatched with palm leaves was built at each camping ground, and the mosquito net hung from the rafters. The windward sides were filled in with palm leaves to keep out the driving rain, but the leeward sides were left open. Without these mosquito-proof houses it would have been impossible to do any work after sunset, and there is no doubt that they saved the party from a great deal of fever.

Encouraged by the example of the survey party, one of the Zanzibar Government officials employed by the agricultural department to supervise the gathering of the clove crop camped in the interior of the island for some months, but did not use a mosquito-proof house. He suffered from repeated attacks of fever, and died in Zanzibar a few days after leaving Pemba. With the exception of the survey party no other European has ever attempted to camp for more than a few nights in the interior.

Owing to the very heavy dews and frequent rain, the native boys and servants could not bivouac as they do in most parts of Africa. Native huts were therefore hired for them, and when these were not available thatched huts were built.

HEALTH.

Five grains of quinine a day were taken by every member of the party as a preventive, but all suffered from malaria. There were no cases of blackwater fever, though it is very prevalent in the island, and often follows an attack of malaria, if the patient returns to work too soon. The doctor therefore gave instructions that no malaria patient should return to work, until four or five days after the fever had left him.

Two of the party suffered from severe congestion of the liver accompanied by high fever as the result of chills. It has been suggested by a doctor of considerable African experience that these attacks may have been due to the bite of a tick, which produces similar symptoms in animals. This is a disease that only a doctor can diagnose, and if the proper remedies are not applied early, abscess of the liver is likely to follow.

Owing to the necessity for finishing the survey before the rainy season, it was necessary to work 10 hours a day for seven days a week, and at the end the whole party were much exhausted by the hard work and the effects of malaria. In fact 10 months may be taken as the maximum time that a European surveyor can work at a stretch in the unhealthier parts of Africa. At the end of that time he should have at least two months' rest in a bracing climate before he returns to work.

The completion of the survey before the rainy season was due entirely to the zeal and energy displayed by Lieut. Kyngdon and the three non-commissioned officers. Had the rains broken before the outdoor work was finished, the survey would have been prolonged for another two or three months, and the cost would have been increased by not less than 20 per cent.

THE MILITARY ARCHÆOLOGY OF KENT.

From a Lecture delivered at the School of Military Engineering on November 16th, 1911, by MAJOR A. M. HENNIKER, R.E.

IF officers, as of course they all do, make a point, every night before going to bed, of reading a chapter of their *Field Service Regulations*, they have without doubt come across the expression "strategical point." But however carefully they read those *Regulations* they will nowhere find any explanation of what a strategical point is. It is one of those things that everyone knows—until they are asked. And if you ask some expert on such subjects "What *is* a strategical point?" it is quite possible that the answer may be "What, not know that? You are an ignorant fellow. I thought everyone knew that. Why, of course it's—it's—it's a point of strategical importance! Well, I'm awfully sorry, old man, but I'm busy to-day. If you will come back after next year's manœuvres I'll tell you all about it." Now archæology and modern military science do not seem to have very much in common, but anyone who takes any interest in the military antiquities of the county in which he is quartered can hardly fail to be struck by the fact that certain places have been fortified at every period from the very earliest times. Rochester was fortified long before there was a dockyard at Chatham to defend—in prehistoric times, by the Romans, by the Saxons, the Danes, the Normans, and in mediæval times. Canterbury is perhaps an even better example. There are earthworks there dating from the Stone Age; in the early Iron Age the largest earthwork in the county of Kent was constructed in the immediate neighbourhood; the Roman camp there was the hub on which the whole system evolved by the Romans for the coast defence of Kent turned; the Normans thought the place of sufficient importance to build there the third largest Norman keep in all England; and as late as 1790 when the Government of the day was building barracks to house the troops that had come home at the close of the American War of Independence, Canterbury was selected as a suitable place for what was then one of the largest garrisons in the country. There are, I think, quite a number of useful lessons to be learnt by considering some of the military problems that the inhabitants of Kent at various periods have had to face, and the steps they took to solve them.

Before we can consider the military problem in prehistoric times all on his own side and is compelling the invader to attack him there. Most of the prehistoric earthworks in Kent seem very badly supplied with water. One reason I think is that they were not intended to be occupied for more than a day or two at a time. And some at least of them are provided with special enclosures for cattle.

Plate I. is a map of early Kent. On it are marked a number of British camps. Possibly it may be said that it is incomplete or that it contains some works not constructed until much later times, but it is a list made out not long ago by a competent authority and we will accept it. We cannot go into everything shown on the map but will take one small part as a sample. Notice the line of earthworks marked 2, 3, 4, and 5, so regularly placed about 5 miles apart. Suppose pirates landed anywhere along the coast between Deal and Folkestone. All the population except that in the immediate neighbourhood of the landing place is nearer one of these earthworks than the invader is. At the first alarm the women, cattle, and corn would be removed to the nearest shelter while the men collected to meet the invader and forestall him at any entrenchment for which he might make. With all the food of the country swept up into these camps he could only retire to his boats, move inland, or starve. And suppose the invader moves inland; he is brought up by the river Stour. He cannot get up to its upper reaches because of the forest. From the forest to its mouth it ran through impassable marsh. The only way by which he could cross was by a ford at Thanington, near Canterbury. As long as that was held securely the whole of the country west of the Stour was safe. Similarly with an invader coming by land. If that ford near Canterbury was held all the country east of the Stour was safe. The importance of the place is obvious. Overlooking it the ancient Britons constructed the largest earthwork in the county. It was in fact a point of the utmost strategical importance. Applied to a concrete case the meaning of "strategical point" is clear.

Let us pass on to the next era (*Plate* II.). Under Roman rule Kent enjoyed peace for 200 years, but about the year 250 A.D. it began to be subject to raids by bands of roving pirates from northern Europe. To protect the county the Romans evolved a highly organized system of coast defence. Half of the garrison hitherto employed to guard against inroads from Wales was brought east and quartered in four great fortresses—Reculver, Richborough, Dover, and Lympne—and these great garrison towns were linked up by 80 miles of paved road which form the groundwork of the roads in eastern Kent to-day. Imagine the thoroughness and tenacity of purpose required to think out such a disposition of forces and then to build the fortresses and construct the roads. We ourselves are doing something of the same kind at the present day on the north-west frontier of India. Notice the distribution of the garrisons and the skilful arrangements by which we must form some idea of what the country was like in early days. First, the whole of the interior was covered by the great forest known in later days as the forest of Andred, 30 miles from north to south and 120 from east to west, stretching from the high ground above Folkestone right away into Hampshire. The centre of Kent is still called the *Weald* of Kent, which is only the Saxon name for the forest. The forest itself lasted until quite modern time; its influence on the topography of the country remains still. As late as 1802 the engineer Rennie describes the centre of Kent as possessing no roads but only tracks used by smugglers. The country being more wooded the rainfall was heavier and the rivers larger. Much of the low-lying ground along the courses of the rivers was impassable marsh—in the Weald for instance and along the Stour from Ashford to Canterbury. Before the days of bridges the rivers were only passable at a few fords. Great changes have taken place in the coast line. It is an interesting study, closely connected with the modern question of coast erosion, but there is not space to go into it in the present article. Thanet is still an island, but without some exploring it is not easy to say exactly where you pass from the mainland of Kent on to the island of Thanet. Yet even in the 8th century the Wantsum, the channel dividing Thanet from the mainland, though much shrunk was still 600 yards wide. The name Stourmouth shows that in Saxon times the mouth of the river Stour was at a point now 4 miles inland. Dungeness did not exist. Oxney Island is still surrounded by water but the water is fresh; the island is 5 miles from the nearest sea. Only one road existed, the track by which perhaps the ancient Britons brought tin from Cornwall for shipment across the Straits of Dover to the Continent, the road which in much later times received the name of the Pilgrims' Road by which it is still shown on the Ordnance maps. The population, confined by the forest to the coast line, was very small and scattered.

Now what form of attack had the inhabitants to provide against? The enemy whether coming by land or by sea had no Field Companies of Engineers or Bridging Train; he could cross the rivers nowhere but at the few fords. And he had no Transport and Supply Columns to provide him with food; he had to live on the country. An invading force could only support itself on what it could collect from the local population. When that was consumed it had to move on or starve. It could never sit down and besiege a place. Suppose now that the defenders collect their cattle and their corn into defensible entrenchments. What can the invader do? If he cannot capture such a concentration camp by assault he must immediately move elsewhere in search of food. And by assaulting he is surrendering the initiative; he is doing just what the defender wants. The defender has selected and prepared a place where the advantages are a force could be rapidly concentrated anywhere on the coast or at Canterbury. The map shows the garrisons towards the end of the Roman occupation of Britain, when they were cut down to the lowest limit by the withdrawal of troops for service nearer home. The Roman garrison of Kent was just like one of our colonial garrisons at the present day. Just as we have a High Commissioner to look after our interests in the Mediterranean, so the Romans had an official commonly called the "Count" of the Saxon shore. He had a staff just like ours—a chief staff officer, a military secretary, two staff captains, and so on. The headquarters of the Eastern Coast Defences were at Richborough. Military life at a colonial station was very much the same then as now. We read of medical officers who no doubt prescribed mixtura diabolica to patients suspected of shamming; of auditors who no doubt ruled that when young centurions went down to the treasury to draw the pay of their centuries they must travel two in a quadriga.

Inside each fortress were the barracks, officers' quarters, canteen, offices, and the stores. In the cornfields outside Richborough, in a dry summer when the corn is ripening, to this day you can trace by its stunted growth the streets of the Roman Old Brompton.

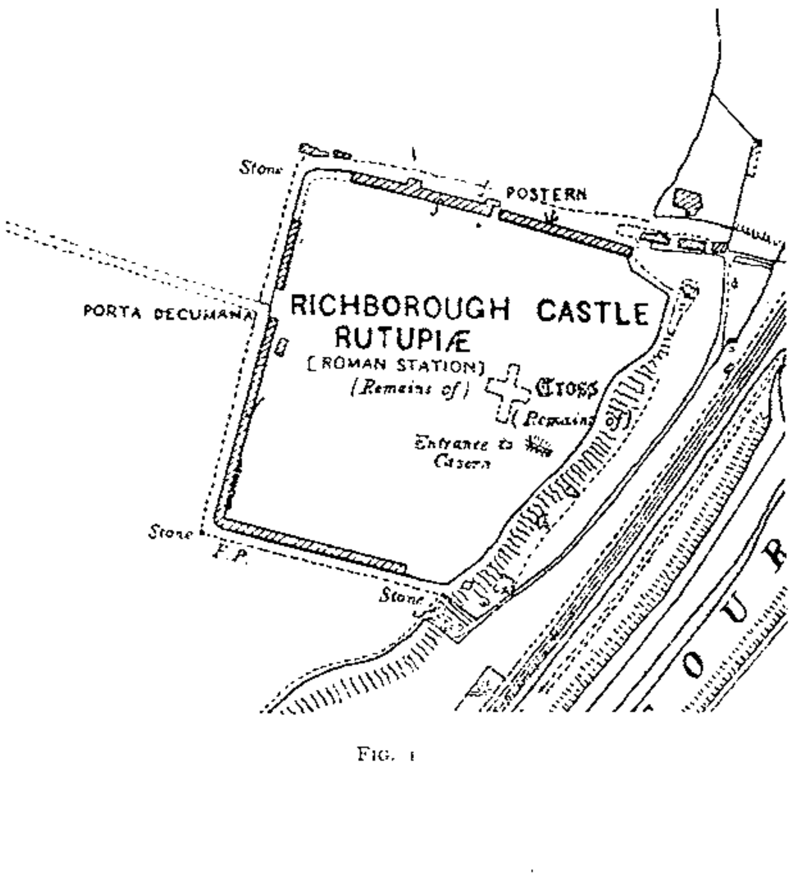


FIG. 1

Fig. 1 is a plan of part of the fortress of Richborough—the one with the best harbour and the principal port of cross-channel traffic. It was then on an island; now part of the fortress has been cut away by the river Stour. Archæologically the great interest of Richborough lies in the dotted cross shown inside the walls of the fort. It marks the site of a huge mass of buried concrete, 144 ft. long by 104 ft. wide. How deep the mass goes is unknown; water is reached 29 ft. below the surface but not the bottom of the concrete. All sorts of theories have been advanced as to its object but space is not available to go into them; the most likely solution appears to be this. When the Roman garrison left in A.D. 411 they thought they were going on a short summer campaign and would be back again in garrison before winter. Bede, who wrote within 300 years of the time they left, tells us that what they did not want to take with them on active service they buried, and that no one had ever been able to get at it. Suppose that the garrison of Chatham was ordered on service and the barracks were to be shut up and left unguarded; and that arrangements were made for all the peace equipment, everything in fact which could not be taken on active service, to be stored in a large secure storehouse. What would we expect to find in such a store? There would be spare arms and clothing, garrison and regimental archives, the plate from the Officers' Mess, the trophies from the N.C.O.'s Mess, the more valuable personal belongings of officers and men, and many other things. It is quite possible that that mass of concrete contains to this day the Roman equivalent of all that.

Under three centuries of Roman rule the Britons had lost the power of self-defence, and when in A.D. 411 the Romans left for good and the Roman garrisons which had guarded them from invasions from Scotland and Wales were withdrawn, they fell an easy prey to the Picts. Unable unassisted to defend their own country they struck a bargain with those same Saxon pirates against whom the Romans had erected the great fortresses in the south-east. In 449 they called to their assistance a band of roving Jutes under the leadership of Hengist and Horsa, promising them the island of Thanet in return for their military services. Thanet no doubt was chosen as particularly suitable. Settled there the Jutes would be cut off by an arm of the sea from the rest of the British territory and under the watch of the two great fortresses on its banks. The Picts were easily defeated by the Jutes, so easily in fact as to suggest to the conquerors "if these can defeat the Britons so that they have to call upon us for assistance, how easily can the Britons themselves be overthrown by us. Why should we be content with Thanet when we can have the whole country for the asking?" Under what pretext they attacked their paymasters and how they avoided the fortresses overlooking them we do not know. But attack they did, and swept up the great Roman highway through Canterbury towards Rochester. The fortifications of Rochester turned them southwards to find another crossing place of the Medway, and at Aylesford they found the Britons waiting to dispute the passage. All we know of the fight is that it was costly to both sides; the invaders carried the ford but lost one of their leaders, Horsa. A point of interest to us at Chatham is that his name survives in that of the modern Fort Horsted, which stands on or near the site of the tumulus which tradition reports to have marked his tomb. Next year the invader penetrated further into Kent and again met the defenders at a river crossing, this time at Dartford. Though the defenders lost heavily the battle seems to have been a drawn one, for next year we find the same forces again fighting for possession of the same ford. This time the invader was completely successful; 4,000 of the defenders fell and the *Saxon Chronicle* records that "the Britons then forsook Kent and in great terror fled to London." A year or two later the fortresses of Richborough, Dover, and Lympne fell into Saxon hands. Meanwhile the invaders were slowly pushing their way along the coast south of the Weald, and with the capture of Anderida in 491 the whole of the south-east passed into their hands. In the brief words of the *Saxon Chronicle* again "Aella and Cissa beset Anderida, and slew all that dwelt therein, so that thereafter was not one Briton left there." The lesson I think is this. The finest fortresses and the most perfect communications are worth nothing unless they are held by a warlike race. You sometimes hear people say that if only we spend enough money on fortifications we can make the country perfectly safe. The Britons had all the advantages of ready-made defences of the most perfect type of the day, but they availed nothing against a hardier race. National safety depends on a nation's spirit, not on its fortifications.

And these campaigns illustrate the importance in early times of river crossings. Nearly every one of the fords in Kent (Catford, Crayford, Dartford, Eynsford, Otford, Rochester, Aylesford, Canterbury) has been the scene of one or more pitched battles. Another point worth noting is that it is generally the crossing nearest the mouth of a river that is the most important. Watling Street, the great Roman road from Dover and Richborough into Wales, crosses every river on its route through Kent at what was the lowest crossing place in Roman times; it aims at Westminster, then the lowest ford on the Thames, and thence it aims for Wroxeter, the lowest ford on the Severn.

The Saxons drove out the Britons; in their turn the Danes overthrew the Saxons. For 230 years—from 787 to 1016—Kent was in a chronic state of war. Though there is much of local and archæological interest in the Danish campaigns, the fighting was too desultory to be of much military interest at the present time. Sometimes the Danes besieged Rochester; sometimes they were themselves besieged there. Alfred began a great campaign by an attempt to prevent the junction of two Danish armies which landed, one at Milton near Faversham and the other at Appledore. His scheme was frustrated by administrative difficulties and by the wooded and marshy nature of the Weald, and the issue of the campaign was fought out on the borders of Essex and Middlesex. The secret of the success of the Danes lay in their mobility and their sea power. They brought horses from over-sea with them, and collected more after landing. Whenever they won a victory almost invariably the first condition imposed on the defeated side was that they should furnish remounts. And whenever they themselves were pressed and in danger of defeat they "take horses and ride where they like," or they "ride away by night" to the coast and are transported by their fleet beyond the reach of pursuit. Alfred recognized the want of ships, but a navy cannot be built in a day. He himself designed and had built ships not merely capable of meeting the Danes at sea on equal terms, but ships both larger and more efficient than any built before. He has been called the father of the English Navy; he might almost claim to be the first inventor of Dreadnoughts. In many other respects he was far in advance of his time. His military organization contains the germ of the modern system of a standing army with reserves.

The next great invasion which threatened the shores of Kent was that of William of Normandy. There are few periods of English history more dramatic than the short reign—40 weeks and 1 day—of Harold. Harold was confronted with most difficult problems, political, strategical, tactical, and in the administration of his military forces. And his history is well worth our study because in many respects the problems he had to solve are identical with those which our General Staff have to consider at the present day. Besides isolated raids anywhere round the coast, he had to provide against invasion by a large army of highly-trained Regulars in the south, while another army of unknown strength made a diversion in the north. For the defence of his kingdom he had to rely on a large army of Territorials stiffened by a small nucleus of Regulars. Like ours, his Territorials were excellent fighting men individually, but they had not the discipline and cohesion which only long training together can give. He did not dare trust them to meet the southern invader in the open field. His strategic aim was to seize some point which the Normans could not disregard, so that they would be obliged to attack him on ground selected by himself and entrenched. And his solution of all the problems that beset him was eminently successful. He collected at Sandwich in Kent the largest army and the largest fleet ever assembled in the history of the country before. And he kept it under arms, and fed it, for just three times as long as the military organization of the day contemplated. Then, after a forced march of 270 miles he surprised and defeated one invader at Stamford Bridge, near York. Within three weeks, after another forced march of 240 miles, he seized a point such that the Normans had no option but to attack him there. And his final overthrow, and death, were due, not to any mistake on his part, but solely to a momentary want of discipline on the part of his Territorials. In the very moment of victory, carried away by their own enthusiasm, they disobeyed their orders, and the result was utter disaster. Not with any idea of unduly exalting his achievements, but merely to show that there may be something of military interest even at the present day in the events of those last five weeks of Harold's life, the following particulars of his two great marches are given :—

A.D. 1066.

Harold leaves Sandwich	Sept. 8th.
Defeats Harold Hardrada at Stamford Bridge, near York	Sept. 24th.
(266 miles; average $16\frac{1}{2}$ per day).	
William lands at Pevensey	Sept. 28th.
Harold hears of the landing	(?) Oct. 1st.
Harold's troops in position at Senlac	Evening of Oct. 13th.
(243 miles; average $20\frac{1}{4}$ per day).	
Battle of Senlac. Harold killed	Oct. 14th.

Napoleon's Grand Army, 1805, the Channel to the Rhine—
400 miles in 25 days = 16 m.p.d.

Sherman's march, 1864, Atlanta to Savannah—
300 miles in 24 days = $12\frac{1}{2}$ m.p.d.

Lord Roberts' march, 1878, Cabul to Candahar—
232 miles in 15 days = $15\frac{1}{2}$ m.p.d.

For 140 years after Harold's death England was ruled by foreign kings. The Kings of England were Dukes of Normandy as well. And on whichever side of the Channel they happened to be there was always a danger of a rising against their authority on the other. On the English side therefore they needed, first, secure harbours on the south coast into which their despatch vessels, and if necessary their transports, could put safely; next, safe roads inland from those harbours, with every point where the roads were liable to interruption garrisoned by their own forces; and in London a fortress to overawe the capital, and an arsenal and base if necessary for operations further inland. The work of fortifying the important points was entrusted by William the Conqueror to his great military architect, Gundulph. In the library of the Royal Military Academy at Woolwich is a tablet with a list of distinguished officers of the Corps of Royal Engineers, and the first name on that list is Gundulph. Of his original work not much remains in Kent, but the military importance of the places he fortified is shown by the fact that within 80 years of his time every one of them had to be enlarged or strengthened. Every one of them at one time or another has shown by the attacks made on it the importance it possessed in giving to its holder some definite military advantage. The holder of Rochester Castle secured for himself a free passage across the Medway and denied it to his enemy; within 300 years of the time the Norman castle was built it was besieged six times.

A few examples of Norman castles are: (1). Pevensey Castle, a Norman keep standing inside the Roman fortress of Anderida. Pevensey of course is in Sussex, not Kent, but it is of military interest in so many ways that mention of it needs no excuse. The castle is a mile inland now, but the fact that the Roman walls are built on piles reminds us that it originally stood at the waters' edge of a great harbour. It was here that William disembarked his army, and for some hundreds of years after it remained one of the principal ports of passage to the Continent. (2). Dover Castle, the great square keep built in 1155 standing in a walled enclosure of every date from Roman to modern times. (3). Canterbury Castle, the third largest Norman keep in England, now used by the local gas company as a coal store. (4). Rochester, which is too well known to need any description. The remains of Gundulph's original tower are inside the Cathedral enclosure. (5). The great White Tower in the Tower of London, the only perfect example of Gundulph's work extant.

In the 300 years following the Norman invasion many feudal castles were built in Kent and numerous Kentish towns were fortified with masonry walls. Such works are not of great interest from a military point of view except in one particular way. They represent the culminating point of the art of fortification prior to the invention of explosives. On the north-west frontier of India, in Burma, in Africa, and elsewhere we have numbers of posts designed to be defensible against an enemy unprovided with artillery. During the South African War after the Boers had lost all their artillery we put up a considerable number of solid stone blockhouses. Any one who has to design such a work may pick up some useful hints from mediæval examples.

Let us pass on to the next noticeable period, the reign of Henry VIII. Prior to his time the towns along the south-east coast had fortified themselves under penalty of being burnt by the French. Henry was, I think, the first to take a comprehensive survey of the coast defences of the country as a whole. Working on a definite plan he caused them all to be overhauled and a number of entirely new ones to be constructed. And the new ones were not necessarily near towns at all; many were sited to protect possible landing places and to deny to an enemy the use of various harbours. The effect of the growing power of artillery is seen in the massiveness of his castles; in strength and solidity they were a great advance on any previous coast defences. It says much for the ability and foresight of his engineers that though in the succeeding 300 years his works were often overhauled and extended, yet no further great scheme of building permanent works was undertaken until the invention of rifled guns combined with a French scare led to the Royal Commission on Coast Defence of 1859. Several of his new forts—*e.g.* Hurst Castle and Southsea Castle—are the nucleus of present-day coast batteries of the same name. Four were erected in Kent—Sandown, Deal, Walmer, and Sandgate; a fifth, Camber, lies just over the border in Sussex. They are all very similar in plan, a large circular keep in the centre surrounded by five or six circular bastions connected by curtains.

Camber is now almost a mile from the sea, but it is said that when it was erected the largest ship afloat could lie within biscuit toss of its walls; yet within 100 years Charles I. ordered it to be sold as being too far inland to be of use. On the other hand the Royal Commission on Coast Erosion in their final report recently published say that War Office records show that when constructed Walmer, Deal, and Sandown Castles were all a quarter of a mile from the sea. One hundred and fifty years ago they had to be protected from the sea. The width of the shingle bank along the coast here is constantly varying; in front of Walmer and Deal it is now I think two or three hundred yards. Sandown has been almost entirely washed away; only a small part of one bastion remains.

Though Henry built forts, he was wise enough to build ships too, and the great outburst of naval activity which began in his reign culminated at the time of the Spanish Armada. We know now that the Armada planned to sail up the Thames and land 50,000 men. We know too that from mismanagement and other causes, even if it had not been beaten at sea it could hardly have landed even 30,000. At the threat of its coming all the defences of the south coast were overhauled, fresh guns mounted, and garrisons provided. We hear of a battery being contemplated on the site of the Gunwharf (at Chatham); a chain was stretched across the Medway from

Upnor Castle; guns were mounted at Cooling Castle, and so on. Twenty thousand men garrisoned the defences of the south coast, 23,000 were camped at Tilbury and Gravesend, 34,000 formed the army of reserve. The Lord Lieutenants were given powers of "driving" their counties, that is to say of forcibly removing to secure places inland all the inhabitants, corn, horses, cattle, and forage, immediately the invader landed, recalling the prehistoric system of defence.

To ensure the rapid transmission of the news of a landing all over the country an extensive system of beacons was arranged; there were over 50 stations in Kent alone (*Plate* III.). All about the county you will find a number of eminences marked on the Ordnance maps "Beacon Hill"; there is one on Chatham Hill (near Jezreel), on the south side of the main road from Chatham to Dover; another 2 miles west of Faversham, and another near Benenden. Most of these got their name I think in Armada times. The intention was to signal a landing by smoke by day and by blazing tar barrels by night. In the event of invasion we might even at the present day have to depend for a time on visual signalling. Does the signalling officer of the emergency battalion at Chatham know the best places at which to establish signalling stations to communicate with, say, Canterbury, or the great defensive position near Sutton Valence, or even Gravesend? If not he might do worse than put in his pocket a map showing the positions of the Armada beacons.

For nearly 200 years after the time of the Armada the military history of Kent records no striking events. The capture of Sheerness and the burning of ships in the Medway in 1667 was not an invasion but a purely naval raid. It is not until the 18th century that we begin to hear of invasion projects and defence schemes. From 1773 onwards the problem of the defence of Kent from invasion increased yearly in importance. During the American War of Independence most of our regular troops were abroad, and in 1778 we find camps of militia at Dartford, Chatham, Coxheath (just south of Maidstone), and at Warley, in Essex. The French General Staff published some years ago a large work giving particulars of every French scheme for the invasion of the British Isles down to the time of Napoleon. The scheme of 1778 was worked out by General Dumouriez, then Commandant at Cherbourg and afterwards Minister of War and Commander-in-Chief. At the time of the French Revolution he left France and placed his services at the disposal of the British Government. For their benefit he gave full details of his scheme of 1778 and these are shown on *Plate* IV. Space only allows of noticing one or two points in it. The various columns are shown at the places at which they were to camp each night. The daily marches are short, averaging only about 8 miles, no doubt because opposition was to be expected. In some cases the places at which he proposed to halt were actually the sites of militia camps at the very time the scheme was prepared. One wing was to move *viâ* Rochester; the Great Lines as we know them at Chatham and the land defences of Rochester were just being started. If Dumouriez knew of them he probably counted on their being so incomplete as to be able to offer little resistance. If you try to put each day's march on a modern map you will find that the roads are very inconvenient; there is seldom a good road from one halting place to the next. The reason no doubt is that in 1778 there were very few roads in the Weald at all; the marches were cross-country ones. The decisive battle was expected to take place on the sixth day, along a line from Forest Hill to Deptford. It was just about the time that this scheme was prepared that three floating bridges were constructed at Gravesend to enable troops to be readily transferred from Essex to Kent or *vice versâ*. In the event of invasion such bridges might play an important part at the present day. Suppose a Territorial Division is mobilized at Warley, in Essex, and another say at Trosley, on the chalk ridge overlooking Kemsing and Wrotham. Suppose further, an invader lands in the south and it is desired to bring the division in Essex to reinforce the division in Kent. The distance is only 20 miles as the crow flies and with bridges at Gravesend it would be only a single day's march. If the movement were to be effected by railway *viâ* London it could hardly be completed in less than three days.

After the year 1778 the regular troops who had been serving in America began to return home and barracks had to be built for them. The south-eastern district was the danger spot and we find barracks being put up at Chatham, Canterbury, Deal and Rye. There was a proposal to purchase Rochester Castle and convert it into barracks. But a large number of troops were still kept under canvas along the coast during summer and withdrawn inland and billeted during the winter. We hear of complaints by the civil population of the hardships caused by billeting, and a military writer of the day points out that it would be much better if the troops were kept near the coast, not for defensive reasons, but because they could be fed so much more cheaply near the sea on fish! The number under canvas was often very considerable; as many as 15,000 were camped near Brighton in 1793 and 1794. In 1796 George III. wrote to the Commander-in-Chief pointing out the danger of their withdrawal in winter and recommending temporary barracks at Canterbury, Ashford, and Chelmsford. Napoleon was well aware of the withdrawal in winter. In 1798 he wrote that an invasion carried out in the months of November or December would almost certainly be successful. At the present day if the Territorials were called out in the winter the problem of how to house them would be a serious one; you cannot billet say 20,000 men in one place for six months at a stretch.

In 1796 the expected invasion appeared imminent and the Cabinet called upon the War Office to formulate a defence scheme. The War Office, after some search, produced it—from the Public Record Office! It was the scheme drawn up at the time of the Armada 200 years before. This of course was quite unsuited for the new conditions and Sir David Dundas, the Quartermaster-General, drew up a new one. From this time until after Trafalgar in 1805 the scheme underwent constant alteration, so that it is difficult to say what the arrangements in force at any particular date were. Space is not available to trace its evolution, and it will only be possible to touch on one or two points.

At first it was intended to "drive" the southern counties immediately a landing was effected, *i.e.* to withdraw inland all the inhabitants, live stock, corn, forage, and vehicles. The district was mapped out into areas each under a commandant and places of concentration selected. But when worked out in detail the scheme proved quite impracticable. Sussex alone needed 18,000 wagons to remove the corn and 35,000 to remove the hay, while in addition there were 60,000 aged and infirm persons to be removed. At least 110,000 draft animals would have been required while all told there were only 37,000 horses and oxen in the country. It was decided therefore that all that was to be attempted was to remove all the horses and vehicles and to burn the corn mills. An enormous number of works were undertaken to protect every possible landing place; although in recent years the War Department has disposed of a great many pieces of land yet it still possesses plots, originally the sites of batteries, practically every half-mile all round the coast of Kent and Sussex. Many of the works were not completed till long after the danger was past.

It is interesting also to consider the mobile defences. What was Napoleon likely to do? We know now that he had in French ports ready to embark at an hour's notice 90,000 men with over 400 guns and rations for 10 days. He calculated that the crossing would take from six hours to three days according to the state of the wind and tide, and that he would reach London four days after his landing. On his way to St. Helena he made three statements as to where he proposed to land. (1). Between Deal and Margate. (2). As near Chatham as possible. (3). Wherever it suited, preferably on the coast of Kent. He reckoned on securing Chatham as a point of retreat if defeated on land. Dundas, who commanded all Kent and Sussex with his headquarters at Canterbury, based his scheme of defence on suppositions that we now know were quite wrong. He concentrated his principal defences between Dover and Beachy Head. Apparently he did not anticipate a landing by more than 40,000 men.

Dumouriez thought that Kent could be made secure by 60,000; the Duke of York, Commander-in-Chief, thought 55,000 would be enough for both Kent and Sussex. Actually the regular mobile defence was divided into three armies, one 30,000 strong in Essex, one of 15,000 in Kent, and the third, also 15,000 strong, in Sussex. Each was supplemented by large numbers of local volunteers.

On the assumption that the invader would attempt to land west of Dover, and that he was successful, Dundas' plans were these. News of the landing was to be disseminated from his headquarters at Canterbury by beacon fires on 15 or 16 of the most conspicuous hills in Kent. His right and centre were to be drawn back on his entrenched camp at Dover; if disregarded he would press on the invader's right flank and rear. Chatham being held, the invader would have to move on London *viâ* Maidstone, through a marshy and wooded country unfavourable to his cavalry, with few roads, such roads as there were being broken up. The force in Sussex, 18,000 strong, was either to be moved in carts to reach the great chalk ridge before the invader, or to hang on his left while he was embarrassed in the Weald. The army in Essex was either to cross at Gravesend (by the floating bridges) or retire on London. In 1796 he thought the best line of defence near London would be along the Ravensbourne, through Dulwich to Norwood. In 1803 the Duke of York thought that 500 men with 300 horses could in three days entrench a line from Blackheath to Wandsworth. Later again Dundas considered that the best line of defence would be on a line from Greenwich through Southwark to Lambeth, the defenders being relieved from time to time as fresh combatants arrived from the country. One cannot help thinking that there was something radically wrong with his whole scheme. He justified it on the ground that it would be "madness" to meet the invader, even on the great chalk ridge, with the troops under his command—they were not good enough. But what Dundas had to expect then, is very much what, if invasion does come, we may expect at the present day. An invading force will be composed of picked and highly trained Regulars, capable of marching at least 25 miles a day. If the defenders draw off to a flank as Dundas proposed, they will never see the enemy. He will march straight ahead and they will never catch him.

In connection with the fixed defences at the beginning of the 19th century was a system of visual telegraph stations. There are several places in Kent called "Telegraph Hill," "Telegraph Farm," and so on. There is a Telegraph Hill near Minster, in Thanet; another near Higham, between Strood and Gravesend; there is a Telegraph Farm near Tilmanstone. These got their names in Napoleonic times, when the Admiralty organized lines of signal stations along the coast and from various places such as Sheerness, Deal, and Portsmouth to London. In London there was a station at first on one of the towers of Westminster Abbey and later on the top of the Admiralty Offices. The crew of each station consisted of a midshipman and five or six seamen, and messages were transmitted somewhat in the same way as by the naval semaphore system of the present day. Under favourable conditions a message could be sent from Yarmouth to the Nore in five minutes. Another great defensive work was the Royal Military Canal and Road. Dymchurch wall, the bank which keeps the sea out of Romney Marsh, affords a very favourable landing place for troops disembarking in small boats from transports and so was looked upon as a very likely landing place for the French. The canal and road, 23 miles long; were constructed between 1805 and 1812. They were designed as a retrenchment to this dangerous part of the coast, the canal being an obstacle while the road provided a covered route for the movement of troops to any threatened point. The canal is laid out in straight lengths with gun positions at the angles to flank it.

Only a brief outline can be given of the early defences of Chatham. The Dockyard was started in the reign of Henry VIII. and then occupied a small area near the Chatham Parish Church. In the museum in the Dockyard is a plan showing the additions made in each subsequent reign. The last great extension was made in 1875 when the whole of St. Mary's Island was taken in. The three main basins lie along what was formerly St. Mary's Creek. Upnor Castle was built by Queen Elizabeth to guard the approach to the Dockyard by river, and another fort was constructed just below Cockham Wood. Later it was found that small boats could come up St. Mary's Creek without coming under the fire of either of these and a blockhouse at Gillingham was added. When in 1667 the Dutch fleet came up the Medway a chain was stretched across the river from Cockham Wood Fort to Gillingham Fort to bar their progress, but it was disconnected by the Dutch and some of their ships got up as high as the Gunwharf. Outside the gate of the Naval Barracks at Chatham and also outside the museum in the Dockyard are some old guns with a varied history. They bear the Tudor royal arms so presumably they were originally English, but they were found on a Dutch man-of-war, the *Mathias*, when captured in 1653. When the Dutch came up the Medway the *Mathias* was one of the ships moored across the river to obstruct the passage. She was however burnt and sunk and the guns lay at the bottom of the river until fished up in 1876. The Dockyard was first enclosed by a wall in 1634, but its land defences were not seriously considered until 1709 when land was bought outside. The first defences appear to have been constructed between 1725 and 1730. The "Lines" were first constructed in 1756 and consisted then merely of an earth parapet

5 ft. thick. The works much as we know them now, took their present form between 1778 and 1780. When completed in 1780 they mounted 60 guns and required a garrison of 7,000 men. The princes who gave the names to the various bastions were brothers of George III.; the other names, Cornwallis, Amhurst, Townshend, etc., commemorate distinguished Masters-General of the Ordnance. Fort Pitt apparently takes its name from Lieut.-General Pitt who commanded the garrison in 1783.

Chatham Barracks were completed in 1778 and were no doubt intended partly to house the Militia so often encamped at or near Chatham about this time, and then to be occupied by Regulars returning from America. Brompton Barracks were built in 1804, St. Mary's in 1807. Fort Clarence, and the Clarence and Medway Towers still remain; Delce Tower has recently been sold by the War Department; Gibraltar Tower has long ago disappeared; it stood near the north-east corner of what is now the Victoria Gardens.

AN ENGINEER OFFICER UNDER WELLINGTON IN THE PENINSULA.

(Continued).

(*Edited by* COMMANDER THE HON. HENRY N. SHORE, R.N., RETIRED).

May 31st (contd.). Thomar was reached next night, where they were billeted on a very good house; and Abrantes the following day, June 10th:—"Where I found Col. Fletcher, Boothby, Burgoyne, etc." Here he remained till the 25th, losing his baggage horse, which had to be shot.

ABRANTES, *June 17th*, 1809.

MY DEAR FATHER,

I wrote to you from Oporto, upon our return to that place; since that time nothing material has occurred. We marched from Oporto to Coimbra and from thence to this town, in the neighbourhood of which all the army are now hutted or encamped, and where Sir A. Wellesley is with Head Qrs. All our officers are now here with Col. Fletcher, making plans, etc. . . .

I understand that Capt. Buchanan is Adjutant vice Jones resigned, notwithstanding what I was promised on that subject; it however gives me little concern, as I had not placed much confidence in it, and indeed am not very anxious about it; yet I think Handfield should let you or me know something more about the affair, for you know his promises were very decided, even in the name of the General. I am certainly very unfortunate in these things. I have had the misfortune to lose my baggage horse for which I gave 90 dollars, when we marched from Lisbon; he died a day or two ago; he was a good deal knocked up during the marches and at last died. If he had been killed or glandered I should have been allowed £18 for him, but as it now happens I shall get nothing. I must do as well as I can to get another before we march from here, but the expenses of this kind will ruin me if it goes on. Notwithstanding these untoward circumstances I feel happy and thankful that my health has been restored and continued to me; I hope it will please God to continue that blessing, and I shall then be able to get through this world somehow or other. . . .

This is a large town upon the river Tagus which runs to Lisbon, about 100 miles from here; it is one of the places I was sent to reconnoitre when I first came to this country. It is said that we are to move into Spain shortly; part of the army is advanced towards the frontiers. On the 10th instant the French endeavoured to force the Bridge of Alcantara, a town in Spain about 50 or 60 miles off, upon the river Tagus; our people blew up the bridge by a mine which Lt. Stanway of our Corps had prepared, and which, luckily for him succeeded; soon afterwards they retired, but I do not know where they are.

M.-Genl. Tilson whom I was attached to returns to England; he could not agree with Marshal Beresford, and was disgusted at being obliged to serve among the Portuguese troops. Capt. Chapman continues at Lisbon still; they are fortifying it upon a large scale; this also is to be fortified, Capt. Patton has been here some time for that purpose.

I hope you will let me know whatever news you have, particularly what B.-Major Handfield says; I really think he has not been long enough in office to entitle him to forget every promise he makes; however you may remember me to him when you see him. You should get a map of Spain and Portugal in order to trace our movements; for if we go into Spain I daresay we shall not be idle. I shall have to resume the study of Spanish, I have my grammar, etc., with me. I get on tolerably well with Portuguese, at least I can make them understand almost anything I wish, yet I have not studied much, thinking we shall soon have occasion for Spanish. In fact I neither like Portuguese nor Portugal, although the country and climate is fine. . . .

On the 29th of May I was 21 years of age; I did not fail to send you all my best wishes, which is the only thing a poor soldier could do (upon a march) when he became of age. Whenever you write give my best love to my dear mother and all my dear brothers and sisters. . . . Tell my dear mother I would write to her as well as you, was I not fearful of the expense of postage; she may be assured I do not want in inclination. I remain, etc., etc.,

RICE JONES.

Capt. Burgoyne and another officer having been sent off to reconnoitre the northern frontier of Portugal,—"Lt.-Col. Fletcher wished me to reconnoitre the river Zezere, but I was unable to do so for want of horses."

June 25th. "The Col. having desired me to proceed to reconnoitre some rivers in Spain," a start was made, in company with Col. Delancy and Lt. D., of the Portuguese Engineers. Passing through Castello-Branco and Salvaterra, they entered Spain, for the first time, paying a visit to Sir R. Wilson and the Lusitanian Legion. Next day, June 29th, "Rode to Alcantara with Lt. Stanway to see the bridge he has destroyed; the second arch from the right bank is blown up, and not a stone of the arch is standing. The arch which is destroyed was blown up and re-built by Charles V., of Spain."

This magnificent bridge—one of the finest specimens of Roman work in the Peninsula, if not in the world, was built across the Tagus, A.D. 105, by the Emperor Trajan. The material is granite, laid in large blocks; no mortar being used in its construction. Its length is 616 ft. with a width of 20 ft. The two middle piers are of a height of 190 ft.; the arch having a span of 150 ft. In the centre of the bridge is a Triumphal Arch bearing a Latin inscription. In the Journals of General Sir A. Dickson, Royal Artillery (edited by Major J. Leslie, R.A.), we learn that the bridge was broken by order of Colonel Mayne, of the Lusitanian Legion; that the Spaniards were very angry, as it was subsequently ascertained that only a small body of cavalry were approaching; they said the bridge had been preserved by the Goths, Moors, and other barbarous nations, and at last destroyed by the Portuguese—the most barbarous of all. As a matter of fact, this piece of vandalism was performed by an Englishman, Lieut. Stanway, of the Engineers, by superior orders.

Placencia, July 2nd. "This morning I received a message from the Junta, saying they wished to see me; upon my going there with Capt. Whittingham (who is a Brigadier-General in the Spanish Service), they requested me to fix upon a spot the most proper for a bridge over the river Teitar; this I promised to do, and they gave me an order for the different villages near to do whatever I required for the service." Proceeding on his mission, our author found himself billeted one night "upon the house of a very well-disposed peasant"; the next "on the house of a cross old widow woman." Reaching Soto Serrano, very late, the night following, "we had to awaken the Alcadi who afterwards had to awaken his Secretario, and after holding a council with him he endeavoured to waken the people of several houses, but for some time in vain; at last we were received into a house, got some supper and then repaired to a clean, good bed."

On the return journey, he passed through Villar, "found here some Spanish troops; the officers were civil and I got good accommodation." Next day he regained Placencia, where he was joined by Colonel Fletcher, and remained there till July 15th, drawing up a report of his late proceedings. On the latter date, he set off, in accordance with orders, to reconnoitre the river Teitar. At Losar he found Sir R. Wilson, with whom he took up his quarters, "and during all the time lived at his table." Next day, July 18th, he accompanied Sir R. Wilson and his cavalry to Arenas, where a visit was paid to the fine palace of the Infant Don Luis which had been given to Godoy,—"and we got the acclamations of the populace."

"Next day Sir R. Wilson and myself rode to the Bridge of Teitar, and returned; he posted his troops in their position."

PLASENCIA, *July* 11, 1809.

MY DEAR FATHER, . . . On the 27th ult. the army marched from Abrantes and arrived here on the 8th instant. Sir Arthur is gone to the Spanish Army under Genl. Cuesta who are on the Tagus at Puente del Arzobispo and we are now halting until his return; the advance has this instant been ordered to march and it is supposed we shall all follow to-morrow morning. The French Army under Victor are at Talavera Veija about four or five days march from us, but is uncertain where or whether they will wait for us at all. I was sent forward from Abrantes on the 26th to reconnoitre the country about the rivers Alagon (which we have already crossed) and the Tietar which we shall cross about 15 miles from hence. When I arrived here I found the French had left this place just a week; their outposts had never entered this city although they had been in sight of it some time. They have as usual burnt and destroyed all the bridges, towns, etc., on their retreat.

During the whole of the march the army have been encamped in huts, so that I was fortunate in being sent alone in front, as I always got in the best quarters, being the only British officer they had then seen. I am considered as attached to the 4th Division of the army, but I have not yet joined them and we expect a new arrangement when B.-Genl. Craufurd with the light troops from England come up; they are barely two or three days march behind. . . . The Colonel has made me an offer of the Adjutancy when vacant which I told him I should accept with pleasure. . . . In the meantime he desired me to be with Mulcaster in order to see his method of carrying on the service. This will give me three shillings a day more pay, and is most probably a more permanent situation than most other Adjutants; besides which I shall be with the Col. at Hd. Qrs. of the army always.

I have bought another horse for 60 dollars, but it is a poor-looking beast; however he will do very well to carry my servant and baggage. My large horse is very much out of condition and has rather a sore back; I mean to give him all the rest possible until the time when we are likely to have an action, and then I shall mount him. How does my old friend Hollyhock go on? he would be invaluable in this country; you cannot imagine the superiority of the English horses; I will certainly never leave England again without one. You know very well that on service the greatest cares and troubles of mounted officers are their horses. . . . I hope you will continue to send me all the news you can; nothing gives one so much pleasure as receiving a letter from you. . . . My love waits on my dear mother, my dear brothers and sisters. . . .

RICE JONES.

Great events were impending. The British Army was advancing, and a few days later would be engaged with the enemy at Talavera. Napier, in his history of the war, tells us that "Wilson, ascending the right bank of the Teitar, gained the pass of Arenas and the pass of San Pedro Bernado in which position, having 4,000 troops, he covered the rich Vera de Plascencia and menaced Victor's communication with the King."

To continue the diary:—"*July 20th.* At 4 o'clock this morning I set off from Arenas with my servant and a guide, until we arrived a short distance from Parillas, where we were informed that a party of 40 French Dragoons had just entered that village which they were then plundering; we therefore turned to the right towards Naval Carno which place we were also prevented entering by hearing that 13 of the enemy's cavalry had just arrived there. Presently we found some German Dragoons, and proceeded quietly to Oropesa. Upon my arrival I saw Sir A. Wellesley and delivered him some messages from Sir R. Wilson. I was soon ordered to be in readiness to return to Sir R. Wilson to-night."

This very day the British Army had reached Oropesa, having crossed the Teitar two days previously;—"An English officer of the Staff-corps,"—says Napier, "having taken the materials of an old house, felled some pine trees three miles off, and in one day thrown a solid bridge over that river."

July 21st. "At 11 o'clock last night I set out with my servant and a guide, and having an order to take a Spanish escort of cavalry with me from—(?), I left my horse there to return with my servant to the army, and mounted on a Spanish Dragoon horse, and accompanied by one Dragoon I rode to Naval Carno where I procured another horse, an escort of 19 men and a guide, and proceeded towards Buenventura hoping to find Sir R. Wilson there. At Hontares near the Puento de Teitar, a party of French Dragoons commenced firing upon us which we were unable to return for want of ammunition, but upon our proceeding to charge they retired up the hills, on the other side of which they were supported by a patrole of cavalry; we therefore thought it prudent to give up the pursuit of them, and continued on the bank of the Teitar to Buenventura; at this place I left the corporal and eight of the men, their horses being unable to proceed, and with the remaining ten men I followed Sir R. Wilson who had left that place in the morning. Soon after leaving the town I learnt that the enemy were in Navalmorguerde, and I therefore sent orders for the party at Buenventura to continue their route after Sir R. Wilson's troops, as far as they were able. I overtook Sir R. Wilson on his march, and he soon after took a direction towards the Teitar on the banks of which he encamped, near Ladrada. I dined with him, and slept there."

July 22. Left Ladrada at daylight, at a distance of 2 leagues found the corporal and his party of Spanish cavalry, halted and got a cup of chocolate, and taking with me 10 Dragoons ascended a steep hill to Navalmorguarde, where we were received with the greatest enthusiasm. Hearing that firing had been heard all the morning in the direction of Gamonal, I made the best of my way towards that town, avoiding the villages occupied by the enemy, and rode as fast as I could towards Talavera, which the British and Spaniards were then entering. I had the greatest difficulty before I could pass the Spanish column, but at length joined the army once more. I procured a billet, but altho' I walked about to find my servant and horses until dark I was obliged to retire to rest without either.

Talavera, Sunday, July 23rd. At dawn of day I walked over the British camp, but was some hours before I could find my servant, etc. I immediately mounted my horse, in order to find Col. Fletcher who has appointed me his Adjutant. I joined the column in advance expecting that he would soon arrive there, but hearing that he was with Sir A. Wellesley near the bridge over the Alberche, I proceeded there where I found him at a conference between Sir Arthur and Cuesta; reconnoitred the banks of the river with the Col., and was just beginning to act with Lord Macduff, Wittingham, etc., when Sir Arthur mounted and I was obliged to follow him; he rode towards the army and ordered them to return to the ground they had occupied during the night, the intended attack being postponed until next day.

Monday, July 24. "At 2 o'clock this morning part of the line began their march towards the River, where they arrived about half past 4 o'clock, and were surprised to find that the enemy had left their position—(the Left of which was on the Tagus, their Right on Casalegas, and their Front was hid by the river Alberche) during the night. I remained at the Convent until Genl. Hill's Division arrived, being ordered to Maj.-Genl. Tilson's for the day. Finding the French had retreated I crossed the river and proceeded through the French camp towards Casalegas, and returned by the bridge of the Alberche to Talavera. The Spanish Army began a pursuit of the French, whilst our advance halted near Casalegas, and the rest of our army returned to the neighbourhood of the town."

TALAVERA DE LA REYNA, *July* 24, 1809.

MY DEAR FATHER,

Since my last letter which was from Plasencia, the army has moved to this place; on the 17th inst. we marched from Plasencia; on the 22nd our advance fell in with that of the French at Gamonal, a town 2 leagues from this; they were driven out of that town and also from this; their main body continued posted on the other side of the Alberche a river which runs into the Tagus about 4 miles from this place. The next morning our troops moved towards the river intending to cross it by a ford near the right of the French, whilst the Spanish Army under General Cuesta was to cross it over a bridge on the left of the enemy. Sir Arthur however thought it prudent to put off the attack until the next morning, particularly (it is said) by desire of General Cuesta; accordingly our army as well as that of the Spaniards was put in motion this morning about 2 o'clock with the intention of forcing the passage of the river at daybreak; this would I daresay have cost us a great number of men, and I much doubt if the Spaniards would have been able to force the bridge as the enemy has had so much time to prepare us a warm reception. Upon reaching the bank of the river we were not a little surprised to find that they had all left their position the day before, and their camp on the other side deserted; we found that they had retreated during the night or early this morning. Our troops are ordered to halt here till to-morrow, which appears to be a good arrangement, as we should only fatigue our troops by an useless pursuit. The Spanish Army are in full march after them: they are very numerous but we do not think they will fight well, but it is impossible to say; they certainly ought to behave well in this country. The French Army are calculated at 18 or 20,000 men; they have another under Sebastian near Toledo of about 17,000 men; it is thought therefore that they mean to unite their force before they give us battle.

During the march from Plasencia to this town I was again sent forward to reconnoitre; I went up the river Teitar and along the right flank of the French to Arenas; I went with a column of Portuguese and Spaniards under Sir. R. Wilson who as usual behaved extremely kind to me. From Arenas I (with my servant only) crossed the French patrols and videts and rejoined the British Army at Oropesa; there I found Sir Arthur and informed him that Sir R. Wilson was on the right of the enemy; Sir Arthur then desired me to return to Sir Robt. Wilson that night and gave me an escort of Spanish dragoons with which I found Sir R. and returned to the army at Gamonal. I have had several providential escapes of being taken prisoner—was obliged to go across the country, avoiding the roads, etc. I am greatly indebted to the peasants of the country who always informed me when the enemy's patrols were near, as well as the best way of avoiding them.

Our promotion is come out and I am now living with Colonel Fletcher as his Adjutant which I hope I shall continue to do for some time. I am extremely well in health and spirits and hope you all continue so. . .

R. JONES.

Tuesday passed off in quiet; two of the Engineer officers being ordered to reconnoitre the Tagus and the Alberche, respectively.

Wednesday, July 26, also passed off quietly:—"Rode this day to Casalegas and ordered the entrenching tools from the German Brigade to the Guards. The Spaniards returned to the bridge over the Alberche this evening, the French having turned upon them. The town began to be crowded with the Spanish fugitives."

Thursday, July 27. "At daybreak rode along our camp to find the entrenching tools under charge of Corpl. Black; at last I discovered him near the entrance of the town. I then followed Colonel Fletcher who had gone with Sir Arthur to see General Cuesta at the bridge of the Alberche; on the way I overtook Foster; after waiting a short time on the other side of the river they all returned, as did Foster and myself. As soon as we were all in the town, the Col. informed us that at 11 o'clock we were to begin constructing a Redoubt for ten guns which is to be on rising ground forming the centre of the position to be occupied by the British and Spanish troops in the event of an attack being made by the enemy. We immediately began to lay it out, and a party of 200 men from Colonel ——'s Brigade were set to work; this party was relieved at 3 o'clock by one of the same strength from Brigadier-Genl. Campbell's, soon after which the firing, which we had heard for some time towards Casalegas, became nearer and our troops began to take up their ground in the position. At 6 o'clock this line was completed and ready, whilst a cannonade continued advancing rapidly towards our centre from the Convent near the Alberche. At 7 o'clock the enemy were close to our line, and the working-party took to their arms; another party at this moment arrived to relieve the former, but were, by Sir Arthur ordered to return to their regiments. The Spaniards whose left were in the redoubt at the same time commenced a brisk fire, but without anything opposed to them at which it could be directed. After waiting to collect the tools which were scattered about, I joined Col. Fletcher, and we proceeded towards our left where a heavy and running fire had just commenced; this soon after ceased and we found Maj.-Genl. Hill's Division in quiet possession of the little hill which formed our left. The remainder of the night we rode amongst our line, but were not able to find Sir Arthur; at length we lay down under a tree to sleep, but were roused in a quarter of an hour by firing again which continued at intervals until daylight.

Friday, 28th July. At dawn this morning Col. Fletcher and myself found Sir Arthur on the hill which formed the left of our position, and the enemy's line (having several batteries along their front) drawn up opposite our left and centre. About 5 o'clock a heavy cannonade commenced by signal from the enemy and which was soon answered by our artillery; this was immediately succeeded by an attack upon the high ground upon our left and which was obstinately contested. During this time I was ordered by Col. Bathurst to find the cavalry and direct them to proceed up a valley which lay between the small hill we had occupied and a range of rocky heights. I first met the Duke D'Albuquerque to whom I communicated this order, and shortly after saw Genl. Fane moving up with the Heavy Dragoons; after this I returned to Sir Arthur through a heavy fire and found the enemy had been repulsed. The cannonade continued until the middle of the day when a short lull took place whilst the enemy might easily be seen cooking at a distance in the rear. Soon after, a general attack upon our whole line commenced; this was first repulsed by Brigadier-Genl. A. Campbell's Brigade on the right, and 19 cannon and some standards, etc., taken was the result of his charges. At the same time the centre under Lt.-Genl. Sherbrooke came to the bayonet and drove the enemy a considerable distance, but were obliged to retire rather precipitately, their left flank being totally exposed to the fire of the French Batteries which at that time nearly enfiladed the whole of our centre line; this was ably supported by the 1st Battalion, 48th Regiment, which had been ordered by Sir Arthur to cover their retreat, and which Regiment formed and kept possession of our ground until the guards rallied, when, coming once more to the charge, the French retired in every direction. During this time the enemy repeated their attempt on the hill on our left by moving three heavy columns along the valley to the north; this movement was rendered useless by the very gallant charge of the 23rd Light Dragoons which Regiment suffered extremely, but the enemy were prevented deploying from the close column they had formed in, the remainder of the day. The Heavy Dragoons continued in line directly in front of these columns and effectually kept them in check. After having thus defeated this general attack we remained tolerably quiet until dark, when the Col. and myself dismounted in a vineyard, between the bivouac of Sir Arthur and our line. We were fortunate enough to procure a little biscuit and wine from the Commissary who had brought a little for headquarters and had a good night's sleep.

Saturday, July 29th. At daybreak this morning the Col. and myself were upon the hill on our left, and waited anxiously for sunrise to ascertain where the enemy were; in a short time we had the pleasure of seeing they had all quitted the field during the night, and had thus given us complete possession of the Field of Battle. We immediately rode to Sir Arthur, and Col. Fletcher communicated this information to him, at which he seemed pleased, and sent us into Talavera to desire Capt. Canning, his A.D.C., to inform General Cuesta; after meeting him we returned to the hill and from thence rode along our line to the town of Talavera; on our way we met Mulcaster who had just arrived from reconnoitring the Tagus. We found Goldfinch and Forster were both well, and that Stanway was slightly wounded in the belly. We went to the Col.'s Quarters at Talavera and found poor Boothby with his leg badly wounded ever since the night of the 27th July; I went directly for Fitzpatrick, Surgeon to the Ordnance, and luckily found him; he said that amputation was the only chance of saving his life, and very soon after he performed the operation about 2½ in. above the knee; from that time Boothby gradually got better. I sent in a return of killed and wounded, and then went with Lt. Forster to sketch the Field of Battle.

July 30th. Rode with Forster the other side of the Tagus and sketched its course as well as that of the Alberche; the enemy's posts upon that river still. Next morning rode with Capt. Chapman over the Battle Field.

August 2nd, the army ordered to march to-morrow morning; great uncertainty which road we shall take.

TALAVERA, *July* 29, 1809.

MY DEAR FATHER,

Through divine mercy I have once more to let you know that I am very well in health and have been preserved unhurt in one of the most dreadful battles that has lately been fought; and our loss has been extremely great, as has been that of the enemy; the newspapers will give you the Gazette account of the affair. A private soldier of the 71st Regiment, in describing the earlier battles of the war, gives a vivid picture of the characteristic traits of the opposing troops:—"They (the French) came upon us crying and shouting, to the very points of our bayonets. Our awful silence and determined advance they could not stand; they put about and fled." And again;—"How different the duty of the French officers from ours! They, stimulating the men by their example; the men vociferating, each chaffing each until they appear in a fury. After the first huzza, the British officers restraining their men, still as death—'Steady, lads, steady!' is all you hear, and that in an undertone." And on another occasion—"Down they came shouting, as usual; we kept them at bay, in spite of their cries and formidable looks. How different their appearance from ours! their hats set round with feathers, their beards long and black gave them a fierce look; their stature was superior to ours; most of us were young; we looked like boys; they like savages.

But we had the true spirit in us; we foiled them in every attempt." The French have now retired beyond the river Alberche to their old position, but whether they mean to remain there, retreat, or attack us again, it is impossible to say. Fortunately for us the Light Brigade have just arrived and will make up for the numbers we lost yesterday. We are very much in want of provisions, which I believe prevented our moving forward some days ago. I would send you a longer letter, but it is with difficulty I can get *this Note* taken by the officer who takes the Dispatches. Capt. Boothby was wounded by a musquet ball in the calf of his leg and has been obliged to suffer amputation. Lt. Stanway was struck by a ball which spent itself in passing thro' his horse. . . . I was with the Colonel near Sir Arthur during the whole time, and of course had a great number of narrow escapes for which I desire to return thanks to God. . . .

RICE JONES.

Indirect evidence of the privations of the army during these operations is afforded by Lord Wellington's General Orders: thus, under date, Talavera de-la-Reyna, August 2, 1809, he writes, "The soldiers plunder the inhabitants bringing in provisions, notwithstanding the repeated orders upon this subject, and the knowledge which they all have, that this practice must tend to their own distress." And again, on the 9th of August—"The soldiers themselves render the difficulties of the moment greater than they would otherwise be by their irregularity, as they seize and plunder the mules coming in with provisions, by which the good and regular soldiers of the army are deprived of their just share."

August 3rd. The army marched this morning from Talavera back to Oropesa, in order to attack the force which was coming upon our rear from Plascencia, under Marshal Soult. We were quartered in a Nunnery. Whilst at dinner in the evening, Goldfinch informed us that a Council of War was then sitting and that it was reported the enemy were within a League of us and that probably we should be attacked before daylight; we made the necessary preparations and then went to sleep.

August 4th. The army were out at daylight this morning; soon after, General Cuesta and the Spanish troops came pouring in upon us, having quitted Talavera and deserted our sick; it was soon understood that we should be obliged to cross the Tagus at Puente del Arzobispo, and accordingly our baggage and sick began moving there at daybreak. At half past 7 o'clock we marched from Oropesa, halted at Puenta de Arzobispo and got something to eat; we then slept in a wood which our army occupied, about a mile from the bridge.

August 5th. At 7 o'clock the army marched and halted in advance of this place (Paralidas) which was Hd. Qrs. Col. Fletcher, Chapman and myself were billeted upon a small cottage; we were very short of provisions. Next morning the army marched at 7 as usual, halted at Mesa del Ibor; the Light Brigade advanced towards Almaraz. *August 7th.* "Began our march as usual with Hd. Qrs.: very soon returned, procured a guide with whom we went to the Bridge of Almaraz where we found a Spanish post on this side of the Tagus and a French one on the opposite. The Col. fixed upon the sites of some batteries to defend the passage of the river; during our operations we were a little disturbed by the fire of the enemy. From thence we went to Roman Gordo which was the quarters of the Light Brigade, and on to Deleytosa where we found Hd. Qrs. established. Next day Capt. Chapman was sent to the Bridge of Almaraz to construct the batteries."

August 11th. The army marched from Deleytosa; Hd. Qrs. were fixed for the night at Jaraicejo,—"the town is entirely deserted and mostly in ruins." Next morning, "the Col. and myself pitched a marquee, it being impossible from the number of fleas, and the quantity of dirt to sleep in the village; very much in want of provisions." *August 13th.* "Rode with the Col. to Las Casas del Puerto to see Genl. Craufurd who occupies that place and the neighbouring passes. From the Puente de Almaraz we had a fine view over the country between the Tagus and Teitar, and we thought we perceived the dust of a French Column north of the latter river.

August 15th. Accompanied the Col. to the town (Truxillo); the place being quite full of Spanish troops we with difficulty obtained admittance into a Quarters: we were obliged to remain in a cobbler's shop, where however we enjoyed the luxury of a good sleep upon *Matto*, and also some tolerable bread and wine for supper;—N.B. The first wine we tasted from Talavera. *August 16th.* Searched the Castle and town of Truxillo, along with Col. Fletcher and a Priest, to find timber of a sufficient length to repair some of the bridges over the Tagus. Our search proved ineffectual; I was therefore desired by the Col. to proceed to Caceres whilst he returned to Hd. Qrs. and reported the result of our search. Accordingly I left Truxillo with a Spanish Lt.-Col. who was acquainted with the resources of the town."

Our author remained three days at Caceres, which contained about 3,000 inhabitants, and had never been plundered by the French. His mission proving fruitless, he rejoined the army on August 20th:— "Upon my arrival I met the Col. and Chapman endeavouring to make good their billet upon a house which, as well as the rest of the town (Truxillo) was full of Spanish officers; in order to effect this we were obliged to have recourse to the Junta, etc., but at last succeeded in getting miserable accommodations." While here he visited the remains of the tomb of Pizarro, etc., "it has been defaced and the church nearly destroyed by the French."

"It was this gloomy city, situated on a black eminence," wrote W. Beckford, "that gave birth to the ruthless Pizarro, the scourge of the Peruvians, and the murderer of Atabaliba: the nakedest and most dreary region I ever beheld."

August 23. "Halted at Medellin, where grapes were obtained for the first time; in the evening I rode with the Col. over the field of battle between the French under Marshal Victor and the Spanish under Cuesta when the latter was completely routed. The enemy appear to have received the attack of the Spaniards in a perfect plain; their left being upon the river, and their right a little east of the town. We afterwards visited the fine old castle." Thence on to Merida on August 24th, where a halt was made till the end of the month;—"the army was hutted in the environs; the weather was intensely hot; the evenings we generally spent in riding about the neighbourhood which abounds in Roman antiquities, particularly the remains of an aqueduct, of Temples of Diana and Mars, and an Amphitheatre and a Triumphal Arch (still perfect)."

September 2nd. The army marched for Badajoz which was reached next day. "Here the Col., Chapman, and myself were billeted upon a Dignitary of the Church and remained idle for some time."

TRUXILLO, *August* 25, 1809.

MY DEAR FATHER,

My last letter was from Talavera the day after the Battle; in it I had only time to let you know of my welfare and since then no opportunity has occurred of writing to you. You are no doubt before this time in possession of full details of the glorious although fatal results of those days; and I have only to express my gratitude to God who so wonderfully preserved me during the dreadful slaughter that took place and was I believe never exceeded amongst so small a number of men. Our total number, according to returns that day did not exceed 20,000 men, whilst the enemy had, according to their own accounts 45,000, but it is generally thought they had more in the field. We lost about 5,000 altogether, and the French not less than 10 or 11,000. . . . From Jaraycejo, where we halted ten days, we moved yesterday to this town. For some days before the Battle of Talavera provisions became very scarce, and for some days we were all without anything except what accident threw in our way; we have never tasted wine or anything of that kind until we came here; the roads were very bad and the weather extremely warm. I am however very happy to find that we have at last begun to retreat in earnest. It is understood that we are to take a position for the present upon the frontiers of Portugal; we can at present do just as we please as I fancy the French have no idea of attacking us, and we cannot possibly attack them, our cavalry being completely done up, and nearly half our men either sick or wounded. Sickness is daily increasing, and I have little doubt we shall soon see England. No good I am convinced can ever be done for these people. . . .

RICE JONES.

(*To be continued*).

MEMOIR.

LIEUT.-GEN. SIR GORDON DOUGLAS PRITCHARD, K.C.B., COLONEL COMMANDANT, R.E.

GORDON DOUGLAS PRITCHARD was the seventh son of William Waugh Pritchard, Esq., Proctor at Doctor's Commons, and was born on April 22nd, 1835. He was educated at the King's College, London, and obtained his commission in the Royal Engineers in 1855, passing out of Woolwich at the head of his batch.

After the usual course at the S.M.E., he was posted to the 23rd Company and embarked with it for China on the 23rd of April, 1857. The voyage was a long one—round the Cape of Good Hope—and it was three months before *The Captain* (a small sailing ship) touched at Singapore, the first point of call.

The Indian Mutiny had meanwhile broken out and Lord Elgin (the Plenipotentiary) ordered the 23rd Company on its arrival to be landed and at once re-embarked for India on H.M.S. *Sanspariel.* Leaving Singapore on September 1st, it arrived at Calcutta on the 18th, being amongst the first troops to land in India after the Mutiny had commenced.

The first action in which Pritchard took part was at Khujiva, when the Company had its captain and five men wounded. He also took part in the Relief of Lucknow, under Lord Clyde, and was present at the storming of the Secundra Bagh—where 2,000 of the rebels were slain and the British loss was 400 men. He was with the force which escorted the Lucknow garrison to Cawnpore, which the Gwalior contingent had captured, and was at the Battle of Cawnpore on the 6th of December, 1857. He was also at the action of Khodagunge and at the subsequent Siege and Capture of Lucknow. Other actions he took part in were :—The attack on Fort Roya ; the action of Aleygung, the capture of Bareilly ; the captures of Doundettera and of Fort Oomreah, the action of Burjidia ; the capture of Fort

Musjidia and the affair on the river Raptee when the Nana Sahib escaped into Nepaul. For these services he received the Mutiny medal and two clasps.

Pritchard remained in India with the 23rd Company till the end of 1859 and then went with it to Hong Kong, where it formed part of the Expeditionary Force under General Sir Hope Grant. After wintering at Canton it proceeded north to Talienwan Bay in the spring of 1860. The main army was encamped here in two divisions, one under Major-General Sir John Michel and the other under Major-General Sir R. Napier. On his arrival at Talienwan, Pritchard was ordered to join Sir John Michel's Division and to take over the command of the 10th Company, relieving Lieut.-Colonel Fisher, R.E. He was with this division at the capture of Pehtang and the occupation of Sinho and Tangku.

The 2nd Division under Sir Robert Napier had meanwhile besieged the North Taku Fort, and Pritchard was now ordered to join this division and report himself to Major (afterwards Sir G.) Graham, who had orders to lead the assault using the British portable bridges.

When however it took place it was found to be impossible to use the bridges, and the passage of the ditches was ultimately effected by ladders. The desperate nature of the fighting can be best realized by the fact that no less than 7 V.C.'s were gained during the assault.

The attack on the fort is described as follows in Sir R. Napier's despatch :—"The English pontoon bridge, carried by a party of Marines, advancing on the line of the causeway, opposite the centre of the fort, was met by so heavy a fire that half the carriers were immediately disabled and the construction of the bridge rendered impracticable. Lieut.-Colonel Travers, R.M.L.I., and Major Graham, R.E., were also wounded in attempting to carry out this duty. I therefore directed ladders to be brought forward and passed across the ditches towards the right. This was carried out by Lieut. Pritchard, R.E., and parties of our infantry, effecting a passage of the ditches some by means of the ladders and others by swimming made their way to the gate."

In the list of officers mentioned at the end of the despatch, Lieut. Pritchard is referred to for "gallant conduct in taking up ladders, and bridging the ditch under heavy fire." He was present at the affairs of the 18th and 23rd of September and also at the taking of Pekin, being twice mentioned in despatches and receiving the medal with two clasps and the brevet of major.

At the end of the campaign Pritchard was relieved at Tientsin by Major Charles Gordon, and on arrival home was quartered at Colchester under Capt. (afterwards Sir Andrew) Clarke.

After a course of musketry at Hythe, where he obtained a special certificate, he was successively quartered at Aldershot, Portsmouth and Chatham.

In 1867 he applied to Sir Robert Napier to be allowed to join the Abyssinian Expedition, and he served through the whole campaign in command of the 10th Company. He led the assault at the storming of Magdala and was wounded in the right shoulder and arm, being ultimately mentioned in despatches and given a brevet of Lieutenant-Colonel in 1868.

He returned to Dover with his company and remained there two years, when he exchanged with Major Thackeray, V.C., for a tour of service in India. On arrival there he was posted to the Irrigation Department, and in 1872 relieved Capt. Helsham-Jones as Executive Engineer of the Agra Canal, which was then under construction. This canal, which joined the Ganges near Delhi to the Jumna at Agra, covered an enormous tract of hitherto barren land. It was completed in 1874 and its success has been since proved by the great tract of land it has made fertile.

In 1876 Pritchard was made Colonel, and he returned to England in 1881 after an absence of 11 years in India. In 1882 he was appointed C.R.E. at the Curragh, which appointment he held until 1886, when he was made a Major-General and created a Companion of the Bath. He became a Lieutenant-General in 1890, retiring a year later in 1891.

General Pritchard became a member of the R.E. Charitable Fund in 1890, and at the time of his death had been its Honorary Secretary for over 18 years. The untiring devotion with which he carried out his duties as Secretary is best judged by the reference made to him by Colonel L. Jackson at the last Annual Corps Meeting. "We all know," he said, "the extraordinary amount of work he did in connection with the Charitable Fund. He was a member of the Councils of at least four other charitable institutions, but the Royal Engineers Charitable Fund was particularly the thing that was nearest his heart, and he continued his labours long after failing health might have caused him to give them up. He gave us 18 years of devoted service to this work, and continued it to the last. I feel it will be impossible to replace him."

Sir Gordon Pritchard was also Vice-Chairman of the Committee of the Royal Soldiers' Daughters' Home; member of the Committee of the Royal Free Hospital, Grays Inn Road; member of the Committee of the Royal Cambridge Asylum for Soldiers' Widows and Chairman of its Finance Committee; and member of the Committee of the National Memorial Gordon Boys' Home.

Through being a member of the first three named Committees he was in a position to help any R.E. cases that were up for consideration at the meetings, and he never missed an opportunity of attending —even at great inconvenience to himself.

He married in 1863, Agnes Maria, daughter of W. Hinkes-Cox, Esq., J.P., and had four sons and one daughter.

In 1902 Sir Gordon Pritchard became a Colonel Commandant and in 1906 was promoted in the Order of the Bath and made a K.C.B.

He died at Weybridge on the 23rd of January, 1912.

TRANSCRIPT.

REPORT ON ARTIFICIAL ILLUMINANTS, OTHER THAN ELECTRIC, SUITABLE FOR BARRACKS, WORKSHOPS AND LARGE OPEN SPACES.

By Capt. L. N. Malan, R.E.

Introduction.

Good illumination is not necessarily obtained by brilliant lighting, but rather by so arranging and husbanding the sources of light as to obtain the best effects with the minimum waste of power. The choice of a suitable illuminant, the power of each individual source, its siting and proper shading and the colour of the surroundings are therefore all important if a good effect is to be obtained with the least possible cost.

The brightness of the sky has been estimated at 3·5 candle-power per square inch, and it has been recommended that the intrinsic brilliancy of sources of light liable to fall on the direct field of vision should not exceed 5 candle-power per square inch, above which figure the light is found to be harmful to the eye, with the exception of the frosted incandescent electric lamp : flame gas burners, candles and ordinary oil lamps, modern illuminants, exceed this brilliancy to a more or less great extent from the Welsbach gas mantle of 25 candle-power per square inch to the electric arc of 200,000.

It is therefore apparent that to obtain the best results with the minimum of harm, bright sources of light should be kept out of the field of view, or, if visible, their brilliancy ought to be suitably reduced by the effective use of shades.

Such shading has been commonly obtained by the use of frosted or opalescent glass, which, while undoubtedly reducing the brilliance and securing diffusion, does so at the expense of a very large portion of the light absorbed by the shade. In the last few years however the question of scientific shading has been seriously considered, and has resulted in the production of the Holoplane shade. This fitting is designed for all forms of illuminants, and is so arranged that the light is diffused and distributed in a scientific manner, with the minimum absorption of light.

In considering the question of artificial illumination it may not be out of place to borrow from the Holoplane Company their effective motto :

"Light on the object, not in the eye."

A.—A Coal Gas.

1. *General.*—It is not within the scope of this report to enter into an elaborate description of the manufacture of coal gas, as this forms a branch of engineering in itself and many text-books on the subject have

been published. It may be said, however, that its distillation from coal, and its purification, require a considerable plant and attention, while storage for the products is required owing to the necessarily intermittent nature of its manufacture.

The yield of gas from one ton of good coal is about 10,000 cubic feet, having an illuminating power of 16 to 17 candles in a burner consuming 5 cubic feet per hour.

2. *Water Gas.*—In practice, coal gas is frequently enriched with "carburetted water gas." Water gas is produced by passing steam through incandescent coke or coal and thus obtaining carbon monoxide. The water gas thus produced is practically non-luminous but burns with an intensely hot flame: it is therefore carburetted or enriched by means of the vapour of crude oil, or cheaper distillate, until a gas is obtained having an illuminating power of about 15 to 20 candles in a 5-ft. jet. Carburetted water gas, containing as it does, about 33 per cent. of carbon monoxide, is highly poisonous and therefore dangerous in the case of leakage. In the mixture of coal gas and carburetted water gas usually employed, this percentage is not more than from about 12 to 15 per cent., and for this reason such a mixture is less dangerous in practice.

3. *Size of Installations.*—It is thus apparent that since the manufacture of coal gas is one of some elaboration it would not be economical to generate it on a smaller scale than would be required for, say about two battalions, and for a small plant of this nature the cost of production would certainly be not less than five or six shillings per 1,000 cubic feet, while in very large plants the cost may not exceed three shillings.

4. *Burners.*—Gas flame burners in common use are of three general types, viz.:—(*a*). Flat flame. (*b*). Argand. (*c*). Regenerative.

(*a*). The flat flame is the least efficient, but is in very common use and may be found in two varieties, viz., the "Batswing" and "Fish-tail." The latter form has a concave tip and two small orifices, while the former with a dome-shaped tip has a slit for the exit of the gas. A good "Batswing" type of burner which is the type in more common use of the two, consuming not less than 4 cubic feet per hour, will give about 2·5 candle-power per cubic foot of 16 candle gas, while a 5-ft. burner will yield from 2·75 to 3 candle-power per foot per hour.

(*b*). The Argand type of burner consists of an annular burner of steatite set within a chimney of glass, and has an efficiency of about 3 to 3·5 candle-power hours per foot with a 16 candle-power burner. This is superior to the flat flame type but with a very rich gas, however, the flat flame burner, particularly the "Fish-tail" pattern, gives better results than one of the Argand type.

(*c*). The Regenerative burner, which is suitable only for very powerful lights of from 100 to 200 candle-power, consists of an inverted burner so contrived that the entering gas and air are heated before their combustion. With gas of about 16 candle-power standard these burners will give from 5 to 7 candle-power per foot per hour. Regenerative burners producing a flame of so high a candle-power throw off considerable heat which renders their continuous use in small rooms undesirable.

5. *Modern Improvements in Gas Lighting.*—The introduction in recent years of the incandescent mantle and the employment of high pressures, have so far revolutionized the use of coal gas as to make it a serious competitor with electricity, both in efficiency and in economy. In fact the Corporation of the City of Westminster are now installing coal gas in place of the existing electric light in all the streets within their jurisdiction. For house lighting, moreover, the inconveniences of coal gas have been greatly reduced by devices for controlling the light with the ease usually only associated with electricity.

6. *Mantles.*—The Welsbach or incandescent mantle consists of a fine gauze of the oxides of some rare earths such as thorium. In the first place the mantle is constructed of cotton, it is then impregnated with the metal solution and is ignited; the cotton is burnt away and its form is left composed of metallic oxide. Mantles are heated to incandescence in the flame of the Bunsen burner, either of the ordinary upright or of the inverted type, and have an efficiency of about 20 candle-power per cubic foot per hour. Although mantles have much improved in strength of late years and are specially treated to strengthen them for transport, they are still very brittle once they have been in use, and may be said to have a life of not more than 200 hours on an average.

7. *High-Pressure Gas.*—The use of gas under high pressure has led, more perhaps than even the introduction of the mantle, to the great developments of recent years in the gas industry. The advantages of high-pressure gas are that more intimate mixture of gas and air can be obtained, coupled with a greater velocity of gas as it issues from the burner, and therefore higher flame temperature with more perfect combustion as the result.

The pressures in use at the present day vary from 50 to 55 ins. of water, and are obtained by the employment of a compressor driven by any suitable form of available power. The gas under this pressure is led through the pipes into a chamber in the lamp where it mixes with the requisite amount of air: this mixture then passes through a heater as near the orifice of the burner as possible and thence to the burner when it is consumed under a mantle, the principle being somewhat similar to that of the regenerative burner. An efficiency of 60 candle-power per cubic foot per hour is claimed with ordinary gas of 16-candle standard, while a light of 73·6 candles has actually been obtained in tests. Lamps are constructed in all sizes from 60 to 1,500 candle-power with one or more mantles.

Mantles for use with this system require to be more strongly woven, and are undoubtedly more liable to breakage; for this reason it is advantageous to employ lamps designed for two or three small mantles rather than one large one of the same aggregate power.

In some high-pressure gas systems, air instead of gas is compressed; the advantages claimed are that the ordinary gas pipes can be used for the gas and in the event of anything going wrong with the high-pressure system the light is diminished only and not extinguished. On the other hand the high-pressure air requires a separate system of pipes—an arrangement that is expensive, and not always convenient.

8. *Self-Contained Highly Efficient Lamps.*—For use with low-pressure gas supply, or where a high-pressure system is not practicable, attempts have been made to introduce into ordinary gas lamps local pressure-raising or regenerative devices, well-known types being the Lucas Thermopile and the Chipperfield lamps. These lamps are relatively small, are self-contained and can, it is claimed, be used with any pressure and quality of gas off the ordinary supply pipe.

It is moreover claimed that their efficiency is a minimum of 40 candle-power per cubic foot per hour.

9. *Fittings (Low Pressure).*—An excellent gas pendant has been devised at Aldershot for use in barracks, called the "Armee" light. The pendant is similar to the usual type used with an upright incandescent burner, but is so designed that the shade can readily be removed for cleaning purposes without disturbing the light. The fitting is enamelled white and the shades, which are adjustable, are so curved as to throw off the maximum of light. These fittings are only obtainable from Hewlett & Co., 55, High Holborn, London, E.C., at a cost of 11s. 3d. each.

The Bland inverted incandescent burner introduces an improvement in that the mantle is supported by the globe instead of on the burner. When the burner requires cleaning the mantle can be easily removed without damage and replaced, which is not always possible with a fitting of the ordinary type.

10. *Control Devices.*—For domestic or other indoor use two useful contrivances for controlling gas lights from any distant convenient place are the "Norwich" and the "Bland Pneumatic Switch."

In the former system a conveniently situated fitting similar to an electric-light switch checks the passage of gas to the burner and directs its course through a separate passage to the by-pass tube and pilot light. This system requires much extra piping.

The Bland Pneumatic Switch is a fitting entirely separate from the gas system itself and is so arranged that the by-pass on the lamp is actuated by a small pneumatic valve controlled from a distance through a length of fine tubing by the pneumatic switch.

Electric ignition is also in use but not to any great extent.

For the control of lights in high-pressure gas systems "Automatic distance lighters" can be arranged, which enable the lamps to be lighted and extinguished by the increase or decrease of the pressure.

11. *Cost.*—From the above it will be seen that under the best conditions, with gas at 3s. per 1,000 cubic feet, the price of coal gas burnt in a flame burner per 1,000 candle-power hours varies between 1s. 2d. and 5½d. With a mantle, however, the cost of a 1,000 candle-power hours is reduced to about 2d. or 2½d., in addition to the cost of maintenance of the burners, mantles and globes, for which between 2s. and 3s. per annum per burner must be allowed. With high-pressure gas this cost is yet further reduced to 1d. or 1½d. per 1,000 candle-power hours.

9. *Sewer Gas Lamp.*—Mention may here be made of Webb's patent sewer gas extractor and destructor lamp. This lamp, which can be

arranged for oil or gas, draws up the foul air and gases from the sewer or other place to be ventilated, and subjects it to a minimum temperature of 600° Fahr., whereby all germs and noxious gases are completely destroyed.

These lamps have been installed successfully in many parts of the world, including India, for sewer ventilation, and are also used to ventilate the mortuaries and post-mortem theatre of the London Hospital.

B.—Petrol Air Gas.

1. *General.*—Although the employment of the lighter of the many hydro-carbon series as an illuminant was started so long ago as 1831, it is only within the last few years that satisfactory methods of employing it have been successfully placed upon the market. Petrol air gas or as it is commonly called "Air Gas" is no new thing scientifically, but having only recently been brought into use on a sound basis it is not as yet widely known nor do any exhaustive treatises on the subject exist. It may not be out of place, therefore, to give in this report a somewhat more detailed description than otherwise might be necessary.

For further information a reference may be made to *Petrol Air Gas*, by Henry O'Connor, published by Messrs. Crosby, Lockwood & Sons.

2. *Nature of Petrol.*—Air gas is a mixture of petrol vapour with air in such proportions as to be non-explosive. Petrol, motor spirit, or carburine is a volatile spirit of petroleum obtained by fractional distillation and consists roughly of 84 per cent. of carbon to 16 per cent. of hydrogen. This spirit consists of a mixture of several hydro-carbons of varying specific gravities and boiling points, and when stored is liable to settle into its component parts in layers of different weights. As any spirit will more freely volatilize when warmed, a rise of temperature will tend to make the lighter hydro-carbons of the petrol volatilize more freely and thus leave a residue of increased specific gravity. For these reasons it is important that the specific gravity of the spirit used should not be too high, as in this case the residue may after a time become too heavy to freely volatilize and thus be useless for making air gas.

The majority of machines now on the market for the manufacture of air gas use a spirit of specific gravity ·680, but one or two in which the spirit is warmed can work with as high a specific gravity as ·720 or even ·760.

3. *Storage of Petrol.*—Petrol has no other than a cleansing effect on metals and may be stored in tanks, barrels or tins, but whatever the method adopted such receptacles except for the necessary small vents must be quite air-tight; and beyond the small quantities required for immediate use, petrol should be kept apart from the engine room, to which it should be led or pumped by suitable piping. Rubber or oil should never be used in connection with petrol as both are dissolved therein.

4. *Filtration.*—Petrol as used in air gas machines and explosion engines must be quite free from water, grit or other foreign matter. Filtration is therefore essential both within the machine, in filling the tanks, and before the gas is passed into the main. For this purpose

the petrol or gas is passed through a gauze of 60 meshes to the inch, which, while being large enough to pass liquid petrol and gas will retain all water and sediment.

5. *Danger of Petrol.*—Petrol vapour is very inflammable and when mixed with air in a proportion of from 2 to 5 per cent. of vapour is highly explosive, particularly when under compression. Petrol vapour is moreover heavier than air and is therefore likely to hang about in sumps and holes in the ground for some considerable time. For this reason petrol requires special care in handling and storage and should never, under any circumstances, be exposed in the neighbourhood of any naked flame, or thrown down sewers and drains along which it may be carried on water and thus be the cause of a serious accident.

6. *Air Gas.*—A mixture of petrol vapour with air weaker or stronger in vapour than the above, while non-explosive, is still highly inflammable; the former produces by combustion a hot and non-luminous flame, and the latter a cooler but luminous flame. As, however, the dilution with air of the stronger mixture would tend to produce an explosive gas, the weaker mixture is usually employed commercially under the name of air gas, and is moreover so proportioned that all the air required for the complete combustion of the petrol vapour in the mixture is generally contained therein, and is supplied therewith through the pipes.

7. *Hygienic Effect of Combustion.*—The usual mixture employed contains from 1·4 to 1·8 per cent. of petrol, the remainder being air and this being all that is required for its combustion. Air gas has the great advantage of requiring little, if any, air from the room in which it is being burnt, while coal gas is said to vitiate the air to the same extent as three adult persons for each 50 candle-power burner used. Air gas, however, passes into a room the actual products of combustion in the same way as coal gas though perhaps not to the same harmful extent. This mixture moreover being so largely composed of air is almost free from smell and may be considered as unharmful to health and has no ill-effect on its surroundings.

8. *Danger of Air Gas.*—The absence of all smell has the one disadvantage of making leaks difficult to discover, but on the other hand should leaks occur the mixture is so weak in petrol vapour that any further dilution with air would render it innocuous and non-inflammable. In fact it is claimed by the makers that air gas cannot be ignited except at the proper burners, and it may reasonably be considered that the risk of fire is no greater with air gas, if as great, as with any other form of artificial illuminant.

On the other hand, owing to the fact that air gas requires no air for combustion, it can burn in a confined space and is liable to burn back along the pipes unless means are adopted to prevent its doing so. For this purpose all burners are provided with fine gauzes over the orifices which also serves to break up the gas for a more ready combustion. Such an accident as suggested above has actually occurred at Bordon, but its recurrence has now been rendered impossible by the introduction of gauze baffle plates in the main pipes where they leave the machine.

9. *Condensation in Pipes.*—It is claimed that air gas does not condense in the pipes, and this is substantiated by the reports of the many users

visited by the writer with the exception of a case of condensation at Bordon, in which case the cause of condensation is not easy to understand. It is suggested that moist air may have been sucked back into the pipes through burners, which had been left turned on during the day when the gas was not being made and then condensed in the cold pipes.

It is reasonable to expect that there should be no condensation, for the air in the mixture has by no means absorbed all the vapour it is capable of taking up and has, moreover, been subjected in the carburetter to the low temperature produced by the evaporation of petrol which is lower than any temperature it is likely to meet in the system.

In any case, although perhaps not necessary, it is advisable to lay all the distributing pipes to drain to certain points that can, if required, be examined.

10. *Burners.*—Air gas, as usually employed, being non-luminous, is burnt in special burners and is employed with the Welsbach mantle such as those already described under the heading "Coal Gas." These mantles are made in sizes varying from 25 to 125 candle-power each, and may be said generally to require about 1 cubic foot of air gas per hour per 10 candle-power. The burners are usually of the inverted type and are somewhat similar to the ordinary Bunsen burner, but since, as a rule the gas requires no more air for its combustion, the air holes of the ordinary Bunsen burner are in this case usually absent. The burners, which are so arranged as to reduce the pressure at the point of ignition to atmospheric pressure, are covered at the orifices by a fine gauze, and it is essential that this gauze shall be whole and clean in order to prevent the gas burning back along the pipes and to ensure a steady light. The accident already referred to as having occurred at Bordon, where in one case the carburetter exploded, is attributed to the gauzes having become clogged and then damaged by the men in the barrack room attempting to clean them.

11. *Pipes.*—Since the pipes used are required to carry the air necessary for combustion as well as the vapourized spirit itself it is obvious that they must be of fairly large size and no pipe less than $\frac{3}{8}$-in. bore should ever be used, while for 100 100-candle-power lights a pipe of 2 in. internal diameter is required. Some makers claim that the pipes used for coal gas lighting are sufficiently large for air gas but this is not strictly the case. The piping laid down in the first instance for the "Praed" installation at Fort George, Inverness, had eventually to be replaced by larger pipes, although, in this plant, a gas is employed richer in petrol vapour than is commonly the case. No great pressure is required in the supply of air gas, as the induction of air at the burners necessary with coal gas is in this case not usually required. About 2 in. of water column is generally sufficient or just enough to ensure that the gas shall be brought well up to the burners throughout the service. It is however, essential that the pipes should be well fitted and quite air-tight, and to ensure this screw joints are used. Any leaks or holes may be stopped with such a mixture as red or white lead mixed with gum arabic; red lead paint must not be used as the petrol vapour would in time wash out the oil and cause a leak. The arrangement of the distribution pipes is much the same as for coal gas and calls for no special remarks. At

Lydd the distributing system consists of a "tree" fed at one point from a "distribution box" into which the engines supply gas. The pipes of the system diminish in size as the load in each decreases and vary from 2 in. in the mains to 1 to 1½ in. in the services. At Fort George the system is similar with the exception that each pair of engines feed into the system at opposite ends of the main supply pipe. In all the installations visited by the writer the lighting is said to be steady and constant even in places remotest from the engine.

12. *Manufacture.*—Air gas is manufactured in special machines of which many types are now on the market, and which have proved very generally successful. The main principle of the modern air gas machine is to force well-filtered air into intimate contact with petrol either in its liquid or vapourized form in such a way that it shall become carburetted or impregnated with hydro-carbons to the required degree. In order to be able to regulate the mixture to the proportions required, means are always provided for the adjustment of the petrol or air valves, the strength of the mixture being regulated by the appearance of the flame of a pilot lamp. When the combustion is perfect this flame should be of a pale blue colour with a purple outer zone. A tinge of yellow indicates a mixture too rich in petrol, while too weak a mixture will burn, if at all, with an almost invisible flame.

13. *Engine Driver Plants.*—The machines now on the market are worked by small motors from ⅛ to ½ horse-power in size, which may be of any suitable type The usual motive forces employed are water, weights, and hot-air engines which burn gas from the machine itself or in larger plants a separate petrol engine.

The details of how such machines work may perhaps be explained by a brief description of some of the various types now in successful operation. It must not be supposed that the plants described in the following pages are the only reliable ones on the market, for there are many such plants as good and perhaps better. The examples taken have been merely chosen to show the general principles of manufacture.

(i.). *The Centenary.* (*See Fig.* 1 *of Plate*).

In this type, of which a plant is installed at Tidworth, a hot-air motor (*a*) drives by a belt a turbine generator or motor (*b*); this motor consists of a revolving drum immersed to just above its axis in a seal of water mixed with glycerine. The drum is divided radially into several sections and each section into three compartments as shown in *Fig.* 2. On revolving in the direction of the arrow each compartment in turn fills with air, which is brought into intimate contact with a regulated film of petrol floating on the water. As the drum continues to revolve the air in each compartment in turn mixes with the petrol, and is forced out through a central axial passage to a small gas holder of 2 or 3 cubic feet capacity which serves to maintain a uniform pressure. The gas holder when full throws the driving strap of the motor on to an idle pulley, and at the same time shuts off the supply of petrol to the motor and thus causes the manufacture of gas to cease until the holder drops again. The plant is simple and has given no trouble, but requires adjustment for any considerable change in temperature. The spirit used is specific gravity 0·715.

(ii.). *The Machine Gas Company.* (*Cox*). (*Fig.* 3).

The blower (*b*) driven by a hot-air motor (*a*) forces air through the carburetter (*c*) into which petrol led by gravity is allowed to drip and to spread on a revolving spiral of gauze from which it can freely volatilize. The air passing longitudinally through the carburetter becomes thoroughly mixed with vapour and passes out into a small gas holder (*d*) similar to the above. The gas holder regulates the manufacture by opening and closing an air escape (*e*) in the pipe supplying air to the carburetter and by shutting off the petrol valve (*f*). This plant also requires adjustment for temperature and this is effected by adjusting the rise and fall of the air escape (*e*), until the required mixture is obtained.

Four 150-light machines of this type have been installed at Fort George and two 75-light plants at Lydd, and have worked satisfactorily.

(iii.). *Non-Explosive Company.* (*Airalite*). (*Fig.* 4).

This is somewhat similar to the Machine Gas plant except that the carburetter (*c*) contains no moving parts and is so arranged that air passing through it in an upward direction passes over a series of superimposed plates on which petrol falling from above spreads and vapourizes. From the carburetter the mixture passes to a motor (*d*) which lifts petrol from the tank (*e*) by means of a small bucket wheel (*f*) and empties it bucket by bucket into the carburetter through the pipe (*g*). The gas then passes to a small gas holder, as before, which governs by opening and closing an air escape similar to the Machine Gas plant.

(iv.). *The National.* (*Fig.* 5).

In this plant air is driven by a blower (*b*) and hot-air engine (*a*) in two streams one of which (*c*) passes over a surface of petrol in the carburetter. This air becomes more or less impregnated with petrol vapour according as the flow is slow or fast and this mixture then passes through the gas valve (*e*) into the mixing box (*f*) where it combines with the other stream of air from the blower entering through the air valve (*g*). These two valves are controlled in opposite directions by the gas holder (*h*) to which the final mixture then passes in such a way that when the consumption is fast and therefore the mixture passing through the gas valve is weak the air valve is partially closed and the gas valve partially opened, and *vice versâ*. By this means a gas of uniform quality is obtained irrespective of load. The carburetter is warmed by the water from the cooling jacket of the engine which ensures the evaporation of all the petrol and is said to enable a spirit to be used of so high a specific gravity as 0·760.

A special feature of this plant is the "Thermostatic control" which is designed to ensure that the gas produced shall be uniform no matter what may be the fluctuation of the atmospheric temperature. The "Thermostatic control" is so arranged as to open or close a valve within the air valve (*g*) above mentioned, according as the temperature of the air rises or falls, for when the air is hot it may absorb a larger quantity of petrol vapour and will therefore require more dilution with air in the mixing box.

The plant is somewhat complicated and requires some looking after, but is very favourably reported on at Tidworth where a machine is installed. The engine, however, is stated to take about one hour to start unless the cold water of the engine cooling jacket is replaced by hot water, in which case 10 minutes is sufficient to start the plant.

(v.). *The Aerogen Plant.*

The Aerogen plant is more or less a combination of the Centenary and the Non-Explosive Gas Companies machines and requires no special description. The plant installed at Aldershot in the Army Accounts building is favourably reported on, and, although only worked intermittently and at partial load, has given no trouble and is quick to start up. With this plant, storage capacity can be supplied and as the gas is rich, smaller pipes than usual can be used.

(vi.). *The Praed.*

The Praed plant makes a rich mixture which requires air at the burners. A plant of this nature at Fort George works well and successfully, but produces a very unpleasant atmosphere in the engine room. This plant will not work with petrol of higher specific gravity than 0·680 and appears to be somewhat wasteful in petrol, as it is said that one quart daily has to be drawn off and thrown away. It has the advantage, however, of a fairly large storage capacity.

(vii.). *British and Colonial.* (*Simpetrol System C*). (*Fig.* 6).

This plant, of which there is a 250 100-candle-power light installation at Bordon, differs considerably from any of the foregoing. In this plant, which is larger than the usual size, the only working parts are a ½ horse-power Gardner petrol engine (*a*) and a Roots blower (*b*) driven by it. The blower forces air into a rising holder (*c*) which by its rise and fall governs the admission of air by a valve (*d*) and thus ensures the pressure within it being kept constant. From the holder the air passes by two pipes in which are regulating valves (*e*) and (*f*) into any or all of three carburetting chambers connected in parallel, one (*e*) admitting air into the carburetter below the level of the petrol, the other (*f*) above. The petrol level in the chambers is kept constant by a float and needle-valve (*g*), and thus the air bubbling through the petrol has always the same depth to pass; the mixture in the carburetter is regulated when necessary to the flame of the pilot lamp by adjusting the two valves (*e*) and (*f*) mentioned above.

The plant works well with petrol of specific gravity 0·680, but soon chokes if spirit of any higher specific gravity is used. It moreover requires a man in constant attendance during the hours of running.

14. *Engine Rooms.*—All the above plants are worked by an engine and are accompanied by more or less noise. Some, however, may if preferred, be driven by weights or water power, which are quieter and less objectionable from this point of view. In any case, on account of the danger inherent in the use of petrol, it is advisable that engine rooms should always be placed apart from any other buildings. A small room of about 8 ft. × 8 ft. will usually be found quite large enough to take any ordinary plant with a separate small lock-up attached for the storage of petrol.

15. *Water-Driven Plants.*—Two water-driven plants seen by the writer are the Mitchellite and the Victor, and appear to be simpler, quieter and easier to maintain than those requiring an engine of any sort. They suffer, however, under the great disadvantage of requiring water perfectly free from dirt or sediment, however finely divided, as the smallest trace of foreign matter soon clogs the motor and causes the manufacture of gas to cease. These plants, moreover, consume a considerable amount of water, which must be under a pressure of at least 15 lbs. per square inch; for the smallest plants the consumption being from 4 to 16 gallons per 1,000 candle-power hours, at pressures from 45 to 15 lbs. per square inch.

Water-driven plants work much on the principle explained in *Fig.* 7, which is a diagram of the Mitchellite plant. A double-acting water piston (*a*) with a mercury-weighted throw-over valve (*b*) actuates an air pump (*c*) which drives air in the balance holder (*d*). From the holder (*d*) the air passes into the carburetter (*e*) where it is carburetted to the required degree and then passed away to the mains. The balance holder governs the plant by shutting off the water when the flow of gas ceases, and by controlling the inlet of petrol to the carburetter.

16. *Weight-Driven Plants.*—Weight-driven plants require a fall of the weights of from 20 to 30 ft. according to the size of the plant. These plants work much in the same way as those described above and deliver the mixture into a small gas holder in a similar manner. When the flow from this holder ceases, the holder rises to the top of its travel and closes a valve which stops the manufacture of gas. As the pressure against which the weights have to work increases beyond their power to overcome they are brought to a standstill until the flow of gas again commences and the holder in consequence falls.

17. *Comparison of Different Types.*—Weight or water-driven plants, provided the weights are wound up or the water supply constant as the case may be, have the great advantage of requiring no stopping or starting by outside agency, the simple turning on of any of the burners connected with the system being sufficient to start a flow of gas, which in itself starts the apparatus. Directly consumption ceases the water is automatically shut off, or the fall of the weight stopped, and manufacture ceases. On the other hand, engine-driven plants cannot start themselves, and before any light can be obtained gas must be made for the burner of the engine by turning the motor for a short time by hand. An engine-driven plant will, moreover, usually require to be stopped in the engine room itself, but in order to obviate the necessity for going out on a dark or wet night, plants can be fitted with a magnetic cut-off valve on the gas supply to the burner of the motor actuated from any convenient place within the house. The disadvantage, however, of not being able to start it again except by hand is always there.

18. *Storage of Gas.*—The absence of storage capacity (the majority of plants are only provided with a small balance holder) is undoubtedly a serious one, for if the engine stops but for a moment, all the lights go out and have to be relit. It is said that air gas will deteriorate if stored, but there seems to be no good reason why plants should not be provided with gas holders sufficient say for one hour's supply provided the gas is

only stored for a reasonable length of time. Such storage capacity is in fact provided with some makes of plant such as the Aerogen and Praed.

19. *Maintenance.*—All the plants now on the market are automatic once started, and it is claimed that no further attention is required beyond cleaning up after running. This is no doubt a just claim in the case of small installations in private houses where a groom or gardener can do in half an hour or less daily all that has to be done, but in the large installations required for barracks it has generally been found necessary to detail a man or men specially to look after the plant both by day and when working. It is also advisable that all lighting up should be done by specially instructed men as more mantles are damaged by careless lighting than are ever burnt out in fair use. The control of lights with air gas is much the same as with ordinary coal gas except that where all lights are extinguished at one time it is not essential that they should individually be turned off at the burners since any escape when again turned on is quite harmless and unnoticeable provided the burner is lit within a reasonable time. In some installations this practice is adopted and thereby much labour saved, while in others each light is carefully turned off when no longer required.

In England the working of the plants is looked after by the Royal Engineers, while the supply of petrol and renewal of mantles, globes and shades are in the hands of the Army Service Corps. Petrol is supplied to the troops as required, and a free issue is made of mantles at the rate of one per burner every six weeks in winter and every two months in summer, and of one globe and one mantle prop per annum.

20. *Fittings.*—The fittings supplied generally by the various firms are rather light and flimsy and not on the whole well adapted to barrack use. It is essential that the mantles shall not be subjected to undue vibration, and in India that the lights shall be protected from the wind of the punkah. The most satisfactory fittings are probably those now in use at Lydd, where the latest pattern barrack-room light (*Fig.* 8) consists of a flat circular enamelled iron air chamber suspended from the ceiling. The air chamber is divided in half horizontally and hinged, the lower portion supports a glass globe having a 1½-in. hole at the bottom for lighting. The gas is controlled by a lever worked by chains, marked "OFF" and "ON." These labels are specially necessary with air gas where there is practically no smell to indicate whether a lamp is off or on. The price of this fitting is 13s. 6d.

Small lights in passages, etc., are of the maker's standard pattern, enclosed in wall lanterns of the usual oil or gas lamp type. For outdoor use the globe of the lamp which must be waterproof and almost air-proof should also be protected from rain on account of its heat. This has been most successfully done by enclosing the maker's standard pattern indoor lamp within a lantern of the ordinary street pattern.

21. The light from the mantles is very intense and in the writer's opinion trying to the eyes when lights of over 50 candle-power are used. It is thought that the more powerful lights would be improved by a frosted glass shade. For officers' quarters, messes and similar places the maker's standard fittings would probably be found suitable so long as, in India, the burners are enclosed within globes so as to be punkah

proof. On the whole the fittings supplied by the Centenary Company appear as well designed and finished as any, and their pendants in particular are excellent, the lamp being supported by a flexible metal tube, in place of a rigid pipe, which tends to reduce shock to mantles to a minimum. In any case it has been found in practice that the rigid pendant with a mantle is unsatisfactory and that some "give-and-take" attachment such as the ball and socket joint should always be employed. Not only does the vibration of the ceiling, particularly if there is an upper floor, very soon destroy the mantle when rigidly connected, but the lighting, no matter how carefully done, sets up vibrations which speedily prove fatal. Such pendants are therefore not commonly employed in buildings containing more than one floor, wall brackets in this case being more generally used. The necessity for using brackets, which give less satisfactory general lighting than pendants, is not however supported by the evidence obtained from the three-storied barracks at Fort George where the mantles on such pendants as are fitted with the ball and socket joint are stated to have lasted quite as long as those fitted on brackets, while those attached to rigid pendants quickly perish.

22. *Scale of Illumination.*—The scale adopted with air gas in barracks in England appears to be very considerably above that authorized for India (1 candle-power per 20 square feet in barrack rooms). At Lydd, barrack rooms 60 ft. × 20 ft. or 1,200 square feet are said to be quite well lit by three nominal 100* candle-power burners equally spaced or on the scale of 1 candle-power to 4 square feet. This is, it is thought, undoubtedly excessive, a good and quite sufficient light being obtained with a scale of 1 candle-power per 12 square feet. For outdoor lighting nominal 100 candle-power lamps spaced 80 yards apart are found sufficient to light up barrack roads, while 40 candle-power lamps are used in latrines, closets, pantries, etc.

23. *Initial Costs.*—The following table compiled from the reports of various stations gives a rough idea of the cost of an air gas installation in barracks:—

Place and Use.	Firm.	Points.	c.p. of each.*	Total c.p.	Initial Cost.	Cost per pt.	Cost per c.p
					£	£	£
Fort George (Barracks)	Machine Gas Company (Cox).	621	80	49,680	1,578	2·54	·026
Bordon (Barracks) ...	Simpetrol	254	100	25,400	446·5	1·75	·0175
Lydd (Barracks) ...	Machine Gas Company (Cox).	176 80	100 50	21,600	656·5	2·56	·0304
Fort George (Barracks)	Praed	95 12 12	75 50 25	8,025	422	3·54	·0515
Tidworth (Concert Hall)	National	93	—	5,750	246	2·64	·043
Tidworth Institute ...	Mitchellite ...	67	60	4,020	194	2·9	·0483
Netheravon (Riding School).	Non-explosive (Airalite).	39	100	3,900	140	3·6	·036
Newhaven Barracks ...	Non-explosive (Airalite).	45 41	25 50	3,175	235	2·73	·074
Tidworth Gymnasium	Centenary... ...	37	60	2,220	52	1·4	·0234
Tidworth Sergeants' Mess.	Machine Gas Company (Cox).	27	60	1,620	52·00	1·93	·032

* The above candle-power ratings are the maker's figures, and are probably not attained in practice. The nominal 100 candle-power lamp may be said to give on an average a light of 80 candles, while the smaller lamps may be reduced *pro rata*.

24. *Recurring Costs.*—The actual cost of producing air gas is not a very easy matter to determine and most of the maker's claims must be taken with some caution. On the other hand, few of the installations in barracks have had a really long enough trial to exactly determine these costs, and very few private users keep accounts from which useful results can be deduced.

The following figures are given of the various stations named :—

Bordon. 1 year: 250 lights: 1,600 hours: at 55 c.p. per light candle-power hours ... = 22,000,000

			£	s.	d.
Petrol at 10d. a gallon	1,496 gallons	...	62	6	8
Mantles at 2s. 11d. per dozen ...	102½ dozen	...	24	19	0
Globes at 2s. 9d. per dozen ...	25 "	...	2	18	4
Sundries	...	...	0	9	6
Wages at 6d. per hour	...		40	0	0
Depreciation on £446 5s. at 5 per cent.	...	...	22	6	6
			£153	0	0

This works out to approximately 1·67 pence per 1,000 candle-power hours.

The figures reported from Lydd and Fort George are 1s. 7d. and 1s. respectively per 1,000 c.f. of gas, but as it is not known how many burners were in use, for how long they were burning and what the candle-power was, these figures cannot be reduced to a basis of comparison with other illuminants, for it is obvious that since coal gas requires five to six times its volume of air for complete combustion while air gas requires little, if any, a comparison on the basis of the cost per volume is of little practical use.

Tidworth reports a price per 1,000 c.p. hours, as follows:—

Mitchellite 1·1, Machine Gas 1·2–1·3, Centenary 2·4 (this being used in the gymnasium and therefore intermittently is probably the explanation of so high a figure), National 9.

On the whole it may probably be safely stated that air gas will cost something under 2d. per 1,000 candle-power hours.

(To be continued).

REVIEW.

THE STORY OF JERUSALEM.

By COLONEL SIR C. M. WATSON, K.C.M.G., C.B., M.A., ETC. *Illustrated by* GENEVIEVE WATSON.—(London: J. M. Dent & Sons, Bedford Street, W.C. 1912).

SIR CHARLES WATSON is so well known as the able and indefatigable secretary of the Palestine Exploration Fund, that any book coming from his pen dealing with the topography and history of the Holy Land is assured of a cordial welcome. This little volume, which may perhaps be regarded as an extension of the article in the *Encyclopædia Britannica*, is adapted for the use of the intelligent tourist who, in the case of a city of such ever-living human interest as Jerusalem, rightly demands something more than the best guide book generally supplies, and is content with something less than the original works of historian or archæologist.

The book opens with a description of the topography of the city site, illustrated by a map, which we may say at once appears to us the weakest part of the whole work. We presume that the cost of production prohibited the inclusion of maps printed in colours showing the positions of the walls at different times in the town's history, but, even excluding this possibility, the one map given appears to us quite inadequate.

The topographical description is followed by a somewhat naïve and uncritical summary of the early history of the city, taken direct from Biblical sources. Thus the old and now generally discarded version of the slaying of Goliath is quoted without comment. The author asks (p. 40) how to account for the sudden rise to greatness of the Israelite monarchy under David, and how did a simple shepherd boy obtain that influence over men which enabled him to carry his ideas into effect. The present place is perhaps hardly suitable for any detailed discussion, but we would suggest that the author should re-read his history in the light of modern biological research with a due recognition of the prime importance of inherited racial characteristics. Briefly we may state the case as follows:—In the highest degree of probability David was not a Jew, *i.e.* not of Semitic blood, but was probably an Amorite, a member of a fair-haired, blue-eyed, northern race. The Semitic races have never produced great rulers, and the rise of the nation to greatness under David was due to the subjection of the somewhat servile Semitic people to the virile and energetic northern character. If David was not a Jew *à fortiori* Solomon was not, it being very improbable that the wife of a Hittite was of Semitic blood, and we have therefore the two great Kings of Israel virtually foreigners.

The history of the city is followed to modern times. Those interested in the problem of an oversea invasion may be recommended to study the story of the Crusades especially the seventh under Saint Louis. The King finding Damietta unprotected occupied it and remained there with his whole army for six months. He then moved inland with the result that he was completely defeated and his entire force either killed or captured.

The book is illustrated throughout by charming little sketches by Lady Watson, and we can cordially recommend it to any intending visitor to Jerusalem, or to anybody who wants a succinct and clear summary of the varied chronicle which centres round those rocky hills where so much of history that touches most closely the human family, has been enacted.

E.H.H.

NOTICES OF MAGAZINES.

Kriegstechnische Zeitschrift.

The April number contains an article by Capt. Von Blittersdorff on a new apparatus for signalling between the battery and the observing station.

It consists of a small box in a knapsack form, which can be easily carried on the back by a man either mounted or on foot. The box contains a white band some 8 ins. wide, wound on two rollers, and on this band the letters of the alphabet and 10 figures are clearly marked. On opening the lid of the box and turning a handle any desired number or letter can be quickly brought to view.

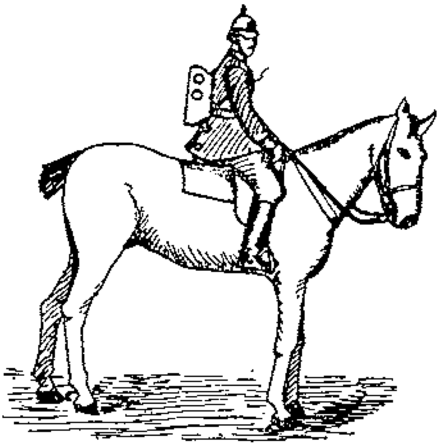


Fig. 1.—*Mode of Carrying Signalling Box.*

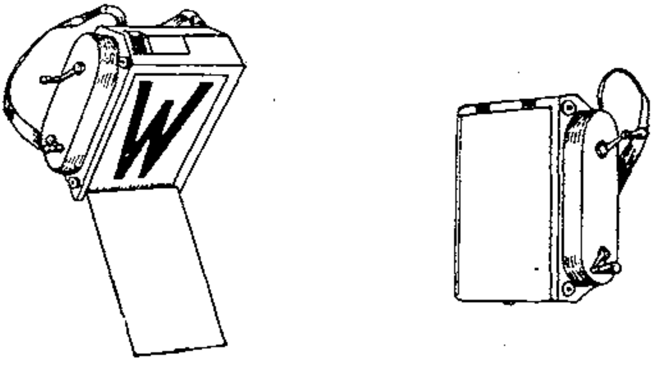


Fig. 2.—*Signalling Box—Open and Closed.*

The letters are about 10 in. × 7 in. in dimensions, and the writer claims that they are clearly visible with field glasses at ranges of from 500 to 1,000 yards according to the conditions of light and atmosphere.

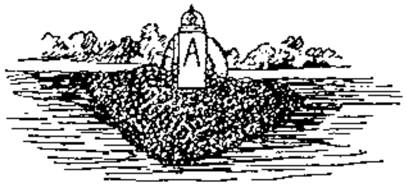


FIG. 3.—*Method of Signalling.*

The time taken to send a message by this means is only one-third of that required when signalling with flags.

The advantages of the apparatus appear to be as follows:—

1. Whereas as many as five dots or dashes may have to be sent and read for one letter by the Morse system, only one signal is here needed for each numeral or letter.

2. The changing into dots and dashes and back again, always a source of possible error, is avoided.

3. The signals can be sent and read by anyone and therefore can be at once grasped by all six guns in a battery, instead of having to be translated for them by trained signallers, and then conveyed to each No. 1, a process which involves loss of valuable time.

4. The employment of this method is not nearly so conspicuous as the ordinary "flag-wagging," and is therefore less likely to attract the enemy's attention.

5. The man who is signalling can keep well under cover, and therefore the apparatus is well adapted for signalling back from the firing line.

6. The setting up and dismantling of the new signal station is very quickly accomplished, as the man has simply to take the case off his back and can start sending messages at once.

In this particular it is a valuable supplement to the telephone which always takes some time to lay out, and especially so at critical moments, as for example when guns first come into action from a covered position and fire has to be opened at once. The telephone is also liable to break down, in which case the apparatus would be available as a substitute.

This method of signalling can also be used with advantage at night, if the letters are illuminated by means of an ordinary bicycle acetylene lamp or strong pocket electric light. Under such circumstances the letters can be easily read at a distance of 500 yards. In daylight the letters can be read with the naked eye up to a distance of about 200 yards.

C. OTLEY PLACE.

Rivista di Artiglieria e Genio.

On the Advantages of using Boats constructed of Thin Metal Plates for Bridge Equipment.—By Lieut.-General Pio Spaccamela.—For more than 20 years General Spaccamela has advocated the use of metal boats for bridge equipment, and he now returns to his argument with the absolute conviction that with such a change the greatest advantages will be obtained. This specially applies at the present day, as the progress in metallurgy admits of uniting two valuable conditions formerly at variance, viz., those of resistance and lightness. For instance steel plates can now be constructed $\frac{4}{10}$ths of a millimetre thick, with a resistance up to 70 k.g. per m.m., and this would allow of the construction of boats of great capacity and resistance, and of not great weight.

The reasons given against the change to the use of metal boats are the following:—

1. Greater difficulty in executing repairs, as compared with wooden boats.
2. Greater difficulty of preservation.
3. Greater difficulty of construction.
4. Greater cost.

But the experience of other armies shows that such difficulties may be easily overcome.

1. With regard to the first objection, it may be noted that it is based on the experience of some 60 years ago when metal boats were first introduced. At that time such an objection had a certain weight, but this is no longer so to-day, when the science of metallurgy is well understood in all civilized countries.

There cannot therefore be any difficulty in securing the services of a sufficient number of skilled workmen who are capable of repairing metal boats. On the contrary the regiments of engineers find some difficulty in recruiting an adequate number of caulkers, because, whilst the number of metal workers increases from year to year, the number of carpenters—and more especially those capable of repairing wooden boats—diminishes annually.

2. The second objection is that it is more difficult to preserve metal boats. It may at once be argued that they rust easily, and are constructed of thin plates which may be easily perforated. That steel plates may rust easily cannot be denied, but it is also true that they can easily be preserved from rust by covering them with varnish. If this varnish does not adhere to the plates, there is no difficulty in renewing it from time to time as required, and to omit such precautions only shows that little care has been taken, and that there has been little knowledge of the material on the part of those entrusted with the work. The Austrians, the Japanese, and the Russians, make use of varnish for their boats, and although it may not adhere very strongly it succeeds very well as a preservative against rust. On the other hand if this is not satisfactory, a solution of zinc may be used, as is done in the French and Prussian Armies.

3. The difficulty of construction is one that cannot have any value, in view of the fact that in late years boats constructed with steel plates have given good results for the equipment of bridges for both divisions of cavalry and infantry.

4. It is true that the plated boats cost more than wooden ones, but considering the advantages of better preservation, it would seem that after a period of 10 or 12 years the plated boats would cost even less than those of wood. France, which has to contend with rapid rivers, sometimes frozen (as for instance the Rhone), has decided on plated boats.

To the advantages of metal over wooden boats stated above there may be added

1. The carrying of a greater load with a less weight.

2. Less friction is presented to the current in the metal boats.

The first advantage is indisputable. At Pavia, two years ago, two boats plated with steel were constructed by the engineers, with the result that compared with wooden boats there was a superiority in the portage of ·200 cubic metres with a reduced weight of 65 k.g.

The resistance that a boat meets with depends in a great measure upon the friction of the water against the immersed surface of the boat. From recent experiments of Suppon, head of the steam navigation of the Danube, there seems to be no doubt that a wooden boat presents a resistance nearly twice as great as an iron boat of the same capacity, and it is well to note that the boats referred to by Suppon have a more wrinkled surface than those used in Italy. Wooden boats require to be kept in suitable places, neither too damp, nor too dry, and these are sometimes difficult to find, so that the boats required cannot always be reckoned upon as being ready for use. In fact it may be necessary to keep them in the water for two or three days to allow the wood to swell. All these inconveniences may be avoided by the adoption of metal boats.

The examples of France and Germany are instructive, the first having adopted metal boats of only one piece, and the second having completely modified the primitive plated boats, which in the old equipment had a length of 7·50 metres with a load of 6,000 k.g., and having substituted boats of only one piece, length 8·50 metres and a carrying capacity of little less than 10 cubic metres. Germany also has retained the boats of one piece only for the equipment of the army corps, but they are divisible into two for the equipment of the bridge divisions: thus obtaining the greater lightness and mobility which is so necessary for carriages which are required to accompany the troops on the march.

By adopting two kinds of construction of boats, that of one prow piece and one prismatic piece, a certain number of permutations and changes can be made which render the boats serviceable under any circumstances. Thus, the junction of one prow piece, and one prismatic piece will suit for constructing bridges on still water. The junction of two prow pieces is advantageous for casting and raising the anchor, for the transport of troops, and for all the manœuvres that require small boats. The junction of two prow pieces and one prism will give the boat such strength and length that it can be used even in rapid currents. Finally the junction of two prow pieces and two prisms will give even greater stability.

There are however many inconveniences in the divisible boats. For instance there is the necessity of joining the several compartments among themselves. This can be done when the construction is very exact, and the joints perfect, but after a certain time these become worn, and in any case the joints constitute an element of weakness in the boats. The supposed advantage that a boat constructed in compartments increases the facility of transport is more apparent than real. In fact the great length of the boat wagon does not depend only upon the length of the boat, but also on the length of the planks. As a means of transport for troops the divisible boat has less advantages than the boat of one piece. There is a loss of precious time in placing the parts separately in the water and in reuniting them. It is true that the boat in pieces is divisible into compartments, but this would probably not prevent a catastrophe, if one of the compartments became filled with water at the moment when the boat was carrying troops; nor would it serve to sustain a submerged bridge for active passage. For these considerations, and after many trials, the French do not intend to adopt the Birago boat.

Before going further it may be well to examine the calculations for fixing the number of wagons required for transporting the boats for the Austrian bridge equipment. With the last orders for such equipment a new carriage (pontonwagen) is said to have been adopted for the boat in two pieces.

Supposing that it is required to construct a bridge for which 30 boats are necessary. With the Austrian system about 52 wagons would be used Under General Spaccamela's system 30 boats only would suffice, and the greater mobility of a column of 30 wagons compared with one of 52 wagons is obvious. It may be added that a boat of one piece placed in the water is ready with the exception of being planked, while the boat in two pieces requires to be first of all joined together, sometimes two and two parts, sometimes three and three. It may be conceded therefore that the bridge constructed with boats in one piece can, under similar conditions, be more rapidly constructed than one with boats of two or more pieces.

The German Army, in endeavouring to find a bridge equipment that would allow of the passage of a load of even more than 5,000 k.g., has given preference to the boat of one piece.

Supposing that an autocar weighing 5,000 k.g. passes over a bridge of boats, and that the distance between the boats from axis to axis is 5·33 m.; applying the formula of Della Rooene :—

$$P = P' + P'' \frac{(L - C)}{L}$$

In which P is the greatest weight supported on the planking.

P′ and P″ the weights of the hinder portions and the fore part respectively which are supposed to be $\frac{3}{4}$ and $\frac{1}{4}$ of the weight of the wagon.

C = width of the car = 2·80 m., L the length of the planking = 5·33 m.

then P = 4,343 k.g.

and adding the weight of the superstructive equal to about 700 k.g. we have a maximum pressure of 5,043 k.g.

It might be contended that, in calculating an interaxis of 5·33 m., the width would be too restricted for bridges in strong currents, but at the trials made at the great manœuvres of 1911, a bridge of wooden boats was thrown across the Po with boats having their axis 5·33 m. apart and with a velocity of current of about 3 m., and an entire army corps passed over with autocars weighing about 4,000 k.g.

Before closing this article a comparison is made between the steel boats of the French Army, those used by the Germans and Austrians, and those proposed for the Italian Army. The Austrian boat of two pieces is 7·75 m. in length, height at the prow 1 m. and at the stem ·80 m.; weight 605 k.g. and the net load carried is 9,374 k.g. That of the Germans is 8·50 m. in length, height at the prow 1·10 m. and at the stem ·85 m.; weight 500 k.g., with a net portage of about 10 cubic metres. The French boat is 8·55 m. long, height at prow 1 m., in the centre ·80 m., at the stem ·90 m.; weight 750 k.g., with a net capacity of 8·95 cubic metres.

The boats proposed by General Spaccamela are of steel plates 7·70 m. in length, height at the stem ·90 m. and at the prow 1·15 m.; weight 510 k.g. with a capacity of 11,210 cubic metres and carrying a load of about 10,700 k.g.

The following are the relation of weight and portage:—

Austria	$\frac{9374}{605} = 15·50.$
France	$\frac{8950}{750} = 11·92.$
Germany	$\frac{10000}{500} = 20.$
Italy (proposed)	$\frac{10700}{510} = 20·98.$

These figures would seem to show clearly that the boats of Austria, and France are inferior to those of Germany and those proposed for Italy. It is in fact clear that those who advocate the retention of wooden boats in preference to adopting boats of metal plates, close their eyes to progress, and condemn the Italian bridge material to a serious inferiority in comparison with that of other countries.

E. T. THACKERAY.

ENGINEERING.

21st June, 1912.

In this number Lieut.-Colonel J. T. Bucknill, late R.E., contributes an interesting article on the U.S. Battleship *Maine*. He makes a critical analysis of the finding of the recent Board appointed by the U.S. Government to report upon the cause of the disaster, and still holds to the theory he enunciated in 1898.

RECENT PUBLICATIONS OF MILITARY INTEREST.

REVIEWS OF BOOKS.

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HISTORY.

BRITISH BATTLES—WATERLOO. By Hilaire Belloc. 206 pp. 8vo. London, 1912. Stephen Swift & Co. 1s. net.

This is the third of the series of monographs dealing with British battles, which Mr. Belloc is engaged in writing. The account of the four eventful days, into which the campaign of Waterloo was compressed, is given in the same clear and concise manner as distinguished those of Blenheim and Malplaquet, which have already appeared.

No attempt is made to enter into details which might obscure the main facts of each day's events, nor does the size of the book admit of more than a very brief examination of those points on which interest and enquiry have chiefly centred.

In reading this book the two features which strike one most are firstly the emphasis laid on the events of the 16th June, which the author truly describes as the decisive day of the campaign; and secondly, the many excellent little sketches, a good example of which is the one that shows the positions of the various divisions of the Anglo-Belgian Army as Wellington imagined them on the 16th June and as they really were.

TIRAH, 1897. By Colonel C. E. Callwell. 164 pp., 5 maps and plans. 8vo. London, 1911. Constable. 5s.

This is one of the series of "Campaigns and their lessons"; it furnishes the classic example of operations by a disciplined army against irregular tribesmen in a mountainous country such as the North-West Frontier of India, and gives the practical soldier a well-arranged and concise account in outline of the 1897 operations in Tirah, and the lessons to be learnt from them.

The value of the principles inculcated is intensified to-day by the better armament of the tribes in question; the lessons and criticisms clearly placed before the reader enable him to form useful conclusions in amplification of the principles laid down in Part I. of the Field Service Regulations.

THE CAMPAIGN OF GETTYSBURG. By "Miles." 202 pp., with 3 maps. 8vo. London, 1911. Forster Groom & Co., Ltd. 7s. 6d.

Much credit is due to the author, who is understood to be an officer of the Royal Engineers, for his clear and instructive account of this campaign. It is open, however, to the criticism that for the sake of clearness the controversial points, with which the campaign bristles, are too easily dismissed.

In the opening chapter the author makes no allusion to the alternative strategy, which would have sent Longstreet westwards for a movement to the banks of the Ohio. If that course had been adopted in May, Grant might have been forced to abandon his campaign against Vicksburg. Lee's invasion of Pennsylvania at the end of June came too late to exercise any influence upon the course of events in the Mississippi Valley.

"Miles" seems to have handled his authorities on somewhat eclectic principles. For the battle of the 1st July he frequently cites Doubleday's volume in the Scribner series. Yet in his review of that engagement he lays the chief responsibility for the Federal defeat upon Doubleday, a view evidently shared by Meade. It might therefore have occurred to him that Doubleday's version was rather likely to be of the nature of special pleading. Similarly in his account of the artillery duel, which preceded Pickett's charge of the 3rd July, after several quotations from Alexander, Longstreet's Chief of Artillery, he suddenly throws that officer over altogether and states that the artillery combat lasted without a break for nearly two hours, though Alexander's account makes it of considerably shorter duration. Nor has he apparently felt it necessary to attempt to reconcile the discrepancies existing in Lee's two reports of the campaign.

Had he consulted Alexander's "Military Memoirs of a Confederate," he would perhaps have modified the statement (p. 155) that "the salient at Cemetery Hill could not be enfiladed from either side, whilst the hill was itself so strong that there was no fear of its being captured, if held by good troops." For Alexander insists that this salient "offered the only hopeful point of attack upon the enemy's entire line," and again "it must ever remain a grave reflection upon the Confederate conduct of the battle that the weakest part of the Federal position was the only portion which was not attacked."

The view that Stuart was completely successful in his object, whilst fighting with Pleasanton in the Bull Run Mountains, seems hardly tenable. For it was due, in part at any rate, to Pleasanton's success that Hooker was enabled to cross the Potomac without Lee's knowledge. The writer also gives the Confederate President more credit than he deserves for the assistance which he rendered to Lee in this campaign. It is difficult to believe that Jefferson Davis regarded the invasion of Pennsylvania in any other light than as a gigantic raid for the purpose of relieving the Commissariat Department at Richmond.

The statement on p. 16 that the Potomac below Harper's Ferry was unfordable needs considerable qualification. How did Lee cross the river in the previous summer? On p. 78 Rock Creek is spoken of as 6 inches deep. "Inches" should be altered into "feet."

It has often been pointed out that, although popular and military interest in the battle of Gettysburg is now very great, no complete account of it has yet been written. The volume under review goes a considerable way to supply the want.

MY EXPERIENCES AT NAN SHAN AND PORT ARTHUR WITH THE 5TH EAST SIBERIAN RIFLES. By Lieutenant-General N. A. Tretyakov.

Translated by Lieutenant A. C. Alford, R.A., edited by Captain F. N. Baker, R.A. 312 pp., 6 maps, several portraits, plans and illustrations. 8vo. London, 1911. Hugh Rees. 12s. 6d.

The original Russian work appeared first in serial form in the *Voenni Sbornik* in 1909. The narrative has now been translated into English, with the author's permission and approval.

The book presents for soldiers a day-to-day record of the adventures of the author, and the regiment which he commanded. It is written on lines somewhat parallel to the naval narrative supplied in Semenov's "Rasplata," but devoid of the bitter lament as to "what might have been," which characterizes that volume.

It is the story of a soldier's life—told in straightforward soldier's language—amidst the stirring times in the Kuan-tung Peninsula from the commencement of the Russo-Japanese War to the fall of Port Arthur.

In the words of the preface, "we follow the fortunes of the General's own unit, we live with his men amidst the blood-stained wreck of their trenches on 203 Metre Hill, losing all thought of the general conduct of the attack and defence of the fortress—in a word, we are transported from the dry bones of military history to the living realities of the battlefield."

Various references are given in footnotes alluding to or explaining discrepancies between the author's account and our Official History of the War; excellent maps which are included make it easy to follow the operations. It is a book which should appeal strongly to the regimental officer, more particularly to the infantryman. Not the least of its merits is the unassuming character and cheerful self-restraint of the author, who "rarely criticizes, but instead shows us everyone doing his best to make bricks without straw"—a narrative of daily combats and daily work, of duty well performed and honour well sustained.

Although chiefly valuable as a psychological study, the book throws much light on various problems connected with modern siege warfare. Commenting on the Japanese assaults in August, 1904, the author speaks of the importance of a preponderating artillery, and of the danger of exposing guns (p. 113). In several places he corroborates earlier accounts of the value of star rockets in repelling the night assaults which then took place. He emphasizes the value of barbed wire for entanglements, refers to the shortage of barbed wire at Port Arthur, and gives the places where it was used (p. 153).

On p. 146, he writes:—"It is indispensable to teach the infantryman field fortification thoroughly so that . . . he needs no supervision in war time. In the 5th Regiment not only the non-commissioned officers but the men also could point out where trenches should be constructed, and of what length and depth they should be."

By way of comparison, the following, taken from the writings of a French officer who was recently attached to the Japanese Army, is of interest:—

"The construction of shelter trenches is considered in Japan to be chiefly an exercise for N.C.O.'s (to teach siting, etc.), since, say they (the Japanese), regularity of trace, etc., is of small importance in such works, the soldier, instead of spending his time in constructing these, should learn to throw up more ambitious types of cover, *e.g.*, cover-trenches, traverses, machine-gun emplacements." A British officer corroborates this statement, as does also the practice of the Japanese during their most recent war, in which artillery and infantry often had to construct extensive cover without the aid or guidance of engineer personnel.

On pp. 204—205, General Tretyakov discusses types of hand grenades, and gives his reasons for preferring some to others.

On pp. 251, 256, 267, he describes instances of their use which would seem to prove that the reports of attachés underrated somewhat their material effect.

In several places—notably p. 271—he describes the terrible effects of the Japanese 11-inch howitzer shells.

As regards the explosion inside Fort Sungshu (Work No. 3), which followed shortly after the blowing up of the parapet, and killed many of the garrison, General Tretyakov states positively that about 1,000 hand grenades stored in an excavation were detonated by a Japanese shell.

The German General Staff account surmises that this catastrophe was due to a delayed mine explosion; the Russian account advances several hypotheses, but inclines to the view which is stated as a fact by General Tretyakov. Our history speaks (Vol. III., p. 119) of "some outside agency" as causing the explosion.

Turning to miscellaneous matters:—

On p. 145 the General says that a retreat is always started by one man . . . in most cases . . . physically weak. "Therefore," he continues, "it is essential to recruit soldiers from men who are physically strong."

Whilst warm in his tributes to the behaviour of the sailors who helped to hold 203 Metre Hill, he calls attention to the shortcomings of naval details for land warfare, and instances their deficiencies in outpost duties. He likewise warns against mixed detachments of any kind in a defensive line.

On p. 294, he gives a telling description of the peculiarly trying conditions of siege warfare.

The remarks on pp. 262—263 as to the type of officer needed for modern war are applicable to us no less than to Russia. . . . "What really matters is the spirit, the individuality . . . honourable pride . . . a sense of the high calling of an officer's profession . . . this is what every military man should have ingrained into his nature. Physical strength and health are also important factors; therefore officers must be encouraged to indulge in sports of all kinds."

POLITICS.

WAKE UP, GERMANY! (Deutschland sei wach). Anonymous; published by the German Navy League. 216 pp., with an index. 8vo. Berlin, 1912. Mittler. 1s.

This publication is one among many of its kind that have been sown broadcast in Germany during the interval between the Moroccan crisis of 1911 and the introduction of the Defence Bills in the spring of 1912. The attitude of the writer towards the question of Anglo-German politics is based, as in all works of this kind, on the hypothesis that German foreign policy is so transparently straightforward and pacific that no honest person has ever suspected it of being otherwise; while that of Great Britain is inherently aggressive and inspired by motives of self-aggrandisement, and the desire to pose as the supreme arbiter of European affairs. In the historical survey which occupies the first portion of the book this argument is elaborated in characteristic fashion. Among the many crimes imputed to England are that at the Vienna Conference in 1815 British influence prevented Prussia from receiving Belgium as "her well-earned reward," a significant phrase which is applied to Belgium more than once in the book; that by taking Heligoland from Denmark, Great Britain compelled Germany to purchase it in 1890 with territory in East Africa—the inference being apparently that if the island had remained Danish, it might have been had for nothing; and that having driven Turkey and Italy into a war in open pursuance of her own plans (sic) England has now cynically profited by the occasion to seize Sollum for herself.

The most important conclusion drawn by the author from the historical portion of the book is that Great Britain has persistently used sea supremacy as a stepping-stone to world supremacy; that with this object in view she has in the past allied herself with such of the weaker Continental states as were not likely to develop into competitors, in order to defeat the Power most immediately dangerous to her ambitions; and that she has in this way repeatedly overthrown her rivals, with a comparatively small sacrifice of personnel, though at the cost of a lavish expenditure of money. The writer labours to prove that England endeavoured in this way, notably in 1890, to use Germany as a "Continental sword" against Russia when the latter Power's advance towards India was causing her anxiety; and that, having been foiled in this attempt by the shrewdness of German statecraft she began in 1895 to seek a counterpoise for Russia in the growing power of Japan. It was at the beginning of the 20th century, we are told, that Great Britain decided that the position of *primus inter pares* among the world Powers could no longer satisfy her ambition, and that the whole world must henceforth be brought permanently under the British sceptre; the only obstacles to this plan were the rising commercial and maritime prosperity of Germany, and the forward policy of Russia in Asia. It was to meet the latter peril that Great Britain abandoned the "splendid isolation" to which she had clung for a century, and contracted the alliance with Japan in 1902. Though the Russo-Japanese War was thus waged in her interests, Great Britain still contrived to keep on good terms with Russia's ally, and to draw her into an *entente*, thus acquiring the long-desired "Continental sword" against Germany. The meeting at Reval, and the *entente* with Russia were, the writer asserts, prompted solely by the blind Germanophobia of British statesmen, who sacrificed their real interests in the Middle East in order to combat those of Germany. All suppositions that the policy of *ententes* may have been based on defensive rather than on offensive considerations, or that the fears of a German invasion were anything more than a mask for aggressive designs are rejected as the merest subterfuges. Similarly all talk about British trade interests or the traditional sympathy of England for oppressed nationalities is regarded as transparent hypocrisy.

British policy, the author insists, is essentially aggressive and domineering, governed solely by antagonism to Germany, and, in recent years, by chagrin for her failure to play the arbiter in the Bosnian crisis. The naval war scare was, we are told, merely an election cry for the Liberal Party (sic) in 1909. On the other hand, the phrases "preservation of peace" or "defence of her interests" are put forward to prove the purely defensive nature of any action, however militant, on the part of German diplomacy.

By a somewhat circuitous argument the author lays the responsibility for the growth of the

German fleet at the door of England. He quotes the famous *Daily Telegraph* interview to show that Germany considered herself unable, in 1900, to join in a coalition against Great Britain, owing to the risks to which the German troop transports plying between Europe and China would have been exposed in a war with a stronger maritime Power. The realization of this fact brought home to Germany the need for strengthening her navy. Hence, the author naïvely concludes, England, by means of the Boer War, was actually responsible for the development of German sea power.

Turning next to the strategical aspect of the question, the author is faced with the problem of finding a reason for an increase of the navy without giving any handle to accusations of aggressive designs. The general line of argument is as follows:—At the time of the Moroccan crisis of 1905, when war between France and Germany appeared imminent, it was decided to land a British force at some point on the Jutland coast; the existence of this project is held to account for the visit of the British fleet to Esbjerg and the landing of parties (sic) there, and on the east coast of Jutland. On this occasion, however, war was averted because France found herself unprepared. The question of British military action in aid of France continued, however, to be discussed, and it is this problem which, in the author's opinion, underlies the frequent reforms, or rather the continuous reorganization, of the British Army. French statesmen insisted with reason that Dreadnoughts could neither go to Berlin nor steam up the Meuse Valley, while, on their part, the English became more and more convinced that the security of Great Britain depended on a defeat of the French Army on the land frontier being adverted at all hazards. The scheme of a landing at Esbjerg was, however, abandoned, both because it would be too eccentric to be effective as a diversion, and because, unless the German fleet was absolutely blockaded in its ports, the transport of an expedition to the Jutland coast would be impossible during the first stage of a war. A landing in French territory might have appeared safer, but this plan again suffered from the defect that the force would be unable to reach the scene of action within the decisive period. It was therefore resolved that the British should land in Belgium and act in conjunction with the left wing of the French Armies.

That this plan had been agreed on is held to be confirmed by the protests raised in England against the fortification of Flushing by the Dutch.

This landing in neutral territory would be excused by England on the ground that Germany was herself contemplating a violation of Belgian neutrality in order to outflank the left wing of the French line. Here the author pauses to disclaim any such intention on the part of his country, but adds that Germany must be prepared at the first news of the embarkation of troops in an English port to take vigorous action in Belgium in anticipation of the enemy's plan; it would be of vital moment to Germany to oppose the landing of the British force, and its junction with the French left wing.

It is in this stage of the operations that the German fleet can play a decisive rôle. British strategy will, in the author's opinion, consist at the outset of the war, in "sealing" the North Sea with vessels of secondary importance, while the main fleet remains concentrated in a central position whence it can strike at the German fleet, whenever the latter should put to sea.

This strategy will, however, be seriously hampered by the necessity of covering the transport of the Expeditionary Force to the Scheldt. The British fleet will thereby lose much of its freedom of action, and will tend to remain in the western part of the North Sea, leaving the eastern coast of England exposed. If, however, the German fleet is skilfully and vigorously handled, command of the sea sufficient to ensure the safe transport of the British force may not be attained by England for some weeks after the commencement of war, that is to say, not until the assistance of this force will be too late. A great advantage of this plan, from the author's point of view, is that the German Army will thus be relieved of a possible danger without having become in any way weakened in the process. The German Navy must, therefore, be strong enough not only, as in the past, to cause grave risk to any naval Power venturing to attack it, but henceforward to prevent the transport of British troops to the Scheldt during the first stage of the war. For this purpose, it is pointed out, absolute strength is far more important than relative strength, so that a corresponding increase of the British navy need not affect the success of the strategy outlined above. The author predicts that if the German fleet can be strengthened to the required point, the British projects for sending troops to the aid of France will have to be abandoned; Great Britain will then be thrown back on the expedient of a protracted and inconclusive war against German commerce, while France will become convinced that the British alliance can do nothing to save her from defeat on land. A "re-grouping" of the Powers is then *certain to follow*: in other words, France will range herself on the side of Germany. The author lays great stress on this point, maintaining that France has already lost golden opportunities through her subservience to British policy, and that once the conviction has gained ground that England is powerless to help her the logic of facts will prove stronger than the logic of sentiment.

Turning to the Baltic, the author finds fresh arguments for an increase in the navy. The attitude of Russia in a war between Germany and the Western Powers is, he thinks, difficult to predict. It is most improbable that Russian statesmen would agree to fight Germany unless Russian interests were at stake, or, in any case, that they would consent to Russia's acting as a "Continental sword" for England; assurances were interchanged at the Potsdam interview in 1910 that neither Russia nor Germany would join an offensive coalition directed against the other. The recent strengthening of the Russian Baltic fleet has probably, he considers, only been undertaken at the instigation of Great Britain and France in order to induce Germany to weaken her squadrons in the North Sea. Nevertheless, he continues, the dislike of the Russian people for Germany cannot be overlooked; nor can the recent withdrawal of Russian troops from the frontier of German Poland be interpreted as a sign of goodwill to Germany, as this step was no doubt primarily due to considerations of mobilization. The increase of the Russian fleet must therefore be taken into account as a new factor; Germany can no longer concentrate her full strength in the North Sea against England, while the latter Power, thanks to her *entente* with France, can now unite her whole force against Germany, a condition which was assumed to be impossible in the Navy Bill of 1900. Only a treaty with Russia, the author concludes, can relieve Germany of this anxiety as to her position in the Baltic.

With regard to the Mediterranean, the author observes that Germany is the only Great Power which has no direct voice in Mediterranean questions; nevertheless her interests are those of Austria and Italy. The withdrawal of British ships to the North Sea to make head against Germany's growing strength in that quarter—though in one sense a victory for Germany—has given France a predominant position in the Mediterranean; the strengthening of the Austrian and Italian fleets offers some counterpoise to Franco-British supremacy, but only so long as Austria and Italy put aside sentimental rivalries and co-operate in support of their true interests. Meanwhile, Germany must realize that in case of a European war her navy will have to contend alone and unsupported against the fleets of Great Britain, France and Russia.

As regards pacification in general, and the limitation of armaments, the author favours arbitration treaties of limited scope, as tending to eliminate wars on secondary issues, but urges that any form of unlimited arbitration before an international tribunal is incompatible with the sovereignty of the State. Germany, he says, has to provide for an annual increase of 900,000 inhabitants; for these she requires elbow-room both politically and commercially, a right which has recently been denied her with menaces of war. She must now decide whether she will be content with the limited rôle of a European Power, or assume her rightful place as a World Power; in the latter case she must be prepared to make sacrifices both of money and blood, to withstand the enemies who are seeking to hem her in. No agreement to limit the development of her fleet can, he insists, be contemplated by Germany; the initiative for any such step should, he contends, properly come from Great Britain as being the stronger Power, and yet Great Britain has never made any definite proposal—an argument which appears somewhat disingenuous considering the result of our last attempt in that direction.

Finally, the author, after gratuitously asserting that Englishmen of high position have endeavoured to induce the United States to join Great Britain in opposing the development of Germany, makes a proposal that this country and Germany should develop their empires in co-operation instead of in antagonism. Expressions of this sort occur from time to time in the book; whether inserted by another hand or intended to produce an impression of open-mindedness and impartiality, we do not know. It can only be said of them that they are little in harmony with the author's theme. Even admitting that a book which is written with the object of enlisting support for a particular measure is not to be judged by the ordinary standards, it is difficult to see what object can be served by the dissemination of literature of this sort, except—to quote Herr Haussmann's indictment of the German Navy League—"the propagation of fear of England and antagonism to England."

RAILWAYS.

RAILWAYS IN WAR. By Colonel Domelunksen, Russian General Staff. 217 pp., with numerous plates. 4to. St. Petersburg, 1908. General Staff Press. 6s. 3d.

Colonel Domelunksen was in charge of troop movements on the Trans-Baikal and Circum-Baikal Railways during the Russo-Japanese War, and he has written his book primarily for the military student.

He divides his subject into three parts; he deals first with broad-gauge railways (Russian gauge, 5 feet); then with light railways worked by locomotives; and lastly with horse-traction tramways. In the opening chapter the author describes the construction of permanent way, and gives details of station equipment, rolling-stock, and line maintenance generally. Traffic management is described in Chapter II. The movement of troops by railway in peace and war, and the special expedients for coping with heavy military traffic, are dealt with in Chapters III. and IV.

Railway management generally and the duties of the military officials who supervise Russian railway traffic are included in Chapters V. and VI.

The method of constructing, equipping, and working a light railway of 750 millimetres (29·5 inches) gauge is given in Chapter VII. The horse-tramway described in Chapter VIII. is also of 750 millimetre gauge; data are given of various makers' types of rail and rolling stock, and of the means adopted for laying the track rapidly and for working the completed line.

STRATEGY AND TACTICS.

THE DOCTRINE OF NATIONAL DEFENCE. (La doctrine de défense nationale). By Captain Sorb. 416 pp. 8vo. Paris, 1912. Berger-Levrault. 6s.

Captain Sorb's new book—the greater part of which has appeared in serial form in the *Revue Militaire Générale*—practically amounts to an appreciation of the international situation in Europe from the military, and to some extent from the naval, point of view.

Such a study involves consideration of the military and naval potentialities of Germany, France, Great Britain, Russia, Austria, and Italy. This is a very great undertaking, involving as it does a close acquaintance with the strategical schools of thought in the countries concerned, intimate knowledge of the organization and mobilization arrangements of their armies, as well as statistics on the railways and roads of the whole of Europe. In addition, the tendency of the foreign policy of each of the countries concerned must be correctly fathomed, and the financial consequences of a vast European war must be estimated. It is extremely difficult for a private individual to compile a work of so wide a scope, and this fact should be borne in mind by readers of this interesting and courageous book.

Captain Sorb is of opinion that the policy of the Germans will be to force a decision with the least possible delay in order to crush the French Army before the intervention of the Russian and British Armies has become effective. Therefore, from the purely strategical point of view it would be advantageous for the French to postpone a decision as long as possible; on the other hand, if this postponement were to involve a general retrograde movement of the French forces and the abandonment of a considerable portion of French soil to the German armies, the advantages to be gained would be more than counterbalanced by the injurious moral effect produced in France and among the nations friendly to France. The solution suggested is the organization of a line of resistance not far removed from the French frontier, followed by a decisive counter-offensive viâ either Toul or Verdun, according to the situation. Stress is laid on the importance of winning the first battle; in fact, the author is of opinion that the result of the first battle will decide the campaign, a view that has already aroused considerable opposition in French military circles.

Not the least interesting portion of this book is the chapter dealing with the Anglo-French entente. The effect of Lord Haldane's reorganization is followed in some detail, and numerous extracts are given of the speeches of British statesmen and military writers. The author finally comes to the conclusion that although the entente may provide valuable assistance to France in case of war, it is undesirable to transform the entente into an alliance, firstly because the function of our Expeditionary Force is still uncertain, secondly because Great Britain might be tempted to precipitate a war in which the French Army would be forced to act as the "soldier" of England.

Although, as has already been said, the scope of the book is perhaps a little ambitious, it is full of most interesting matter and provides much food for thought. The Morrocan crisis of 1911 has produced a host of literature on strategical subjects, among which "La doctrine de défense nationale" takes a high place.

BOOKS RECEIVED.

TRENCH'S MANŒUVRE ORDERS, 1912. Eleventh Revised Edition. By Major B. M. Bateman, R.G.A. William Clowes & Sons, Ltd., 23, Cockspur Street, S.W. 1912. 2s. net.

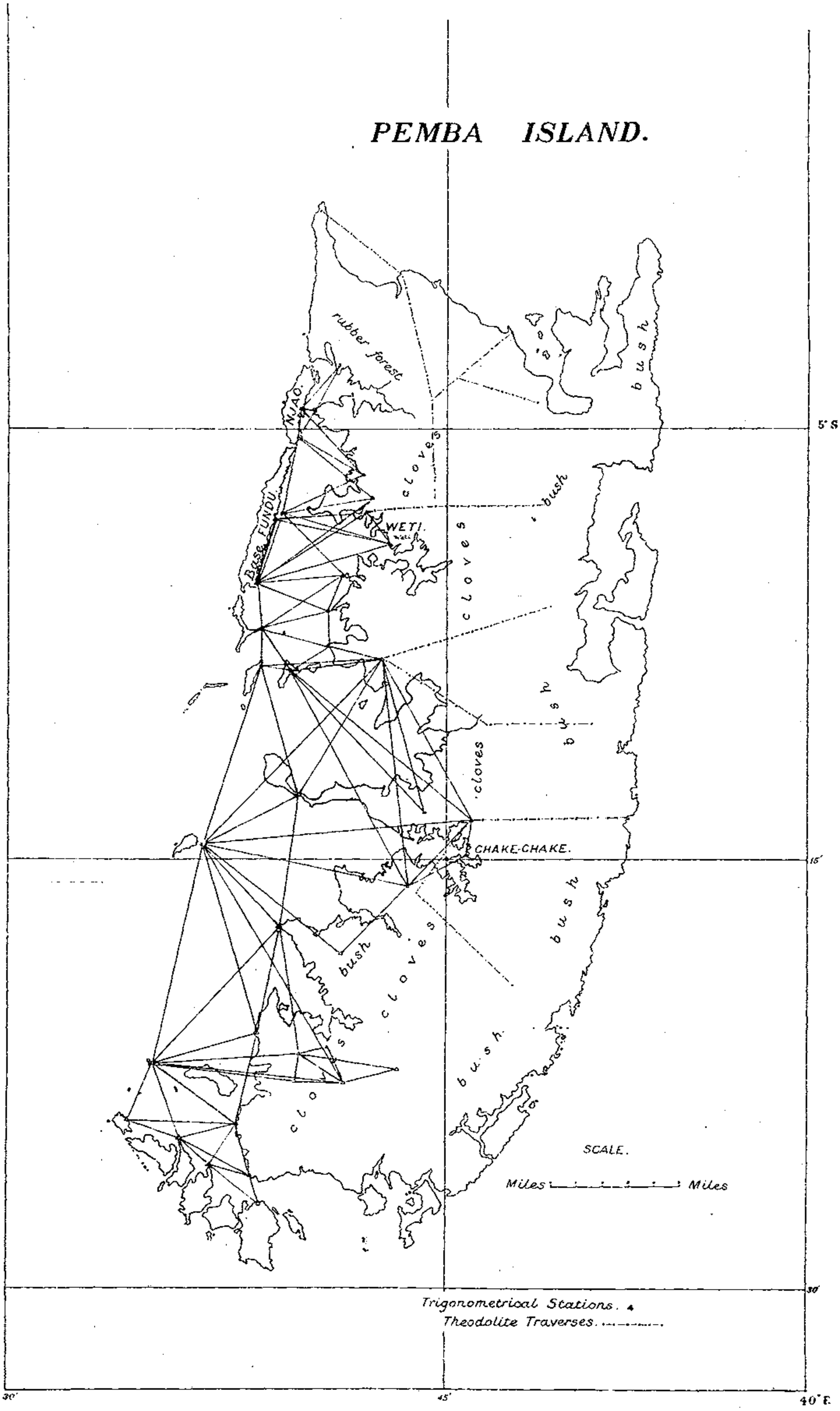
MILITARY HYGIENE AND SANITATION. By Col. Chas. H. Melville, R.A.M.C., late Secretary and Expert on Sanitation, Army Medical Advisory Board, W.O., etc., etc. Edward Arnold. London, 1912. 12s. net.

THE PRINCIPLES OF STRUCTURAL MECHANICS TREATED WITHOUT THE USE OF HIGHER MATHEMATICS. By Percy J. Waldram. B. T. Batsford, 94, High Holborn. 1912. Price, 7s. 6d. net.

THE CIVIL ENGINEERS' COST BOOK. Compiled for the use of Civil and Municipal Engineers, Public Works Contractors, etc. By Major T. E. Coleman, Staff for R.E. Services. E. & F. N. Spon, Ltd., 57, Haymarket, London. 1912. Price, 5s. net.

GUNNERY: An Elementary Treatise, including a Graphical Exposition of Field Artillery Fire. By Jennings C. Wise, B.S., Captain and Adjutant, First Battery Field Artillery, Virginia Volunteers. B. F. Johnson Publishing Co., Richmond, Va. 1912.

PEMBA ISLAND.



NOTE The tidal creeks extend much further inland than is indicated on this diagram. All the creeks are filled with mangrove swamps.

PLATE I.

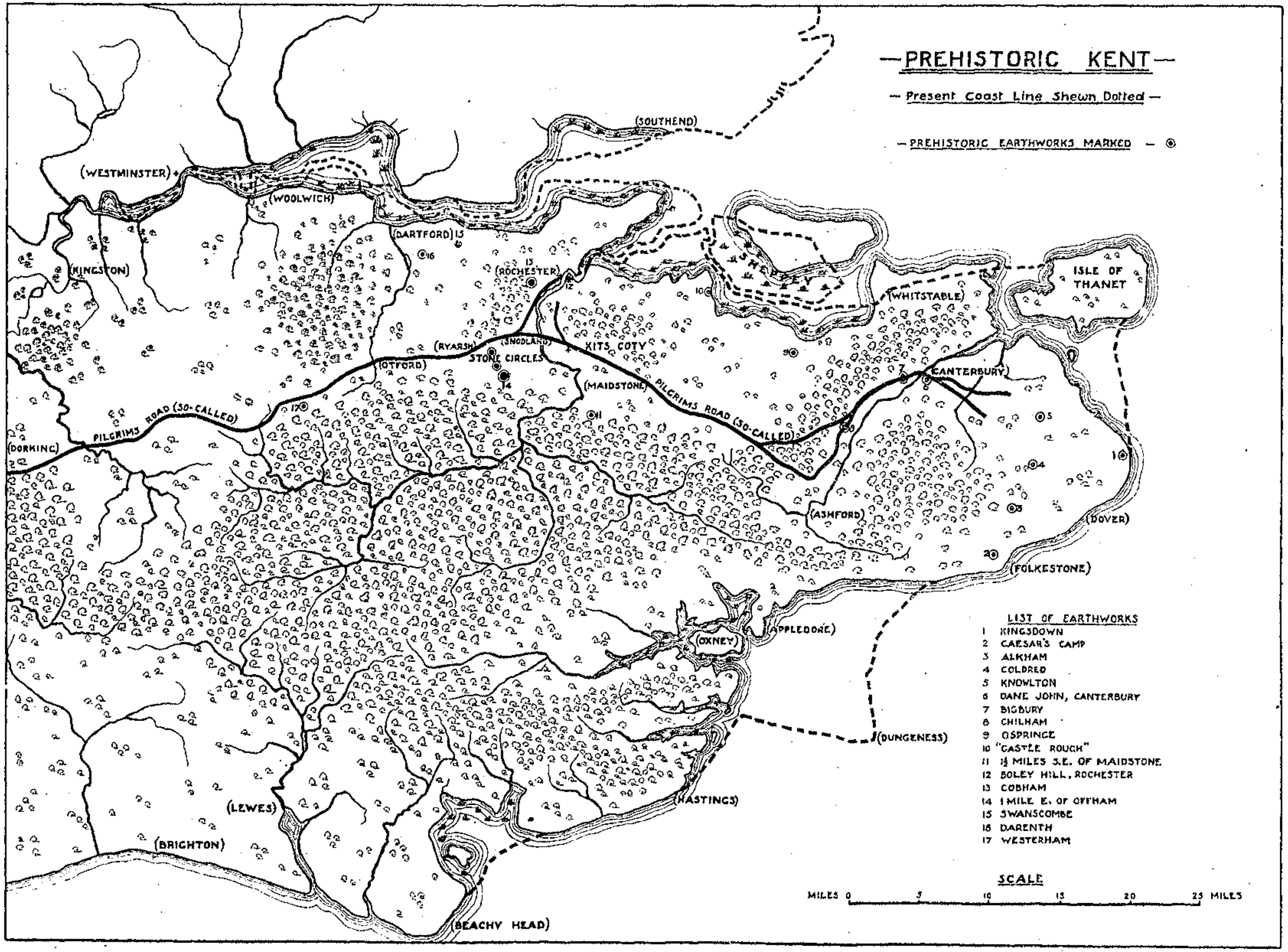

—PREHISTORIC KENT—
— Present Coast Line Shewn Dotted —
— PREHISTORIC EARTHWORKS MARKED — ⊙
(SOUTHEND)
(WESTMINSTER)
(WOOLWICH)
(KINGSTON)
(DARTFORD) 15
16
(ROCHESTER)
13
12
10
SHEPPEY
(WHITSTABLE)
ISLE OF THANET
(RYARSH)
(SNODLAND)
STONE CIRCLES
KITS COTY
14
(OTFORD)
(MAIDSTONE)
11
17
PILGRIMS ROAD (SO-CALLED)
PILGRIMS ROAD (SO-CALLED)
(DORKING)
9
7
6
(CANTERBURY)
5
1
4
3
2
(ASHFORD)
(DOVER)
(FOLKESTONE)
(APPLEDORE)
(OXNEY)
(DUNGENESS)
(HASTINGS)
(LEWES)
(BRIGHTON)
(BEACHY HEAD)
LIST OF EARTHWORKS
1 KINGSDOWN
2 CAESAR'S CAMP
3 ALKHAM
4 COLDRED
5 KNOWLTON
6 DANE JOHN, CANTERBURY
7 BIGBURY
8 CHILHAM
9 OSPRINGE
10 "CASTLE ROUGH"
11 1½ MILES S.E. OF MAIDSTONE
12 BOLEY HILL, ROCHESTER
13 COBHAM
14 1 MILE E. OF OFFHAM
15 SWANSCOMBE
16 DARENTH
17 WESTERHAM
SCALE
MILES 0 5 10 15 20 25 MILES

PLATE IV.

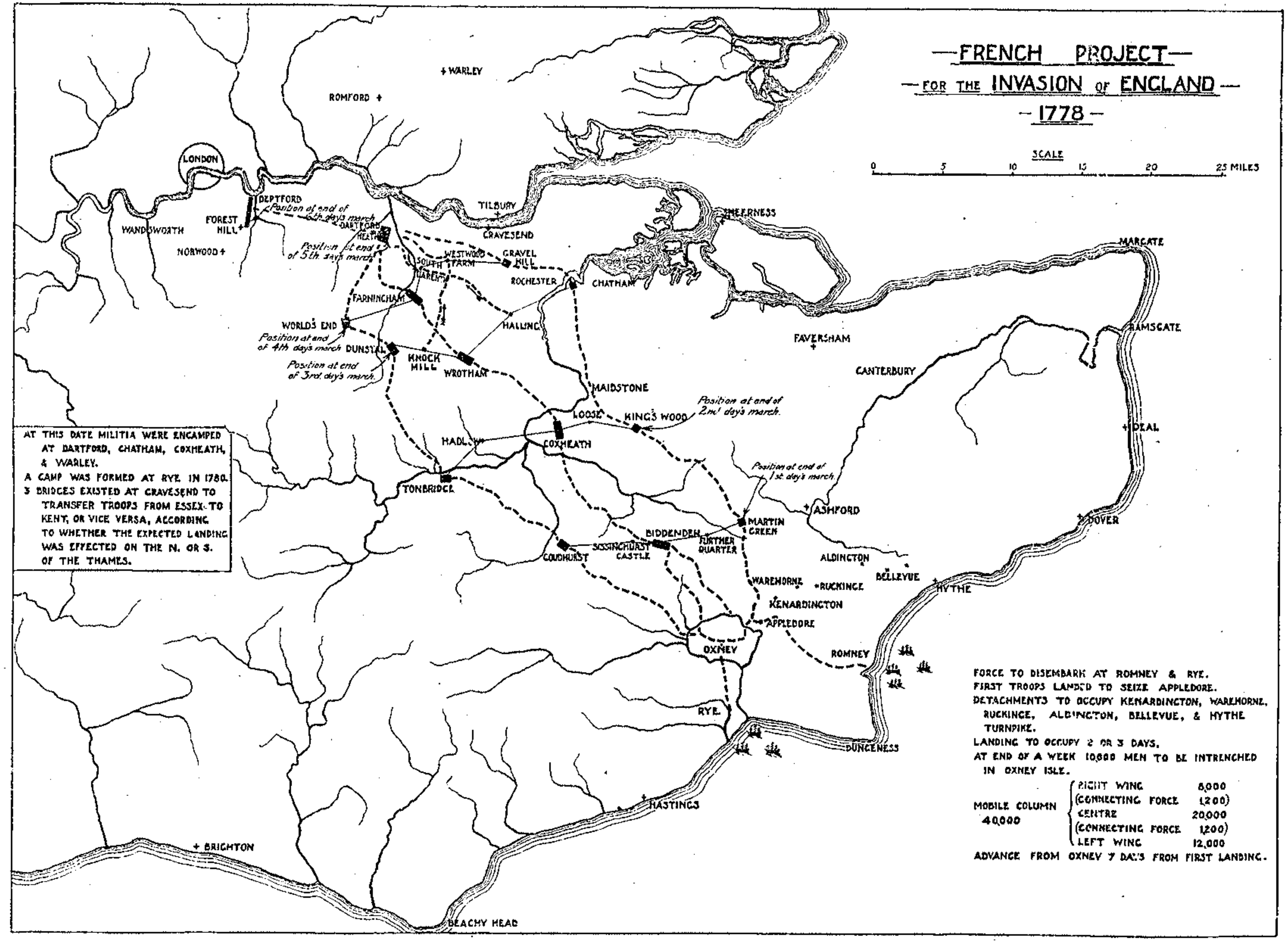

—FRENCH PROJECT—
—FOR THE INVASION OF ENGLAND—
—1778—
SCALE
0 5 10 15 20 25 MILES
LONDON
WANDSWORTH
FOREST HILL
NORWOOD
DEPTFORD
Position at end of 6th days march
DARTFORD HEATH
Position at end of 5th days march
ROMFORD
WARLEY
TILBURY
GRAVESEND
WESTWOOD FARM
GRAVEL HILL
SOUTH DARENTH
FARNINGHAM
ROCHESTER
CHATHAM
SHEERNESS
WORLD'S END
Position at end of 4th days march
DUNSTAL
KNOCK HILL
Position at end of 3rd days march
WROTHAM
HALLING
MAIDSTONE
LOOSE
KING'S WOOD
Position at end of 2nd days march
HADLOW
COXHEATH
TONBRIDGE
FAVERSHAM
CANTERBURY
MARGATE
RAMSGATE
DEAL
DOVER
Position at end of 1st days march
ASHFORD
MARTIN GREEN
BIDDENDEN
FURTHER QUARTER
SISSINGHURST CASTLE
GOUDHURST
ALDINGTON
BELLEVUE
HYTHE
WAREHORNE
RUCKINGE
KENARDINGTON
APPLEDORE
OXNEY
ROMNEY
RYE
DUNGENESS
HASTINGS
BRIGHTON
BEACHY HEAD
AT THIS DATE MILITIA WERE ENCAMPED AT DARTFORD, CHATHAM, COXHEATH, & WARLEY.
A CAMP WAS FORMED AT RYE IN 1780.
3 BRIDGES EXISTED AT GRAVESEND TO TRANSFER TROOPS FROM ESSEX TO KENT, OR VICE VERSA, ACCORDING TO WHETHER THE EXPECTED LANDING WAS EFFECTED ON THE N. OR S. OF THE THAMES.
FORCE TO DISEMBARK AT ROMNEY & RYE.
FIRST TROOPS LANDED TO SEIZE APPLEDORE.
DETACHMENTS TO OCCUPY KENARDINGTON, WAREHORNE, RUCKINGE, ALDINGTON, BELLEVUE, & HYTHE TURNPIKE.
LANDING TO OCCUPY 2 OR 3 DAYS.
AT END OF A WEEK 10,000 MEN TO BE INTRENCHED IN OXNEY ISLE.
MOBILE COLUMN 40,000
RIGHT WING 6,000
(CONNECTING FORCE 1,200)
CENTRE 20,000
(CONNECTING FORCE 1,200)
LEFT WING 12,000
ADVANCE FROM OXNEY 7 DAYS FROM FIRST LANDING.

PLATE III.

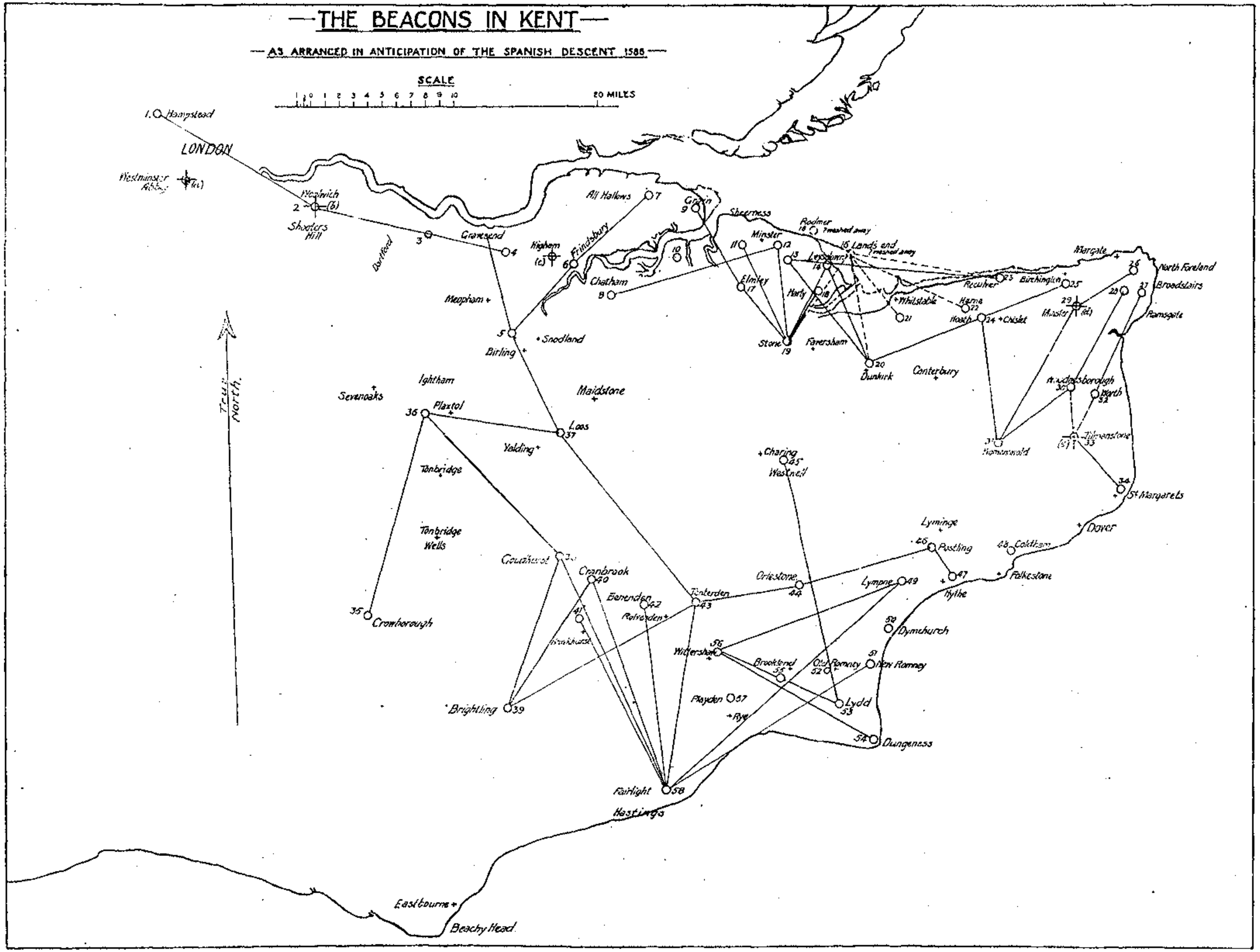
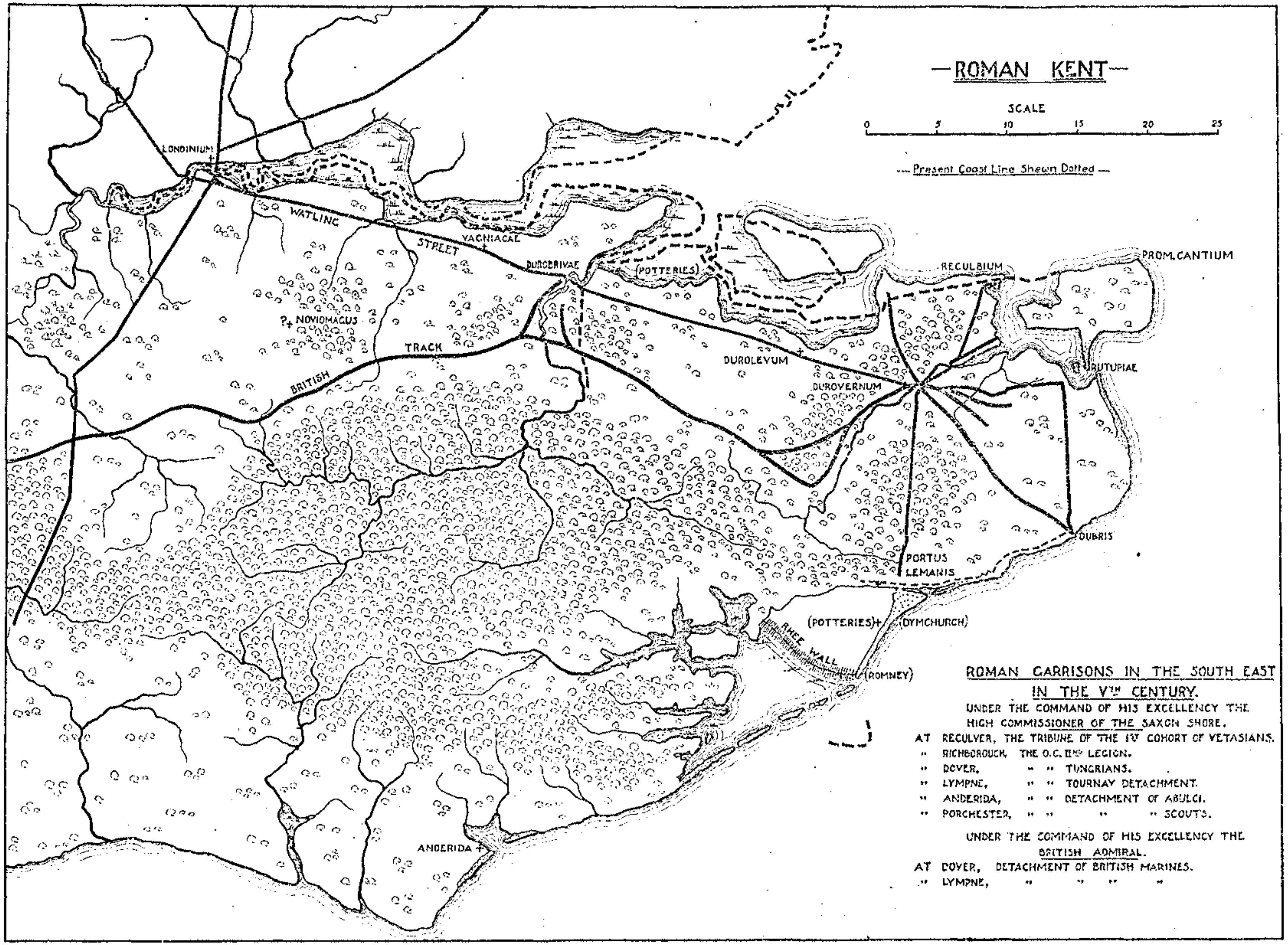

—THE BEACONS IN KENT—
—AS ARRANGED IN ANTICIPATION OF THE SPANISH DESCENT 1588—
SCALE
20 MILES
True North
1. Hampstead
LONDON
Westminster Abbey
2 Woolwich (b)
Shooters Hill
Dartford
3
Gravesend
4
All Hallows 7
Grain 9
Higham (c)
6 Frindsbury
Chatham
8
Meopham
5
Birling
Snodland
Sheerness
Minster
Elmley 17
Harty
Stone 19
Faversham
20 Dunkirk
Canterbury
Whitstable
Herne 22
Reculver 23
Birchington 25
Margate
North Foreland
Broadstairs
Ramsgate
29 Minster (d)
Hoath 24
Chislet
Knowlesborough 30
North 32
Tilmanstone 33
St. Margarets
Dover
Coldham
Folkestone
Postling
Lyminge
Hythe
Lympne 49
Dymchurch
New Romney
Old Romney 52
Lydd 53
54 Dungeness
Brookland 55
Wittersham 56
Playden 57
Rye
Fairlight 58
Hastings
Eastbourne
Beachy Head
Brightling 39
Goudhurst
Cranbrook 40
Benenden 42
Rolvenden
Tenterden 43
Orlestone 44
Charing
Westwell
Ightham
Sevenoaks
36 Plaxtol
Loas 37
Yalding
Maidstone
Tonbridge
Tonbridge Wells
35 Crowborough

PLATE II.


—ROMAN KENT—
SCALE
0 5 10 15 20 25
— Present Coast Line Shewn Dotted —
LONDINIUM
WATLING STREET
VAGNIACAE
DUROBRIVAE
(POTTERIES)
NOVIOMAGUS
BRITISH TRACK
DUROLEVUM
DUROVERNUM
REGULBIUM
PROM. CANTIUM
RUTUPIAE
DUBRIS
PORTUS LEMANIS
(POTTERIES)
(DYMCHURCH)
RHEE WALL
(ROMNEY)
ANDERIDA
ROMAN GARRISONS IN THE SOUTH EAST IN THE Vth CENTURY.
UNDER THE COMMAND OF HIS EXCELLENCY THE HIGH COMMISSIONER OF THE SAXON SHORE.
AT RECULVER, THE TRIBUNE OF THE IV COHORT OF VETASIANS.
" RICHBOROUGH, THE O.C. IInd LEGION.
" DOVER, " " TUNGRIANS.
" LYMPNE, " " TOURNAY DETACHMENT.
" ANDERIDA, " " DETACHMENT OF ABULCI.
" PORCHESTER, " " " " SCOUTS.
UNDER THE COMMAND OF HIS EXCELLENCY THE BRITISH ADMIRAL.
AT DOVER, DETACHMENT OF BRITISH MARINES.
" LYMPNE, " " " "

ARTIFICIAL ILLUMINANTS.

DIAGRAMS OF AIR-GAS PLANTS.

FIG: 1.

CENTENARY

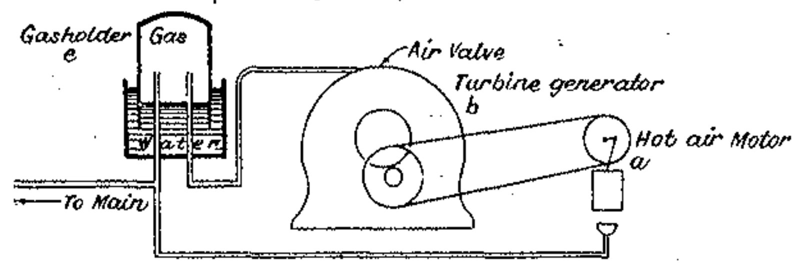


FIG: 2.

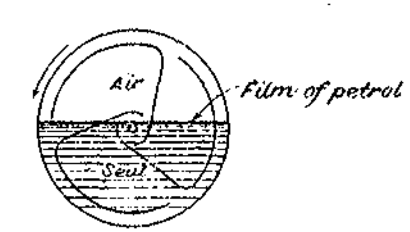


FIG: 3.

MACHINE GAS COY.

(COX'S AIR GAS)

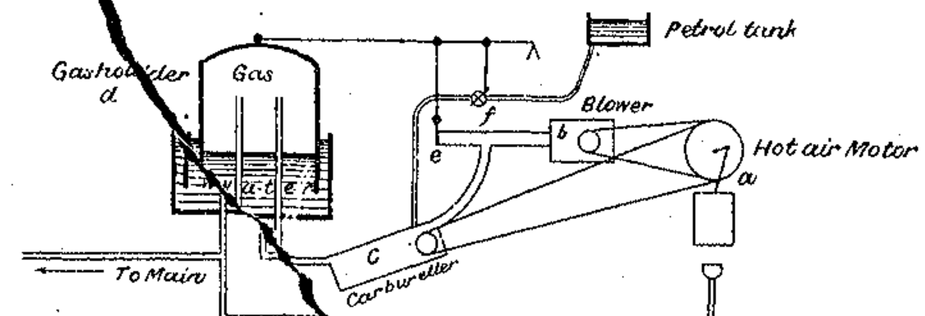


FIG: 4.

NON-EXPLOSIVE GAS COY.

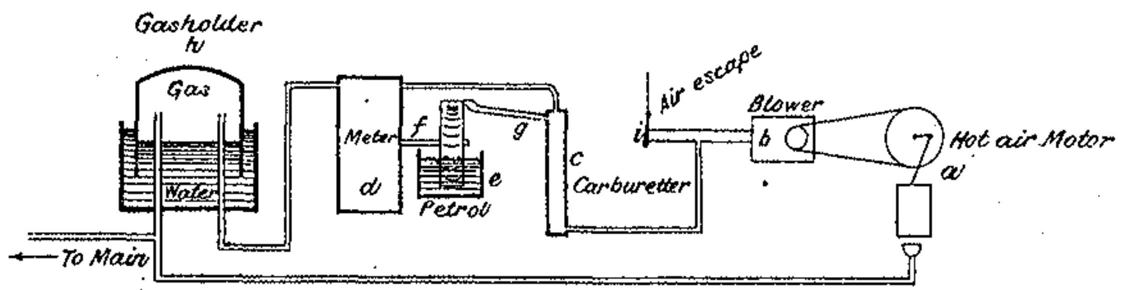


FIG: 5.

NATIONAL

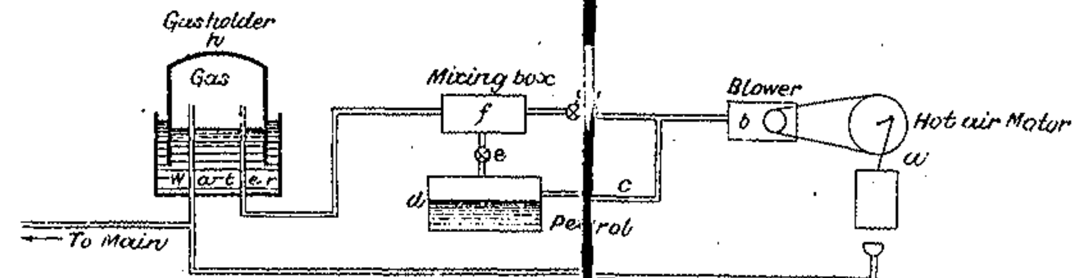


FIG: 6.

SIMPETROL SYSTEM C.

(As installed at Bordon)

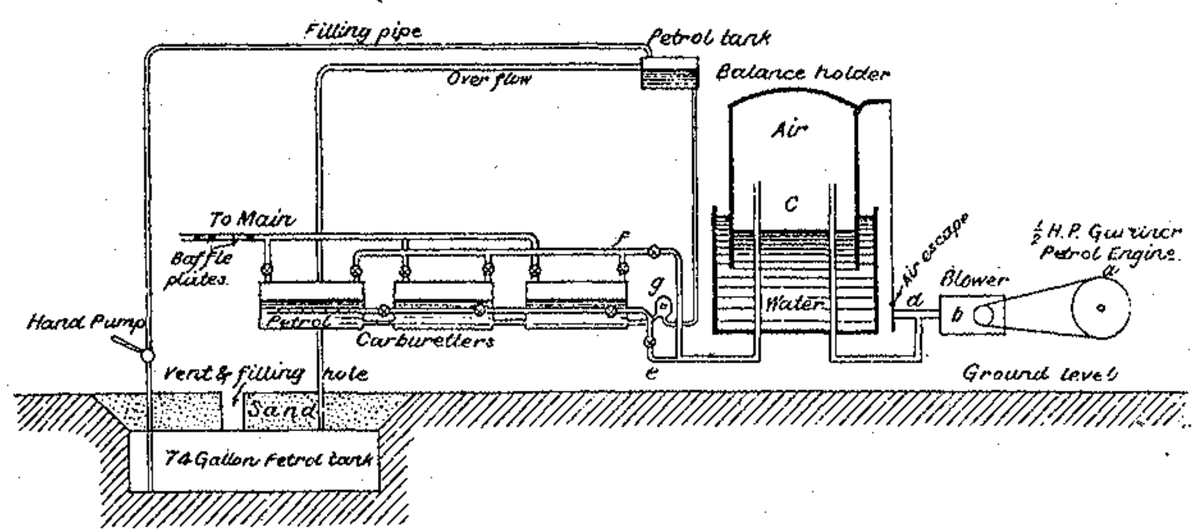


FIG: 7.

MITCHELITE

(Water driven)

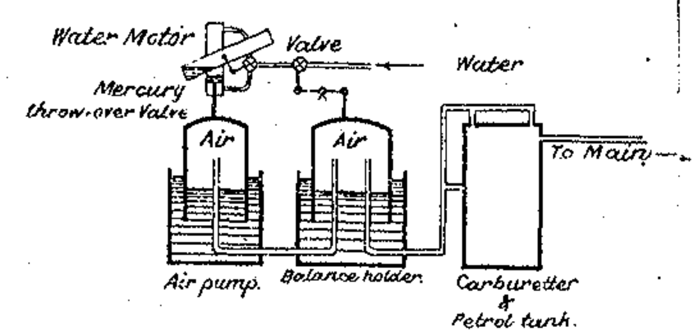


FIG: 8.

TYPE OF INDOOR LAMP

As used in barrack rooms.

At Lydd.