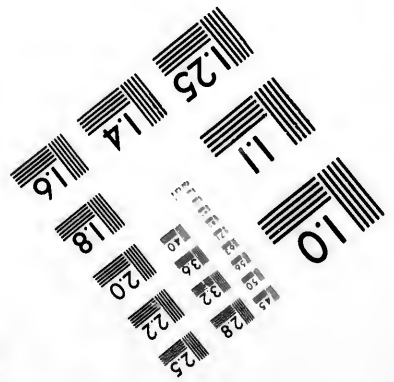
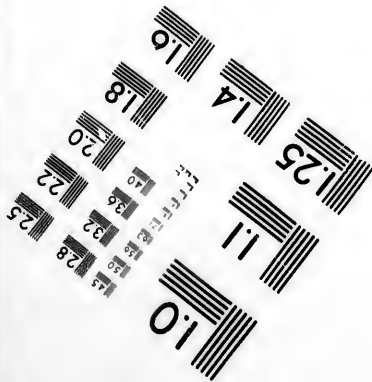
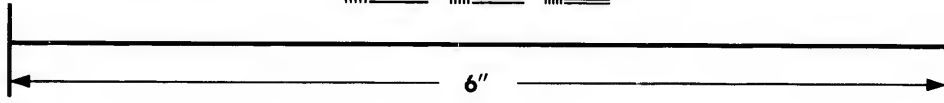
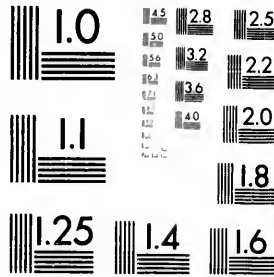


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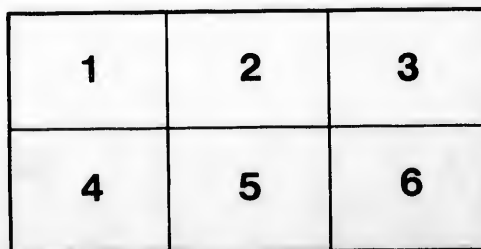
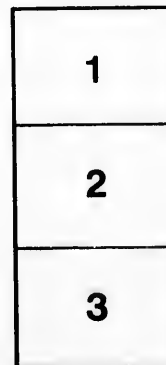
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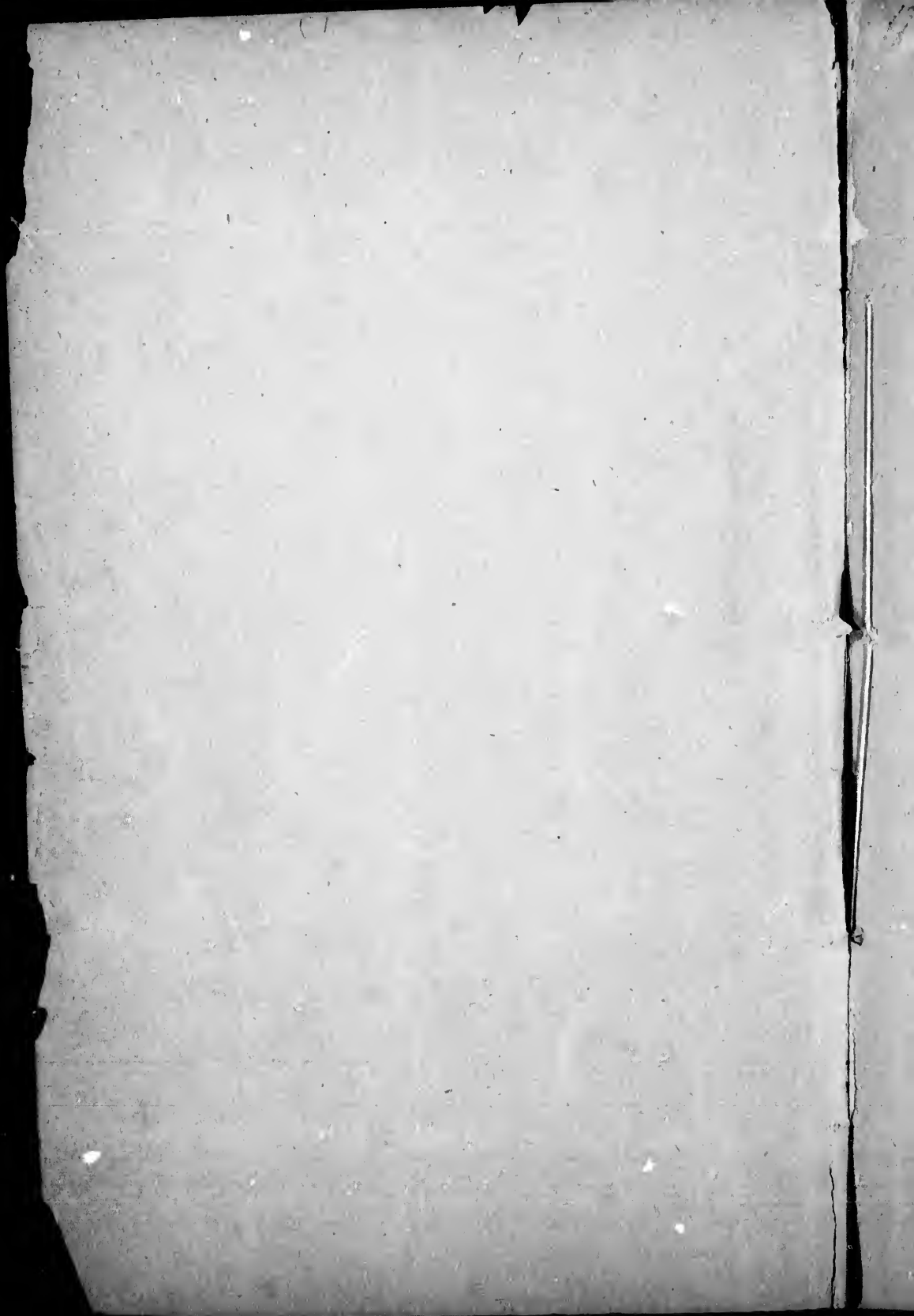
ROYAL UNITED SERVICE INSTITUTION.



LECTURE  
ON  
THE USE OF RAILWAYS FOR COAST  
AND HARBOUR DEFENCE.

BY 2ND LIEUT. P. C. GIROUARD,  
ROYAL ENGINEERS.

[For Private Circulation only].



Can. Girouard, Edward, P.C.  
Pam  
G  
(For private circulation only.)

ROYAL UNITED SERVICE INSTITUTION.

Friday, April 24, 1891.

MAJOR-GENERAL R. N. DAWSON-SCOTT, Commandant, School of  
Military Engineering, Chatham, Member of Council, in the Chair.

THE USE OF RAILWAYS FOR COAST AND HARBOUR  
DEFENCE.

By 2nd Lieut. E. P. GIROUARD, R.E.

In approaching the study of the coast defence of Great Britain, one is at once confronted with the vexed question of what the nature of the defence should be.

Innumerable books and papers have been written upon the subject, and yet no clearly defined principles to act upon are to be found. The general impression, however, after reading the more modern views upon the subject, is practically the same whether the mind dwell upon the influence of the sporadic raider, which some contend to be our only future foe, or upon the escaped squadron and the invading foreigner. All degrees of opinion unite in demanding some form of coast defence.

The opinions differ in the method of the defence only. None dispute the necessity of using guns and submarine mines or torpedoes for the local defence of our arsenals, dockyards, and unprotected coast towns; though some differ as to the necessity of provision against invasion.

All admit the weakness, for a general local defence of the country, of our present system of coast defence. It leaves many of our commercial centres and coast towns quite open to the insults of an enemy. Everywhere on sea and land our present defence is admitted to be deficient in gun power. Even if our Navy were in the strength we all hope to see it, our coasts would, as defended at present, be in no condition of security from light attacks. What is urgently needed is gun power; gun power to ward off the raider from our unprotected towns and ports, if the Navy is at its strongest; gun power to ward off any attack until the Navy reaches that point; and gun power to prevent landings upon our shores. Is this gun power to be obtained by an extension of our movable coast defence? Naval authorities themselves say no; all ships must for the present go towards strengthening our first line of defence. Can this superiority of gun power be attained by an extension of fixed fortifications? Probably so at important points. But the extension of fixed fortifications of a modern type for the defence of every exposed point of our coast is an

utter impossibility. The cost of such an extension would be enormous.

Gun power must be obtained, if possible. A moving coast defence on the present system cannot be provided for it, and the cost of a fixed coast defence is prohibitive.

There is, however, another system, which I beg to submit to the judgment of this audience as being one of some considerable promise.

In Great Britain and Ireland we have systems of railways which are the admiration of the world.

Why not put this magnificent system to a practical use for the defence of the country, mount guns upon trucks which could travel on these lines and be fired from them?

Of the existence of the network of railway lines which cover this country, everyone is doubtless aware. Probably but few, however, have ever given a thought to the fact that they suggest the truest and most economical basis for resistance to any aggression or insult on our shores. Their construction was of course due to commercial reasons only. But physical conditions have determined for them in many places a course close alongside the seaboard, and thus they give us all the necessary elements for a powerful line of defence along the exposed portions of our coast.

By their proper utilization the country could be formed into one huge fortress, and prompt communication ensured between the parts. Such would be the elasticity of the system, that an enemy would have opposed to him at any exposed point of the coast the armament of a first-class fortress.

Before proceeding to any details of a proposed system for coast defence based upon the use of our existing railways, I should like to invite attention more especially to one or two points, which the foregoing suggestions emphasize.

Our existing system of coast defence by coast-defence vessels and fixed fortifications is an extremely partial one. It omits large portions of our coast line, whereas the system of defence here advocated is universally applicable to the whole coast line of Great Britain and Ireland. Moreover, it must be carefully borne in mind that ships and fortifications under modern conditions rapidly become obsolete, whereas our railways are always kept in excellent working order by the companies concerned without any expense to the Government, and are at the shortest notice ready to bring into action guns of the then latest and most improved pattern.

#### *Practical Examples of Firing Guns from Railways.*

Before proceeding to the details of a proposed scheme one important point must be discussed and settled if possible.

Can guns be fired from an ordinary line of railway with any degree of safety?

If the gun is to be fired in the direction of the line or at a small



angle to it, no difficulty exists. This method of firing guns is used in all arsenals for the proof of the heaviest guns in existence.

But the fire will undoubtedly have to be exercised over a wide area, and in most cases at angles to the lines, if not actually at right angles to them. Can this be effected with safety? Theoretically I am able to say, yes. Using as a basis the results of actual experiments it will be found that the 6-inch B.L. gun of 5 tons may be theoretically fired at a right angle to the line.

Not feeling that my authority for this statement would bear any weight, I asked Colonel Kensington, R.A., Professor of Artillery at the R.M.A., if he would kindly assist me. He has been good enough to go into the theory of the subject, and has consented to say a few words on it at the conclusion of this paper.

A series of very valuable experiments was carried out at the Camp of Exercise at Delhi in January, 1886, to test the practicability of firing guns at right angles to an ordinary line of railway.

The gauge of the railway on which the experiments were carried out (Rajputana Malwa Line) was one of 1 metre or 3·37 feet.

The gun used was the 40-pr. R.B.L. of 35 cwt. having a muzzle velocity of 1,180 feet per second.

The following trucks were requisitioned for the experiments:—

1. A 4-wheel wagon. Weight 2·87 tons. Length 13 feet 5 inches. Width 6 feet 3½ inches.

2. An 8-wheel bogie truck. Weight 5·36 tons. Floor dimensions 25 × 7 feet.

The conclusions of the members of the Experimental Committee were:—

Mr. Jones, Carriage Superintendent, Rajputana Malwa Railway.

1. That 40-pr. guns can be fired with perfect safety broadside from either—

- (a.) Small empty wagons mounted on four wheels.
- (b.) Small empty wagons weighted up to 4 tons.
- (c.) Empty 8-wheel bogies.

2. That a bogie wagon weighted to 19·4 tons was perfectly stable when fired from broadside with a shotted 40-pr. gun. When so fired the deflection of the wagon bearing springs was actually less than half an inch.

Major Bissett, R.E., came to the same general conclusions as the above.

The success of the above experiments is very remarkable if the natures of the carriages, and the fact that no attempt was made in any way to reduce the energy of recoil, be considered.

The difference would, it is only just to assume, be even more remarkable if—

1st. A lower and heavier carriage, specially designed for the purpose, were used.

2nd. The recoil were taken up by the latest form of buffer.

3rd. The gun were fired from a 4 feet 8½ inch line, in lieu of one of 3·37 feet.

If it be recalled to mind that the 40-pr. R.B.L. gun has a muzzle velocity of 1,180 feet per second, the following assumptions even without theoretical proof would not seem a lengthy flight of imagination. That presupposing the provision of a carriage specially adapted to the purpose, by the use of all modern improvements, the firing of a 6-inch B.L. gun having a muzzle velocity of 1,780 feet per second could be effected with safety from a standard gauge railway.

*Proposed Organization for England.*

It was my intention, after pointing out the practical possibilities of firing guns from railways, to give an outline of a proposed organization for the defence of Great Britain by the use of our existing lines.

From want of time I have been obliged to abandon my original idea, and limit this paper to England only.

The accompanying explanatory map (No. 1) of the proposed scheme as applied to England has been prepared on the basis of a range of 7,000 yards for gun fire and of 3,500 yards for machine-guns.

On this map the portions coloured red indicate water covered up to 7,000 yards by the use of the railway lines. The green represents the zone of light Q.F. gun fire (3,500 yards). The black the areas which are inaccessible by reason of the presence of natural obstacles, &c. The chain dotted line indicates the position of the 5-fathom line. The results obtained upon this map are of course purely of a theoretical character; undoubtedly cuttings and other obstructions in the field of fire would, in the event of a practical survey, be found to interfere in some places.

Starting from the Thames on this theoretical map it will be observed that that estuary, and with it the River Medway, are closed. Proceeding northwards, the first important point is the supposed favourable landing between the Rivers Crouch and Blackwater. To make good a landing at this point, only forty-five miles from London, an enemy must take advantage of a pocket or channel north of the Gunfleet Sand, called the Wallet.

Thence he could land between the Crouch and the Blackwater, and take up an excellent commanding position, facing London; or he might land in a less favourable position between the Colne and the Stour, on the beach of Clacton.

To reach the shore at the first-named place his boats would have four miles to row at low tide, to reach the second about three.

Within a range of 7,000 yards, as the map shows, the Wallet is to a great extent covered, and from an actual study of this particular piece of coast I am able to say that the practical limits of fire at this point would be identical with the theoretical results here shown. By a short extension of the railway from Clacton towards the south, the whole of the Wallet might be covered, and this dangerous point absolutely secured.

Leaving Clacton, the Stour and the harbour of Harwich are reached; these, being already defended, can be neglected.

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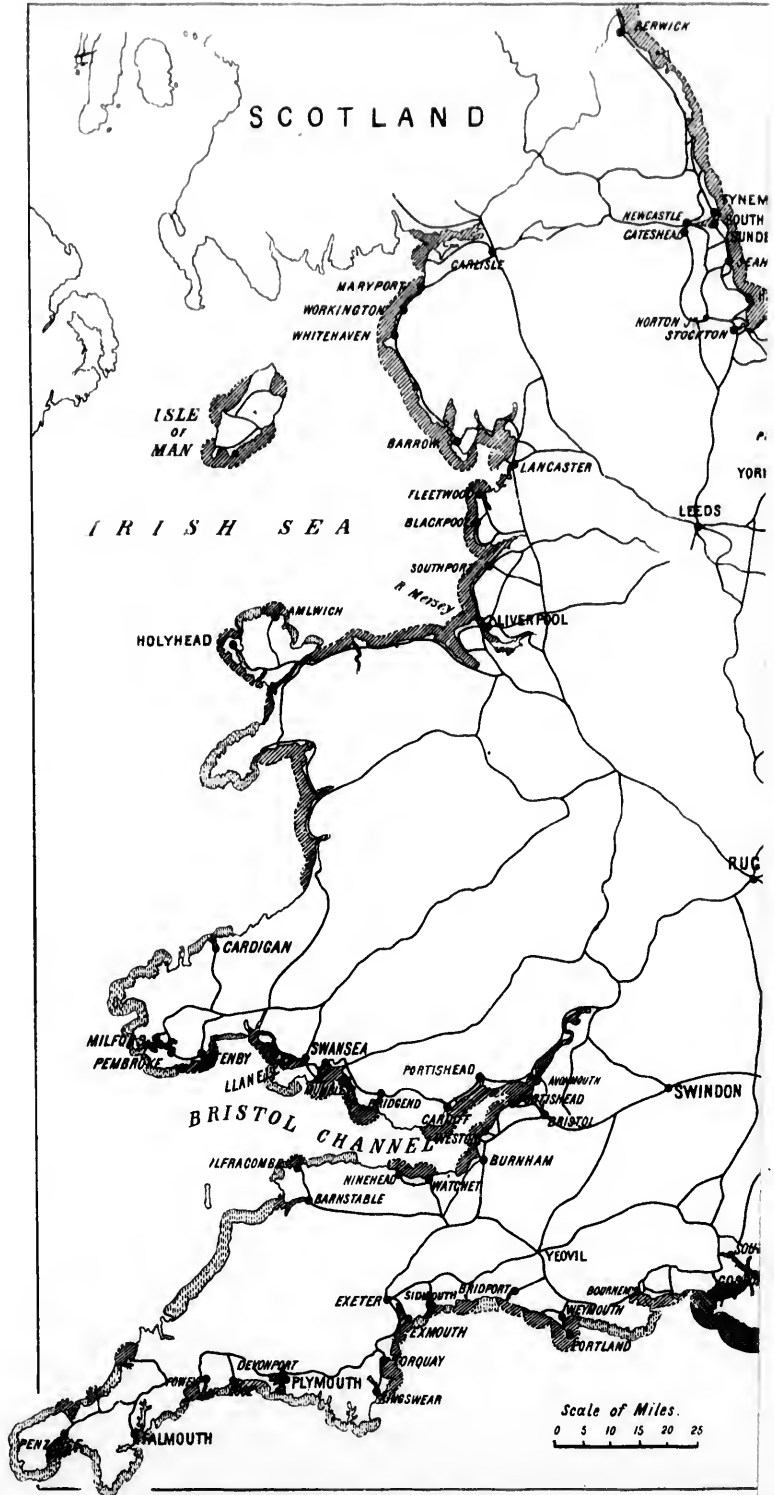
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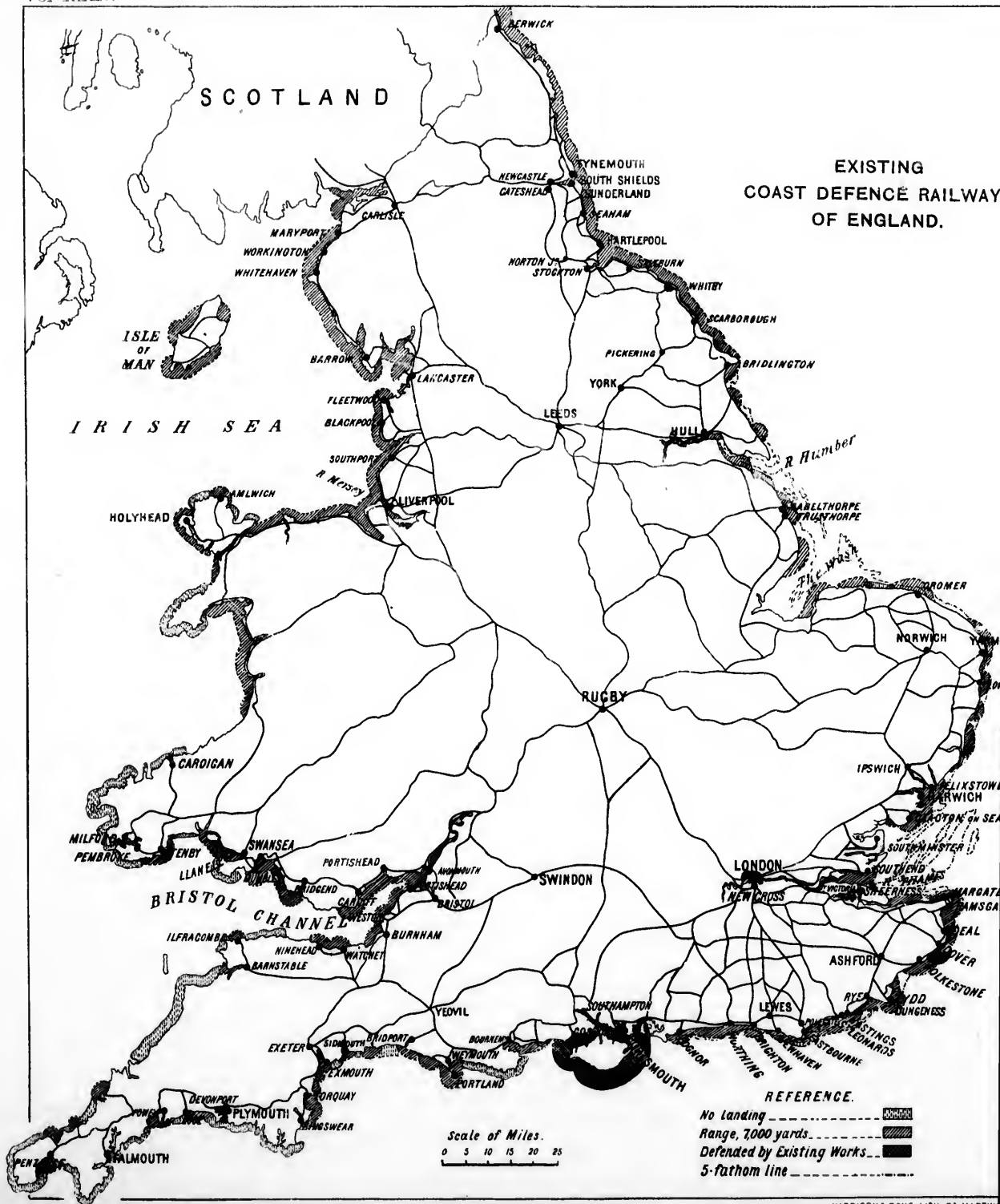
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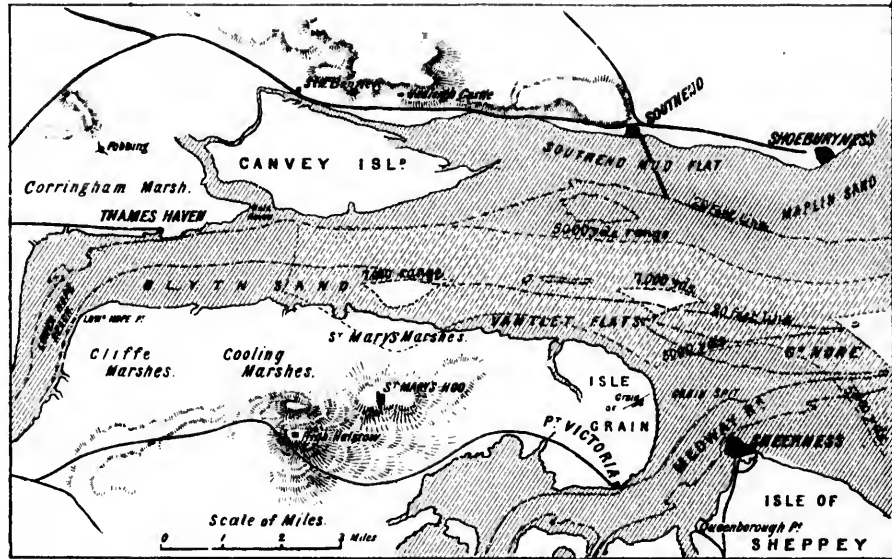
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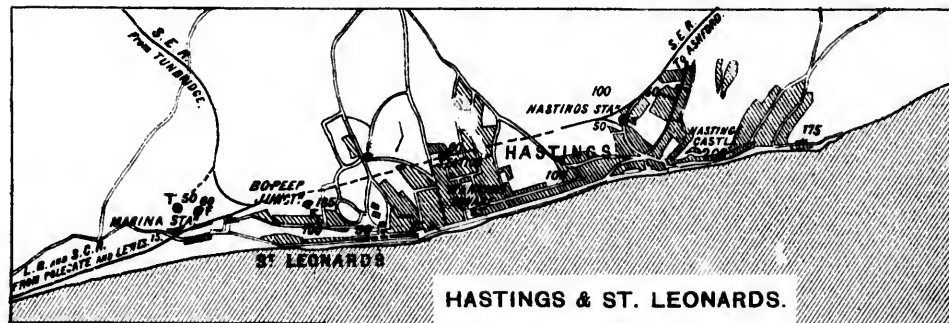




MOUTH OF THE THAMES.



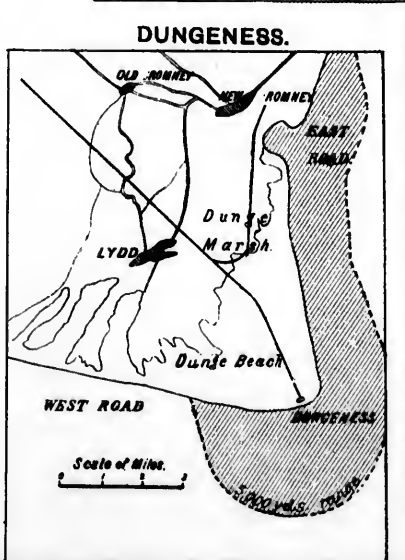
EXISTING  
FENCE RAILWAYS  
ENGLAND.



HASTINGS & ST. LEONARDS.

Scale of Yards  
0 500 1000 2000

REFERENCE  
Heights..... 100  
Position-Finders..... F.  
Turn-Tables..... T.



Then comes a short length of coast which would be undefended except by a few ancient martellos. Following these are the intricate windings of the Ore, which make the coast practically inaccessible. Aldborough, Lowestoft, and Yarmouth are well defended. After them comes a length of 12 miles totally undefended, 120 miles from London, however; then Cromer and its vicinity, which are covered. And now the vagaries of the 5-fathom line, in the Wash, will permit us to leave it aside and cross to Theddlethorpe, a possible landing, which can, however, be secured. Again the 5-fathom line runs out to sea, and the Humber is reached and closed. In the neighbourhood of Withernsea a possible landing exists, which is unsecured; this might, however, be remedied at small cost by a short extension of the line. From Bridlington north to the Border, 150 miles, the whole coast line is admirably defended on paper, and the towns of Bridlington, Scarborough, Whitby, Saltburn, Middlesborough, Seaham, Hartlepool, Sunderland, Shields, Tynemouth, and Berwick could be protected.

A considerable portion of this coast is, however, inaccessible, and would in practice be neglected.

Crossing to the western coast, the accessible shores from the Solway to the Menai Strait are completely defended, including the ports of Barrow, Fleetwood, and Holyhead.

The western coast of Wales is not completely defended, but is in itself a sufficient obstacle.

In the Bristol Channel, Milford Haven, Llanelly, Swansea, Barry Docks, Cardiff, Avonmouth, and Bristol are covered.

The northern coast of Cornwall is in most places inaccessible; on its southern coast Penzance, Falmouth, and Fowey could be protected. Plymouth and Portsmouth may be neglected; between the two, however, Kingswear, Torquay, Exmouth, and Sidmouth would be covered.

From Portsmouth to the Thames there is a coast line of 170 miles, and of this very important section 160 miles are defensible, and the unprotected towns of Worthing, Brighton, Eastbourne, Hastings, Folkestone, Margate, and Ramsgate, all at present quite open to insult, could probably defy an enemy.

Summarizing, the unsatisfactory portions of the coast railway defence would be few and far between, and could, if thought necessary, be remedied at a trifling cost.

In Table I the details of the coast line of the English counties are given. In a total length of 1,900 miles of coast, 1,270 could theoretically be defended from the railways; 425 are inaccessible, thus increasing the total defended to 1,695, or 89 per cent. of the whole.

Of the coast of the counties close to London, and to the great manufacturing centres, namely, the counties of Lancashire, Cheshire, Norfolk, Suffolk, Essex, Sussex, Kent, and Dorset, 92 per cent. is defensible.

Every English coast town of the slightest importance is defended; every estuary and harbour the same.

(a.) *The Subdivision of the Defence.*—From the configuration of the

coast, the line to be taken in the subdivision of the defence is an obvious one.

1st. A South-eastern section.

2nd. A special defence for the Thames.

3rd. The Eastern counties.

4th. The Lincolnshire coast.

5th. The coast of Yorkshire.

6th. The defences of the Middlesborough-Newcastle district.

7th. A North-western section.

8th. A Bristol Channel section.

9th. The Portsmouth and Southern district, the major part of which is already defended.

In addition, a few minor sections might have to be introduced.

Each of these sections would, as I propose, be organized into series of—

1st. Firing lines, consisting of guns stationed at vulnerable points along the coast, or concentrated at junctions from which they could readily move up to threatened points.

2nd. Supports placed at some central point of the sections, from which the firing lines would receive their first reinforcements.

3rd. Behind these reinforcements at central points in the country would be stationed grand reserves.

Thus, if an attack be imagined at any point on the coast line of a particular section, the firing line of the section would immediately come into action if on the spot, or move up to the threatened point. Within a few minutes the support could by telegraph be started on its way to replace the firing line, and the reserve be on its way to perform this same relief for the support.

To ensure a good working system, the different sections would have to be served as far as possible by distinct lines of railway. In this country this could be effected without disturbing the divisions which the configuration of the coast line dictate.

Thus, in the south-eastern section, the South Eastern Railway and London, Brighton, and South Coast Railway would cover the whole ground, and the London, Chatham, and Dover Railway (except for Sheerness) would be an alternative route. Ashford and Lewes would be the natural positions for the central points of the firing line, New Cross the best position for the support.

For the special defence of the Thames, the South Eastern Railway on the south, and the London, Tilbury, and Southend Railway on the north.

In the eastern section the Great Eastern Railway would practically cover the whole of the ground.

In Lincolnshire, the Great Northern would do the same.

In the North-east, the North Eastern Railway, with Pickering, Norton Junction, and Gateshead as central points for the firing line, Leeds as support.

In the North-west, the London and North Western, with Preston as centre, Leeds again as support.

In the Bristol Channel, on both north and south, the Great Western



Railway could be made the section line, Bridgend as a firing line on the north, Swindon as support.

In the South-west, the Great Western Railway again, with Plymouth as firing line centre.

In the South, the London and South Western Railway, with Yeovil as firing line centre. In both this section and the south-western one Swindon would again be the position for the support.

Behind all these firing lines and supports would be kept a general reserve for the whole English system, which might be advantageously stationed at Rugby.

(b.) *Proposed Personnel and Co-operation with Railway Officials.*—To ensure the perfect success of any movable defence by sea, the directions for all general movements should emanate from one central authority.

The same would apply to any movable land defence. Generally speaking, it would seem necessary to provide a personnel somewhat on the following lines:—

(1.) One responsible head, who would be in command of all the coast defences of the country, and be in close communication with the naval and railway authorities.

(2.) Artillery Officers in charge of the subsections of the defence and of the reserves.

(3.) A nucleus battery of artillery in each section to perfect the system in time of peace.

(4.) Militia and Volunteer artillery to work the sections.

(c.) *Types of Proposed Ordnance (Heavy, Medium, Light).*—As pointed out previously, any gun can be fired from a railway in the direction of the line; relative efficiency would determine the nature of heavy gun to use upon railways. For the purposes of this paper, the 22-ton gun has been assumed to be the heaviest ordnance which would be so employed. The use of these heavy guns would seem necessary if the fire of the defence is to reach like natures of guns mounted in ships.

Too much stress can hardly be laid upon the desirability of using a great number of modern howitzers and mortars to fire out of cuttings, from behind hills, &c.

In medium ordnance the 6-inch B.L. gun and the various natures of Q.F. guns would seem to be the best.

For points where landings are possible, the lighter natures of Q.F.'s, machine, and field guns could be employed.

(d.) *Proposed Carriages.*—The design of carriages to fire guns from in the direction of the line is already well established, by their use in European arsenals. Carriages for firing at angles to the line would be a matter for experiment.

(e.) *Emplacements for Heavy Guns and Positions for Lighter Natures.*—In places where heavy guns would have to exercise an all-round fire, special emplacements would have to be provided. These emplacements might take the form of turntables located upon short sidings specially constructed for the purpose. The turntables would be of considerable diameter, their bridges of wrought iron, with hydraulic

or other suitable buffers to take up the recoil, the whole swinging in concrete lined pits.

The lighter guns could be fired directly from the main line from existing sidings, or from specially constructed lines.

(f.) *Method of Controlling and Directing Fire*.—Taking into full consideration the great advances which have been made in the last few years in the art of controlling and directing the fire from guns, even when mounted in concealed positions, there would seem to be no practical difficulty in adapting one of the systems to the requirements of the proposed system of railway coast defence.

(g.) *Estimate of Cost*.—Any estimate of the cost of the railway system of coast defence is naturally extremely difficult to reach and yet retain a semblance of probability; undoubtedly a practical survey of the ground would materially alter dispositions made upon theory.

On the same basis that all of the water covered from the existing railway coast have to be defended, the theoretical disposition of guns of different natures previously exemplified was effected, and their cost, with that of all other requisite matériel for the defence of England, would roughly be—

	£
31 22-ton guns, with all spare parts and 3,100 rounds..	221,960
106 medium guns, &c.                         "                 "         10,600     "	241,680
151 Q.F. guns   "                 "         15,100     "	141,940
155 carriages for the above (guns mounted in pairs) ....	268,000
Machine-guns .....	100,000
Carriages for same .....	50,000
Emplacements and sidings .....	150,000
Magazine carriages, &c.....	25,000
In round numbers .....	£1,200,000
Add 10 per cent. ....	120,000
Total for matériel .....	£1,320,000

This estimate as stated is not practical, but it affords to the mind a basis for comparison thoroughly with the probable cost of extending any actual system to perform the same work.

#### *Advantages of the Proposed System.*

The advantages of using for the defence of this country a system based upon the use of guns firing from existing lines of railway are numerous and apparent.

1st. The amount of resistance which could be offered at any point of our seaboard in a given time would be infinitely greater than by the use of any other practical system.

2nd. The resistance would also be the most economical that could be provided for a general defence of the country.

3rd. Once in working order, the cost of the system would depend upon the moral and physical life of its guns and their mountings.

All fixed defences and ships are dependent upon the march of the science of gunnery, as well as upon the life of the guns they contain, therefore a standard of excellence is never reached.

In maintenance expenses, the proposed system would cost less than fixed fortifications, and infinitely less than that of keeping ships in commission.

The cost of *personnel* would bear the same ratio to other systems as that of maintenance.

4th. The system could promise the rescue of all unprotected towns from bombardment.

5th. At the few landings which exist, a heavy force of artillery to oppose any enemy could be concentrated in a short space of time.

6th. Tide, storm, and darkness would have no effect upon the efficiency of a concentration. Fog would delay, not deter.

7th. The supply of coal for motive power and of munitions for the guns would be practically unlimited.

8th. In accuracy of fire the guns should compare favourably with like ordnance mounted in fixed defences.

9th. In mobility all existing systems would be distanced.

10th. The guns could in most places be concealed by natural features. Naval artillerymen tell us that good practice from ships against forts depends upon one important point, viz., that a distinct object must be fired at. A fort is not deemed a distinct object, a particular gun must be selected as a mark.

The result of naval fire against the guns of Alexandria did not, however, tend to show that firing at distinct objects was ever likely to be extremely damaging to that object. If the ships' guns were obliged to fire at a puff of smoke issuing from behind a hedge, or from out of a cutting, it is safe to assume that the effect of the fire would be still less damaging, though it might possibly have the effect of forcing the railway gun to shift its position from time to time. Smokeless powder would introduce the sole remaining factor requisite for total invisibility.

Finally, the system could be practically tested in time of peace in conjunction with our fleet manœuvres. Certain sections might be fully mobilized against the attacks of a squadron or cruisers which were to attempt secret aggression of some form along its shores, and umpires decide upon the efficiency of the system. In fact this might be done without actually providing the guns. Railway trucks could represent the armament, and thus the system be tried before any great expense for guns, &c., was gone into.

#### *Examples of Ground adaptable to the Railway System of Defence.*

A few examples in detail of well-known sections in their adaptability to the purposes of the railway system will I think emphasize the enormous command which our railways give us over the waters which are immediately contiguous to our shores.

As examples I have chosen an estuary, a landing, and an unprotected coast town.

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To follow the phases of possible attacks against these chosen places would be mere theory, and I shall therefore limit myself to describing them in as short a manner as possible, and allow the accompanying maps to speak for themselves as to the chances an enemy would have in engaging the guns the railways could provide.

*Estuary—The Thames.*

As an example of an estuary, I have chosen the mouth of the Thames. In spare moments I have been able to make a close study in the field of the railways, and the ground from Sheerness to Gravesend on the south, and from Southend to Thames Haven on the north.

The accompanying map represents the result of this study. The portion coloured blue indicates the water covered up to 4,500 yards, that coloured red the same up to 5,500.

The dotted line indicates the limits of the 20-foot channel at low tide.

At Sheerness a line of railway runs in from the south, and close to the town divides into two branches, one running into the town itself, the other to Queenborough Pier.

The line into Sheerness would not be of much practical use unless a short extension of it was made towards the east, in which case a strong reinforcement to the guns of Sheerness might be brought up. The Queenborough line would afford a position for firing down the River Medway, thereby flanking the dockyard and the forts.

On the opposite bank of the river, at Port Victoria, a good position well concealed behind the sea wall could be taken up. From this portion of the line, guns could fire directly down the channel of the Medway towards the Nore light.

Moving in a westerly direction good positions exist for taking an enemy in reverse, should he force the defences of Sheerness.

After this point, which is about two miles from Port Victoria, the line runs behind and up a low range of hills to emerge and sight the Thames close to High Halstow.

At this point a good position exists. The railway concealed by small trees and hedges is at an elevation of 100 feet above the Thames, on which 5,000 yards away every boat could be plainly seen. Behind High Halstow a high-angle fire battery might be stationed, controlled by a range-finder station in the church tower (210 feet above the river).

Between Halstow and Gravesend several very good sites for batteries could be found, the fire of which might assist in the defence of mine-fields in the river.

On the north side the railway (London, Tilbury, and Southend Railway) is mostly situated in low-lying land, and is for many miles within a few hundred yards of the river bank.

Excepting for the short stretch from Southend to Shoeburyness, ideal positions for range or position finders are to be found on the hills directly behind the line.

From the railway itself every funnel and mast in the channel can be distinctly seen, and direction thus obtained without difficulty. The guns could not be seen from the decks of vessels, and even if looked for from the mast-head would be exceedingly hard to distinguish, as hedges exist on both sides of the line.

At Thames Haven a branch line would afford an opportunity for establishing guns to fire directly down the channel.

The piece of country which I have just described has unfortunately been the only one which time would permit of my studying in detail on the ground. I can only hope that other important points will after a practical study lend themselves as readily to the purposes of the railway idea.

The ranges would not be excessive, many opportunities for crossfire exist, no costly extensions of the existing lines would be necessary, and the control of the fire should be thorough and effective.

#### *Unprotected Coast Town.*

Let us now consider the case of an unprotected coast town. A well-known Admiral of a foreign Power made the statement not long since, that in the event of war with this country, he would have no hesitation in bombarding our defenceless coast towns; what would be the probable influence of the railway-gun upon his idea?

If he approached by day, our lookouts should give the necessary time for bringing up a heavy force of guns. If, however, he eluded the lookouts and took the town unawares, his punishment of it could not be of any duration; it would not, for the satisfaction of bombarding a defenceless town, pay him to risk the loss of a ship nor waste ammunition, the use of which might at any moment become of vital necessity to him. His best chance of success would, therefore, lie in an approach by night, when he might hope to pass the lookouts, and open fire on the town (if he happened to have struck it off in the night) immediately after daybreak.

As an example of a place which might be so visited, let us consider the case of Hastings and St. Leonards, which form a single town open to the sea for a length of  $2\frac{1}{2}$  miles.

Double lines of railway approach the town from three directions:—

(a.) From the north-east the South Eastern, entering the town at the east end.

(b.) From the north-west the South Eastern line from Tunbridge, entering the town near the west end in combination with

(c.) The London, Brighton, and South Coast line from Lewes.

From the map it will be observed that all these lines run within a short distance of the shore, and that the hills, &c., favour concealment. Several good positions for guns are to be found on the railways. Thus at the east end of the town we find, close by Hastings station, three existing sidings well located for fire along the line; on one of these a turntable might without difficulty be laid down for a 22-ton gun; in addition to these three sidings there is a set of four more which could be utilized for any nature of fire.

At Hastings Castle a good observing station for a position finder might be established.

From Hastings Station to the Warrior Square Station the line is in a tunnel, which might serve as a shelter if the fire of an enemy became too heavy. At Warrior Square there is an open length of about 200 yards; here a battery of howitzers and mortars might be stationed, and their fire observed and directed from a church close by. After passing through a second tunnel, Bo-peep Junction is reached; here the South Eastern Railway and the London, Brighton, and South Coast lines separate, the former running into a deep cutting and bearing away towards the north-west. Excellent positions could be taken up close by this junction for flanking the front of the town or for direct fire out to sea.

The high ground close by would afford sites for range or position finders.

For the above notes of the lines about these towns I am indebted to a brother Officer, who has a knowledge of the vicinity and kindly volunteered to give me a few hints.

#### *Landings.*

As I have not actually been on the ground at Dungeness, I shall content myself with drawing your attention to the accompanying map of that section of the country which seems to demonstrate the possibility of bringing a heavy fire of all natures of guns on the water which an enemy's boats would occupy in any attempted landing. I have lately had the opportunity of visiting another of the dangerous landings of the country, that of Clacton. Here, close beside the row of ancient martellos built for the purpose of denying the landing, a line of railway could be built at a very small cost. The guns mounted upon it would be hidden behind the sea wall and could cover the water which an enemy would occupy, both in landing and in covering his landing.

In conclusion, I may be allowed to recapitulate the leading points of my argument.

The strong point of our defensive position in England is, as I submit, our enormous railway power. Whether we regard it from the point of railway mileage open, as compared with square mileage of area to be defended in Great Britain and Ireland generally, or whether we look to the length of our extended coast line as compared with the railway mileage at or near that coast line, and therefore locally available for its defence, the conclusion is one and the same, namely, that our defensive railway power is far greater than that of any other country.

What the nature of our defensive position should be is not within the province of this paper, and I trust that I have not made statements which are construable into opinions on this vexed subject. What I have wished to point out is that the railway system of coast defence is equally applicable to all shades of opinion.

The weak point of England's defensive position is, as I have submitted to your judgment, our existing deficiency in gun power. Our coast defence is admitted to be very partial and incomplete. It leaves great lengths of our seaboard and important commercial centres on the coast, nearly if not quite undefended. And when we look inland, we find a similar deficiency of gun power for that field force which successive generations of responsible Ministers have thought to be a necessary provision for our defence in the event of invasion.

My argument therefore is, and has been throughout this paper, Why not use our strength to correct our weakness? Why should we not

TABLE.—*Details of English Coast Line by Counties.*

Coast county.	Length of coast.	Coast defended from railways.	Inaccess-ible.	Total defended.	Remarks.
Kent .....	miles 97	miles 90	miles 5	miles 95	From Canvey Island.
Sussex .....	84	71	3	74	
Hampshire .....	100	99	1	100	
Dorset .....	67	40	25	65	
Devon {	69	32	24	56	
{South ...	53	13	36	49	
Cornwall .....	171	65	96	161	
Somerset .....	58	42	—	42	
Gloucester .....	5	5	—	5	
Glamorgan .....	104	70	10	80	
Carmarthen .....	28	20	6	26	
Pembroke .....	94	16	67	83	
Cardigan .....	44	15	4	19	
Merioneth .....	28	28	—	28	
Carnarvon .....	95	55	40	95	
Anglesea .....	78	56	17	73	
Denbigh .....	9	9	—	9	
Flint .....	26	26	—	26	
Cheshire .....	18	18	—	18	To mouth of Mersey.
Lancashire .....	102	93	9	102	Morecambe Bay and River Ribble assumed inaccessible.
Isle of Man .....	69	51	?	51	
Cumberland .....	62	60	2	62	To Bowness.
Northumberland .....	64	50	14	64	
Yorkshire .....	116	84	15	99	To Grimsby.
Lincoln .....	68	30	30	60	The Wash assumed to be inaccessible.
Norfolk .....	80	54	10	64	
Suffolk .....	53	40	7	47	
Essex .....	54	38	4	42	To Canvey Island.
Totals .....	1,896	1,270	425	1,695	

turn to account the enormous advantage which our great railway power gives us to concentrate every available gun at a threatened point in the right and the shortest time, which the proper utilization of our railways can and will do; thereby, as I submit, practically doubling or quadrupling our available gun power?

The CHAIRMAN: We have been listening to a very instructive lecture upon a subject which must be new to many of us, and I am sure there are many who will be able to help us by offering some remarks in the discussion which is invited.

Colonel E. R. WETHERED: I rise not with a view of criticizing any part of the lecture, and I must congratulate the lecturer on the intelligence he has exercised, and the large amount of labour and time he must have expended in working out in detail theoretically his plan of operations. To take it shortly and briefly, it is sufficient to look at the map, and let us admit for example that it is possible to fire guns of heavy calibre from our railway metals as proposed, subject, of course, to certain modifications which could doubtless be easily carried out. If you look at the coast line of England and consider our present system of defence, the distances our ships would have to travel round that coast, you will see what a number of vessels we should require to be constantly on the move and how our existing Fleet, which would be required in all its strength to strike a blow, and protect our commerce, would be supplied. Now, looking at the map, suppose we had a large reserve of heavy guns mounted and equipped at Rugby, or some more suitable central position, how easy it would be to move direct to any given point of the outer circle, which our railway system provided for. You could move your guns in one quarter, or even one-tenth, of the time that it would take to get a ship round from point to point of our extended seaboard. I have listened to the lecture with considerable interest, I may say, almost with a kind of parental feeling, not because as an old man I rise to compliment the young lecturer, but he has taken up my child, and naturally the parent always likes the man that fondles his offspring. I am getting on in years myself, and I am therefore glad to see that a very young man has risen up and taken an interest in this subject. Twenty years ago I suggested the very same thing. I wrote to the War Office proposing it. I will read you a portion of my letter. My infant met with the usual War Office attention, and I suppose it was put asleep in the pigeon-hole, and if this young man had not raised the question it might have lain there long after I had been laid in the grave. "January 4, 1871. Sir, as the defences of our country are now occupying much national concern, I hope I may not be considered presumptuous in briefly and very superficially offering a suggestion relative to this important subject. In view that all our heavy ordnance is at present mounted in fixed positions and incapable of concentration at any threatened point of our coast, or even at any particular face of a fortification without considerable labour, I would propose to utilize generally our railway system for defensive purposes, and would mount all our guns on wheel carriages, so that they could be moved along any of our lines from point to point: the advantages of such a system must be obvious, as not only would it enable us to concentrate our artillery with overwhelming force at any given point, but guns on such movable carriages could be fought with infinitely less exposure to the men." This was the reply I received from the War Office:—"War Office, 13th January, 1871. Sir, I am directed by the Secretary of State for War to acknowledge the receipt of your communication, dated 4th instant, containing suggestions for the adaptation of the railway system for defensive purposes by mounting guns on carriages which could run on the lines; and for the defence of the metropolis on a similar plan." I am not aware that any gun was ever previously mounted for firing purposes upon a railway wheel-carriage platform before this, but not being either a gunner or a sapper, or in any way mixed up with gunnery experiments, I am unable to speak from personal knowledge. Shortly after this, at the proof butts at Woolwich, an 81-ton gun was thus mounted and fired on the very principle I proposed. In 1877 I wrote to the "Times" as follows: it was printed in the "Times" of the 25th May, 1877, headed—



## "PORTABLE BATTERIES.

"To the Editor of the 'Times.'

"SIR,—Any suggestion which has for its object the rendering of our seagirt island so impregnable in itself against the possibility of invasion or injury from hostile forces that our powerful Navy may be left free and unfettered by home fears or necessities to protect our extended Colonies and commerce, or to strike a blow with all its power at any given point, cannot fail to be of interest at the present time, and will, I trust, plead a sufficient excuse for soliciting space in your columns to draw attention to my proposal.

"Our present conscious security is based mainly on the command we possess on the high seas, and should any combination of circumstances render our fleets powerless to cope with the enemies' navies, the invasion of this country would admittedly be feasible. In such adverse circumstances we should depend for the defence of our coast on the existing fortifications, supplemented by such earth-works as time permitted, together with the aid of all the gunboats and torpedo craft we could command; our telegraph system would enable us to direct our floating batteries and all available troops to proceed by most expeditious means to the points threatened. The objections that occur to me in trusting exclusively to this means of defence are—

"1. All our scattered or detached forts, with their fixed complement of guns, men, and material, weaken our powers of concentration, for these forts cannot be denuded of troops, as not only must the material and stores be protected, but the transfer of gunners to any other point would be of very little service without their guns. Again, an enemy once effecting a landing and getting possession of one or more of these fortifications would secure a solid armed basis of communication, which, supported by their navy, would render their position impregnable.

"2. Our gunboats and torpedo craft, besides being largely dependent on the weather, and having very long distances to travel round the outer circle of the coasts, would not be enabled to concentrate at any given point in sufficient time; in fact, the enemy, having command of the Channel for the time being, could bar the approach of any vessels of this kind on both flanks of their disembarking troops.

"The collecting of a large force of Militia and Volunteers at any particular spot would occupy considerable time.

"Again, the enemy would, in all probability, make a feint to attack on two or more points, and having thus drawn our forces in those directions would, under cover of night, run with the main body of his troops for another part of our shores.

"Our island home, being providentially surrounded by water, possesses the strongest natural barrier against invasion that can possibly exist, and it appears to me that if we provide the means of concentrating with unerring certainty a crushing force of artillery, with guns of heavier calibre than even the war-ships of the invader could command, on any given points of the coast, before the enemy could possibly set foot on the shore, it would be impossible for the vessels of an invading force to approach near enough either to disembark or cover the landing of their men.

"My proposal is simply to take the full advantage which our railway system, in connection with our insular position, affords, and provide powerful movable batteries, which can be sent fully equipped in fighting order direct by railway to any required point, and the recent experimental trials of the 81-ton gun have proved that the heaviest ordnance can be moved and fought on railway metals with considerable advantage, the incline of the rail at the firing point forming almost an automatic platform, the recoil taking the gun up the incline, where it is held in position by the brakes, and when liberated returns to the firing point by its own momentum.

"In connection with our present main lines of railway, which probably would require strengthening at certain points, I would construct branch lines or sidings leading to every strategical point of our coast and into every fort, as far as possible,

with requisite platforms, either on the incline principle, turntable, or other mechanical arrangement. These branch lines during peace would, doubtless, be of some small commercial value. I would mount as many of our heaviest guns as practicable on railway gun-carriages, so that they could be moved by rail from one face of a fort to another, and from one place to another. The locomotives required for this service could be so mechanically constructed as to facilitate the loading of the guns by steam power, and thus save manual work. I would suggest three large central depôts, where a number of guns thus mounted, fully equipped, and ready for use, should be kept. These central depôts might be so constructed as to form an inner circle of fortifications to defend the metropolis. At each of these stations the regular Militia and Volunteer Artillery might be instructed in everything that pertains to the working of these guns—the construction, repair, and destruction of railway lines, besides the formation of a locomotive corps specially trained to conduct the traffic.

“Besides the drill and instruction imparted at these stations, a number of these heavy guns, fully equipped, with proper complement of men, ammunition, and material, might be occasionally moved to different points of the coast for drill and gun practice. Practical instruction of this kind would be highly calculated to interest our Volunteer soldiers, who should be given every encouragement and opportunity to render themselves efficient artillerists. The cost of such a system would not be great, for when once we have established a means whereby our heavy guns, as well as men, can be moved expeditiously from place to place, we can afford to diminish the number of our scattered forces and present immovable batteries.

“I have merely stated my views superficially; the details are easily worked out.

“I remain, Sir, yours faithfully,

“E. R. WETHERED.

“Woolwich, May 24th, 1877.”

Immediately after this letter appeared, I had a number of copies printed for circulation, to which I appended the following footnote:—

“If, in addition to connecting some of our light-ships by telegraph cable with the shore, some provision were made for running out, in the event of war, from these ships a further length of cable, some 10 or 20 miles out to sea, and there establishing a temporary telegraph post, our cruisers would, by these means, be enabled to communicate any movements of the enemy or other information, without loss of time or having to quit their cruising ground.”

I am an old-fashioned man myself. I prefer one practical test to ever so many theoretical ideas, and firing at a direct angle on a railway is a point that requires very careful practical experiment, because we are taking the line at the very weakest point. The rails, the sleepers, bolts, and everything are taken at the weakest point. The wheels, metals, chairs, sleepers are constructed mainly to bear the vertical strain, and the sudden shock of discharge would throw a very considerable pressure on the outer rail. The sleepers also run across, and the bolts which hold the sleepers run with the grain in the direction of the side pressure. These are all very weak points. Therefore it would be impossible, I think, for any mathematical calculation to arrive at any conclusion as to whether the carriage and the railway metals would bear right-angle fire. Then if the gun was fired from any part of a curve, if the recoil is towards the upper side, the raised outer rail would strengthen the power of resistance, but, if the recoil was in the reverse direction, the carriage would stand partly tilted up in the direction the recoil would force it. These are matters of detail. Only admit the principle, and everything else can be worked out without much difficulty.

Colonel KENSINGTON, R.A.: I have been referred to in the lecture concerning the calculation of the overturning effect of fire at right angles to the line of rails. This problem is not easy, because it is difficult to calculate the energy of recoil exactly. It is not sufficient to take it as due only to the momentum of the projectile, because there are other causes which must not be neglected, as has been ably shown by Dr. Anderson, F.R.S., Director-General of Ordnance Factories. There is the force expended on driving the air out from the bore of the gun, which alone

is too much to be neglected. There is also the great amount of the reaction due to the expansion of the powder gas on leaving the bore, besides the actual velocity acquired by the very considerable weight of powder. By Dr. Anderson's calculations it would appear that the energy of the recoil of the 6-inch B.L. gun is probably about half again as much as the energy of recoil which would be due to the momentum of the projectile alone. This would bring the amount to 25 foot-tons at most, taking the muzzle velocity at a rather larger figure than the lecturer has given, namely, close upon 2,000 feet per second, which I believe is nearly correct. Making then these assumptions concerning the energy of recoil, and taking into consideration the average amounts for the weights of the truck and mounting that might be employed and the position of the centre of gravity, as well as the width of the track, I find that, even if the whole of the energy of recoil were available for upsetting the truck, there would be sufficient stability to prevent a complete upset. In fact, however, a large amount of energy of recoil would be absorbed by the hydraulic buffers, also by the action of the springs of the truck; so that I think that it may be fairly be assumed on mathematical calculations alone that the 6-inch gun might be fired at right angles to the truck. Further, I have considered the question in connection with experiments with the 40-pr. R.B.L. which have been alluded to, the energy of recoil in that instance not being more than 4 or 5 foot-tons, or about one-fifth of the amount for the 6-inch B.L. It appears that the gun-carriage might have in that case been able to recoil about 6 inches at most, whereas for the Vavasour carriage used for the 6-inch B.L. there is a recoil of 3 feet allowed. This would compensate for the greater energy of the 6-inch B.L. The new Vavasour carriage for garrison service is only constructed for a recoil of 1½ feet, which according to my calculations would, I think, be insufficient, because the question is not merely to consider what will prevent the carriage from overturning, but rather that the front trucks should not leave the rails at all. I am satisfied that with a recoil allowed of 3 feet the truck would remain safely on the rails. I should like to say a few words on some further points connected with the lecture. I think that the system which has been brought before us is admirably adapted for the high-angle fire, which has been proved so effectual, and that the apparently long ranges the lecturer has taken, up to 7,000 yards, are not by any means excessive when considered in connection with ranges at which high-angle fire has been experimentally employed with very great success. Experiments have been made at the Isle of Wight, extending up to 10,000 yards, when a moving raft, the size of the deck of a vessel, has been successfully hit. Further, I have just been informed that at Shoeburyness the practice has been adopted of firing guns from curved rails, thus easily obtaining any required direction. It has recently been suggested that all our lighthouses ought to be connected by telegraphic communication with the land, chiefly for the purpose of giving information concerning shipwrecks that may occur near them. This would be invaluable in connection with the question of coast defence, so that the earliest information might be obtained. I think the lecture is very instructive, as showing the short period of time within which armaments of very considerable power can be brought together, and must altogether be considered a valuable contribution to the vexed question as to which of the sister Services, Army or Navy, should be responsible for coast defence.

Captain BUNBURY, R.A.: I should like to say a few words from the point of view of the man at the gun. Colonel Kensington says 7,000 yards are not extreme for high-angle fire, but I think with the medium guns, the 6-inch guns to which the lecturer alludes, that we should find considerable difficulty in hitting a ship at 7,000 yards by direct fire; in the first place, even if that range was taken from the gun itself. In many cases, as you see by the map, the town to be bombarded would be some little distance nearer to the ship than the gun would be. The ship also would be firing at a very large object; there would be no necessity for her to anchor as long as she throws her shells anywhere into the town. We should have, therefore, the difficulty of firing at a moving object. I am diffident about saying anything about position-finding in the presence of Major Watkin, who, I have no doubt, will be able to overcome any difficulties that will be raised, but, at present, it would be very difficult for us to use high-angle fire directed by position-finders, which are a necessity to accurate high-angle firing, with guns firing from trucks and moving on

railway lines. We are dependent for accuracy on direction, and without accurately laid training arcs I do not see how you are to get good results. Then, again, there is the electric communication of ranges and training, and I do not see how that is to be managed with guns running freely on railway lines. I think that points to the necessity of having short sidings running into emplacements for guns and howitzers. I also think the supply of ammunition in open trucks without magazines would be rather a hazardous experiment. I do not think it would tend to confidence in serving the guns. It would be difficult also to supply ammunition to individual guns if you had five or six guns in a row, unless you had a siding or branch line which would carry the ammunition round. I think the question of interruption of traffic has hardly been given sufficient attention. I fancy the War Office arrangements for moving troops and stores would be very much interrupted if a considerable portion of the line was to be taken up for the use of the guns. I fancy it would lead to friction, to say the least of it. Then, again, the ordnance would require to be practised from in peace-time, and there is local traffic to be considered. I do not know whether the railway companies would be ready to give up a portion of their lines and interrupt traffic without considerable compensation. There is one point the lecturer has not alluded to, in which I think the system would be of very great value. We depend, in time of war, very much for our coast defence upon the services of the Auxiliary Artillery, Militia and Volunteers. At present the great majority of them have little or no training with modern B.L. weapons. As to the Militia, I may say, without exaggeration, most of them have to train with the old 64-prs., though they are sent occasionally at long intervals to be trained at the forts. Under some system such as that proposed, instead of the whole regiment going to the guns, we can have the guns sent up for the use of the Militia and Volunteer regiments at their own headquarters. That, I think, would do away with great part of the difficulties we have at present in training our Auxiliary Artillery in the use of new type guns.

Lieutenant-General LAURIE: It is, I think, rather an interesting fact that the first Canadian Military College Cadet who has delivered an address in this theatre should have spoken on the subject of the protection of the shores of England. It does strike me as rather a peculiar thing that his attention should first have been directed to the defence of the mother country. As regards this subject, it strikes me that perhaps he is suggesting too much, and so may overdo his proposal. He tells us in the same address that we are short of guns. He then proposes to lock up a very large number of our guns by mounting them on these carriages. It seems to me, speaking not of course as a gunner, that it would be more desirable to fit the carriages so that the guns could be readily placed upon them whenever required, so that they could be utilized for that purpose, rather than to lock up permanently a large portion of our armament, which may or may not require to be used elsewhere. Besides, it seems to me you should not make your guns fixtures on the railway trucks, but have them detachable and available to move into commanding positions where the railway track does not and cannot run; hence it would surely be better that the trucks should be fitted to receive the guns, so that they could be utilized for this purpose, but should not be permanently connected. Again, I think, when he suggests putting these heavy guns on the railway carriages he is again going rather far. For light guns to meet raiders it seems to me to be a very serviceable and feasible plan; but to deal with heavy guns and to expect that they are to take the place of forts against ships does seem to me to be going a little beyond what we are at all prepared for at present, and may destroy the chance of carrying out a very reasonable, a very fair, and admirable suggestion. I throw out these ideas, speaking more as an infantryman, a man accustomed to other work, than as a gunner; but we are much indebted to the lecturer for the care and thought he has bestowed on this novel and important subject.

The CHAIRMAN: Perhaps Major Watkin can give us some information on this subject?

Major WATKIN: I have not studied the question enough to answer any of the questions raised, because I understood the lecturer only to put the matter forward as a scheme, and not in detail. I think, when we come to matters of detail, we could possibly meet the objections raised. If you could mount the guns on the

carriage, I think then you come to the question of laying the guns, but I should be very sorry to lay it down exactly how it is to be done.

The CHAIRMAN: I think that the lecturer has done good service in bringing this question forward and suggesting that a movable armament, such as is recognized as part of the defence of a position occupied by a chain of forts, might be utilized for the defence of the country at large, for, if not applicable to the extent he suggests, it might still be adopted for special sites. His proposals are not altogether new. We have been told by Colonel Wethered that somewhat similar proposals were submitted by him to the War Office in 1871, and the Index of Lectures that have been delivered in this Institution shows that the subject was also brought forward by an Officer of the 79th Highlanders in 1865, so that we may suppose that what has occurred to several minds has doubtless a good deal in it. The lecturer's proposals would enable one gun to do the work of two or more, for, by having the guns concentrated and moved to different places on the coast where they might be wanted, they could do a great deal better service than if they were kept locked up in one or two places. Besides which, at a time of invasion or attack in this country, when every available horse would probably be taken up, we should have the advantage of rapidly getting the guns by rail somewhere near the places where they would be wanted, instead of having to rely exclusively upon horse power for the purpose. We have had an estimate put before us of 1,320,000*l.* for doing this; it is a pretty large sum, but I fancy it is not quite enough. It does not include a great many accessories that would be required, such as the cost of providing storehouses and of purchasing land and making sidings and gun emplacements, which would be necessary, not only to prevent the main lines being blocked by the armoured trains at a time when troops would have to be hurried up to points where the attack was likely to take place, but also for the efficient working of the guns. Considering the long range which is proposed for the guns to fire over, I understand that high-angle fire is intended, the guns to be worked by means of the position range-finder from places where they would not themselves be seen. I doubt whether Militia or Volunteer Artillery would be able to do much accurate practice at boats moving about under such conditions. There are, however, others much better fitted to give an opinion upon this point than I am. Machine and other guns for direct firing to oppose a landing could not well be used from the lines of railways; they would have to be brought nearer the points to be defended. The London, Brighton, and South Coast and other lines referred to by the lecturer are pretty close to the sea, but I think there are few places on those railways where we could actually put guns on the metals and look over the sights of those guns to fire at any places where troops might probably be landed; arrangements would therefore have to be made for getting such guns to the front, to points where they could be used. The Officers of the Engineer and Railway Volunteer Staff Corps might have a good deal to say in the matter dealt with in this lecture. They would probably have to make the traffic arrangements in great measure for the armoured trains, if any such scheme as is proposed here were to be adopted, and I am sorry none of them happen to be here to-day to help us in the discussion.

Lieutenant GIBOUARD, in reply: My first thought of this idea was more in connection with siege attack than coast defence, and in its bearing on siege attack I can see no reason why the idea is not quite appreciable. I have examined the country round Paris and Belfort, and apparently the heaviest guns, if necessary, could be brought up and laid directly on the forts, quite out of range of the guns that are mounted in them. But as the question of coast defence was one which more directly affected our own country, I abandoned the question of siege attack and went into coast defence. I then became aware, by going through back papers, that Colonel Wethered and Mr. Walker, of the 79th Highlanders, had proposed the scheme many years ago. At that time, unfortunately, a great many of our present railways were not constructed, and the scheme was not so feasible as it is to-day. Captain Bunbury has spoken of a few objections to the scheme. The lecture to-day was never intended to go into detail. It seems to me that if the general idea is sound there certainly could be no difficulty in the details which might not be got over in some reasonable way. He has raised a few objections; one is the supply of ammunition. I can see no difficulty in this matter.

Special cars are provided, which would come up with the trains and be left at a short distance from the place where the guns would take up their firing positions, and also as to the supply of the ammunition from those cars to the guns. The lines are double, and the simplest method would be to use the second line to run a small car on, and thus take up the ammunition to the guns. In the matter of interruption of traffic, Captain Bunbury, by admitting the fact that an enemy was bombarding a town, certainly admits the fact that the traffic would be interrupted, and in such a case I do not think any regular railway trains could run upon them. Practice in peace-time, which Captain Bunbury spoke about, is, I think, one of the things which makes the scheme peculiarly valuable. It could be practised in peace-time and thoroughly perfected. General Laurie spoke about the locking up of the guns. I cannot quite see myself how one could dismount the guns. They need not necessarily be guns of the latest pattern. We have any number of guns in the country which are not used because guns of later pattern are superseding them. If we separate the guns from the carriages, the scheme could hardly be ready in time of war. The scheme would have to be studied very carefully in peace-time, and all the details worked out. General Laurie also spoke about replacing fortifications by the use of these heavy guns. That, I think, was the last idea I had in my mind in this paper. What I did mean was that we could not hope to extend the present fortifications, and that there were many points on the coast which were totally undefended, and here the scheme could be used to greater advantage. If we only bring up light guns we may have heavy ship's guns to deal with, and I cannot therefore see that the exclusive use of light guns would be advisable; therefore, I proposed at the more important points to put one or two turntables, in order that these heavy guns might serve three or four places. If you put a coast battery for each place it would reach the cost of fifteen or twenty of these guns, or probably the cost of the heavy guns for the whole of the country. General Dawson-Scott spoke about blocking the concentration of troops coming up in case of invasion. Undoubtedly there would be some objection to this, but, at the same time, it is laid down that it does not pay to entrain troops unless they have 20 miles to go. I think it is 30 or 35 miles in Europe, but in this country, on account of our numerous railways, we assume it to be 20 miles. At any of these points it will be noticed that the guns would be up long before the troops would begin to entrain. Ashford is only 17 miles from Lydd, and the guns would be in position before the line would be used, and therefore would not cause a block. This would also seem to be the case at Clacton, as the guns would only have to travel from Ipswich. These are the two most dangerous landings in the country. At other points, if the bombardment of a town is going on, I cannot see how the ordinary traffic could possibly go on. Therefore, I should think no interruption would take place. In conclusion, I must thank the Officers who have kindly helped me. This paper is not an undivided effort, a great many people having very kindly assisted me in every way.

The CHAIRMAN: It only remains for me to ask you to join me in thanking the lecturer for this very interesting paper, and also to thank those gentlemen who have taken part in this discussion.

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