Discussion.

The President. The PRESIDENT, in moving a vote of thanks to the Authors, said he would like to express his admiration for the manner in which the work had been carried out in the face of great difficulties and in a very short time. Many points in the work and also the selection of the site might be criticized, but it had to be taken into account that the country had been in the midst of a great war, and everything had had to be done as quickly as possible. It was very gratifying to engineers that the work had been started and completed in so masterly a way. He hoped the discussion would not dwell upon small details, but would deal with the question of train-ferries. He had spent a good deal of his life in considering the problem of the long-talked-of connection between Ireland and England. Projects for channel tunnels were often being put forward, but he thought the first step would be the development of train ferries. For that reason it would be a great privilege to him to hear the experience of those who had had to carry out the work under discussion and to work the ferry, because the working was really a matter of the greatest interest. He asked the members to join in a very cordial vote of thanks to the Authors, one of whom unfortunately could not be present that evening.

Sir Robert Elliott-Cooper. Sir ROBERT ELLIOTT-COOPER, K.C.B., Past-President, said he had great pleasure in opening the discussion, because not only did he agree with all that the President had said as to the importance of the work from a national point of view in connection with the war, but he had had the privilege of seeing the undertaking in course of construction and of being a member of a Committee which had the advantage of having before it a great deal of detailed information, not only in connection with the construction but also in connection with what was really a most important point—the use to which the work was capable of being put, and to which it had been put. Probably to none of the great works carried out at that time in furtherance of the war had there been more opposition from a certain section than to the work under discussion, and he thought that those who had so bitterly opposed it had scarcely taken the trouble to go into details—even if they had the means of doing so—in order to consider properly the objects of the work and the circumstances in which it was brought into being. Few would

Sir Robert Elliott-Cooper.

be likely to suggest that if it had been intended to construct a commercial harbour the site at Richborough would have been chosen, or that it could, at any reasonable cost, be made into a suitable harbour for modern purposes; but it had to be borne in mind that the conditions at that time were totally different from those attending the free choice of a suitable site for a commercial port. A port was required which would be free of the serious congestion then occurring at many British ports, and it was also necessary, in view of the ravages by submarines, that the port should be as near as possible to the coast on the other side, and especially to the inlets of the canal systems of Belgium and Northern France. Richborough was practically the only site which Officers who were perfectly able to form a right judgment could choose for the purpose; and in his opinion the work that had been carried out, which had enabled the site to be advantageously utilized for the purpose, was a great engineering feat. He did not intend to go into the details dealt with in the Papers, but he would refer to a few of the main features from a national and commercial point of view. In the first place, the ports being so congested, and it being almost impossible to ensure rapid transport from this country, and quick delivery into this country, of such things as salvage materials, everything depended on securing a port free from such congestion, and, in his opinion, from the point of view of economy, the port had certainly done its work well. The opposition to which he had referred had been carried to such an extent that the Parliamentary Committee on National Expenditure requested the Committee of The Institution to visit the site and report as to the groundlessness or otherwise of the criticisms that had been made. In July, 1918, the Committee visited the site and went very fully into not only as many questions as possible involving engineering matters, but also into the question of what the undertaking had accomplished towards its intended purpose. At the time when the Committee visited the site, the tonnage that had been carried by the train-ferry was 106,429 tons, excluding Southampton. With regard to the cost of working this traffic between Richborough and Northern France, the saving on that alone had amounted to £110,420 up to the date of the Committee's visit. There was a larger saving still in connection with the barge traffic. Probably few people realized the vastness of that traffic, and, in his opinion, if it had not been for the undertaking of barge construction, which necessarily added greatly to the cost, it would have been impossible to carry out what had been accomplished at the expenditure incurred, because none of the shipyards had been able to turn out the 1,000-ton steel barges in anything like the time which

would have rendered their construction of practical use in the position of the war at that date. Up to the time when the Committee visited the work there had been a net saving, at the rates of freight from the principal ports available on the east coast, of £754,166. When extravagance was alleged it was often forgotten what had been accomplished and what the return had been, and he thought those facts really went a long way towards justifying the Government in authorizing the work. Brigadier-General Cooper, who had charge of the Traffic Department, and Brigadier-General Allen-Williams, a Member of The Institution, both deserved great credit for the manner in which their duties had been carried out and for the results achieved; and the same might be said of the Authors who had just received from The Institution the acknowledgment which was due to them for the valuable Papers they had presented. The total expenditure on the works up to the time when the Committee visited them amounted to £1,738,293, in addition to which, expenditure in connection with the construction of the barges amounted to more than £1,000,000, and the two ferry-boats cost £380,000. Among the works which had gone to swell the expenditure far beyond what was contemplated when the project was started were such things as a large aeroplane-repair depot, which cost many thousand pounds but saved a very large amount of money, because, instead of the damaged aeroplanes having to be sent away to Birmingham, Coventry, and other places, they were repaired by skilled workmen on the spot, and as soon as they were repaired they could be sent back again to do their work at the front. Up to about 6 months before the visit of the Committee, the training of Royal Engineer officers, and of large numbers of men, was done at Longmoor Camp in Hampshire, but, later on, this training was transferred to a large extent to Richborough, and he thought one of the reasons for the suggestion of great extravagance—and he was bound to say that he agreed at the time with the suggestion himself—was that there was such a large number of officers at Richborough, supervising the construction. The explanation of that was that the place formed a concentration camp for the training not only of officers but of men. An important work was accomplished there in the military training of young engineers—many of them belonging to The Institution—who, on completion of their training, went out to the various seats of war on the Continent, and in Salonica, Egypt and Mesopotamia. The Committee were impressed with the judgment shown in the choice of officers controlling the work, and the manner in which the selections were made. He had been quite prepared to find, as he had found else-

Sir Robert Elliott-Cooper.

Sir Robert Elliott-Cooper.

where, round pegs in square holes; but he was glad to say that in no case at Richborough had the Committee found men employed on special work who were not specially qualified. For instance, in the case of dredging, which was quite skilled work, it was found that the officer who was in charge had devoted 25 years of his life to practically nothing else. Therefore those in charge of Richborough had not only done a great work in training the young engineers for duty at the front, but they had also exercised great judgment in selecting men for the work they had to carry out at home. The result of the inquiry was that the Committee entirely exonerated those who originated the scheme, and those who had so ably carried it out, from any just charge of incompetence in the selection of the site, bearing in mind what had to be accomplished in connection with the other side. Not only had the initiation of the work been justified, but the cost of carrying it out had been reasonable and fair. He was not divulging any secret by saying that the Chairman of the Committee on National Expenditure wrote: "The Committee are very grateful for the trouble your Committee has taken, and are glad to know that your investigations show that the conditions there are satisfactory from the point of view both of the War Office and of the public exchequer." He had been very glad to find that the result of the Committee's inquiries was such that, if the work had to be done over again, he did not think any one knowing all the facts could find a better site for carrying it out at less expense. As an instance of the cost there were 75 miles of permanent way in the sidings. He happened to be carrying out large groups of sidings in Derbyshire, and the work at Richborough cost almost exactly the same as it was costing in the Midlands, where the work was done by a contractor. Although it was only one item out of many, it was a very big item, because 75 miles of permanent way cost a good deal of money, and he was glad to find that in that case at any rate, testing it by something being done under ordinary contract conditions in England, no extravagance had been shown. He was glad to have had the opportunity of mentioning these facts, for the public had rather jumped to the conclusion that there had been waste; he knew of many cases where that conclusion was justified, but the work under discussion was not one of them.

Sir Brodie Henderson.

Sir BRODIE H. HENDERSON, K.C.M.G., remarked that he had little to say on the Paper on Richborough, because he had had practically nothing to do with the construction of the work there, but he had to visit the place on various occasions and would like to testify to one feature that struck him as an engineer, namely, the extraordinary speed with which everything had been constructed.

That was due, as had been said by Sir Robert Elliott-Cooper, very largely to the technical and executive ability displayed by General Allen-Williams. The only reason that took him to Richborough was his connection with the train-ferries, he being responsible for the design of the berths. The President had expressed a hope that there would be a discussion on the Paper, and he therefore referred to the type of boat adopted. He was given to understand that there were three schools of ferry-boat designers or users; that was to say, there were three types of boats, and three methods of conveying the cargo from the shore to the boat and *vice versa*. One method was to have a rising and falling horizontal bridge on the boat, so as to bring the rails on the boat to the level of the shore; the second was to have a rising and falling horizontal bridge on the shore to bring the rails to the level of the rails on the boat; and the third was to have an inclined bridge such as was adopted at Richborough. He was not prepared at this meeting to say which was the best of those methods, but he would like to testify to the extreme ease and rapidity with which the boats were loaded and unloaded by the method of an inclined bridge. As far as he was aware, no mishap ever took place, and it only occupied a few minutes to unload and load the boats with their full cargo. One point that might be overlooked—and it was very nearly overlooked—was that there was a very abrupt change of gradient, both at the boat end and the shore end of the inclined bridge, and with vehicles of very long wheel-base there was the possibility of some of the under-gear of those vehicles fouling the topmost point, where the gradient changed; and also when exceptionally big guns were handled there was a danger of straining the bogies of the vehicles on which the guns were carried. At many train ferries spring fenders had been installed in the berth, in order to take up the shock as the boat came alongside into position. Those springs were very expensive, both in the first cost and in maintenance, and the experience of the trainferry at Richborough, and of other train ferries, proved to his mind conclusively that spring fenders were quite necessary. He wished to put on record how rapidly the work of constructing the termini in France was carried out. The work in England was done quickly, but he thought France beat the time of the English work. At any rate he knew that in France they were ready before they were ready on the English side, and long before delivery of the steel could be obtained.

Sir Brodie Henderson.

Sir ALEXANDER GIBB, G.B.E., wished to make a few general remarks on the work on the French side. The first notice they had in France of the Channel ferries was in the middle of January,

Sir Alexander Gibb.

Sir Alexander Gibb.

1917, when a message was received from the Prime Minister saying that Channel ferries were to be built and to be ready by the end of August. It was necessary then to select the best ports on the French coasts. All the French ports at that time were very congested, and, even if they had not been congested, none of them was very suitable for a ferry-terminus. After examination of about nine ports, Dunkirk, Calais, and Dieppe were chosen, which he believed were the only possible sites for landing-stages. The reason for selecting three ports instead of two was that as Dunkirk had been very much developed during the war as a port for cargo, the Germans were paying a good deal of attention to it; accordingly Calais was brought in as a second string to the bow. It was very fortunate that this was done, because when the ferry was finished Dunkirk was so continuously under fire that it was not fit to take a ferry-boat into. The whole time the work was being done the Port was under fire every night by bombs, on many days by big guns, and frequently it was attacked from the sea, so that the workmen who were there realized what war was. The next thing that had to be done was to get the French to agree to these ports. Negotiations were not easy, as there were numerous authorities to consider—the Army, the Municipal Councils, and the Paris authorities. However, the engineers of the *Ponts et Chaussées* were very helpful, as they understood the brotherhood of engineering. Throughout the work Col. Bourgois at Dunkirk, Mr. Courtain at Calais, and Mr. Gossét at Dieppe gave every assistance with drawings and in other directions, and the matter was dealt with very satisfactorily from the British engineers' point of view. He thought the organization for carrying out the work was almost unique in France. Nearly all the officers and a good many of the men had had practically no training at all in soldiering; they got into khaki and went straight out. They were kept in good physical condition, and kept right with the Army discipline, by the employment of an old Army officer, who did the soldiering part of the work. The whole of the organization was a civil engineering organization, with a certain amount of soldiering, but the civil engineering came first. The results were satisfactory, though the engineers never got the same amount of work out of the men as they would have done on public works. There were many who were highly skilled public works men, but there were a good many who were not. Still, the results were quite good. Chinamen were employed in the ratio of five to every two white men; they worked excellently alongside the British, and were quick and clever at picking up work, and they saved the situation. At that time every man employed there

meant that a man was being kept back from the front. The work was done very cheaply in spite of all the drawbacks. Costs were kept the whole time, and they were really satisfactory. The difficulty of not being able to work to an efficient curve of labour was overcome by doing other work for different departments in France. The work was finished in August, the time stated, but unfortunately the bridges on this side were not ready, and consequently the ferry was not working until the end of the year. The girders at Dieppe had already appeared in the diagrams of a recent Paper[1] on Dover Harbour; they were first of all used in the temporary work at Dover for 6 or 7 years; they were then sent to Rosyth, and did their duty there for about 6 years, and they then went to Richborough and were sent to France, where they were now lying on the viaduct between the landing-stage and the shore. Some of those girders were used at Zeebrugge for the repair of the jetty, and in that way they went back near to their birthplace, because they originally came from some works near Ostend. Sir Alexander Gibb.

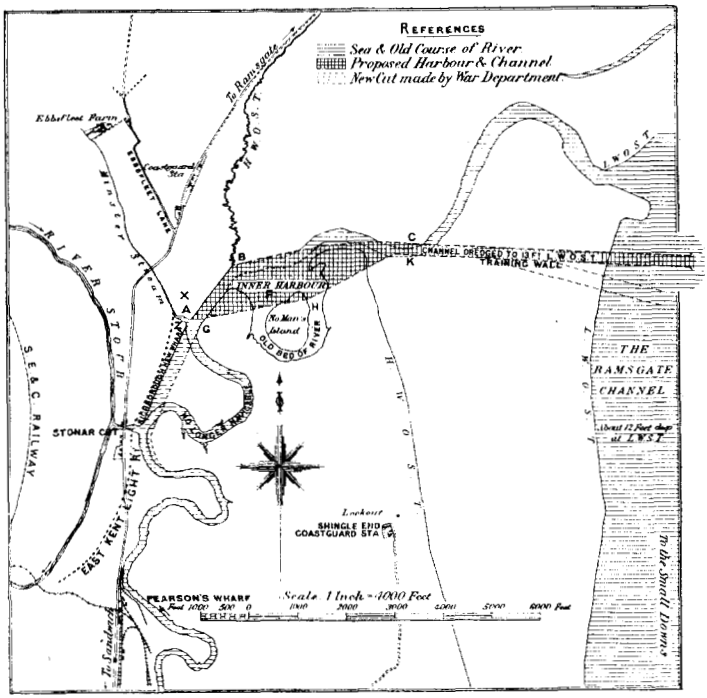
Mr. MARK ROBINSON said he much admired the well-written Papers and the great work which had been carried out at Richborough in so short a time. A good deal of history would have to be written before the world knew how large a part in the winning of the war was played by Richborough. The newspapers viewed its story too much as a text by which to prove the extravagance of the Government, and they could see waste where to more expert observers it was at worst not proven. Undoubtedly there was waste in at least one direction, arising from a part of the work being carried out, in an engineering sense, improperly. The first necessity of the port was a new entrance channel direct to the Ramsgate channel, and protected by training-walls. But that might have taken 1 or even 2 years, a time which could not possibly be allowed, so the right course could not be followed. The result was what he supposed nobody would deny—a very large and practically wasted expenditure upon dredging. In the endeavour to improve the tortuous channel, which was always changing, huge sums of money were spent on dredging a channel which filled up again as fast as dredged. That had been made the most and worst of by critics, who ignored the just excuse that the urgency of the need over-rode everything, and they left the public with the impression that Sandwich Haven was a hopeless proposition, and that it was no good trying to do anything there. In an assembly Mr. Robinson.

[1] M. F. Wilson, "Admiralty Harbour, Dover." Minutes of Proceedings Inst. C.E., vol. ccix, p. 31.

Mr. Robinson.

of engineers it was unnecessary to combat that view. Engineers knew what the difficulties were, and they could see what good work was done, but that was not so with the public, and it was very necessary to point out that Sandwich Haven was not condemned by what had been done or not done at Richborough. There were many public reasons for maintaining and modernizing Sandwich Haven, which had some of the most striking physical advantages that any place could have for the construction of an important

Fig. 1



commercial harbour. The diagram of Sandwich Haven (*Fig. 1*) showed that before the war was thought of the matter was in hand, and it was a curious fact that at the point "B" on the plan it was intended there should be a train ferry, and that point was exactly the point where the train ferry was put by the War Office. No doubt the explanation was that it could not really be put anywhere else. There was now much talk about congested docks on the Thames, and the need for other

dock facilities within easy railway reach of London. Let it be noted that between Southampton and the Thames there was no other site than Sandwich Haven—and he did not except Dover—which was fit to form a commercial harbour; there was neither ground space for sidings or docks or works, nor was there any substantial scour, whereas there was no place all round the south coast where a finer scour could be obtained than at Sandwich Haven. It was in fact the ideal place to fill the admitted need for new shipping facilities. The inception of this new port was in itself a credit to the War Office advisers, whoever they were. The first visit of inspection to the Haven was said to have been made by officers sent over from the Inland Water Transport service in France, to whom it had probably occurred that the big barges, which were possible on the fine French canals, were also big enough to face the sea crossing, if they had only a suitable starting point on the opposite coast. It would be seen, however, that the same idea had already been taken up at home, and in connection with the same port of Sandwich Haven. As light might be thrown upon the future usefulness of Sandwich Haven by inquiry as to the pre-war intentions of those connected with it, it might be of interest to place on record that some years before the war some local residents who understood the Kent coalfield, and knew something of the history of Sandwich Haven and its former importance, saw that the coming development of the collieries would require a shipping port such as the Haven (and no other place in East Kent) could furnish, and they acquired several hundred acres of land and foreshore on the left bank of the river at its mouth, and some upon the right bank, with a view to the ultimate construction of such a port. They gave themselves the innocent name of St. Augustine's Links, Limited, but later, in 1911, a small subsidiary company was constituted for the harbour, who appointed Mr. Robinson to prepare plans and estimates, in conjunction with his friend, Mr. A. E. Carey, M. Inst. C.E. The scheme as produced in 1913 was shown in *Fig. 1.* It was intended to apply for Parliamentary powers in 1914, but the war stopped everything, including the development of the collieries, and therefore the immediate need for the harbour. The intention was to create a public Harbour Board, harmonizing the interests of the Corporation of Sandwich with those of a construction company. In putting down a deep bore-hole at the spot marked x on the plan, in order to test the mineral possibilities of the site *qua* coal, he had already gained useful information about the alluvial deposits, and a brief inspection of the foreshore constituting Pegwell Bay (and some study of the currents) assured him that permanent improve-

Mr. Robinson.

Mr. Robinson. ment of the winding and ill-placed lower-river channel below the point B was impossible, save by absolutely enclosing it by training-walls rising above high water. The only practical course was to make a new and more direct channel at once between two such walls, and the only open questions were the best direction to give it and the best method of construction. The shortest course was due east, as shown on the plan, subject to reconsideration as to inclining the opening somewhat to the south, for reasons it is unnecessary to go into. As to construction, he had no hesitation in deciding upon reinforced-concrete piles with shuttering between, for wharves and training-walls alike, except near the outer entrance of the new channel, where hard bottom might come so close to the surface as to make pile-driving difficult and solid concrete construction advisable. Also the southern training-wall of the new channel was designed to be in wood and avowedly temporary, since the industrial development of the right bank was not expected to come on for some years. Upon the economic side, the 1913 scheme was based upon the beliefs (1) that the shipment of coal must be the mainstay, and at first almost the only business, of the Haven; and (2) that such trade, limited at first to London, the south coast ports, and the Continental ports opposite, could well be carried on by sea-going barges, by the old channel, so long as the new entrance channel was under construction. With the new channel dredged to the same depth at low water as the Ramsgate Channel outside (about 12 to 13 feet), and with an inner pool or harbour dredged to any depth desired, ships of considerable draft, exceeding 20 feet, could be accommodated, and could enter and leave during a considerable time before and after high water. In his view no serious harbour could be thought of without a new and properly formed entrance-channel, and the War Office proceeded upon quite opposite principles. It essayed the really hopeless task of improving the old river where it was not a river but a wandering channel through the mud, entirely submerged at high tide, so that fresh silt could wash in from every side much more quickly than a dredger could remove it. The plan shown in the Paper appeared to indicate a growing recognition of the difficulties of a task which in principle too nearly resembled the task of Sisyphus. It had already been pointed out that, so far as concerns the War Office case, they had the immediate defence that the proper action, in an engineering sense, namely, the construction of a new channel between training-walls, was impossible, for it might well have taken even 2 years to carry it out. Urgency was everything. The best they could do was to try to improve the old channel a little, at no matter what cost. Anyway

Mr. Robinson.

it helped, and largely, to win the war—and that covered a multitude of sins. But the net post-war result was a public belief that Sandwich Haven was a hopeless proposition, and in the public interest this error must be combated, or not merely the wasted maintenance but the permanently useful work of the War Office would be lost. The need of an East Kent coal-port might be taken for granted. The impossibility of finding a good one elsewhere, from (and including) Dover round to the Medway, would be not less obvious to those who knew the coast. Upon all the south coast there was little besides Southampton (and Newhaven to a very limited extent) to assist the overcrowded docks upon the Thames. It was therefore of importance that the public should understand the help which could be given by Sandwich Haven, by reason of its peculiarly safe approach through the Downs; of the saving of many miles of difficult navigation up the Thames; of coal supplies close at hand; and of ample level space for docks and works and sidings, and if in addition it could claim ability to receive large vessels, its recognition as an important national asset could not be long delayed. In support of these claims, and especially the last, he would point out that:—(1) Unlike most riverine harbours, its entrance would open into sheltered water, namely, the continuation of one of the most famous anchorages in the world—the Downs, where large vessels could lie in safety while waiting for deep water; small ones might enter at any time. (2) The shelter referred to was not only that of the Goodwins, but of the Brake shoal, which lay closer in and protected the intended entrance from the east. Incidentally this shelter reduced the first cost by cheapening the work upon the pier-heads. Mr. Robertson described the position as "exposed," but this was a relative term, and he applied it to dredging operations at anchor. (3) All, or nearly all, dredging might be by suction-dredger, and the material to be removed was practically all sand. It could all be disposed of in reclamation. (4) In the river Stour the Haven possessed extraordinary facilities for scouring—a subject to which Mr. Robertson's Paper made little allusion. With a rightly-shaped inner harbour and an entrance-channel between piers it was believed that very little dredging—not more than the regular work of one suction dredger—would suffice to keep the harbour clear. The unusual scouring powers attributed to the Stour result from an extraordinary loop, 6 or 7 miles in length and only about 100 yards across the "neck," where the two parts were joined by "Stonar Cut," containing sluices. The difference of level at these sluices while the tide was falling gave remarkable facilities for

Mr. Robinson. scouring, while by locking the upper river under suitable conditions, addressed to the improvement both of the navigation and the land drainage, almost ideal provision could be made for keeping the harbour and its approach clear from deposits. Both navigation and land drainage are jealously regarded by the Corporation of Sandwich and by the East Kent Drainage Commissioners, and a full public enquiry would be necessary. The Mayor of Sandwich (and "Speaker of the Cinque Ports," to give him his strange old title), Mr. G. C. Solley, who was not only one of the leading land and agricultural experts of the district, but was also the surveyor and executive officer of the Drainage Commission, informed Mr. Robinson that the "water-logging" spoken of was solely due to War Office interference with existing drainage, the ill-effects of which remained for a year until he was at last invited to meet the War Office authorities and pointed out to them the proper use of the sluices. The repeated reference to "marsh land," and the suggestion of "malaria," would not only astonish the remarkably healthy natives of that part, but indicated something more than the voice of the engineer behind the Paper. He had walked over most of these lands, which, in fact, were valuable grazing lands carrying as high a rental as some of the best grazing land in Kent, and though the water was, of course, near the surface, as in all such reclaimed districts (the greater part of Holland for instance) it was much the same as any other good meadow land. The "marsh" they called "Reclamation No. 1" was not only good grazing ground, never flooded, but was a portion of the golf links. This they said they "reclaimed" by spreading 6 feet 9 inches of sand over it, and they evidently thought this was not only good engineering, but something of an agricultural improvement. He did not know Reclamations Nos. 2 and 3 so well, but imagined them to be of the same kind. This had been too much the attitude of the War Office throughout. Full information as to the scheme of 1913, including both plan and estimates, was offered, and much of it was sent to the War Office, when it commandeered the property —and it was not even acknowledged.

Mr. Robertson. Mr. ROBERTSON, in reply, expressed his thanks to the President and the members for the reception accorded to his Paper, and much regretted his inability to be present at its reading and discussion. The remarks made by Sir Robert Elliott-Cooper and the very interesting information communicated by him formed a valuable addition to the Paper, while the remarks of Sir Alexander Gibbs on the work of the French side, which, in itself was of great interest, and the observations by Sir Brodie H. Henderson, went far to

complete the story of the train ferries. The principle underlying the conception and execution of the whole project had been that it was a war work; had the work been designed from the point of view of a commercial port, the whole undertaking would undoubtedly have taken a very different form; and it was submitted that the work done at Richborough could not be regarded as detracting from any claims which Sandwich Haven might have as a potential commercial harbour. Mr. Robertson.

Correspondence.

Sir A. J. ALLEN-WILLIAMS, K.B.E. (late Commandant, Richborough), congratulated Colonel Robertson on his interesting Paper. As reference was made in it to various activities at the port with which the Author had not been directly connected, it might be of interest—in order to appreciate how the establishment was developed and worked to a great extent concurrently with the engineering construction—to record the organization under which Richborough was run. Sir Allen-Williams.

In September, 1916, a new department at the War Office was formed—the Directorate-General of Military Railways (later Movements and Railways), of which the Inland Water Transport (later Inland Waterways and Docks) became part. The first Director-General was Sir Guy Granet (with a seat on the Army Council), and the first Director of Inland Water Transport was General A. S. Collard, C.B., C.V.O., and it was during their tenure of office that the scheme for utilizing Richborough as a military port and base was evolved. Sir Guy Granet was succeeded in March, 1918, by Sir Sam Fay, and General Collard was succeeded by General A. S. Cooper, C.B., C.M.G., in June, 1917, by which time the principal lines of development had been settled, and construction was largely being superseded in importance by operating. In addition to the reasons given by the Author for the selection of Richborough, the following might be added :—

1. Its situation on the banks of the Stour, a tidal river of small rise and fall, was eminently suitable for rapid wharf-construction and for the handling of barge traffic.
2. The sheltered and almost land-locked entrance, with the Goodwin Sands forming a barrier, provided a natural protection against enemy naval raids.
3. Immunity from attack on the cross-channel route (Rich-