INSTITUTE OF MARINE ENGINEERS

INCORPORATED.

SESSION 1900-1901.

President:

COLONEL JOHN M. DENNY, M.P.

Volume XII.

The British Naval Engineer:

His Present Position and Influence on Our Sea Power.

BY

Mr. D. B. MORISON

(VICE-PRESIDENT OF THE NORTH-EAST COAST INSTITUTION).

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READ AT

58, ROMFORD ROAD, STRATFORD,

ON MONDAY, NOVEMBER 26TH, 1900.

DISCUSSIONS CONTINUED AT SEVERAL SUCCESSIVE MEETINGS.

PREFACE.

58, Romford Road,

Stratford, E.

Nov. 26th, 1900.

A meeting of the Institute of Marine Engineers was held here this evening, presided over by Mr. W. Lawrie (Member of Council), when a Paper contributed by Mr. D. B. Morison (Vice-President North-East Coast Institution of Engineers and Shipbuilders) to the North-East Coast Institution of Engineers and Shipbuilders, was read by the Hon. Secretary.

This Paper was read before the North-East Coast Institution, at Newcastle-on-Tyne, and by resolution it was decided to invite kindred societies throughout the kingdom to read and discuss it also, in order to obtain a wider and more extended discussion. Under the terms of the resolution the Paper is now printed and issued to the Institute of Marine Engineers for discussion.

JAS. ADAMSON,

Hon. Secretary.

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THE BRITISH NAVAL ENGINEER: HIS PRESENT POSITION AND INFLUENCE ON OUR SEA POWER.

By Mr. D. B. Morison (Vice-President of the North-East Coast Institution of Engineers and Shipbuilders).

READ BEFORE
THE INSTITUTION IN NEWCASTLE-UPON-TYNE,
On MARCH 26th, 1900.
AND BEFORE
THE INSTITUTE OF MARINE ENGINEERS,
At 58, ROMFORD ROAD, STRATFORD,
On MONDAY, NOV. 26th, 1900.

Chairman:
Mr. W. Lawrie (Member of Council).

Introduction.

In these days, when the necessity for the predominance of British sea power is accepted as an axiom of our Imperial existence, no introductory explanation need be offered for bringing before an Institution of Marine Engineers and Naval Architects an Engineering question having a direct bearing upon our naval supremacy.

Sea power is the resultant of many diverse factors, each one of which demands some special knowledge and experience for its correct comprehension, and it is the object of this paper to draw the attention, not only of the members of this Institution, but of the engineering professions generally, to the present position of one vitally important element of sea power, the full significance of which they, by virtue of their special training and experience, are well qualified to understand and appreciate.

The strategical, tactical, and combative powers and functions of a ship of war are conceived, defined, and executed by the administrative and executive officers of the Royal Navy, but the responsibility for its creation, in the constructional sense, in accordance with the stipulated requirements, and for its ability during its active life to respond readily and effectively to the directing will of its commander, may be correctly said to devolve upon the engineering profession.

It is the engineer who designs and constructs the entire machinery of a warship. It is the engineer who is responsible for the generation of the all-essential steam, and for the vast aggregation of complicated machinery for its varied utilization, and again it is the engineer who is responsible for the maintenance of the mechanism of the entire armament in a state of efficiency.

A modern battleship is the very embodiment of engineering constructive science in its highest form, and steam is the source from which its every organ derives its vitality and utility, without which the entire costly creation becomes a mere inert mass, impotent for either effective attack or defence.

The Growth of Engineering in the Navy.

The following figures afford striking evidence of the enormous and rapid growth of our steam navy, and

of the growth in numbers and in relative importance of the engineering branch of the service.

In 1863 the British Navy possessed only 3 ironclads, and the ships were still chiefly dependent upon sails for their propulsion.

At the end of 1882 there were about 55 ironclads ready for sea duty, and in 1888 there were 139 sea-going steam vessels in commission.

At the present time there are over 500 steam vessels in the Royal Navy, exclusive of harbour service and other small boats, and there are no less than 258 sea-going ships in commission.

In 1898, 30 vessels were launched, having an aggregate displacement of 140,988 tons, and a total of 253,600 I.H.P.

In 1899, 19 vessels were launched, having an aggregate displacement of 122,322 tons, and a total of 196,400 I.H.P.

At the end of 1899, 45 vessels were building, comprising 13 battleships, 14 armoured cruisers, and 18 smaller craft, including 12 destroyers.

Extracts from a Parliamentary Return of Numbers of Commissioned Officers, Subordinate and Warrant Officers, Men and Boys of the Engineer Branch, borne on the 1st Day of April, 1858, 1868, 1878, 1888, *and* 1898 *respectively, excluding Pensioners and Reserves.*

	Commissioned Officers.	Subordinate Officers, *i.e.*, Engineer Students.	Warrant Officers.	Chief and other Engine Room Artificers.	Stokers.		Total.
					Petty Officers	Men.	
April 1, 1858	971	..	..	..	2,880		3,851
April 1, 1868	1,128	..	..	..	881	3,382	5,391
April 1, 1878	809	..	..	571	850	3,397	5,627
April 1, 1888	662	..	..	1,163	1,384	5,327	8,536
April 1, 1898	845	196*	16	2,498	3,853	14,881	22,289

* Engineer students were not included in the numbers voted for the fleet before 1889.

For 1899-1900 the numbers were as follows:—

Commissioned officers	910
Chief and other engine room artificers	3,024
Stoker ratings	21,472
Making a total engineering personnel of ..	25,406

The undermentioned figures will serve to indicate the relative rates of increase of the executive and engineering branches:—

	1878	1898
Executive personnel	27,911	44,336
Engineering personnel	5,627	22,289

It will be seen that the rapid development of marine steam engineering, and the enormous enlargement of the sphere of utility of machinery of various kinds aboard ships of war, have created a new set of conditions, under which the association of engineering with naval power is so intimate and pervasive that it has acquired a predominating influence upon it.

In spite of its undoubted importance, and the fact that it comprises approximately one-third of the total personnel of the Navy, the engineering branch is not represented upon the Board of Admiralty, which is composed entirely of political and naval executive officers. Therefore, the Engineer-in-Chief, who is the responsible head of the department, is placed in a weak and subordinate position, which checks the full and free exercise of his experienced judgment in conformity with what he believes to be necessary for the attainment of the highest possible state of efficiency, throughout the one primarily essential department of our steam navy.

The Education and Training of the Naval Engineer Officer.

Forty years ago the qualifications required of the naval engineer were that he should have served an apprenticeship in an engineering factory, that he should

pass a practical examination in the handicraft of his trade, and that he should satisfy the inspector of machinery at the reserve depôt as to his knowledge of the component parts of a marine engine and their uses.

The increase in the magnitude, complexity, and sphere of utility of machinery in the Navy, and the ever-growing numbers of the personnel falling under the departmental control of the naval engineer officer, rendered it essential for the efficiency of the service that these officers should possess high scientific attainments, and that they should be trained in their youth in the practice of engineering handicraft, and the habits of naval discipline. Arrangements were therefore made for the systematic training of naval engineer students at Government establishments, where the educational requirements, the expenditure incurred by parents and guardians, and the course of training, are such that the social status and mental culture of the engineer officers of to-day fit them to compare favourably in these respects with the officers of the executive and other branches of the service.

Appointments to engineer studentships, at the Royal Naval Engineering College at Keyham, are made by annual open competitive examinations. The students receive a five years' course of combined theoretical and practical training. The theoretical training comprises mathematics, including the calculus and conics, heat, light, and sound, electricity, statics, dynamics, mechanics, mechanism, hydraulics, physical laboratory practice, and mechanical drawing.

There are also frequent lectures on steam and the steam engine, combustion, metallurgy, electric lighting, advanced mechanical drawing, and workshop appliances. The practical training includes the manipulation of hand and machine tools, pattern making, smithing, boiler making, and foundry work in iron and brass. The students are employed, as opportunity presents itself, upon the work of erecting and repairing

machinery of ships afloat, and on board H.M.S. *Sharpshooter* they are given opportunities for gaining some practical experience of engine and boiler-room duties under steam.

During the fifth year, two months are devoted to obtaining some acquaintance with the elementary principles of ship construction and the fittings of ships; five months are spent in the drawing office learning engine drawing and designing, the remainder of the time being occupied in the preparation of drawings from original sketches.

Those students who, in the final examination gain 60 per cent. of the highest possible number of marks obtain first class certificates, and are sent for one year's further study at the Royal Naval College, Greenwich.

The scientific and mathematical papers, submitted both at Keyham and Greenwich, show that the naval engineer officers are, as a body, at least as highly educated as the officers of the executive branch.

This admirable system of education was instituted by the Admiralty, in order to obtain the same homogeneity amongst the engineer officers as is the case with the executive officers trained in the *Britannia*.

This very object has been, and is still being destroyed, however, by the introduction of so-called "emergency engineers," classified as "temporary service engineers," and "direct entry engineers," the former requiring on entry very elementary educational attainments, and the latter passing directly into the Navy from various technical colleges where the standard of examination is lower than at Keyham. There is also a total absence of training in the habits of naval life and discipline.

Dearth of applicants has apparently rendered these expedients necessary, but the ultimate effect would

appear to be the gradual closing of the Keyham College, except for those whose parents are unaware that the same object may be attained by a much less expensive method. The natural and important question is, however, as to the effect of these unsatisfactory expedients on the efficiency of the engineering branch of the Navy.

A statement of the comparative cost of entering the commissioned ranks of the executive, engineering, medical and paymaster's branches of the Royal Navy is contained in the Appendix A of this paper. It will be seen from a perusal of the statement that the costs incurred by parents and guardians for boys entering the executive branch is £494, and the engineering branch £576.

Cost to Country of Training Engineer and Executive Officers.

The cost to the country of training 265 naval cadets on the *Britannia* is £27,443, or £104 per cadet, whilst that of training 194 engineer students at Keyham is £11,624, or only £60 per student.

The last mentioned figure does not take into consideration the fact that engineer students perform valuable work in connection with the construction and repair of machinery on ships of the Navy.

The total cost to the country of 697 midshipmen and cadets' pay for 1899-1900 was £29,780, or an average of £30 each, whilst 183 engineer students' pay for 1899-1900 was £1,070, or an average of £6 each.

The Duties and Responsibilities of the Naval Engineer.

Forty years ago the duties and responsibilities of the naval engineer officer were confined to the care, maintenance, and manipulation of the engines, boilers, pumps, pipe connections, the sluice valves between the compartments, and all sea inlet valves.

Some conception of the onerous duties and vast responsibilities which now devolve upon the chief engineer of a modern warship, may be obtained from a perusal of the following extract from the Queen's regulations, stating the items of machinery and parts of the ship which are placed in his care, and for which he is held personally responsible.

(1) The machinery and boilers of the ship and boats (the *Terrible* and *Powerful* have 48 boilers and 25,000 I.H.P. engines, and cruisers are now building with 30,000 I.H.P. engines. Many ships have four steamboats).

(2) All auxiliary machinery for whatever purpose fitted.

(3) All pumps, with the pipes, cocks, and valves belonging to them.

(4) All distilling apparatus, etc.

(5) All gun-mountings and torpedo carriages.

(6) Propeller lifting apparatus.

(7) All steam and hydraulic, pumping, and other engines for loading and working the guns, for supplying ammunition, and for turning turrets, barbettes, platforms, etc.

(8) All ventilating engines and gear.

(9) Capstan engines, shafting and spindle of capstan and windlass, and steam steering engines and steering gear as far as the rudder, with spare gear for the same.

(10) Hydraulic jacks, with the exception of those in the gunner's charge.

(11) Steam winches and gear for hoisting in torpedo and other boats.

(12) All water-tight doors and sluice valves, including horizontal trap and flap doors, as well as vertical hinged doors.

(13) Steam fire engines, and all pipes, cocks, and valves in connection with the fire main.

(14) Instruments and gear for telegraphing signals in connection with the machinery.

(15) Whitehead torpedoes, submerged discharge tubes, and gear for torpedoes.

(16) All air-compressing machinery, reservoirs, separators, and charging columns.

(17) Electric light engines and dynamos.

(18) All flooding gear, including valves, cocks, pipes, and other fittings.

(19) Refrigerating machinery.

(20) All such other parts of the hull, double bottoms, and exposed iron-surfaces as may be in his care, either wholly or jointly with other officers.

Items 5, 7, and 15 should be specially noted.

In addition to the above, the regulations also state:—"That the chief and other engine-room artificers, and chief and other stokers, are to be under the immediate direction of the engineer of the respective watches, the engineer officer to be responsible for the general decorum, good order, and cleanliness of the engine-room, and he will see that the engineers and the other persons employed under his control perform their duties with promptitude and to the best of their abilities."

Duties of an executive nature connected with evolutions, and inspections of the engine-room ratings and their clothing, also devolve upon him, and make an appreciable demand upon his time.

The chief engineer is also responsible for the whole of the clerical work connected with the department, but as no special clerical assistance is provided, a certain proportion of the valuable time of this officer, and almost the whole time of one of his highly trained assistants is unprofitably expended in that direction. It is obvious that, if he is to successfully perform his varied and important functions, the naval engineer officer must not only possess high professional qualifications, but must also be endowed with considerable administrative capacity, resourcefulness, and decision of character.

The marvellous progress which has been made in war ship design and marine engineering, and the consequent growth of the duties and responsibilities of the naval engineer, will perhaps be better realised from an inspection of the descriptions of typical war ships contained in Appendix B.

The Dearth of Naval Engineer Officers.

The number of engineer officers borne upon Her Majesty's ships of war is dangerously inadequate for the correct and complete fulfilment of the multifarious duties to be performed in accordance with, not only the

exacting letter of the Queen's regulations, but with the mere practical necessities of efficiency and safety.

In this connection, the following comparative statements of the complements of officers provided on board certain men-of-war and ships of the Mercantile Marine are significant and interesting.

It is true that the machinery equipment, and the conditions to be fulfilled upon a man-of-war and a mail steamer, are so different that the relative values of the engine-room complements cannot be determined from an inspection of the mere numbers; but, as those differences call for much larger complements on men-of-war, they only emphasise the disproportion revealed.

H.M.S. *Terrible*, of which a full description is given in Appendix B, is fitted with two sets of triple expansion engines capable of developing a total of 25,000 I.H.P. She carries one fleet engineer, 1 engineer, 5 assistant engineers, and 1 artificer engineer—a total of 7 commissioned and 1 warrant engineer officers. In addition there are 3 chief engine-room artificers, and 15 engine-room artificers, but the artificers, although mechanics, have no direct responsibilities.

Neither the chief engineer nor his senior assistant can take regular watches, as their general supervision must be constantly exercised over the whole of the machinery throughout the ship, and it must be remembered that a large portion of the time of the chief engineer, and almost the whole of the time of one assistant engineer, is absorbed in the clerical duties appertaining to the department. Therefore there are only 6 engineer officers available for regular watch-keeping, although the Admiralty instructions state that the officers must personally superintend, and are held responsible for the whole of the work of the department. As an example of the strict interpretation of this regulation, the Court Martial held upon the chief and senior officers of H.M.S. *Blake* may be cited. These

officers were severely reprimanded and dismissed their ship for not having personally superintended the fitting of water-gauge glasses by an artificer, at a time when important work connected with getting the ship under way demanded their attention elsewhere.

The Cunard Co.'s R.M.S. *Lucania* is fitted with twin screws and two sets of triple expansion engines capable of developing a total of 28,000 I.H.P. Each set of engines comprises 5 cylinders, 2 H.P. 37 inches, one I.P. 79 inches, two L.P. 98 inches, the stroke being 69 inches. The steam is supplied by 12 main and 2 auxiliary boilers, having a total number of 102 furnaces. The auxiliary machinery comprises air, circulating, feed, bilge and fire pumps, evaporating and distilling plant, fans, electric light and refrigerating engines, and the usual deck machinery. She carries 22 engineers, of whom 10 hold first class and 3 second class Board of Trade certificates, 2 electricians, 1 boilermaker, 24 greasers, 78 firemen, 60 trimmers, 2 storekeepers, and 2 donkeymen. There are 7 engineers in each watch.

The White Star Co.'s R.M.S. *Oceanic* is fitted with 2 sets of triple expansion engines, capable of developing a total of 28,260 I.H.P. She carries 23 engineers, of whom about 15 hold first class Board of Trade certificates, and 34 greasers and water tenders. There are 7 engineers in each watch.

H.M.S. *Vengeance*, first class battleship, fully described in Appendix B, is fitted with 2 sets of triple expansion engines, capable of developing a total of 13,500 I.H.P. Vessels of this class carry 6 engineer officers. There are in addition 3 chief engine-room artificers and 9 engine-room artificers.

One representative vessel of this class, at present in commission in the Mediterranean, carries 1 fleet engineer, 1 engineer, and 4 assistant engineers (of whom no less than 3 are probationary).

The Cunard Co.'s R.M.S. *Umbria* is fitted with 1 set of engines of 14,500 I.H.P. She carries 10 engineers, of whom 5 possess first class and 2 second class Board of Trade certificates, 2 electricians, 1 boiler-maker, 9 greasers, 54 firemen, 40 trimmers, 1 store-keeper, 1 donkeyman. There are 3 engineers in each watch.

First class cruisers, fitted with 2 sets of engines of as much as 16,500 total I.H.P., 30 Belleville boilers, and about 72 auxiliaries, carry from 6 to 7 engineer officers. From 4 to 5 of these officers are "assistant" or "probationary assistant" engineers, most of whom are mere youths with from two or three months' to two or three years' sea-going experience.

H.M.S. *Crescent*, a first class twin-screw cruiser, of 10,000 I.H.P., N.D., and 12,000 I.H.P., F.D., which is at present the flagship on the North American Station, carries 1 staff engineer, 1 engineer, and 3 assistant engineers.

In a well-known line of mail steamers running to South Africa, the twin screw boats, fitted with two sets of engines, having a total of 10,000 I.H.P., carry 13 engineers, of whom 9 possess Board of Trade certificates. There are 4 engineers in each watch.

Innumerable comparative instances might be cited, but the above will suffice to reveal the great disparity between the complements of engineer officers carried in the Navy and the Mercantile Marine respectively.

On ships of the Royal Navy, the ratio of engineers to men ranges from 1 to 21 in battle ships, to 1 to 37 in ships of the *Terrible* class, and rises as high as 1 to 48 in some destroyers.

Taking the *Lucania* and *Oceanic* as typical examples of Mercantile Marine practice, the ratio of engineers to men is about 1 to 8.

It should be here stated that the naval complements cited above are those provided in time of peace on board ships in commission on the most important stations.

Some slight idea of the character of the complements of engineer officers, which will be available when the whole of our Navy is mobilized on a war footing, may be obtained from a perusal of the following extract from a pamphlet entitled "The Royal Naval Engineer as Student and Officer":—

"It is a noteworthy fact, showing how desperately shorthanded the Navy is for engineer officers, that during the manœuvres just completed, 1899, more than one-half of R.N.E.'s who have directed and assisted in the work of the engine-room staff on all the cruisers and battleships engaged, have only had two years', or even less, service in the Navy (some 35 or 40 of them passed out from the R.N.E. College last June). Each of these young officers is now expected to do the work which, ten years ago, was allotted to two R.N.E.'s, and which in time of 'real' war it would be utterly impossible for them to perform. It is doubtful whether if re-inforced to the extent of one-third their present numbers, they would even then be on a sufficiently strong war-footing."

A large proportion of the junior engineer officers attached to ships in commission have had less than two years' service, and many of them have had only a few months' experience afloat. These inexperienced junior engineers, are, of course, quite unfitted for independent action and responsible duties. They have to be trained by the seniors, and are consequently for at least two years a source of extra anxiety and work rather than effective assistance.

When the young engineer leaves Keyham and joins his first ship, he is absolutely lost, because he has not yet learnt the practical significance and bearing of the theoretical knowledge which he has acquired, and he is therefore, quite devoid of that judgment, resource, and confidence which can only be created by long and intimate acquaintance with the machinery. These young engineers should undoubtedly be borne as supernumeraries for training, and should not form part of the engine-room complement amongst whom the responsible work has to be distributed.

In estimating the relative values of Naval and Mercantile Marine engine-room complements, it must be remembered that in mail steamers and other high-class high-powered vessels in the Merchant Service, the engineers are most carefully selected from the large number which is available, and that a considerable amount of previous experience in engine-room duties afloat is an essential qualification for the recipient of an appointment as a responsible watch-keeping officer.

It is also customary for the members of the engine-room staff to remain for long periods in one ship. They are thus enabled to become thoroughly familiar with the minutest details of the machinery, and the lengthy association of the men creates a feeling of mutual confidence and interest, which cannot but tend to enhance the efficiency of the whole body.

It is a fact well known amongst the responsible heads of our engineering industries, that of the total number of boys who serve an apprenticeship in engineering establishments, only a very small percentage are endowed with those qualities which enable them to emerge from the crowded ranks of mediocrity.

In the Navy, every engineer student who succeeds in passing out of the Royal Naval Engineering College at Keyham automatically rises through the various ranks until he attains a position involving great responsibilities, and demanding exceptional qualities for their proper fulfilment.

The number of students entered is small, and the demand for officers is great. Therefore, on the one hand, the law of averages precludes the possibility of obtaining an average sample truly representative of the material obtainable in such a country as our own; whilst, on the other hand, the necessity for replenishing the ranks to compensate for the depletion due to promotion, retirement, and the ever-increasing number of our ships, further prevents the continuous maintenance of a high standard of excellence.

The conditions and exigencies of the Naval service give rise to very frequent changes in the composition of the engine-room staff of a ship, and it is a very usual occurrence for a ship to enter upon a commission, and participate in complicated fleet manœuvres, or start out upon a long voyage, with an engine-room complement comprising a preponderating proportion of officers and men who are total strangers to her machinery. This is no doubt unavoidable, but it surely indicates that naval engineer officers, who are called upon to undertake responsibilities under such conditions, should be engineers of exceptional capacity and ripe experience.

Mr. Frank T. Bullen, who is himself an ex-officer in the Merchant Service, in his highly interesting little book, entitled *The Way they Have in the Navy*, describing his experiences on board the first class twin-screw battleship H.M.S. *Mars* (10,000 I.H.P., N.D., 12,000 I.H.P., F.D.) during the manœuvres of 1899, makes the following statement regarding the engine-room complements in the Navy :—

"It is no doubt a bold assertion to make, but from a personal comparison of the two, I feel perfectly justified in saying that in both men and morale a first class battleship is far worse equipped in the engineering department than any ordinary liner.

"The following figures will not appeal, of course, to landsmen very much, but to sea engineers unacquainted with the Navy they will be terrifying. For the battleship whose complications I have been describing above—1 fleet engineer, 1 engineer, and 4 assistants, the oldest of whom is 23 years of age, and the youngest just out of Keyham College.

"Is it any wonder, then, that the chief engineer is practically always on duty? He trusts his young confreres fully, as he must do if he would remain sane; but at the same time he must be ready to rush to their assistance at any moment.

"Beneath the assistant engineers come 3 chief engine room artificers (E.R.A.), and beneath them again the engine room artificers, of whom there are 9. These hold the rank of chief petty officers and petty officers respectively, and as in the deck departments, they are the backbone of the engine-room. But they are not responsible men. If they fail at any time it is the engineer's blame, and his punishment for a failure he was absolutely powerless to foresee, or attempt to prevent, is infinitely greater than theirs.

"In the stokeholds there are 6 chief stokers, 11 first class leading stokers, 5 second class leading stokers, and 108 stokers, all of whom are under the immediate supervision of the youth who happens to be on watch at the time as assistant engineer. And, as if that were not enough work for these young men, one of them must expend most of his time in purely clerical duties—for, unlike any other department of the ship, there is no clerk allowed for the engine-room staff."

And, later on, in Mr. Bullen's concluding remarks upon the engineering department, one finds the following significant passage:

"I think I have said enough, even in these few lines, to show why the berth of naval engineer becomes harder and harder to fill, and it becomes necessary to trust the engines of our most gigantic men-of-war to clever but inexperienced lads, under the control of one older man, whose responsibilities are so tremendous that he dare not think of them."

Undermanning in the Engineering Department.

Unfortunately, the weakness of our naval engine-room complements is not limited to a lack of numbers and experience in the ranks of the engineer officers.

Owing to the normal state of prosperity of skilled mechanics in this country, it has not been possible to obtain a sufficient number of thoroughly skilled artificers, and in order to procure the numbers provided for in the estimates, it has unfortunately been necessary to admit a large proportion of men of inferior capacity.

The engine-room artificer is a most valuable and indispensable member of the engine-room staff, and it is highly desirable that means should be devised for inducing the right class of men to enter the service.

The stokers are drawn from various classes of unskilled labour, and the great majority of them have had absolutely no experience of boilers or machinery before entering the Navy.

There is no system for effectively training stoker recruits in stokers' duties before drafting them to ships

in commission, and it is customary for about one-third of the total number of stokers in a ship to be absolutely green hands.

The minute sub-division and wide distribution of the coal bunkers on board men-of-war necessitate the employment upon the work of trimming and passing coal of a number of men which is out of all proportion to the requirements in the Merchant Service.

This point is well brought out in the following extract from a series of articles entitled "The Engineer Officers of the Royal Navy," which appeared in *The Engineer* last year:—

> "Quite recently one of our large and modern cruisers ran a trial of sixty hours' duration at about seven-eighths of her maximum indicated horse-power; this entailed the additional services of 60 seamen to enable the coal to be trimmed with sufficient rapidity to supply the boilers. She, like many others, has about 50 coal bunkers. This is a condition that would obtain every day in war time, when these seamen would be required for other duties, and could not be spared for such work, and it clearly shows the weakness of the stoker complements."

It is an astonishing fact that in 1892, at a time when the Navy was in a state of rapid development, and the engineering personnel was already known to be inadequate, the Board of Admiralty decided to reduce the engine-room complements by about 12 per cent., the change involving the substitution of chief stokers for a certain proportion of artificers, thus effecting a reduction in mechanical skill as well as in the numbers of the engine-room staff.

The unpopularity of the engineering branch of the Royal Navy, and the consequent difficulty experienced in obtaining the required numbers of officers and men of the various ratings, have led to expedients being adopted at various times to fill the gaps. These expedients have invariably involved a lowering of the standard of both officers and men, which is highly detrimental to the efficiency of the service.

At the present time it is impossible to provide full engine-room complements for the whole of our ships in the event of mobilisations, and even if it were possible to provide the mere numbers, it must be remembered that under the existing system the engine room complements of the majority of the ships would contain so large a proportion of inexperienced junior officers, artificers of inferior skill, and stokers without any knowledge of boiler-room duties whatever, that it would be nothing short of miraculous if the conditions attending actual warfare did not lead to disaster.

There is a popular belief, which has certainly not been discouraged by official utterances, that in time of war the military spirit and patriotism of the engineers and mechanics employed in the Mercantile Marine, and in our shipbuilding and engineering industries, will lead them to offer their services to the Navy in such numbers that all deficiencies of personnel can be made good. This is a most dangerous belief, and it will be an evil day for the nation when it depends for its success in a naval war upon its realisation. The very special character of the boilers and machinery in use upon modern warships renders it quite impossible for even a sea-going engineer from the Merchant Service to become sufficiently familiar with them to fit him for responsible duties in less than two or three months. In the case of a landsman, it would take that time for him to acquire the sea-habit alone, and considerably longer before he would become a useful member of the engine-room staff.

Moreover, the conditions under which the duties of the engineering staff would have to be executed in time of war are so peculiarly trying that perfect discipline and mutual confidence are essential to their satisfactory performance, and these qualities can only be created by long training and association.

Weighty testimony to the supreme necessity for maintaining a high standard of excellence in the

engineering branch of the Navy is afforded by the following extract from an article entitled "Readings from Experience in Naval Engineering" (which appeared in the *Engineering Magazine* for March, 1899), by Rear-Admiral George W. Melville, who by his great professional attainments and far-sighted policy, in his capacity of Engineer-in-Chief, has contributed so much to the creation of the present high state of efficiency of the engineering department of the United States Navy:—

"The utter failure of Cervera's fast armoured cruisers, which had trial speeds of 20 knots, to escape from the United States vessels at Santiago, none of which were making 17, shows the disastrous results of discouragement of the mechanic. As we now know, the condition of the two fastest ships at Santiago, the *New York* and *Brooklyn*, was such that only half-power could be used immediately, and it seems almost certain that, had Cervera's ships been able to make their maximum speeds, they would have escaped. The mechanical instinct, too, is just as important for the care and manipulation of the modern guns and turrets as for the care and manipulation of the motive power, I believe that in this respect also the mechanical aptitude of the American people was an important factor in the victory."

The Present Position of Engineer Officers.

The engineer officers have published a statement of the reforms which their experience leads them to believe to be necessary, in the interests of the efficiency of the engineering department of the Navy. That statement is so clear and concise that it has been deemed advisable to append it to this paper in its entirety. Appendix C.

The engineering department of the Royal Navy is included in the civil branch of the service, the whole of which is subordinate to the executive or military branch, and the officers of which receive no military rank or title, and are not empowered to award punishments to their departmental subordinates for any offence whatever. So-called "relative" rank has been assigned to naval engineers, apparently with a view of simply defining their order of precedence as commissioned officers in H.M. service, but it carries with it absolutely no powers affecting the performance of their duties. Throughout

their active career they remain plain "Mr.," and are retired as civilians, with no mark or outward sign to denote that their lives have been spent as officers in a military service.

The civilian rank of the engineer officer and his consequent inferiority to every officer of military rank places him in many anomalous and humiliating positions, and completely undermines his authority over the men in his own department, whom he is expected to control without being invested with any powers of punishment or reward. If an offence is committed, the engineer officer and the defaulter appear before the commander at the hour appointed for dealing with offences. In many cases the offence is technical, and the commander, being possibly unable to appreciate its gravity, may consider it trifling, and merely sentence the man to be punished by standing at attention and looking seaward for so many hours. If the commander considers the offence grave, then the engineer and the man resume their duties and re-appear before the captain the next day. The offender is never sent to work out his punishment in the engine-room, but always on deck, and always unremuneratively, as regards the engineering department, so that a calculating criminal engaged in a boiler-room or bunker in the tropics may commit an offence with considerable personal advantage. To fully appreciate the evil effects of this unfortunate system, it must be remembered that stokers, unlike seamen, enter the service at an adult age, and are, therefore, not trained from boyhood under strict naval discipline. They are as untrained as many of their brothers in the Mercantile Marine, and are correspondingly difficult to manage. How, then, is it possible that, under such conditions, the civilian engineer officer can get the best work out of his men? If there is one department in a modern warship in which officers require to be vested with plenary authority, surely it is the engine department, where the work is of the hardest and most trying nature, and also of such technical importance that trifling carelessness might easily result in serious consequences.

To those of our members who are superintendent engineers, the wonder will be that such a system can produce anything but failure, as it is in direct opposition to what experience has shown to be necessary for success, both in industrial establishments and upon ships of the Mercantile Marine. Failure is ahead, however, and all that is required to develop it is a naval war.

Those officers in the highest ranks of the service who are responsible for the policy of withholding executive rank from engineer officers, are surely adopting a very dangerous course. Such a change would in no way lessen the power of the executive branch, whose assumed interests they are now too jealously guarding, whilst it would vastly increase the efficiency of a branch which deserves all the assistance and encouragement which can be given to it. It can only be presumed that they do not realise the evil effects of their policy, though it is very difficult to believe that they have failed to hear the warning voices of those influential and competent authorities who have long predicted the disastrous consequences which must inevitably ensue when the Navy is called upon to pass through the crucial test of battle.

The systematic repression of the engineer as an individual has no effect, per se, except that of making the service unpopular for engineers, but its bad effect upon the general efficiency of the entire engineering branch is undoubted, and constitutes a danger which should be recognized and dealt with.

Our engineer Members of Parliament are, of course, fully aware of the danger, and that they do not succeed in causing its removal clearly shows how powerful are the reckless opponents of reform.

It should be clearly understood that the object of this paper is not to advocate that engineers should hold military rank merely to satisfy personal vanity, as they no doubt rightly consider that their profession of engineer does not require further adornment. The question is, therefore, not personal but national, and resolves

itself into whether the efficiency of the engineering branch can be increased. It is immaterial to the nation whether or not the engineer as an individual objects to be classed as a civilian having no executive control over his men, but in a naval action it may make the utmost difference to the nation if the artificers and stokers give a higher interpretation to the rank of Lieutenant Smith, R.N.E.C., who has power to punish offenders when on duty, than they do to civilian Mr. Smith, who has no such power. There are no men who have a greater respect for the power which rank confers than sailors and soldiers, and it absolutely unquestionable that the efficiency of the entire engineering branch would be very largely increased if those officers were formed into a military corps, and vested with power to deal with all minor offences, such as are now dealt with by commanders. It would seem unnecessary that power to punish should be extended beyond those offences committed when on actual duty in the engine department, as all offences when off duty could be dealt with by the commander or captain, as at present.

Still another feature of the utmost value accruing to the change would be the increased popularity of engineering in the Navy. The effect of the policy of repression is discontent, and when parents appreciate the present position they will very naturally dissuade their sons from becoming naval engineers. This result is already being felt, and although we are told in Parliament that there is no lack of engineers, yet the fact remains that, notwithstanding the great efforts which are being made, their numbers are very disappointing.

There are other aspects of this question of rank which, although apparently more sentimental and personal than practical and national, have nevertheless a very direct bearing upon the efficiency of any officer in a fighting service.

It is well to remember that it is only sentiment in

one form or another that impels men to risk their lives, and lay them down if need be, for their country.

In this connection may be quoted the following extract from a speech by the Marquis of Lansdowne, relating to the concession of military rank and title to Army medical officers:—"I sometimes hear it said, 'What does rank matter? Is not the title of doctor or surgeon by itself to be regarded as a title which anyone would be proud to bear without further adjuncts?' I think the answer to that is, that, in the Army, rank is the outward and visible sign of consideration and authority, and that, although a 'man *may be* a man for a' that,' it is necessary if he adopts the military profession, that he should have a military stamp to distinguish him, and to secure him his proper place amongst his comrades."

It is also interesting and suggestive to recall the following passage from a speech made by Mr. Goschen in the debate on the Navy estimates, 1877-8:—"It (rank) was a matter of extreme importance to the well-being of the ships, and it ought to be dealt with in a broad and comprehensive manner. If the engineers were to have equal pay with the other branches of the service, but inferior rank, that branch would not attract equally able and good men. We had to think of the safety of our ships, and to consider whether the authority of the engineer was so great and so well defined as it ought to be."

The Pay of Engineer Officers.

In addition to his inferiority in rank, the engineer officer is at a distinct disadvantage in the matter of pay.

A sub-lieutenant can become a lieutenant at 23 years of age, after 3 years' service, and he then has his pay increased from 5s. to 10s. per day, which latter rate is only attained by the engineer after 9 years' service, when he is usually about 30 years of age. The engineer has to serve 11 years before he obtains 11s.

per day, whilst the naval surgeon receives 11s. 6d. per day when he first enters the service at 21 years of age. The engineer continues to receive 11s. per day until he is 34 years of age, whilst in the meantime the rates of pay obtained by the naval surgeon and the paymaster rise to 21s. and 15s. per day respectively. At 35 years of age the executive officer has generally attained the rank of commander, with 20s. per day. The surgeon is then in receipt of 21s., the paymaster of 15s., and the engineer of 14s. per day, and it is only at 47 years of age that he becomes a "fleet engineer" and receives 20s. per day.

The maximum rates of pay for fleet surgeons, fleet paymasters, and fleet engineers, are 33s., 33s., and 26s. per day respectively.

Engineer officers, when in charge of the machinery on one of Her Majesty's ships, receive, in addition to the above-mentioned rates of pay, an allowance called "charge pay," which varies from 1s. to 9s. per day, according to the size of the ship and the character of her machinery. This allowance is not taken into account for leave, invaliding, or superannuation. The rate of "charge pay" relatively to the responsibilities incurred by the engineer has been decreased during the past 12 years. Twelve years ago the chief engineer of H.M.S. *Polyphemus* (2,640 tons, 5,500 horse power) received 9s. per day charge pay, and had 5 or 6 assistant engineers to help him. Now, such monsters as the *Powerful* (14,000 tons, 25,000 horse power) only entitle their fleet engineers to 9s. a day, and he has only 7 officers, while, to make matters equal, possibly, as the French proverb has it, by way of encouraging all the others, the Admiralty have cut down the charge pay of all the ships of the *Polyphemus* type to 6s. a day, and only allow 2 assistant engineer officers, thus saving large sums at the naval engineers' expense.

It may be mentioned here that officers of the executive branch also receive various extra allowances

for command and special duties, of which the following are representative examples:—

Rank.	Special Duty.	Special Allowance.
Sub-lieutenant	Navigation	£45 per annum.
Lieutenant	,,	£73 ,,
Navigating Lieutenant	Charge of Stores	£27 ,,
Senior Lieutenant of a ship		£45 ,,
Lieutenant of 8 years	Torpedo duty or Gunnery duty	£63 ,,
Lieutenant	Command	£86 ,,
Captain	Command money	From £91 to £328 per annum.

As illustrating the relatively inferior prospects of engineer officers in the service, it may here be stated that, out of a total number of 910 engineer officers, there are at the present time only 14 who hold the relative or nominal rank of captain. This is a proportion of 1 in 60, whereas out of a total number of 1,940 officers in the executive branch, there are 73 admirals and 193 captains, or a proportion of 1 in 7½.

About 8 years ago, the optional retirement of engineer officers at 50 years of age was suspended, and they were compelled to serve an additional 5 years, which has recently been reduced to 3 years. This is neither more nor less than a breach of the contract which was made with the engineer officers when they entered the service. The extension of the period of service also seriously retards the promotion of the junior ranks.

It can be shown that the engineer officer is also placed at a disadvantage in respect of the pensions conferred upon him when retiring at various ages.

When one considers the comparative duties and responsibilities of the officers of the various branches of the Royal Navy, it appears to be nothing less than absurd that the engineer officer should be placed in a position of such inferiority relatively, not only to officers of the executive branch, but to officers of the medical and paymasters' branches.

Junior Engineers called upon to undertake Senior Responsibilities.

A number (about 100 at the present time) of engineer officers of "engineer" rank are borne "in lieu of chief engineers" upon various steam vessels, principally of the destroyer type, and are therefore called upon to perform the duties and undertake the responsibilities of "chief engineer" in boats fitted with complicated high speed machinery, developing in some cases as much as 9,000 I.H.P. This arises from the fact that certain appointments in the Navy are considered to be of such importance that they require an officer of "chief engineer" rank to perform them, and undertake the responsibilities connected with them; but, as there are not sufficient officers of this rank in the Navy to fill these appointments, they fall upon junior officers of "engineer" rank. These junior officers are thus called upon to bear the responsibilities of a rank senior to their own, while their daily rate of pay remains unaltered; and should they be unfortunate enough to meet with any accident or break-down while performing these higher and more responsible duties, it would undoubtedly prejudicially affect their promotion to that higher rank, the duties of which they are already called upon to perform. This imposition upon junior officers of the duties and responsibilities appertaining to a senior rank, unaccompanied by the increased pay and privileges belonging to that higher rank, has no parallel in any other branch of the service.

When a junior officer in any of the other branches is required to perform the duties of a higher rank, he has that acting rank conferred upon him, together with the increased pay and privileges attaching to it.

This arrangement is particularly hard upon the engineer officers in the case of torpedo boat destroyers, where the "engineer" has rarely less than three years' seniority, and is the superior in age and relative rank of the commander, who may be a sub-lieutenant of about 21 years of age.

At the present rate of promotion an engineer does not become a "chief engineer" in Her Majesty's service until he is from 38 to 40 years of age, and his promotion to "fleet engineer" takes place eight years subsequently—viz., from 46 to 48. A fleet engineer has the same duties and responsibilities as a chief, but being an officer of greater experience, is usually appointed to the charge of the most important ships. He practically continues to hold the position of fleet engineer until retirement at the age of 55, as, although inspectors of machinery are promoted at the average age of 52, there are only 14 out of the total of 900 engineer officers in the entire British Navy, including home and foreign dockyards. The age at which an engineer is placed "in lieu of chief" is usually about 30, so that for 8 years he may be called upon to undertake the great responsibilities of a position for which he gets absolutely no recognition, either in promotion, pay or relative rank. It is impossible not to admire the true British pluck of these officers as, nothwithstanding all their service disabilities and the anxiety consequent on the rapid development of steam engineering in the Navy, which often involves radical changes and inevitable experiments, they do their work with dogged perseverance, and never give in until the intense nervous strain affects their health, which, unfortunately, is too often the case even in these times of naval peace.

The fact that the Admiralty does not adopt the obviously just and fair course of promoting these junior officers to "chief engineer" rank would seem to indicate that such a policy would seriously deplete the junior ranks, and by destroying the proper proportions of the various ranks, would upset the traditional system of pay and promotion, and would draw attention to the inadequacy of the annual supply of engineers.

The monstrous injustice of this system would find a parrallel in the Merchant service if the chief engineer of one of our mail steamers were suspended, and the second engineer appointed to take up his duties and

responsibilities whilst still retaining the position and pay of second engineer.

The men of the engine-room staff, more especially those of the stoker ratings, are trained to perform combative duties in connection with the armament, landing parties, etc., and they then come under the direct control of the executive officers, whose orders at all times take precedence over those of the engineer officers.

The commands for the performance of these extra departmental duties are generally made in an arbitrary and unexpected manner, and, when the engine-room staff is busily engaged upon important overhaul and repair work, whilst the ship is in port, they frequently completely disorganise the chief engineer's plan of work. The fact that the engine-room complement at his disposal is diminished, however, in no way relieves him of his personal responsibility for the execution of all work necessary to maintain the machinery in a state of efficiency.

Courts Martial.

Courts martial for the trial of engineer officers for even technical offences are constituted entirely of executive officers, who are not qualified to understand the intricacies of engineering technicalities. Without reflecting in the slightest degree upon the honour and integrity of the members of such courts martial, it may truly be said that they are necessarily quite incompetent to appreciate the significance of much of the evidence which it is their duty to sift and adjudicate upon.

Prohibition of Communication with the Engineer-in-Chief.

The engineer officer is entirely cut off from direct communication with either the Board of Admiralty or the engineer-in-chief of his own department. His communications must all be addressed to the captain,

who not only has power to comment upon, or even suppress the document, but is by regulation obliged to have it transcribed and forwarded in his own name, so that the individuality of the engineer officer is absolutely sunk.

The conditions of the naval service no doubt demand that all official communications with the Admiralty should pass through the hands of the captain, and that he should have the right to comment upon them; but it is very doubtful whether it is in the interests of the nation that any communication from a responsible officer should be liable to suppression. It is impossible to conceive any good reason for the transcription of a letter composed by an officer whose educational qualifications certainly fit him to express his ideas intelligently, and to address the authorities in suitable language. This is only one illustration of the systematic manner in which the individuality of the engineer officer is obliterated, excepting on such occasions when blame has to be apportioned.

It will be seen that the vast responsibilities of the naval engineer are not accompanied by a corresponding power of control, or by adequate assistance for their proper fulfilment, nor does the position carry with it the rank or emolument due to its importance, and to the necessarily high qualifications and onerous duties of its occupant.

The Influence of the Engineer upon a Naval Action.

The influence of the naval engineer upon the result of an action can scarcely be over-estimated. The first essential of a modern war ship is that she shall be able to steam, as, and when required, in conformity with the wishes of her commander, based upon the expectations as to her powers, which have been created by the official data supplied to him.

Any failure of duty on the part of the engineer, or lack of efficiency of the machinery, might render it impossible to place or maintain the ship in a position for effective action, or to make use of her armament. Therefore, the whole of the potential powers of the entire fighting machine are dependent, for their active development, upon the mobility of the ship, and the workability of the armaments, for both of which the engineer is primarily responsible.

In action the engine-room staff, closed down below the protective deck, amid a stifling atmosphere, are called upon to perform duties upon which the whole utility and safety of the ship may depend. The intense nervous strain, created by the realisation of the grave though unknown dangers to which they are being subjected, is unaccompanied by the inspiriting excitement of battle, which so greatly enhances the human powers of endurance. Under these conditions, strict discipline, cool judgment, and an intimate knowledge of the vast maze of mechanism, are essential to the successful performance of the necessary duties.

One cannot forget the lives which, even in times of peace, have been sacrificed in the engine-rooms of Her Majesty's Navy—deaths displaying a noble devotion to duty, and resulting from explosions and accidents, appalling and horrible in their associations and effects, upon which it is painful to dwell. Such accidents must inevitably occur with greater frequency in the stress of battle, when the entire mechanism is strained to the utmost, and in view of the terrifying effects of escaping high pressure steam there will, at times, be a great tendency to demoralisation.

It is at these times that the immense value of the engineer officer will be made apparent. He is the man who alone can inspire or restore confidence, and who, by his skill, experience, and cool judgment can minimise the consequences of an accident and initiate the method of repair. It is he who, in moments of dire emergency

and panic, when all others fail, will have to remain at his post, and face death, if need be, in the fulfilment of his duty; unstimulated either by the glory and glamour of battle, or by the hope of that personal distinction and recognition which fall to the lot of the ordinary combatant. Is it just or wise, in time of peace, to rob this responsible officer of that rank and authority which are so vital to the exercise of complete disciplinary control; and then, in time of war, to place him in a position where, under the most difficult circumstances, he is called upon to exercise absolute control over men who have been taught to regard the executive officer as the sole representative of plenary authority?

The danger of such a policy is magnified by the fact that the members of the engine-room complement are mainly enlisted at an adult age, and having been subjected to naval discipline for only a short period, are lacking in that instinctive habit of unquestioning obedience and self-repression which is so invaluable when duties have to be performed in the face of personal danger. Moreover, during an action, the engine-room staff are entirely removed from the jurisdiction of the executive officer, and the engineer officer has, therefore, to rely entirely upon his own personal influence to secure obedience and induce discipline.

The serious issues involved in the execution of their duties, the great potential dangers residing in the boilers and moving machinery, and the knowledge that any revealed error of omission or commission will be made the subject of a court martial, necessarily impose a very severe strain upon the responsible officers. Under such conditions of life, contentment, enthusiasm, and freedom from avoidable causes of irritation are essential to the maintenance of the human machine in a high state of efficiency.

It will be seen, however, that the naval engineer is called upon to undertake grave personal responsibilities

without adequate powers of control, and to perform important and multifarious duties without adequate assistance. He is ever liable for blame, and seldom eligible for commendation. Under such dispiriting conditions of life, the conscientious performance of his mere duties becomes an act of almost heroic virtue. When young, he regrets having entered the service. When old, he looks anxiously forward to the time when he will be permitted to lay down his heavy burden and retire from the service, hoping that he may be fortunate enough to escape the numerous pitfalls which beset his path, any one of which may land him into a court martial, and envelop the termination of his career in an atmosphere of disgrace and humiliation.

This is the man whom the nation may require at any moment to perform, under circumstances requiring the greatest courage and devotion, duties which are vital, not only to the safety and combative efficiency of the ship and her crew, but to the highest interests of the nation which it is their purpose to defend, and who may be called upon to make the ultimate and greatest sacrifice which a man can render to his Queen and country.

Grave Danger of Present Position and Necessity for Prompt Action.

So long as the present serious state of affairs in the engineering branch of the Royal Navy is allowed to continue, there is undoubtedly a grave danger of disaster overtaking us in a naval war. The paper values of ships will not count in warfare, and should a ship be unable to steam in accordance with the requirements, she would not only run the risk of being put out of action and falling a prey to the enemy herself, but by being unable to fulfil her functions at the critical moment, she might endanger the other vessels in the fleet and imperil the vital issue of a closely contested engagement.

The conditions of modern naval warfare render it

impossible to make good defects in organisation, equipment, or personnel after war has been declared, because a naval war must necessarily be of short duration, and the high degree of skill and special knowledge required to fit the men in every department for the efficient performance of their duties cannot possibly be acquired in the short period of time available.

It will be of far greater value if our efforts are primarily devoted to increasing the efficiency of our existing ships rather than to increasing their mere numbers and paper values, unaccompanied by the removal of those points of weakness, which at present make it impossible to render our theoretical naval power really existent and effective.

There is a tendency, even in some high and responsible quarters, to display a very spurious kind of calm which confuses preparation with panic, but surely no merit can be claimed for the "too late" method, which ignores weak spots and defects until they are revealed at a moment of national danger; when, owing to the neglect of every precaution dictated by reason and duty, disaster mercilessly brings them into the full light of publicity, and necessitates the hurried and uneconomical expenditure of energy and wealth, with the result that, even at the best, the nation is robbed of many initial advantages, which would be gained had the remedies been opportunely applied.

Public ignorance, regarding such questions as that which is the subject of this paper, renders it dangerously easy for the responsible authorities, by means of specious arguments and incomplete statements, to create a feeling of public confidence which is quite unwarranted by the true facts of the case. The experiences of the past do not encourage thinking men to repose blind confidence in those who are, at any given time, according to the vicissitudes of party politics, entrusted with the safe-guarding of our empire. Our whole national history teaches us that reforms, no matter how obviously

essential, are rarely brought about otherwise than by the force of organised and intelligently-directed public opinion.

Unfortunately, the questions at issue are, to a great extent, so special and technical that, by the means hitherto adopted, it has been impossible to educate public opinion up to that state of enlightenment which alone can endow it with intelligent activity and determination, and disaster would seem to be necessary in order to convince the responsible authorities that reforms are absolutely necessary in the engineering branch of the Navy.

The executive branch, which alone is represented on the Board of Admiralty, is, to quote the words of one of its own members, "a close corporation," which is very jealously guarded, in strict conformity with traditions and ultra-Conservative principles that are in many respects irrelevant to, and out of harmony with, the requirements of a modern steam navy. The interests of the nation demand that the Navy shall be constituted and administered in accordance with those principles which are best calculated to conduce to the attainment of maximum efficiency, and traditional prejudices should not be permitted to interfere with the institution of reforms which are obviously necessary for the welfare of the empire.

The existing difficulties and defects were recognised more than 20 years ago, in the early stages of their growth, by such prescient and liberal minded authorities as Admiral Sir Cooper Key, Admiral Fellowes, and Sir Edward Reed; and the necessity for drastic reforms in the engineering branch of the Royal Navy has been constantly urged during the whole of the subsequent period, but unhappily without any effect whatever.

In more than one instance, those who have, in their public utterances, recognised the need for reform, have

passed into the highest administrative position at the Admiralty, but, strange to say, they have hitherto failed to give any practical effect to the beliefs which they had formerly expressed.

It is an interesting and significant fact that, as far back as the year 1876, an Admiralty Committee, under the chairmanship of Sir A. Cooper Key, which was appointed to inquire into the condition of the engineering branch, reported unanimously as follows :—"The chief engineer has a large body of men under his immediate orders, many of whom are quartered at guns, and have to take an active part in action. His duties are in many respects executive. We are, therefore, of opinion that engineer officers should in future be classed with the military or executive branch of the profession, among those who would not on any occasion succeed to command." That important recommendation has not, up to this day, been adopted, although during the 23 intervening years of inaction the necessity for the change has become daily accentuated by the rapid development of the new conditions.

It is surprising, indeed it is alarming, but nevertheless true, that in spite of the undeniable importance of the questions at issue, and in defiance of unmistakable evidence of the urgent need for their satisfactory solution, the Admiralty have, up to the present time, given no sign of their appreciation of the position, or of any sincere intention to rectify it. Such apathy is inexplicable, in the face of an array of facts which should constitute the strongest incentive to action on the part of a public department which has no legitimate interests to serve but those of the nation, and whose first duty it is to place the Navy in the highest possible state of efficiency and preparedness for the performance of its ultimate momentous functions.

With a determined persistency, every effort is being made to retain a system which has long outlived the conditions under which it was created, and which is

quite unsuited to the present requirements of the service. It is, therefore, not surprising to any unprejudiced mind that the present state of things has caused a feeling of intense dissatisfaction to permeate the ranks of the naval engineers, which strikes at the very root of efficiency, and, were the true state of affairs known and realised by the general public, there would be a natural anxiety and a disturbance of confidence, which, unfortunately, would be only too well justified.

This question cannot be ignored. It is a grave national danger, and an immediate solution is imperative, in view of our vast and increasing Imperial responsibilities, and of the large number of high-powered complicated ships of war now in course of construction, for which it will be impossible to find engine-room complements of adequate numbers, skill, and experience.

In view of their special ability to understand the nature and full significance of the more or less technical questions which are at issue, it is a duty which the engineering professions owe to the country to lend their powerful advocacy to the cause of reform. That duty devolves with particular directness upon marine engineers, and members of this and kindred institutions. The gravity of the question demands their attention. Let them speak with no uncertain voice, and give to the nation the benefit of their life's experience, and their true and fearless estimation of this national danger.

In order to fulfil any useful purpose, their support must be active, and must take the form of arousing professional and lay interest in the subject, by collecting and disseminating full information as to the facts of the case, and by bringing the subject under discussion at the meetings of the various engineering institutions. Such action can be effectively undertaken only by an organised body, and the writer would venture to suggest that a committee, representative of the engineering professions of the country, should be formed to deal with the matter.

There could be no better conclusion to this paper than the following impressive and eloquent passage, extracted from one of those famous letters which Sir E. J. Reed wrote to *The Times* in 1877:—"If this Navy of which I am writing belonged to the few politicians and admirals who regulate it, we might smile at the absurdity of such arrangements, and there leave the matter. But . . . . the Navy of Britain belongs to the people of Britain, and the depression, I would even say the degradation, of a class of officers upon whom its efficiency and glory must so largely depend in future, is a matter of the most serious public concern. . . . . It is shameful to leave an evil of this kind to wait for redress until the engineers themselves require and demand it. Their interest in the matter, however great, is only secondary; it is for the country's interest that the position of naval engineers should be raised to a level corresponding to the greatness of their present trust, and to the weight of their enlarged responsibilities."

ADDENDUM.

Since the above paper was written, the statement of the First Lord of the Admiralty, explanatory of the Navy estimates for 1900-1901, has been publshied, and it contains the following passage referring to engineer officers:—

"The promotion, status, and pay of engineer officers have been recently considered by a committee of the Board, with the result that the following changes have been approved:—The list of chief inspectors of machinery has been increased from 5 to 8, and that of inspectors of machinery from 8 to 13; the Engineer-in-Chief has been given the relative rank of rear-admiral; the rank of staff-engineer has been abolished; chief engineers will rank with lieutenants of eight years' seniority, instead of as now, with but after lieutenants, and engineers on promotion will rank with lieutenants instead of with but after. In other respects the relative rank of engineer officers remains unchanged. Engineers will be given a new scale of pay, viz.:—

On promotion	10s. a day
After 4 years	11s. a day
After 8 years	12s. a day

—and the allowance of 1s. a day at present paid to senior engineers for all ships will be replaced by a scale varying according to responsibility, from 1s. to 2s. 6d. a day."

It will be seen that the changes proposed are of a trivial character, and leave untouched all the questions of vital importance.

It is difficult to conceive the spirit which prompts responsible ministers and public officials to deal with the engineering *personnel* in a manner which would appear to indicate that their chief object is to stifle criticism by granting minor concessions, and so create an impression in the public mind that the entire question has been thoroughly considered and effectively dealt with.

APPENDIX A.

Comparative Costs of entering the various Commissioned Ranks of the Royal Navy.

The following interesting extracts from a letter by a retired naval officer were given in the *Naval and Military Record* of the 29th September, 1898, making a comparison between the expense of educating two of his sons—one for the engineering branch, who started his Keyham course at 16, the other for the medical branch of the Navy at 17. He says, "My estimate, based on actual figures, and there was no stint in either case," is as follows :—

Engineering Branch.—(Boy starts at 16.)

	£	s.	d.
Entrance Examination	1	0	0
Five years' course at £40	200	0	0
Uniform at start	50	0	0
Plain and underclothing	50	0	0
Recreation fund (partly compulsory) five years..	25	0	0
Books, stationery, models, instruments	50	0	0
Annual expenses, washing, etc., plain clothes, uniform, and details, £40 per annum ..	200	0	0
	£576	0	0

MEDICAL BRANCH.—(The boy started at 17.)

	£	s.	d.
School for one year	100	0	0
Matriculation examination	1	0	0
Hospital fee (London Hospital)	105	0	0
Examination fees, registration, etc.	49	0	0
Instruments, anatomical dissections, books, etc.	50	0	0
Plain clothes, (renewal of), washing, etc. ..	50	0	0
Board and lodgings (allowing for holidays, etc.)	200	0	0
Examination for entrance into Navy	1	0	0
Details not recollected	40	0	0
	£596	0	0

This parent adds: "In each case I do not include cost of uniform for entry as a commissioned officer, though anyone can see that the cost for the engineer, due to the rough usuage in connection with machinery and duties generally, must be more than the cost to the surgeon for his walk to the sick bay a few times a day."

These figures are, of course, subject to a little fluctuation, according to the views of parents as to what is necessary, but this would not affect their proportions.

Another letter in the *Naval and Military Record*, same date, says: "A doctor in the service sent a friend a copy of the *Lancet* (the Students' number), in the editorial of which the writer states that for £400 a boy could graduate." It could be done for even less.

EXECUTIVE BRANCH.

Now let us glance at the cost of training in H.M.S. *Britannia*, and until independent. (Boy enters 14½ to 15½, average 15).

	£	s.	d.
Entrance examination	1	0	0
Fees, four terms at £25	100	0	0
Outfit at start	50	0	0
Plain and underclothing for five years	50	0	0
Books, stationery, instruments, sextant, etc. ..	45	0	0
Annual expenses, washing, renewals of uniform and plain clothes, etc., for four years at £40 per annum	160	0	0
Allowance of £50 per annum, compulsory, for 3¾ years after leaving *Britannia* till rank of Sub-Lieutenant is attained	187	10	0
	£593	10	0
Deduct one year's schooling, from 15 to 16, which the Engineer Student, Doctor and Paymaster have to pay	100	0	0
	£493	10	0

PAYMASTER'S BRANCH.

Expenses of clerks entering the Navy on same scale as preceding estimates. (Over 17, and under 18).

	£	s.	d.
One year extra at school	100	0	0
Examination fees	2	0	0
Possibly one half-year, if not passed at first trial	50	0	0
Medical examination, and expenses to London and back for same	10	0	0
Allowance by parent for first year till appointed assistant clerk	20	0	0
	£182	0	0
Deduct from this—			
Pay from 18 to 19 .. £45 12 0			
Pay from 19 to 20 .. 73 0 0 ..	118	12	0
	£63	8	0

Parents are only out of pocket, £63 8s.

APPENDIX B.

DESCRIPTIONS OF THE MACHINERY OF TYPICAL BRITISH WARSHIPS.

The steam screw frigate, H.M.S. *Agincourt*, was built about 1865. Her engines were of the horizontal cylinder return connecting rod type, the 2 cylinders being each 101 inches diameter, with 54 inches stroke.

The steam was supplied, at a pressure of 25 lbs. per square inch, by 10 rectangular return tubular boilers, having 40 furnaces.

Her nominal H.P. was 1,350, but on her trial trips her engines developed 6,867 I.H.P. at 61½ revolutions per minute.

The engines were very heavy, and were fitted with jet condensers.

The auxiliary engines were only 3 in number.

There was no mechanism in connection with the armament.

The first-class twin screw battleship, H.M.S. *Vengeance*, has a displacement of 12,950 tons, and is fitted with 2 sets of triple expansion engines, which are capable of developing 13,500 total I.H.P., with natural draught.

The maximum speed of this vessel is 18 knots per hour.

The cylinder diameters are 30 inches, 49 inches, and 80 inches respectively.

The stroke is 51 inches, and the engines run at 108 revolutions per minute.

The steam is generated at a pressure of 300 lbs per square inch by 20 Belleville water tube boilers, fitted with economisers, and is reduced at the engines to 250 lbs. per square inch.

The auxiliary machinery, consisting of 78 engines, is as follows :—

2 Starting engines.
4 Main circulating engines.
2 Hotwell engines.
4 Fire engines.
5 Furnace air pumping engines.
3 Dynamo engines.
4 Air compressing engines.
2 Refrigerator engines.
2 Capstan engines.
5 Ash hoist engines.
2 Ventilating engines for engine room.
3 Hydraulic pressure steam engines.
2 Turning engines.
2 Auxiliary circulating engines.
6 Feed engines.
1 Workshop engine.
4 Distilling engines.
2 Steering engines.
2 Boat hoist engines.
1 Drain tank engine.
2 Coal hoist engines.
8 Ventilating engines for ship.
6 Ventilating engines for boiler room.
4 Hydraulic engines for barbettes.

The armament consists of four 12-inch and twelve 6-inch guns, about thirty-eight smaller guns, including Maxims, and two submerged torpedo tubes.

This ship carries 3 steam-boats and 19 torpedoes.

Exclusive of the 2 sets of main engines and their direct driven air pumps, the chief engineer has under his charge, 78 auxiliary engines and machines, the machinery of 3 steam-boats, 2 submerged torpedo tubes, and 19 torpedoes, together with the mechanism of the whole of the gun mountings and the innumerable water tight doors and compartment, flooding and pumping arrangements fitted throughout the ship.

The first-class cruiser, H.M.S. *Terrible*, has a displacement of 14,200 tons, and is fitted with 2 sets of triple expansion engines developing 25,000 total I.H.P. with natural draught, and propelling the ship at a maximum speed of 22 knots per hour.

The diameters of the high and intermediate pressure cylinders are 45 inches and 70 inches respectively, and there are 2 low pressure cylinders each 76 inches in diameter. The stroke is 48 inches, and the engines run at 112 revolutions per minute.

The steam is generated at a pressure of 260 lbs. per square inch, by 48 Belleville water tube boilers, and is reduced at the engines to 210 lbs. per square inch.

The auxiliary engines and other machines, exclusive of armament mechanism, are 93 in number, viz:—

6 Main feed engines.
8 Auxiliary feed engines.
4 Main circulating engines.
2 Auxiliary circulating engines.
2 Hotwell pumps.
4 Fire and bilge engines.
2 Reversing engines.
2 Controlling pumps for feed engines.
2 Steering engines.
3 Electric light engines.
2 Evaporator pumps.
18 Fan engines.
4 Air-compressing engines.
1 Refrigerating engine.
12 Ash hoist engines.
2 Coal hoist engines.
2 Boat hoist engines.
1 Workshop engine.
2 Turning engines.
12 Air furnace engines.
2 Capstan engines.

The armament consists of two 9·2-inch, twelve 6-inch, eighteen 12-pounder, and a number of smaller guns and Maxims, and four submerged torpedo tubes.

The armoured cruiser, H.M.S. *Drake*, which is now building, will have a displacement of 14,100 tons and a total I.H.P. of 30.000 when working with N.D. Her speed is to be 23 knots per hour.

The torpedo boat destroyer, H.M.S. *Mermaid*, is a representative specimen of a batch of 12 new boats.

Her displacement is only 320 tons, but she is fitted with twin screws driven by 2 sets of triple expansion engines, each 19 inches, 29 inches, and 46 inches by 18 inches stroke, developing under F.D. no less than 6,541 total I.H.P. when running at 400 revolutions per minute.

Under these conditions, the speed attained on the measured mile was 30·98 knots per hour, and the speed maintained during a three hours' run was 30·833 knots per hour.

Her auxiliary machinery, consisting of 18 engines, is as follows :—

2 Circulating engines.
4 Feed engines.
1 Bilge engine.
1 Steering engine.
1 Air-compressing engine.
1 Electric light engine.
1 Distilling engine.
1 Capstan engine.
2 Starting engines.
4 Fan engines.

The torpedo boat destroyer, H.M.S. *Express*, now building, is to be fitted with engines capable of developing 9,250 I.H.P. under F.D. conditions.

APPENDIX C.

STATEMENT OF THE CHANGES IN ORGANISATION, ETC., WHICH THE ENGINEER OFFICERS, ROYAL NAVY, CONSIDER NECESSARY TO PLACE THEIR DEPARTMENT UPON AN EFFICIENT FOOTING.

THE ENGINEERING BRANCH OF THE ROYAL NAVY.

The engineer officers of Her Majesty's fleet consider it their duty to make known to all those interested

in the efficiency of the Navy, the intense dissatisfaction prevailing amongst them with regard to the unduly subordinate position their department holds in that service.

This dissatisfaction is of long standing, affects all ranks and ratings, and, owing to the development of modern ships of war, leads those officers who are responsible, to entertain grave doubts of the ability of their department to bear the stress to which it must be subjected during actual warfare.

The Causes of Dissatisfaction are :—

1. Engineer officers are still classed as a civil branch of the Navy. They have no executive control in their own department, and have no power to award even *minor* punishments.

The officers are not permitted to sit on courts martial when an officer or man of the engine room department is being tried for departmental offences.

2. The rank held by these officers is, age for age with the executive branch, unsatisfactory, considering their great responsibilities. The numbers of officers, too, in the highest ranks of these branches is disproportionate, as there are only 14 engineers out of a total of nearly 900 ranking with captains, who number 189 out of a total of 1,786 commissioned officers of the executive. There are also 65 flag officers on the active list, with the most junior of whom not one engineer officer has equal rank. There is, therefore, an officer of or above the rank of captain for every 7 commissioned executive officers, whilst in the engineering branch there is but one of captain's rank for every 69 engineer officers.

3. The engineering branch has not a single representative on the Admiralty Board, notwithstanding the fact that it has a *personnel* of about 25,000, and responsibilities in connection with nearly the whole of the *materiel.*

4. The pay of these officers generally, more especially on promotion to the rank of "engineer," and while serving in that rank, is quite inadequate.

5. The compulsory retention of engineer officers beyond the age of 50 is detrimental to the interests of the service, and causes a serious block in the promotion of officers from the rank of "engineer."

6. Engine-room complements are too small to carry out the work of the department under high rates of steaming, or under such stress of circumstances as may be expected during war time.

7. Writers are not allowed to the chief engineers of H.M. ships, consequently highly trained officers have to be employed for merely clerical work. There is no regulation which ensures that specially suitable persons for charge of engineers' stores shall be included in the engine-room complements.

8. Stokers are not granted re-engaging pay as is now given to the seamen class.

Engineer officers are agreed that the following remedies would greatly increase the efficiency of the Navy :—

1. A corps of Royal Naval Engineers should be formed, and classed as a military branch of the Navy, the officers being executive in their own department, and administering *minor* punishments in it.

On board ship the senior officer of the R.N.E. corps would be responsible for the discipline and conduct of his staff to the captain direct. The engine room ratings in the Naval depots would be under the entire charge of the Royal Naval Engineer officers, who would be solely responsible for the training and distribution of their men.

An officer of the R.N.E. corps to sit on courts martial when an officer or man of the corps is being tried for departmental offences.

2 & 3. The titles and mode of promotion to be:—

Titles and Age.	Corresponding Age of Deck Officers.
Cadet, R.N.E., 16 to 21	Cadet and Midshipman, 14½ to 19.
Sub-Lieutenant R.N.E., 21	Sub-Lieutenant, 19.
Lieutenant, R.N.E., 24 to 25 .. (To commence counting senior time).	Lieutenant, 19 to 22.
Lieutenant of 8 years, R.N.E., 32 to 33	Lieutenant of 8 years, 27 to 30.
Commander, R.N.E. (No. kept at 200)	Commander (by selection).
Captain, R.N.E. (by selection) ..	Captain (by selection).
Rear-Admiral, R.N.E. (5 in number)	Rear-Admiral (by rotation).

Officers of the R.N.E. corps to rank *with* the deck officers according *to* date of commission, with uniform the same as now worn by those officers, but with distinction cloth.

The engineer in chief to rank as Vice-Admiral. An engineer officer to have a seat on the Admiralty Board.

The number of captains, R.N.E., to be 25—For service at the Admiralty, in the fleet and dockyard reserves, the dockyards, depôts, Royal Navy Engineers' College, &c.

4. A parliamentary committee to be appointed to enquire into, and adjust, the pay and retirement of the officers of the R.N.E. corps.

5. Officers of the rank of Commander, R.N.E., to be permitted to retire at the age of 50.

6. The complements of the engine-room departments in H.M. ships to be increased, until a condition of safety has been attained.

7. A writer, recruited from the department, to be added to all engine-room complements. A definite rating called (for example) "Yeoman of Stores" to be established, similar to that of stoker-mechanic, with an allowance while serving in that capacity.

8. Stokers to be granted re-engaging pay, as now given to the seamen class.

Explanatory:—

Naval engineer officers are of opinion that in consequence of the enormous increase in their responsibilities, more especially in the event of war, the time has now arrived for their position on board H.M. ships to be strengthened, and their full value *officially* recognised, so that they may be able to perform their duties in a manner worthy of the best traditions of the service.

The engineer officers are convinced that the best way to achieve this result would be by the *formation of a separate Corps of Naval Engineers*, by levelling up the rank of officers, and by adopting executive titles indicative of the executive nature of their duties.

The habit of command and proper control by the engineer officers of their subordinates is actually hampered by the present constitution of the engineering department, which does not permit those officers to assume any executive authority over their men, nor give them the power to reward merit and punish misconduct. This want of power is more especially felt when the offences are of a technical nature connected with matters relating to machinery or the duties of the engine room, the gravity of which can be best appreciated by the officers in charge of the engineering department. The engine room ratings never feel that their own officers have any power over them which can compare with that exercised by the deck officer, who is frequently a perfect stranger to them until they are—according to the rules of the service—brought before him by the engineer officer for some irregularity demanding investigation and necessary punishment. This absence of direct control on the part of these officers undermines their self-confidence, and has its reflex action on the men, who are always quick to notice any signs of inferiority in the status of their departmental officers. They, therefore, cannot be expected to acquire the proper feeling of respect for the officer who is so little trusted that he cannot be

allowed even to award minor punishments for offences committed almost immediately under his own eyes, and in his own department. It is important to remember that the whole of the men of the engineering branch join the Navy at an adult age; they go to sea without any previous acquaintance with their duties, and have not had the opportunity of acquiring during their youth those habits of order, discipline, and strict obedience which are so valuable a feature in the training of the seamen class who enter the training ships as boys. In all newly-commissioned ships at least one-third of the stoker complement consists of these raw recruits, while of the remaining two-thirds many are frequently of scarcely more than one year's service.

The necessity for executive rank in the engineering branch was recognised as long ago as 1876 by the committee presided over by the late Admiral Sir A. Cooper Key, which, after an exhaustive inquiry, recommended "that the engineer officers should be classed with the executive or military branch among those who would not on any occasion succeed to command." If such a change were necessary then, how much more so is it at the present day?

The naval engineer holds *relative* rank only, and in many grades his uniform—the outward sign of the estimation in which he is held—advertises his inferior position and tends to weaken his authority in the eyes of his subordinates. The officers of the rank of "engineer" may be quoted as an example of this. Many of these officers (over 100 at the present time) are performing the duties of "chief engineer" in various small vessels, principally the "destroyer" type, where the horse-power is, in some cases, as high as 10,000; yet it will hardly be credited that a large number of them have rank to *with, but after*, the most junior lieutenant or surgeon, and, in addition, advertise this fact on their uniform. It is a fact that these officers cannot attain, untill 11 years after the completion of their training, the rank

and pay that a medical officer is granted on entering the service. Can it be wondered at that, with their great responsibilities and lack of official appreciation, this particular grade of naval engineer is very discontented?

Further, at the Admiralty, the headquarters of the largest steam fleet in the world, the head of the engineering branch is not admitted to the councils of the Admiralty. Surely, with the experience that has recently been gained, it is time that an engineer officer of high rank had a seat on the Admiralty Board itself.

The duties of a naval engineer in H.M. ships at sea are (especially during his junior service) of a very trying description physically, and the result is that by the time he arrives at the age of 50 the average officer would be quite unfitted to stand the immense strain which modern warfare would entail. Another reason for permitting optional retirement at 50 years of age is to facilitate the flow of promotion among the junior ranks, in which at the present time there is a most serious block.

In submitting this statement, the engineer officers do so with an earnest concern for the efficiency of their department. It is with them no question of a desire to diminish in any way the authority of the executive; in support of which statement they feel justified in referring to the loyal and zealous performance of their duties under many disabilities as a comparatively new branch of the Navy, and amid the trying conditions incidental to the rapid development of engineering for war-ship purposes. These officers maintain that, in accepting the reponsibilities of their position in their country's defence, they deserve equal honours with the other branches of the fighting services.

The engineer officers unhesitatingly submit that the marks of inferiority which have for so long been the bitter portion of their profession should be removed, so that they may be proud of belonging to the Navy, and

of the uniform they wear. They are convinced that nothing short of a full recognition of the value of the engineering department, and its complete re-organisation, will enable it properly to fulfil its onerous functions, on which the efficiency of the British Navy must so largely depend.

DISCUSSIONS

HELD AT

58, ROMFORD ROAD, STRATFORD, E.

MONDAYS, NOVEMBER 26TH, DECEMBER 10TH, 1900,

JANUARY 14TH, 1901,

AND

PRESIDENT'S ADDRESS

MONDAY, JANUARY 21ST, 1901.

PREFACE.

3, Park Place,

Cardiff.

March 6th, 1901.

A general meeting of the Bristol Channel Centre of the Institute of Marine Engineers was held here this evening, Sir John Gunn (retiring President B.C.C.), in the chair. In the subsequent portion of the evening Mr. T. W. Wailes presided.

The Annual Report was read, stating that the number of members joining the Centre during the past session had exceeded that of any former year. The report bore warm testimony to the services of Sir John Gunn as president during the past two years, and expressed gratification at the acceptance by Sir Thomas Morel of nomination as Sir John's successor. Under the operation of the rules, Sir John Gunn could not be re-elected immediately.

In moving the adoption of the report, the President disclaimed the praise bestowed upon him by the Committee. What he had done, he was pleased to have done, because he had the welfare of the Institute and the Centre sincerely at heart, and whether President or not he would always be delighted to serve their interests. He was glad to know that Sir Thomas Morel was to be his successor. Sir

Thomas would take a deep personal interest in their work, and anything that he could do to assist him during his term of office he should only be too pleased. In the course of his further remarks, Sir John Gunn expressed a hope that before long the Head-quarters of the Institute would be more accessible to country members than were the Offices at Stratford, a remark that met with cordial approval.

The adoption of the Report was seconded by Mr. T. W. Wailes, and agreed to.

On the proposition of Mr. T. A. Reed, a very hearty vote of thanks was passed to Sir John Gunn for his services to the Centre as President, the motion being carried by acclamation.

As the result of a ballot, Mr. T. A. Reed was elected Engineer Representative of the Centre on the Naval Engineer Committee, in association with Sir John Gunn.

A discussion ensued on "The British Naval Engineer."

GEO. SLOGGETT,
Hon. Sec. B.C.C.