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THE EDUCATION OF YOUNG MARINE ENGINEERS

BY

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Reflecting upon the important positions held by Marine Engineers in the industries of our country, it has occurred to me that sufficient consideration is not given to the education of a boy who is intended for a Marine Engineer. It is probably true in some cases that the education has been completed, or nearly so, before it is resolved in what business the lad is to be placed; but as the future of a boy should not be the subject of a caprice, or a moment's thought only, we will assume for the purposes of this paper that it has been decided he is to be trained for a Marine Engineer. Whilst he is at the age of, say, about twelve years—and as at that age a boy has generally given some indication of his natural bent—we will also assume that his desire has been indicated in the direction of mechanical ability generally, and engineering particularly.

It is at the age of twelve years that, in my opinion, the education of a boy should be commenced in the direction of the profession he is intended to follow; and in no profession I am convinced is such preparatory training more necessary than in that of a Marine Engineer.

By means of the various technical institutes and classes, which exist all over the United Kingdom, the ordinary education of a boy can be very readily supplemented and at the same time the ordinary daily instruction he receives can, and should be, directed towards the end desired, by every means possible.

I consider that with a boy of the ordinary amount of intelligence, if it is intended to make a Marine Engineer of him, that his scholastic education should not be prolonged beyond his fifteenth birthday.

We will suppose that he has been (and I consider it most essential to his success in the career chosen, that he should be), from the age of twelve to fifteen well trained in mathematics, geometry, elementary mechanics, natural philosophy, mechanical drawing, freehand drawing, and the French or other Continental language.

I may here say that I am not an advocate of keeping a boy under tuition at school after he reaches fifteen years of age, if he is to be apprenticed to such a business as Engineering; for, in my opinion, it is better that the drudgery of the first year should be got over before he is much beyond sixteen years old.

It is, I know, the practice for some youths to be kept at their education until they are eighteen, and then put into a factory (by paying a heavy premium) for three years, during which time they are hustled through the shops without learning anything of handicraft, and subside into the drawing office, where they sit upon a stool making tracings, and at the age of twenty-one, they are turned out full blossomed engineers nominally, but, as a matter of fact generally, not able to execute the simplest job, either at the vice, lathe, or machine.

My idea of apprenticeship is perhaps somewhat old-fashioned.

I believe in the system of Indentures, where, for a reasonable premium, the master undertakes to teach the apprentice his trade, *and does so*, each party carrying out their contract; the master teaching, and the boy submitting to be taught.

Although I am of the opinion that a boy who wants to be an engineer, and who has been educated as above indicated, can learn (if properly taught) all the hand skill there is in

engineering proper in three years, I would advocate five years as the duration of the apprenticeship, to allow for all contingencies.

Of course, a great deal will depend on circumstances. If the boy is at all anxious to learn, and can find anyone who is equally willing to teach him, three years are sufficient, but if he is allowed to drift about the shop, and pick up his skill and knowledge as best he can, then five years are none too many.

In my opinion, it does not very much matter whether the boy is apprenticed in a Locomotive, Mill-wright's or Marine Engineering Works, as the principle of the steam acting upon the piston is the same in all; the main point is that they shall be Engineers, and teach that trade perfectly.

During the serving of his time, the apprentice should attend classes of a more advanced nature than he went through at school, but upon the same subjects, especially languages, mathematics, and mechanical drawing, and, if so inclined, facilities should be given at home in the shape of a small workshop, with a foot-lathe for him to keep his hand in by making model engines, &c.

The boy having served his time, we may call him a student of Marine Engineering, and he should then enter an engine and boiler making works as an engineer, not necessarily a marine one; but a year spent with a good firm, granting facilities for observation in all the branches—foundry, forge, boiler shop, turning and machine shop, erecting shop, and the fitting of a set of engines and boilers, with all their connections, from the boring out of the stern frame to the trial trip—should turn him out at the age of 21 years sufficient of a marine engineer to be capable of taking a watch at sea as a junior, under the supervision of one with experience of the working of engines and boilers at sea, which our student will find is a slightly different thing to what he may have anticipated.

Let us now take into consideration some of the rules and regulations of the Board of Trade, through whose hands the young engineer must pass before he can become a certificated engineer of the Mercantile Marine of Great Britain. Before I make any remarks upon our own regulations I will give a few of the rules under which the engineers of some foreign and friendly nations, especially the Dutch and German, are granted certificates; and I think, when you have read them, you will agree that we might with advantage adopt a few of them.

I refer more particularly to certificates for third engineers, and I think the time has now come when, considering the amount and variety of machinery in even an ordinary tramp steamer, with feed-heaters, evaporators, grease extractors, hygrometers, refrigerators, electric light installations, &c., no steamer should be sent to sea with only three engineers, one of whom may probably be on his first voyage, and comparatively ignorant of what duties are expected of him.

All ships above a certain tonnage should, in my opinion, have three engineers, all certificated, and as many juniors or assistants as the circumstances of the voyage and vessel demand ; and, further, only certificated engineers should be allowed to take charge of a watch in such.

All ships making voyages of longer than four days average duration, should have not less than three engineers, and the third engineer, if not certificated, should not be allowed to take charge of the watch alone, on his first voyage at sea especially.

In Holland, under a law passed in March, 1891, certificates A, B or C are granted to Marine Engineers who pass the stipulated examinations, as follows :—Certificate A entitles the holder to serve as *second* engineer on board of vessels exclusively engaged in carrying cargo, or as *third* engineer in any merchant vessel. Certificate B entitles the holder to act as *chief* engineer of vessels exclusively engaged in cargo carrying between European ports only, or to such Asiatic or African ports as are situated in the Mediterranean and Black Seas, or as *second* engineer in any merchant vessel. Certificate C entitles the holder to act as *chief* engineer on any merchant ship.

Before the candidate can be admitted to the A examination he must produce evidence to prove :—

1. That he has attained the age of 18 *years*.

2. That he is not suffering from deafness or dulness of hearing. A certificate to this effect must be obtained from the doctor appointed by the Minister of Public Works, Commerce, and Trade.

3. That he has worked at least three years in engine works at the construction or repairing of steam engines, or that he is in possession of the final discharge of the School for Engineers at Amsterdam or from another institution for the training of engineers approved of by the Minister.

4. That he has served at least one year in sea-going steamers as apprentice, assistant engineer, or engineer.

For Certificate B—the sea service (excluding any as apprentice or assistant), must be two years.

For Certificate C the applicant must prove that he has served at least two years as chief engineer in cargo vessels in the European and other trades within the limits of the Mediterranean and Black Seas, or as second engineer in a vessel licensed for passengers in the same trades.

Proof of the required service may be the papers which are granted by the officials before whom the signing and discharging of ships' articles, or such other documents as may be considered satisfactory by the Board of Examiners.

The Board of Examiners decide by voting whether or not a candidate has passed.

Candidates who are rejected at one examination may present themselves again for examination (for the same degree) after an interval of six months.

Before being examined, the following fees must be paid :

For Certificate A	...	...	8s. 4d.
For Certificate B	...	...	12s. 6d.
For Certificate C	...	...	17s. 6d.

These fees are paid into the Treasury, and the expenses of the examinations are borne by the State.

Certificate A.

1. An exercise on a subject in connection with his trade in the Dutch language must be written legibly by the candidate. In special cases, the Government can declare the knowledge of a foreign language satisfactory.

2. Readiness in solving problems, with whole numbers, decimal and vulgar fractions, must be proved.

3. Knowledge of the application of the Dutch and English systems of measures and weights, and their relative proportions, must be shown.

4. A knowledge of the rudiments of physics and mechanics must be shown.

5. An acquaintance with hand and engineering drawing, more particularly the sketching of parts of machinery, must be proved.

6. A general knowledge of the usual marine boilers, their details and fittings, must be shown.

7. A knowledge of the management of boilers when at sea, and when lying under steam.

8. A knowledge of the dangers attending on priming, and the precautions to take against such.

9. A knowledge of the influence of the water-level in boilers, the management and working of same, blowing off, scumming, and use of the salinometer.

10. A knowledge of the means used for the preservation of boilers when a vessel is laid up.

11. A knowledge of the Dutch laws with regard to the use of steam boilers.

12. A general knowledge of the usual type of marine engines, their details, constructiou, working and management when at sea and while lying under steam.

13. A knowledge of the different arrangements for reversing engines, and management of same.

14. Judgment of the condition of engines and boilers and the carrying out of small repairs at sea.

15. A knowlege of screw propellers and paddle wheels, and the execution of repairs to same.

16. Knowledge of the general arrangement of the engineer's log book, and the entries to be made therein.

Certificate B.

In addition to the qualifications required for Certificate A—

1. Knowledge of the English or German language, so that an engineering paper can be understood by the candidate, and so that he can intelligently converse in one of those languages.

2. Knowledge of algebra and the square root.

3. Knowledge of the mathematical properties of lines, angles and triangles, also of the circle and simple geometrical bodies.

4. A fuller knowledge of physics and mechanics than is required for certificate A.

5. Practical knowledge of the working of expansion and condensation, the use of the indicator and the calculation of diagrams.

6. The setting of slides and shafts and a knowledge of the most usual auxiliary engines employed on board a merchant vessel.

7. A knowledge of the most general defects of engines and boilers and the remedies for same.

8. The execution of temporary or permanent repairs to engines and boilers at sea or in port.

9. A knowledge of fuels, packings and lubricants.

10. A knowledge of spontaneous combustion and the developments of explosive gases in holds and bunkers, and the precautions to be taken against accidents from such causes.

11. A readiness in the making of working drawings, of details requiring renewal or repair, and the calculation of dimensions and loading of the several types of safety valves.

Certificate C.

Candidates must pass in all that is required for certificate B, and in addition :—

1. His knowledge of English or German must extend to the translation of an essay upon engineering from one of those languages into Dutch.

2. He must be able to write without serious mistakes a letter in one of those languages on an engineering subject, the chief points of which, will be given by the examiner.

3. He will be required to know :—

(*a*) Algebra, logarithms, cube root, the mensuration (both plane and solid) of regular and irregular forms, root extracting and proportion to the highest degree.

(*b*) Planimetry up to and including the circle, the calculation of surfaces, of polygons, of circles, and the approximate calculation of planes bordered by curves.

(*c*) The methods of calculating the capacity of prisms, cylinders, pyramids, cones, &c., and the measurement of bent surfaces bordered by curves.

(*d*) The trigonometrical functions, and the calculations of the sides and angles of rectangular and oblique triangles.

(*e*) The rudiments of deflection and fracture of beams, and torsion for simple sections.

(*f*) Physics, so far as applicable to engines and auxiliary engines on board ship.

4. He must have a thorough knowledge of the arrangement, working and management of the several types of marine engines and boilers.

5. A perfect knowledge of the fitting up of marine engines and their details, the proportion and strength of the several details of boilers and machinery and the judging of indicator diagrams.

6. A perfect knowledge of the rudiments of boiler construction and the calculation of stays and seams.

7. A knowledge of the general experience in regard to corrosion and decay of boiler plates and the precautions necessary to prevent same.

8. The candidate will be required to give a description of defects (if any) which he himself has observed which originated through defective construction or material, neglect in management, &c., and state at the same time how these defects could have been prevented, and how they could be properly repaired.

9. He must show a fair knowledge of electric light installations, refrigerators, steam steering engines, steam reversing gears, windlasses, &c., so that he can take the management of these machines.

The methods employed in the examination of candidates for the different grades of certificates are as follows :—

For languages, the points gained are multiplied by 5.

For arithmetic and algebra, by 7.

Geometry and trigonometry, by 8.

Physics and mechanics, by 9.

Practical knowledge, by 10.

The programme for examination is:—

A. Arithmetic, practical and theoretical, one hour verbal and two hours writing.

Sketching and drawing half an hour.

Boilers, one hour verbal, one hour and one quarter writing.

Machinery, one hour verbal and one hour and one quarter writing.

For Certificate B, if candidate is in possession of Certificate A.

Language, verbal, half an hour.

Theory of mechanics, one hour verbal and two hours in writing.

Machinery, one hour verbal and one hour and one quarter writing.

Drawing, one hour and one half in which the candidate must make a working drawing to scale with sizes filled in from a piece of machinery supplied by the examiners.

Combustibles, half an hour verbal.

For certificate C, if candidate is already the holder of a certificate B:

Languages, quarter of an hour verbal and half an hour writing.

Theoretical mechanics, one hour and a quarter verbal and three hours writing.

Boilers, one hour verbal and two hours writing.

Machinery, one hour verbal and two hours writing.

Drawing, two hours.

Spontaneous combustion, half an hour verbal.

These examinations for engineers having only just been instituted in March, 1891, and not being compulsory, are, considering the latter condition, being pretty generally adopted by the better class of men, who very correctly suppose that the possession of these certificates give them a certain standing. Though these examinations are not compulsory, the more important lines of steamers generally

carry certificated men, as some of the shippers will not send goods except in vessels so officered. C certificate allows a man to go chief engineer of any vessel in any trade. *B* certificate enables the holder to be second engineer of any vessel in any trade, or chief of a non-passenger vessel not going beyond the Black Sea and Mediterranean. Vessels carrying the C certificated chief engineer generally carry a second with a *B* and a third with an *A* certificate, and vessels with *B* chief engineers have *A* seconds.

Examination of engineers was made compulsory in Germany by decree of June, 1879, and the classes are first, second, and third. Third certificated engineers may take charge of tugboats and such sea-going vessels as do not go further from the coast than 50 German sea miles.

Second certificated engineers may take charge of the engines of steamers in the European trade, and the European ports in the Mediterranean, Black, and Azof Seas.

First certificated engineers may take charge of the engines of any merchant vessel in any trade.

Candidates for certificates as third-class engineers are required to produce vouchers as having served (after attaining the age of fifteen) an apprenticeship of four years, either entirely as one of the hands in an engine-room or part of that time as such, and the remainder of the time in an engineering shop. Of the apprenticeship in the engine-room at least twelve months must be served in a vessel engaged in trade.

Candidates for certificates as second-class engineers must have served five years in engine-room and engine works, of which two years must have been in works and two years of actual sea experience.

Candidates for certificates as chief or first-class engineers must have served at least two years as second engineer in vessels engaged in actual sea work.

The law as to the manning of German vessels, so far as engineers are concerned, is as follows :—

Tugs and vessels which do not go more than 50 German sea miles from the coast must have at least one third-class engineer on board.

Sea-going vessels in European, Black Sea, &c., trades, must have a second-class engineer in charge and at least one third-class engineer.

For vessels going beyond the above limits, there must be one first-class engineer in charge, and at least one second-class.

The examinations are conducted by a board consisting of a president, an officer engineer of the Imperial Navy or an engineer of the merchant marine—provided he has been educated at a technical college—or an engineer engaged in the construction and working of marine engines, who has had at least one year's sea service, and a teacher of navigation of one of the public schools, or a teacher of mathematics.

Requirements for Certificate as Third Engineer.

Candidate must possess a knowledge of the German language in so far that he can report in writing such matters as he is likely to meet with in the capacity of third engineer.

(In particular cases the Government can make allowance to pass in another language).

General knowledge of the most usual marine boilers and their fittings

Knowledge of the management of boilers while under steam in river or sea water, and while under banked fires.

Knowledge about priming.

General knowledge of the use of the gauge-glass and other fittings, the necessity for blowing or scumming, the cleaning of boilers and effecting of small repairs to same at sea and in harbour.

General knowledge of the usual types of marine engines, their details, erecting same, their working and management at sea, while lying under banked fires, and when boilers prime.

Knowledge of propellers, with the methods of fastening same on shafts, and the execution of repairs to machinery at sea and in harbour.

Knowledge of the requirements of the Government as to the safe working of steam boilers.

Requirements for Second-Class Engineer.

Knowledge of the German language, so that the candidate can explain himself clearly and properly in speaking and writing.

(A foreign language may be allowed).

A knowledge of the English language, so far as is necessary to understand the technical expressions respecting the construction aud management of steam engines.

Rudiments of arithmetic, with decimal and vulgar frac--ons and the proportions.

Knowledge of the simple geometrical properties of lines, angles, triangles and the cubic and simple geometrical bodies.

The rudiments of mechanics, levers, tackles, wedges, &c.

The requirements respecting the knowledge of boilers and machinery are very similar, but a little more extended than those for third class engineer.

Knowledge of the management of auxiliary engines, of combustibles and lubricants, and of the properties of steam.

Ability to measure and make sketches of details of engines and boilers.

Knowledge of the requirements of the law with regard to arrangement, testing, and management of boilers.

Requirements for First-Class Engineer.

Languages the same as for second class.

The rudiments of Arithmetic, with whole numbers, decimal and vulgar fractions up to and including equations to the first degree. Calculating square and cube roots, calculating with logarithms.

A good knowledge of geometry.

Knowledge of simple propositions concerning mutual positions of lines, planes, and conic sections ; calculation of the contents of prisms, cylinders, pyramids and pyramid sections, spheres and sections of spheres.

Approximate calculation of bent planes bordered by bent lines or curves.

Knowledge of trigonometrical functions ; calculation of the sides of rectangles and oblique angles.

Knowledge of the simple elements of mechanics, levers, pulleys, inclined plane, wedges, wheel and axle, screw, &c., of simple parts of machinery, screws, rivets, bearings, belt pulleys, gear, wheels, cranks, cocks, ropes, chains, and the resistance against motion, friction, gravity, &c.

Knowledge of the physical properties of bodies, of the theory of heat, properties of steam and the development of heat through combustion.

Knowledge of the size of boilers to produce horse power with the relative proportion of grate and heating surfaces, strength of plates, stays, seams, &c., and the judging and calculating of indicator diagrams.

Knowledge of the supervision of bunkers, bilge, and ballast arrangements, fire extinguishing, and feed heating apparatus.

Knowledge of engineering, sketching and drawing.

Knowledge of setting and regulating slide valves and a knowledge of the law regarding the use of steam boilers.

There is also a practical examination which is generally carried out on board some mail or war vessel in the presence of the Engineer Examiner.

The French laws respecting engineers' certificates appear to vary in the different ports ; as at Havre only is it required that shop service is necessary before a man can pass.

Most of the engineers in the French Mercantile Marine have been and still are in the Navy, as every one is required to serve on active service three years, and up to a certain age in the reserve, being called out every two years for two or three weeks drill, and, unless under exceptional circumstances, the rank they hold in the Navy fixes the grade they are entitled to serve in the merchant ships. Engineers must serve in the lower grades two years before being eligible to pass the examination for the next higher. After reaching the age of 33 years a man cannot pass for second, nor for chief after 40.

The candidates undergo an examination in the elements of arithmetic, geometry and drawing, but the character of their papers from the Navy have a very great influence on the examiners, who are all old Government engineers.

The law requires that no one but a Frenchman can be in charge of the engines of a French steamer, and only *one-fourth of the firemen are allowed to be foreigners.*

Engineers in the French Mercantile Marine, if they infringe the laws of navigation, are subject to fines of from ten to forty days wages, imprisonment, with or without hard labour, for ten days, suspension of certificate, and deportation on board a cruiser at half wages, and the time they are undergoing any punishment does not count towards the pension from the Government, to which they are entitled after so many years service in the fleet and reserves.

In Spain an order was issued by the Government that all vessels carrying passengers should have certificated engineers, and those who had been six years as chief were granted first-class, and those who had been six years in any capacity in the engine room were allotted second-class certificates, and in this way many men who were not engineers at all, but who had managed to creep into office, were given the hall-mark, as was the case in our own country at the commencement of the certificate era, when certificates for service were granted to men who had incidentally been placed in charge of engines for a short time. I knew one man possessing a first-class certificate of service who was utterly unable either to read or write, and who murdered the Queen's English every time he spoke.

In the Italian service a man can pass his first-class examination before he goes to sea at all. Below the second engineer, certificates are not required in Italian vessels, but after a man has served two years at sea he has to pass an examination of a comparatively easy nature and he then gets his first-class certificate.

To return from this digression. Having come home from his first voyage, our junior is in possession of a discharge as assistant engineer, but must, according to our Board of Trade regulations, go to sea and in charge of a watch, too, for twelve months before he can submit himself for examination as second-class engineer.

In many large vessels, the watches are kept by the second, third and fourth, and as nearly all of these are certificated men, it may be a long time before the junior, if he be in one of these steamers, can get the qualifying time in, and therefore I consider it would be better if the present regulations of the Board of Trade were altered and amended.

Firstly, to create a third-class certificate, the qualification for which, should be two years service as an assistant engineer, on any trade, in any steam sea-going vessel of above 100 tons nett register; and the passing of an examination of a slightly lower grade than that prescribed at present, for the second-class certificate. Candidates to prove satisfactorily to the Board of Trade that they have worked in some shop, in the making or repairing of marine or other steam engines, for not less than three years; one year actual sea service with the third-class certificate to be served before a candidate can apply to be examined for admission to the next higher grade; two years service with a second-class certificate, in any sea-going steamship (providing always, that the candidate has charge of a watch all the time), to be necessary before the examination for first-class can be passed.

It will be admitted, I think, upon all hands, that while the regulations I have here advocated may impose more stringent conditions and extend the time in which a man can obtain his certificates, as compared with the regulations at present in force, the result would be, that we should have more experienced engineers to man our ships, and I think more credit would then be given to the holder of a first-class certificate than is now the case.

Under the existing regulations, it is within the bounds of possibility for a man to hold a first-class certificate of competency by the time he is a little over 22 years of age.

Before leaving the subject of the Board of Trade regulations governing the examination of engineers, the rules of

the same body, and their requirements as to the compulsory use of certificates on board British steam vessels, I will just mention a very serious flaw in those regulations.

The law says, "Every foreign going steamship, or home trade passenger steamship," or words to that effect, shall carry certificated engineers.

Now, the above quoted paragraph leaves out of its jurisdiction a very large number of vessels that should, in my opinion, be included in it—viz., vessels that are neither engaged in the foreign trade nor the home passenger trade.

There is a large number of vessels of all kinds, some of them with all the latest improvements in Marine Engineering, engaged upon our coasts and within the limits of the home trade—viz., the Elbe and Brest—which may go to sea and carry paying passengers, too, without a certificated man on board.

In the early days of my sea-going experience not one passenger could be carried in a steamship without a passenger certificate, although I have seen the law evaded by signing the passengers on the articles as part of the crew; and, in fact, I myself had an increase in the "black squad" by the addition of four passengers put on the articles as "firemen"; but I need not say that the work they did at that rating was very small and did not amount to a single pound of steam.

The law has since then been amended, so that steamers may carry passengers up to the number of twelve without the necessity of being examined and surveyed by the officials of the Board of Trade; and as the majority of the vessels engaged in the coasting and home trades (of course, always excepting the vessels of the various railway companies and a few other special vessels) could not accommodate more than twelve passengers, I do not see where the amendment, so far as taking all precautions for the safety of the passengers carried in such vessels, comes in.

It is, in my opinion, not fair or just to those engineers who have passed the examinations prescribed by the Board of Trade, at great trouble and expense, that uncertificated men should be allowed to take charge of Marine Engines at sea.

There are no doubt many able engineers who are uncertificated, but it allows of possibilities which are injurious, and I hope to see the day when such a state of things will no longer be allowed to exist.

I am of opinion that all men who are called upon to take charge of engines and boilers, either at sea or on land, should be certified in some way as being qualified for their posts; and it is only a question of time, I hope, before this

will be made the subject of legislation, for not only do owners and underwriters suffer pecuniary loss, but human life is frequently sacrificed to ignorance and negligence.

The only vessels which should be exempt from carrying certificated engineers are those exclusively engaged in towing upon the rivers of the United Kingdom ; and these vessels should be in charge of certificated engine drivers, or come under the regulations proposed for land engines and boilers.

Having brought our student of Marine Engineering safely through his maiden voyage, we must now consider the training which would be most beneficial to him in his year of sea service, the period fixed by the Board of Trade before he can go up to be examined as to his fitness to act as second engineer of vessels having engines of more than 100 nominal horse power, or chief engineer of vessels under that horse power.

It is highly desirable that the student during his first year of sea service should be under the charge of men who besides being capable of teaching him the points of the profession are also willing to act to that end, and no less is it desirable in this second apprenticeship, as I may call it, that the pupil should be anxious and willing to be so taught by those of larger experience in such matters than himself. During his spare time it would be well if he availed himself (by making notes) of all matters that occur in the daily routine on board, and especially note the many little irregularities that are constantly occurring in the working of engines and boilers, the causes of same, and the means taken to remedy them and prevent their recurrence.

I am very strongly of opinion that under the existing regulations it is not advisable for the student to present himself for examination so soon as he has got the required time upon his discharges, but would advise that he have at least 50 per cent. more, as it were, "up his sleeve," to veer and haul upon, and it is not desirable, at least in my opinion it is not, for the student to serve the whole of his time in one ship, as that prevents him from becoming acquainted with the engines and boilers of more than one make only ; and though the principle of all marine engines is the same, the details very often vary considerably, and it is well to be acquainted with the variations.

In connection with this point, I well remember a case coming under my notice in the early days of compound engines. A young man who had served his time at sea in a vessel or vessels made at the place where he served his apprenticeship (which firm then made their circulating pumps inverted over the air pump), was sent to London to

bring down to the North a vessel built by a firm at the same place, and who also made *their* circulating pumps in the same style; but the first firm made their pumps with buckets, while the second firm's pumps had plungers (both being single acting and drawing through vertical condensers). The vessel duly sailed from London, but was soon towed into Lowestoft with all her furnace crowns down. She was thence towed to her home port, and when the young engineer was asked to account for the disaster he said he could not get the water through the condenser, and consequently was obliged to work high pressure and feed with the donkey from the sea. On being asked if he did not seek the cause of the failure to circulate, he replied that he took the doors off the circulating pump and finding all right replaced them. He was then told to take the covers off this pump there and then. Upon this being done, it was at once seen that the delivery valve and guard had been carried away and lost through the discharge valve on the ship's side, which was on a level with the delivery valve. He was then asked if it was then the same as when he examined it, and replied yes. When told the actual state of the case he said that all the ships he had been in only had one valve at the side like that one, forgetting that in the bucket pump there was a valve upon the bucket, whereas the plunger pump required two valves, each independent of the other, as there was not one on the end The incident will be well remembered by one of our Vice-Presidents, who can endorse this.

Since those days the marine engine has been very much improved, and altered, and the amount of machinery on board of a modern merchant steamer is very greatly increased, besides which the pressure of steam has increased to three times the amount then carried, and the boilers which generate it will not endure the treatment they sometimes formerly received without suffering great injury, and it is highly important that our student should avail himself of every opportunity that presents itself to become acquainted with the manner in which these high pressure boilers may be most economically worked and preserved. I do not think it at all necessary to point out to the Members of this Institute particularly, and to chief engineers generally, that for the benefit of all the student should be encouraged to learn and improve his mind as much as possible, as this fact must be patent to all; but at the same time it may be observed that our student is sometimes to blame if his seniors do not take more opportunities of instructing him. It may be through diffidence or some other cause.

For either technical, practical, or theoretical instruction, there is this Institution formed by engineers, composed of engineers, and for engineers, the value of which, in my opinion, is immense, especially to young men. Assume that our student has now "put in his time, passed the Board," and got his certificate, this gives him the proud privilege of acting as second engineer in any vessel in the British Mercantile Marine, if he can get the berth as such.

He has now become an engineer, a second class one, it is true, but he is practically out of his time, the apprenticeship to the sea being over. But though no longer a student, he must not cease to study ; on the contrary, he must study more than ever, and lose no chance of improving his knowledge of the massive machinery which propels the vessel, so that when the time comes that he "signs on," as chief engineer, he may be able so to manage the engines and boilers, that the men who had a hand in training him may feel proud when they hear of his success in the profession, the records of which already contain particulars of some deeds which make me feel proud of it.

Having graduated our engineer from scholar to chief engineer through all the grades, let him not fancy that he will not require to learn more; far from it. I myself have been at it some time, going to sea for the first time in 1864, when 25lbs. of steam was considered high pressure ; but I find that in this year of grace I know less than I did (or fancied I did) at 21. I am still a learner, and shall be, I hope, until the last watch is called ; and, when I look back and think of how much I used to know, and then look down into myself and find how little I really do know, it makes me glad that I joined the Institute of Marine Engineers, for it is about the only thing that I have really to be proud of.

I must apologise for many defects in this paper, as, when I rashly promised to read one on this subject, I felt that I could say much about it, for I had thought much about it ; but when it came to setting down matter that was to be presented to such a body, I felt very small, and still do so, though I am sure that the criticism of my fellow members, if severe, will be kind and just.

I also apologise for introducing at such length the regulations regarding the examinations of engineers in Holland and Germany, although the former nation has not made it compulsory, but that, no doubt, will come ere long, and it is a consummation to be wished.

In reference to these foreign regulations, I thought that, as they are not generally known, they might be interesting to many of our members, and show how our brethren in those countries are situated as regards the ordeal we must all pass through to qualify for our positions.

You will see that the Dutch and Germans have a system of apprentice sea-going engineers, and of such I must say I approve, and consider that a young man on first going to sea should be so styled for a certain time, and should not be allowed to take charge of a watch without producing from a chief engineer, under whom he has sailed, a certificate to that effect.

There are many vessels sailing from our ports, some of them indicating over 1,000 horse-power, whose full complement of engineers is three, one of whom may be, and frequently is, a youth on his first voyage, and possibly has never been in an engine room with the engines in motion in his life, let alone at sea in a gale of wind. Of course he cannot be trusted alone, and it then devolves upon one of the other two to take him on their watch (which means that they must keep twelve hours of duty per day for an indefinite time), until the novice becomes initiated into the mysteries of the craft and obtains his sea legs, a process which sometimes occupies several days.

If it were the rule that these vessels were compelled to take one apprentice engineer for, say, each 100 N.H.P., it would save, possibly, a deal of expense to owners and trouble to engineers, and be a good school to learn in.

I am aware that possibly the opinions given here may be objected to by some of our Members, and I hope that the discussion which may arise will be the means of attaining to some little benefit for marine engineers generally; and it is not an extravagant wish, when I say that I trust the discussion and the remarks called forth by this humble attempt to say a few words on a subject which, if I do not know much of, at least is one that I am very much interested in, may prove the best part of the paper.

In conclusion, I have to ask your kind indulgence and acceptance of my most sincere apologies for the delay which has occurred in the production of this paper, but a variety of circumstances have combined to prevent me from rendering it before now, and the remaining favour I ask is, that you may look upon the many errors contained in its pages with a lenient eye.

DISCUSSION

ON

"The TRAINING of YOUNG MARINE ENGINEERS,"

HELD

Monday, January 23rd, 1893.

THE CHAIRMAN.

(*The Honorary Secretary.*)

I think Mr. Sage might have spared his apologies for his paper, for I am sure we have all listened to it with great interest and pleasure. The author has given us a great deal of food for thought and reflection, and I think the discussion would be better adjourned until another evening, so that we may have the paper before us, and thus be able to consider the various points more closely than at present. I have a communication from a Member who is unable to attend to-night, and if in accord with the views of Members present, I will read it, and thus also give an opportunity for notes being made on the several points touched on in the paper.

Mr. ALEXANDER D. PATTERSON.

(*Member.*)

Although I can scarcely spare the time, I may perhaps be allowed to give my views in a hurried and condensed form concerning the education and training of Marine Engineers, a subject which, I think, requires serious consideration on the part of the Executive and Members of our useful Institution. I am in favour of the third-class certificate, which

I would suggest should be granted on a basis particularly of practical experience. No vessel steaming six hours out from port, should have an engineer in charge of machinery without a certificate, irrespective of the size of the engines. The candidate for a third-class certificate should have served at least five years in a factory where engines are made and repaired,—two or three years as fitter, one or two years as turner, and one year as pattern maker, draughtsman, blacksmith or boiler maker, as the circumstances of his case permit. During this period he ought to have passed under, say, the Science and Art Department, in the following subjects :—

Elementary Steam.
Do. Machine Construction and Drawing.
Do. Plane and Solid Geometry.
Do. Mathematics.
Do. Chemistry.
Do. Applied Mechanics.

A second-class pass to be the minimum. These subjects, a lad coming from the Board Schools should not now find it difficult to get through, provided the standard is no higher than at present. His twelve months' training at sea should enable him to receive a certificate from his chief engineer, who should be held responsible to the Board of Trade for the veracity of the testimonial, and the number of the chief engineer's certificate should be endorsed on it. This testimonial should show the candidate's practical knowledge in the application of tools, tackles. &c., combustion of coal and its various qualities and characteristics ; also the various modes of stoking, cleaning of fires, cleaning of choked tubes, stopping of same, &c. ; his ability to solder, caulk boiler seams, rolling of tubes with expander, renewal of rivets, making of the various joints, cleanliness of boilers and the methods employed, &c., in all details, cleanliness of bilges, and his ideas of painting, &c., for preservative purposes. It should show further his knowledge of the various oils used, and their effects on various parts of the machinery as between internal and external lubrication. He at least, at his examination, should know the names of the various parts in the hull of a steamer and how to repair a simple damage. He should also know something about discipline as to his relationship with the captain of the vessel, the chief engineer and subordinate engineers, also his position relatively to the firemen and sailors. A great deal of friction is very often caused on board by juniors on this point ; and, in my opinion, based on experience and observation in all classes of ships, it is essential that there should

be uniformity in all vessels on this particular point. He ought also to be able to produce satisfactory evidence of his fitness to overcome sea-sickness to such a degree that there would be at no time an utter incapacity for duty from this cause. As many of our members will be able to bear me out, there have been times in their experience when great worry has been caused by this trouble, not mentioning the grave risks of damage to machinery. So far, I have only dealt with a few outlines in reference to the beginner; but, should the paper be further discussed, I might refer to the second engineer and his training, about which a very great deal can be said. In conclusion, I may add that the great danger at the present time is that our young engineers are building too much on theory, and forgetting that it is expected from the chief engineer downwards that they will all be able to off coats and handle the hammer and chisel proficiently, strip and wrestle with the bilge water, enter the combustion chambers, expand and caulk, and many a time in our smaller vessels handle the shovel, rake, or slice, and often trim their own coal. But how few now, especially in some of the large mail steamers, know anything of this? I am not one to disparage the higher theory, but certainly would do so if the practical parts in any degree were not mastered.

Mr. J. HAWTHORN.

(Member.)

There is perhaps no subject within the whole range of Marine Engineering in which I am personally more interested than in the subject of the paper to which we have just had the pleasure of listening. It is a matter I have thought over for many years, and I think the time has come when we ought to try and raise the status of our young engineers; but I consider we shall never do that unless we raise the status of the certificate. At present the certificate is to a great extent a burlesque. It does not matter whether a man just passes "by the skin of his teeth" or shows the greatest knowledge and proficiency, he only gets the same certificate. I have a scheme in my own mind, and with the kind permission of the meeting I will explain its principal features. Firstly, I propose that the number of the certificates shall be three, and shall be called the 1st, 2nd, and 3rd certificates. The first certificate obtained should be the 3rd. The qualifications for this certificate should be that the candidate is 21 years of age on the birthday next before presenting himself for examination, and

that he produces satisfactory testimonials that he has served for six years on the making and repairing and handling of steam engines. If only three years have been served in the works, then the other three should be served at sea. If four years have been served in the works then the other two should be served at sea. If five years have been served in the works, one year of which should have been served on some shore staff or in works where marine engines only were made, then one year at sea may be accepted with the other five years so served. But in every case the candidate should produce testimonials for six years. This I would insist upon. During these six years of apprenticeship the young engineer should endeavour to acquire by diligent study the rudimentary knowledge of mathematics, including vulgar and decimal fractions, square and cube root, elementary physics, and theoretical and applied mechanics, sufficiently to enable him to thoroughly comprehend the principles upon which a machine works. He should also know sufficient of natural philosophy, so that he could trace the conversion of the heat energy of the coal into mechanical work. I would also insist upon the employer distinctly stating upon what work the candidate was employed during his shop service. These apprentices at sea completing their time should be called assistant engineers, and should not have charge of a watch, but should take the place of those assistants now in most cases recruited from the stoke-hold—that is to say, the greasers, &c.—and, if it were possible, I would say that when a boy is apprenticed to a marine engineer it should be considered the right thing for his employer to appoint him to some of the ships turned out by the firm in which he was apprenticed, so that his time would still be under the firm he was originally articled to. As to the examination for the third engineer's certificate ; upon presenting himself for examination, his age and testimonials being found in every way satisfactory before his papers are accepted, the candidate should be put through a verbal examination in the presence of two or three properly constituted examiners. The examiner putting the questions should have no voice in saying whether the candidate passed or failed. There should be no more one man examinations, and there should be no men examined *in camera*. Having satisfied the examiners as to his fitness in the verbal examination, the candidate should be sent to some marine engineering works appointed by the authorities, and here in the presence of the engine, he should be asked the names of the different parts, also their duties relative to the machine as a whole. It

would be better, if it could be so arranged, that he should go on board some ship other than his own, and be asked to trace some of the principal pipes, &c., naming them and their duties. He should also be examined as to the position of the link motion when ahead and astern, water gauge reading, parts of boiler, &c. Should he satisfactorily pass this part of his examination, which should be looked upon as the most important, he should then be put through the scholastic part, and this should, in my opinion, consist of questions as now given for the second-class examinations, with a few additions. Having passed all three tests, the candidate should be allowed to take charge of a watch and should be rated on the articles as third engineer or fourth engineer. After having served two years in this capacity and having obtained a step of promotion in the meantime, he should be eligible to sit for a 2nd certificate, but no man should be allowed to sit and obtain a higher grade certificate than the one he holds if he did not obtain a step of promotion in the meantime. I could cite many cases in support of this view, and will give you one which is particularly in point. A very smart young man joined a service as fourth engineer, and in due course, at the end of twelve months, he obtained his second's certificate. Just eighteen months afterwards, almost to the day, he, fulfilling strictly the Board of Trade requirements, sat for and succeeded in obtaining his chief's certificate, he never having been out of the one ship and never having been promoted. You may say, "All the more honour to him." This I admit, but it ought not so to be. The examination for the 2nd certificate should be intermediate between that for second and chief as now held, but should include sketching from some actual piece of machinery, the particulars of which are known to the examiners, and not from memory, and the candidate should be allowed only a two-foot rule and a pair of outside and inside callipers. I consider that if a sea-going engineer can take out of his pocket a piece of chalk and give a pattern maker or a draughtsman his ideas, say, on a bulkhead, he has all the drawing knowledge necessary. He should, with this certificate, be allowed to occupy the position of either second or third engineer on any steamer. With two years at sea with this certificate, during one year of which he must have served as second engineer and been responsible for the working of the engine-room staff, he should be allowed to sit for a chief or first certificate, for which the examination should be, say 50 per cent. theoretical and 50 per cent. practical. The theoretical examination should be a little more searching than at

present, and should include questions on mechanical science, square and cube root, algebra up to and including quadratics, and a fair working drawing to some data, say, to suit a ship of certain tonnage or engines of certain horse power. He should also have an elementary knowledge of the principles of ship construction, which should include the principles of framing, bulkheads, and how such could be stiffened, if necessary ; and the different strains that affect a ship due to hogging or sagging, and how such straining action should or should not affect the running of his engines and shafting. Further, he should be able to calculate the difference in the draught of ship, due to burning out his bunkers, and what effect such difference of draught had upon the performances of his engines. His practical examination should consist of questions in methods of removing shafts, cylinders and taking out old engines and putting in new, so that at any time he could be called upon to superintend the same. With regard to the extra chief's certificate, in the first place, I would alter the name and make it some degree of marine engineering, which should carry with it some status. At present it has none, but it should be a qualification for all higher positions in the marine engineering profession. We should then have more men going in for it. I am anxious to make the marine engineer's certificate as valuable to him as possible, and with every respect to the Chief Examiner to the Board of Trade, I think the time has come when the system of examination should be altered, I think the examinations are not sufficiently careful to find out the good men. In my opinion, there are many good men sent back to sea who ought to be passed, and there are many men passed who ought to be sent back to sea. There is one other matter to which I may refer, and it is a subject which, it seems to me, should be taken up by this Institute. I allude to the Royal Naval Reserve. As the engineers who join the Royal Naval Reserve receive no retaining fee, I would suggest that all engineers who join that branch of the service and pass a preliminary examination should be allowed to go through a course of training at the Royal Naval College, and there associate with and receive the same instruction as Royal Naval Engineers. At present, engineers are asked to join the Royal Naval Reserve and get nothing for it. I certainly think myself that all of you who belong to that Reserve have a right to a three months' course at the Royal Naval School, so that, in the event of the day coming when the Government would require your services, they would know the class of men they were likely to obtain.

Mr. A. W. ANDERSON.

(*Member.*)

I think that Mr. Hawthorn is a good deal out in what he says as to the necessary apprenticeship in the works. I would not allow any engineer to go to sea before he has served five years. I am in favour of five years shop time at the least. Then, after he has served a year at sea, I think he ought to know a little ; and the longer he lives the more he will know. With regard to the certificates, I would not give any one of them for any less than the present. When I got my certificate I had to put in a great deal more time than is usually the case now. I had to serve twelve months as second engineer before I could get my chief's certificate, and I think that is quite right. But now a young man may serve at sea as third or even fourth engineer and then present himself for a chief's certificate. I quite object to that for many reasons.

Mr. J. WING.

(*Member.*)

I differ entirely from Mr. Hawthorn in this. I want to know where are the men going to sea now who can erect an engine ? You can cram a man with figures and theory, but can you apply work to his hands or his hands to work ? Will he be a good practical workman ? At sea I prefer a good workman to a good scholar, where you cannot get both combined. Where are you going to find a man to do all that is set out by Mr. Patterson ? It is impossible ; you will have to cast him on purpose. What is the comparison between the cost of upkeep in a steamer in which the engineers are all thoroughly fit for and take an interest in doing their work, capable mechanics who can handle their tools, and the cost of upkeep in another steamer where some of the engineers have not been trained to work the tools, owing to short shop service or being kept at shaping machines all their time ?

The CHAIRMAN.

I quite agree with Mr. Hawthorn that examinations alone are no criterion of excellence. I remember particularly my own experience of one set of examinations, where I got a position much beyond what I was entitled to over others whom I knew were superior to me. My natural liking for

the subject-matter and a good memory stood duty and made up for my deficiencies in Greek grammar. Those who can sit down to an examination with their wits about them may pass with a very superficial knowledge of the subject, while others who may be better men, with even a better knowledge, fail. Those who have to deal with men as employees do not judge a man from his certificates altogether, but are largely guided by experience and touch. Mr. Hawthorn has given utterance to many truths, and I think that the view which he has expressed is very generally held. Those who write on engineering matters as well as engineers themselves, feel that there is need for improvement in the present mode of conducting the examinations. A paper was recently read before the Shipmasters' Society dealing with this subject, and the present system of examination for deck officers was then described as far from satisfactory. I would very strongly discourage anything calculated to promote the idea in the minds of young men that education is only a means to an end. We ought to educate ourselves, not for what education will bring us, but for what it will give us. Class education is in many cases very narrowing in its results, and I would deprecate the laying down of arbitrary rules and subjects for the guidance of those who may be anxious to begin early to train their boys for engineers. I well remember the remarks made by fellow-scholars embodying ideas, shared probably by myself, to a certain extent, to the effect, that for certain walks in life certain studies were useless. Thus, one intended for a farmer scorned classics, another intended for the Church despised botany, and so on Although taught early to look forward to marine engineering as the goal of my ambition, it was also impressed upon me that the attainment of knowledge of any subject one has an aptitude for is certain to be useful, if not in strict relation to one's business in its narrow sense, at least in connection with personal and social life. There are many studies which, apart from their direct bearing on the intended life of a lad, may be of very great service to him in many ways, and I should say that it should be borne in mind to encourage lads to look upon knowledge as a thing to be desired for its own sake rather than for what it may bring in pounds, shillings, and pence. The former view broadens the character; the latter narrows it. In making these remarks I am aware that I show my want of appreciation of the purely utilitarian doctrine, but I admire the broad rather than the narrow view of life, and hold that the man who aims only at making himself right in his own corner, and acts accordingly, has missed altogether the true business of life. I feel very

warmly on this subject, and think we should deprecate as much as possible any idea of class teaching, that is to say, teaching only with a certain defined object in view, apart altogether from the love of knowledge. If we seek to acquire knowledge for its own sake, the other will come in good time. I would strongly impress upon all our young friends present not to look upon education as simply a means to an end, but to have regard rather to the pleasures they will themselves derive in after life from the studies of their early youth. We have all, doubtless, regretted the time we have lost in our younger days, and by time lost I do not consider time spent in healthy and healthful recreation included, but time actually allowed to pass unheeded as of no moment, say the quarter or half hour we allowed to go past without a record to the profit side of our book of life. Recreation is needful and necessary for every one, and I do not consider that recreation is lost time. But if a young man only learns to utilize his time properly and systematically, it is wonderful what an amount of work he can get through, and by devoting to the purpose, say, only ten minutes a day, it is wonderful what an amount of knowledge can thus be acquired.

Mr. NICOLL.

(*Member.*)

There are a good many young men here this evening, and I would strongly advise them to serve seven years instead of five. If I had to appoint six assistants to-morrow, I should select those who had served seven years, because I should consider them the better men.

Mr. J. H. THOMSON.

(*Member of Council.*)

Do you mean you advise them to serve an apprenticeship of seven years ?

Mr. NICOLL : Yes.

Mr. W. J. N. BRETT.

(*Associate Member.*)

I should like to support Mr. Nicoll in what he has said. My opinion is that young fellows go to sea much too soon. When they have been at their trade about two years they make up their minds to go to sea when they are out of their

time, and the result is that they go through their last three years anyhow. I should propose that when a young man has served his apprenticeship of five years he should serve two years as a journeyman. When a man has simply served five years he has not had sufficient workshop experience. Another point is with reference to the Whitworth scholarship. I would recommend a young fellow to serve his five years and then work two years as a journeyman, and during those seven years attend one of the science and art classes which are held at nearly every port, and work according to the syllabus for that scholarship, and if he did not get the scholarship he would certainly be no loser.

Mr. HAWTHORN.

We are in a sense the guardians or guides of the young engineers' education, and I really think we ought to take up this matter. We ought to see that the men who get certificates are the men who are entitled to them, both by reason of their abilities and by reason of their apprenticeship. I say that engineers have brains capable of taking 50 per cent. theory and 50 per cent. practice. It was Ruskin who said that "the education of to-day gives people the facility of knowing things wrongly." Anyone who crams for a fortnight can get a second-class certificate.

Mr. ANDERSON: I quite agree with Mr. Hawthorn, but when a man goes to pass a Board of Trade examination he has to take 50 per cent. conundrums.

Mr. HAWTHORN: I think we ought to formulate certain resolutions and vote upon them.

Mr. NICOLL: In proposing a vote of thanks to Mr. Sage for his Paper, I would also propose that the discussion be adjourned till next Monday.

THE CHAIRMAN.

The discussion will be resumed on Monday, January 30th.

SESSION 1892-3

ADJOURNED DISCUSSION

ON

"*The Training of Young Marine Engineers*,"

HELD

On MONDAY, JANUARY 30th, 1893.

THE CHAIRMAN.

(*The Honorary Secretary*).

We have met to-night to resume the discussion, commenced last week, on "The Training of Young Marine Engineers." I will not take up your time at present by saying more, but I have communications on the subject, which I propose to read in the course of the evening, if the discussion seems to flag. I understand there are several Members who desire to speak, In order to give them full liberty to express their views. I think it will be better if I reserve these letters until later in the evening.

Mr. JOHN NICOLL.

(*Member.*)

I cannot approve of many of the remarks of the speakers at our last meeting. In the course of his paper, Mr. Sage states that "a boy who has been properly educated can

learn all the hand-skill there is in engineering proper in three years." I should advocate five years service in the works, the boy passing through all the departments. This should be followed by two years office work, making a seven years apprenticeship or training, which I consider not at all too long. The diligent apprentice, who has made good use of his time in the works, would, after five years, be ready to take up his office training with greater facility than he would, had he gone at an earlier period. When our young man has finished his apprenticeship of seven years, as I have indicated, and has made a few voyages to sea, should Mr. Wing repeat his question "where were the men going to sea who could erect an engine?" I have not the slightest doubt that he would get a satisfactory answer from the seven years apprentice. I have strong doubts about the three, four or five years young men. Mr. Wing prefers a good workman to a good scholar at sea. I prefer the good scholar and good workman combined, and, having sailed with such, I know their value. It gave me much pleasure and profit to hear the remarks of Mr. Hawthorn, but I was surprised at him suggesting three years shop practice as sufficient, with three years at sea. I still stipulate for nothing less than a seven years apprenticeship.

THE CHAIRMAN.

I think Mr. Hawthorn in that portion of his remarks, remarked upon by Mr. Nicoll, was referring more particularly to the present rules of the Board of Trade, in which the minimum workshop service is three years.

Mr. NICOLL: I think not. I took him to mean that he advocated three years.

THE CHAIRMAN.

I understood him to mean, that if the Board of Trade insisted upon three years shop practice, the young engineer should also serve at least three years at sea before going up for his certificate, thus making a minimum of six years in place of the minimum of four years.

Mr. NICOLL: I do not think he mentioned the Board of Trade.

Mr. J. H. THOMSON.

(*Member of Council.*)

As an old sea going engineer I may be allowed to offer a few remarks as to the class of men we should like to have in the engine room. It is no doubt a very excellent thing to

give a young man a good education, but in the modern system of workshop practice young men have not the opportunities they had in former years. There is so much machine work at the present day that a man has very little chance of actually handling tools. Twist drills, for instance, are made of all the different sizes required, and all you have to do now-a-days is to get out a drill of the requisite size. But in the old days, in many shops if you got a drill and it was not of the right size, you had either to grind it or take it to the smithy and forge it.* At the present day, especially in large shops, young men do not get the opportunities they had in former years of becoming really practical hands at their trade.

Mr. T. J. BURMINGHAM.

(*Graduate.*)

I think, before deciding how to educate our junior engineers, we should first of all consider what is expected of them. If I understand rightly, they are engaged to make all necessary and practicable repairs, and see to the general running of the machinery in such a manner as will tend to keep down unnecessary wear and tear. Such being the case, the most important education I should think would be that which teaches them to use their tools. According to the discussion of last week there seems to be a difficulty in deciding how long this education or "apprenticeship" should extend—some say five years, some six, and some seven years. Should not the time thus spent rest entirely with the apprentice or his employer? If the intelligence and aptitude of the apprentice are such that he can and does master in three years what another, who is recognised as a full-fledged engineer out of his time, has taken five or even seven years to acquire, it appears to me hardly fair to keep the former back for two or four years because the latter is either more lazy or less intelligent. Might I suggest a Board of Examiners to test the practical skill of apprentices who have served at least three years in a marine shop, and to award certificates of competency to the successful candidates, which certificates would entitle them to enter the services of some of our large steamship companies as junior engineers, thus insuring these companies from being imposed upon by unskilful workmen. One member last week said he would always employ an engineer who had served seven years in preference to the one

* This, however, is hardly good form, as alteration in the size of a drill in well regulated works is prohibited for obvious reasons. The reasoning is not in the slightest degree vitiated by this note.—J.A.

who had served three or five years. May I ask which would he select of two—one who has served three years and possessed the certificate just mentioned, or one who, having served seven years is unable to attain it? We must take into consideration that it is possible to find some who could not learn in ten years what others could master in a quarter of that time. If the former are so dense, what may be said as to their holding a first class certificate, which at the present day is very easily earned by what Mr. Hawthorn terms a few weeks cramming. Referring again to the three years' man, is it not fair to suppose that his mathematical career will also prove a quick and ready success. Of course I speak of men as a whole, for I am quite aware that there are some men who are clever mechanics and yet could not possibly work out an indicator card. If engineers are wanted with the 50 per cent. each of theory and practice you must give them space in which to move. It is, as a rule, while young that ambition is stirred if men are at all clever, but if kept back they lose heart at being kept at the grindstone. It is such as these, too, who will pass through their examinations with credit and retain all their theory and be able to put it into practice, while the slower individuals will of course cram themselves sufficiently to pass for a first class certificate, forgetting all they have acquired soon afterwards, and yet hold a voucher—as was referred to last week—which makes them equal in every respect to all holders of the certificate. The former, having a love for study and knowledge will go on investigating everything which others might consider of no import, and they will end by completing their own education. I do not wish these remarks to be misconstrued. I am not advocating that an apprentice should serve three years and then join a ship, with duties put upon him which he knows nothing about. I am still in favour of a further apprenticeship as it were, but on the same lines; *i.e.*, allow him to start his duties when he can prove himself competent, not forgetting to allow time for him to get over the all-important sea sickness, for he can hardly be expected to give proper attention to the main engine fittings if his own internal fittings are all out of gear.

Mr. A. W. ANDERSON.

(*Member.*)

To continue what I said last Monday night, I have been thinking over the matter since, and I consider that Mr. Hawthorn in what he recommended was asking for too high a standard. Mr. Hawthorn says that the examination

should be 50 per cent. theoretical and 50 per cent. practical, and yet he is only going to give the apprentice three years in the workshop. I should like to know where the apprentice is going to get the practice. I do not consider three years sufficient. Mr. Nicoll said the period should be seven years; I say it should not be less than five years, and I consider that the shortest period an apprentice should be asked to serve. I think that apprentices would be able to get all the theoretical knowledge they require by attending evening classes during their apprenticeship, but I do not think they would be fit to go to sea unless they had served five years or more in a workshop. I know a good few who are putting in five years in the workshop, but they are not apprenticed before they are sixteen, and then they serve another year in the drawing office. With five years in the shop and one year in the drawing office, I think they ought to turn out pretty good practical engineers. Mr. Hawthorn said that after serving three years in a shop they would get their knowledge at sea, but, as a sea going engineer, I would not like to take an apprentice who had only been three years in a shop, to sea with me. They can get all the practical knowledge they want in any large town in the country. If you are going to educate them up to Mr. Hawthorn's standard, you will be wanting to make them senior wranglers, and they will be looking out for professorships. I do not think you will get them to go into the bilges and clean out rose boxes. I think that five years is the least apprenticeship that any young man should serve at the tools in the shop. If he also gets the drawing, which any apprentice can get, and he serves another year at that before he attempts to go to sea, I think it will benefit him greatly. With regard to sea sickness, that is a thing you can easily knock out of them.

Mr. HAWTHORN.

(*Member.*)

There seems to have been a great deal of misconstruction placed upon the words I used last week. When I said that three years in a workshop, together with three years at sea, before a candidate should be allowed to sit for a second engineer's certificate, my contention was that there should be an apprenticeship of at least six years, and if three years is considered a sufficient service in a workshop, then I say the other three years ought to be served at sea. If four years have been served in the works, then the other two should be served at sea. If five years have been served in

the works, one year of which should have been served on some shore staff or in works where marine engines only are made, then one year at sea might be accepted with the other five years so served. But in every case the candidate should produce testimonials for six years service. I am not an advocate for three years in a shop and only twelve months at sea, which is all that the Board of Trade requires at present. I do not believe that you can turn out a man properly qualified to take charge of a watch at sea with only four years experience. If three years are sufficient in the workshop, then three years is none too long to enable the apprentice to learn his duties in the engine room. Take the case of a young man who has been working at the making and repairing of steam-engines. The regulations do not require that he shall have been working on marine engines. He may have been brought up in some inland place and never even have seen the colour of the sea. He does not know the thick from the thin end of the ship—as I have actually had a case where a man has spoken so of the two ends of a vessel; he may be a very good mechanic, but twelve months at sea in a junior position is not sufficient to qualify such a man to take charge of a steamer's engines at sea. There are many things in an engine-room that cannot possibly be learnt in a workshop. It is in the engine-room during the first twelve months at sea that an engineer is made or tested. The workshop prepares the raw material, but it is the engine-room that makes the marine engineer. Twelve months is not a sufficient sea training to qualify a man for a second engineer's certificate. Another point I would urge is that it should be the duty of chief engineers to teach their juniors as much as they possibly can. I have known some cases where chief engineers have almost threatened to put men off duty because they wanted to look inside a valve-box or inside a boiler.

THE CHAIRMAN.

I am very glad that Mr. Hawthorn has come to-night, because he has confirmed the impression that I put before the meeting at the beginning of the evening as to his intention and meaning in the remarks he made last Monday. I am reminded by some of the remarks that have been made in the course of this discussion of a circumstance regarding one of the engine room staff, who, as I think you will admit, was rather green. There was a good deal of water in the stokehold of a certain steamer and the boiler maker was exercising his brains how to get it out while the ship was

afloat. At last he went to the second engineer, and suggested to him to take the plugs out of the ship's bottom, in order to let the water run out of the bilges.

Mr. A. W. ROBERTSON.
(Vice-President.)

I had very great pleasure in reading the report of the paper and the discussion thereon last week. I have since re-read the paper and I certainly must say that the Institute has had submitted for its consideration by Mr. Sage one of the largest and most important problems that we have ever had under discussion. Mr. Sage dealt first with the education of a boy intended for a Marine Engineer, and he recommended that the engineering education should commence at the age of twelve. Well, I entirely differ from Mr. Sage on that point. I think that boys should be kept at a good school until they are at least fifteen; but if they have a desire to become engineers, let their teacher understand that it is necessary for them to acquire a knowledge of practical geometry, euclid, mathematics, and algebra. I consider that no young man should start in a workshop as a pupil to learn engineering until he is between fifteen and sixteen years of age. By that time he has got to years of discretion and his mind ought to be thoroughly established. But the next point that arises is this, and it is here where the difficulty lies—is the young man ever likely to become an engineer? Are five or seven years in a workshop sufficient to make him an engineer? because five, or seven, or even ten years will not be sufficient unless he has got engineering ideas in him. In this connection I often recall an anecdote I heard many years ago about a young man who had been at two universities. He made a boast of having been at two universities, and in speaking to an old lady once he vaunted the fact. The old lady thereupon turned round and said "I can remember a calf that sucked two cows and the more it sucked the greater calf it became!" Assuming that a young man is capable of becoming an engineer, his service in a workshop should not be less than five years, but I say there is a heavy responsibility resting on every master who retains a lad in his shop with the knowledge that he has not got engineering abilities. In such circumstances it is the duty of the master to go to the lad and say, "the best thing you can do is to leave the work," and I can only wish there were more masters acting in that candid spirit. But if the young man is capable of becoming an engineer it is necessary for him while in the workshop to acquire a knowledge of the theory of engineering. Many a young man in a workshop

makes very little progress, I mean substantial progress, in engineering, until he has been six or nine months in the drawing office, and I have often found that when after serving twelve months in a shop an apprentice is put in a drawing office for a year, he goes back to the shop and gets through his work with very great credit to himself. A young man in a shop ought to acquire not only a knowledge of the theory of engineering, but also a knowledge of pattern-making and turning, and a slight knowledge of boiler-making. If he has any intention of ultimately going to sea, it is absolutely necessary for him to acquire all that knowledge in the shop. Speaking now as an old sea-going engineer who has had a great number of young men through his hands, I say that a young engineer without the theoretical knowledge, and without the ability or the education to enable him to pass the Board of Trade examination for an engineer's certificate, is not fit to go to sea. I have no belief or faith in the year 1893 in young men having to go to a school of instruction in order to obtain their certificates. I passed twenty years ago, and I never went to a school of instruction ; and, alas for the engineers of the future, if, after they have been through the workshop and served an apprenticeship at sea, they have to attend schools or colleges of instruction to enable them to go through the necessary examination for their certificates. All the education necessary for that purpose should have been acquired before they went to sea at all ; and a young man who does not have that fact deeply rooted in his mind when he serves his apprenticeship, will grow up to be a very poor instrument at sea for many years. The fact of an engineer serving an apprenticeship of five years, and afterwards going to sea for five, ten or fifteen years without obtaining a certificate, proves that his education must have been much neglected while he was in the shop, or that he has no aptitude for acquiring a knowledge of engineering. A young man, when in the workshop, should be strongly impressed with the importance and the necessity of throwing his whole time and energies into the study of engineering, so that when he goes to sea he goes there for the purpose of acquiring a knowledge, not of the theory of engineering, but a knowledge of the practical working of the engines in all the various details, and when he has thoroughly mastered all these matters, I am sure he will rise in a very short time to the position of second engineer, and then to that of chief engineer. There is one part of Mr. Sage's paper, which I think savours too much of trades unionism. I read the paper with great delight until I came

to the part where Mr. Sage says it is a shame that men without any certificate should be allowed to go in charge of engines. Now let us dispel from our minds any idea that the passing of the Board of Trade examination gives us any extra qualifications. It gives us a knowledge, but it does not give us any special qualifications for looking after a pair of engines. There are many good men looking after tugs on the river Thames, of whom I am very pleased to be able to say they are thoroughly competent to take charge of engines indicating over 100 horse-power, in vessels trading as far as Shields and Newcastle, and I would trust them with engines of 250 horse-power all over the world. Unfortunately they had not the opportunity of acquiring education in their youth, and they are now getting on in years. But still the grit is there and the hard-headed knowledge is there and they are far better able to act in an emergency when it arises, than many of our much vaunted engineers holding first-class certificates. A certificate does not stamp a man with that necessary knowledge to qualify him to look after a pair of engines at sea, and I think that Mr. Sage, when dealing with this particular subject, allowed his remarks to savour a little bit too much of trades unionism.

Mr. SAGE.

I never belonged to a trades union in my life and I never mean to. I was considering the subject on quite different ground. The certificate is a protection both to owners and engineers, whether engineers as builders or engineers as responsible for the results.

Mr. HAWTHORN.

In further support of my contention as to the importance of an engineer's training in the engine room, I consider that an engineer should be in a position to think what is going on inside his engines, and if anything goes wrong he should be able to think the matter out. Will all the workshop practice in the world enable him to do that ? You cannot make a sea-going engineer a competent man, unless he has 50 per cent. of theory and 50 per cent. of practice. He must have 50 per cent. of each. Engineers as a whole are not up to the standard they ought to be. Then, again, is there enough brotherly love amongst us ? Do you very often meet a chief engineer who fails to magnify the faults of his predecessor whom he has relieved, recounting the details he had left in bad order, and which he had required to put right ? What is the meaning of the word engineer ? There was not a word in our own language to satisfy the special requirements of the engineering profession. The French

word from which our word engineer is derived means nothing more or less than one who creates or makes out of his own wits. The only man connected with our profession who is entitled to be designated an engineer is a blacksmith. Therefore, I say, every young engineer should learn blacksmithing, and should have at least six months in the pattern shop. My own opinion is that when you put young men in a drawing office, you make them too much of the gentleman for them ever to make good practical marine engineers. If a sea-going engineer can take a piece of chalk out of his pocket and give a pattern maker or a draughtsman his ideas, say, on a bulkhead, he has all the drawing necessary. With respect to the ordinary workshop practice, how many chief engineers are there, forty years of age, who could erect a pair of engines in a vessel or set the safety-valves of a pair of boilers to the proper working pressure from the build of the boilers? A Marine Engineer, to be a competent man, must have 50 per cent. of theory and 50 per cent. of practice. Engineers are sometimes appointed chief engineers of steamers they have never seen before, and hence I say it is necessary to have a knowledge of the theory of engineering as well as the practice. The examinations of the Board of Trade, as at present conducted, are not sufficient for the purpose. Mr. Robertson talks about having passed twenty years ago, and says he did not go to a school of instruction. Granted he did not go to a school; but all have not had the advantages derived from a good education, for one reason or another. We who have gone through the mill are asked to say what in our opinion is the best training for a young marine engineer. My idea is that if he goes to sea with only three years' shop practice, he should serve at least three years at sea before he is qualified to go up for his certificate.

THE CHAIRMAN.

I have had several young men before me who have been anxious to be accepted for sea service after only three years' service in a workshop. I have uniformly declined to have anything to do with them, as I consider that three years' service in a workshop is far too short for the very large majority of men. I grant that there may be a few exceptional young fellows who can learn as much in three years as others can in double that time, but they are the exceptions; and we want to legislate for the many and not for the few. It is not after all so very hard on these exceptional cases that they should be required to serve another two years, making five in all, because in those two years they

can learn other things that will be useful to them in after life. With regard to the subject of class education, my meaning was not made very clear in the reports of the discussion that took place here last week. What I said then was, that we should not have class teaching carried to its narrowest limits. I hold that we should place the means or facilities for education within the reach of all young men and let them choose themselves what subjects they will study. Let them give prominence to those subjects that will bear on their after lives, but do not let them exclude other subjects. My object was to insist upon the avoidance of the absolute utilitarian style of teaching. We do not want to be monomaniacs, but reasonable beings who can live up to our manhood, permeated by the essence or the spirit of true being.

Mr. GREER.

With regard to the question of apprenticeship, I would point out that, under the present rules of the Board of Trade, a greaser or a fireman can get a chief or a second engineers' certificate without ever having been in an engineering shop at all.

Mr. NICOLL.
(*Member.*)

Mr. Burmingham in his communication, which has been read, asks me a question which I should like to answer. He asks me which I would select of two :—one who has served three years and possesses a certificate, or one who having served seven years is unable to obtain it. My reply is that I would take the seven years' man and chance it.

Mr. A. W. ROBERTSON.

I think that Mr. Hawthorn inferred from my remarks that I was speaking in a derogatory manner of schools for educating young men for engineers' certificates. I intended nothing of the sort. My contention was that, before they went to sea, young men should have acquired such a knowledge of engineering as to be able to pass the Board of Trade examinations without going to schools of instruction. Those who take advantage of these schools to enable them to pass the examinations for engineers' certificates have neglected the opportunities which they had within their reach when they served their apprenticeship.

Mr. C. WARD : I am a young engineer and I have come here to-night on the invitation of Mr. Hawthorn. May I be allowed to speak ?

THE CHAIRMAN : Certainly.

Mr. WARD.

(*Visitor.*)

I claim to be a sea-going engineer and served the last twelve months as chief, and I desire to say that if I had to take an engineer to sea I would infinitely prefer the thinking man—the scholar. I claim that an engineer is born, not made. Ten or twenty years' experience will not make an engineer. The knowledge comes by intuition to the true engineer. One of the gentlemen who have spoken said that an engineer should pick up his education without going to a school of instruction. Every man knows most about himself, and speaking for myself I may say that before I went to sea I passed in honours in geometry and took eight science certificates. I served six years in a workshop, but when I got into an engine-room at sea I was lost. The vacuum was lost but I did not know the reason. Had I not gone to one of these schools before going up for my second's certificate I should most certainly have failed, because the Board of Trade examination is not an engineering examination. I now hold an extra chief's certificate, but I consider that the examinations altogether want revising. In my opinion a theoretical training is a most important training for an engineer. The chief engineer of a ship is supposed to look specially after the coal consumption, which is a matter where any saving effected benefits the employer most, and I contend that a man can best reduce or economise the consumption of coal, if in addition to his practical knowledge he has also acquired a knowledge of those other subjects indicated by Mr. Hawthorn. I would also point out that, while condemning the present system of examination, Mr. Hawthorn has suggested an alternative plan. The object of the paper, I apprehend, is to point out the objections to the present system and to elicit the opinions of the Members as to the system that should take its place, and the discussion should be more particularly addressed to those points. I am certainly with those who think some alteration needed, and at present, in my opinion, foreign engineers are much more advanced than British engineers in some respects.

Mr. H. C. WILSON.

(*Member.*)

I have listened with great pleasure and interest to the able paper read by Mr. Sage, and also to the discussion which has followed. If I may be permitted, I should like to say a few words as a young engineer. I may state that I hold a certificate and discharges as chief engineer in over

100 horse-power foreign trade steamers. In my opinion an apprentice should serve not less than five years in a shop on the making or repairing of engines. I say five years, because I do not think it possible, however smart a young man may be, that he will be fit to go to sea and do the work there necessary—perhaps in a gale of wind at the very outset—with less than five years experience. Of course, I know that an ordinary young man who takes an interest and pride in his work can turn himself out as a very decent fitter, &c., in less time than five years. I say himself, because it is unfortunately the exception and not the rule, that our apprentice is systematically taught the practical part of his trade. If I were going to serve my apprenticeship over again, I should do so in a good repairing shop in preference to a big firm, where the division of labour is so great that there are many things which the apprentice has no opportunity of seeing done, much less doing himself. Under the present system I am in favour of a five years minimum apprenticeship, and I am convinced that it would be to the advantage of engineering firms to employ a properly qualified instructor for the apprentices, the saving in gear and material alone, that are damaged and spoiled through the ignorance and inexperience of young apprentices not being taught, would, I am sure, cover the extra expense. With regard to the sea service of the apprentice just out of his time, I am quite in accordance with Mr. Sage, and think that the time has arrived for the Board of Trade to amend some of the regulations relating to sea-going engineers. It was suggested as long ago as last March by Mr. Hawthorn that there was a great necessity for another grade of certificate, and I believe it was then stated by the chief examiner for the Board of Trade that any alteration in this respect must come from Parliament. Now, in my humble opinion, the question of the education of young engineers hinges upon this. I have carefully listened to the various speakers upon this subject, and as far as I can learn, there is not one but who is in favour of a third certificate. To come to the point and not to waste time, it appears to me that it is the duty of this Institute, composed as it is of thoroughly practical sea-going engineers, to come to some agreement as to the position or status that our apprentice takes up when he first goes to sea. That he should be deemed competent to take charge of two boilers and a big pair of engines, even after some "coaching" by his superior officers, is I think decidedly wrong. No matter what has been the duration of his apprenticeship or his opportunities of gaining practical knowledge, I do not think

that that man is qualified to take charge of a watch. I know it is done, I know that I did it myself, but I do not think it is right all the same. That he should be an assistant engineer appears to me to be the most practical way out of the present state of affairs. My remarks are intended to apply more particularly to the "tramp" steamer of large power, with two or more boilers and only three engineers, two only of whom hold certificates. I know that in large lines the juniors are put on watch with a certificated man who is responsible. I think if our assistant engineer served twelve months at sea in this capacity he should be eligible for a third-class certificate, and this certificate should be the result of an examination that proves him capable of working and regulating the feeds of two or more boilers, and in the handling of marine engines, as principal points. The details of the whole examination it would be presumption on my part to lay down. I have very little doubt that if this matter were to be put in a thoroughly practical form, together with the opinion of the Institute that a third grade certificate was necessary, and submitted through the proper channel and in a proper way, to the proper authorities, that it would be listened to; and seeing that but recently the old 1854 minimum scale for the feeding of seamen has been improved and amended, it points to a like suceess attending our efforts for the better education of young engineers and the recognising at its true worth the Board of Trade certificate. I hope that we as a body may come to a practical conclusion. Reports of these proceedings will shortly be sent to the ends of the world, and I am sure the eyes of marine engineers are upon this Institute from every quarter of the globe, as I observe our membership embraces this area.

THE CHAIRMAN.

I think that this Institute has a great and a noble work before it in helping engineers all over the world to the view of what a marine engineer ought to be, and, in my opinion, it has done good work in that respect already. If this Institute and the Members do their duty, we shall not hear remarks such as have been made to-night as to the discipline or the want of it in some engine-rooms; and I hope the time will come when it will not be possible for such remarks to be passed with regard to any one who calls himself an engineer. Mr. Hawthorn's definition of the word "engineer" reminds me of an article I read in a magazine lately, where a writer endeavoured to show that a man who made use of a machine or instrument was an engineer. He argued that because a captain worked a compass, and the

compass was an instrument or an engine, the captain was an engineer. There are very many ideas abroad as to what an engineer really is ; but to put forth such arguments as the one I have referred to, even facetiously, is showing an argument to the limit, *reductio ad absurdum*, otherwise the manipulator of mechanical toys, or the youngster who winds his own or his uncle's watch, may pose as an engineer, while those who carry timekeepers, which may be wound by the hour, might claim to rank as first-class engineers and mechanics.

Mr. A. W. ROBERTSON.

In my opinion, it cannot be too strongly impressed upon young sea-going engineers that as they rise in their profession, all force or violence in the treatment of firemen should be avoided. Nothing approaching that will ever raise engineers in the estimation of their firemen or subordinates, or maintain discipline. You must be firm and decided, but never allow yourselves by any force or pressure to compel a fireman to go down into the stoke-hole. If a chief engineer would command the respect of his firemen, and the respect of his captain and officers, he must respect himself. With regard to the cleaning of the bilge boxes, no one will contend for a moment that that is a primary duty of the engineer. At the same time the engineer is the responsible official in the engine room, and when the bilge pumps have given way and the water is rising very fast, he has to take off his coat and show the way. I, like Mr. Hawthorn, underwent a severe training in my younger days, but I think it a very good thing for some of our young engineers to have a baptism of bilge water.

Mr. MITCHELL : Every practical engineer who goes to sea should go into the bilges, because he ought to be able to feel, when he directs a man to clean out the bilges, that he has been there himself and knows what the work is.

Mr. ANDERSON : I was baptized in the bilges. But if I had a serious job to do in the bilges I would not send a fireman to do it, because I should not consider that he would know what to do. I would sooner send an engineer or go myself.

After some conversation it was arranged that the discussion should be adjourned until Monday, February 6th, Mr. Sage undertaking that he would then be prepared with his reply on the discussion, so far as it had proceeded.

Adjourned Discussion

AT

58, ROMFORD ROAD, STRATFORD,

On Monday, February 6th, 1893,

ON

"The Training of Young Marine Engineers."

THE CHAIRMAN.

(*The Honorary Secretary.*)

We have met to-night to continue the discussion on "The Training of Young Marine Engineers." As arranged at our last meeting, Mr. Sage is now prepared to give his reply to the discussions which took place at the two previous meetings. I will therefore call upon him to read his reply and remarks preparatory to a further discussion.

Mr. S. C. SAGE.

With regard to the remarks of Mr. Patterson read by the the Chairman, I find that practically he agrees with me as to the necessity of practical efficiency being a desired factor for young marine engineers, but I fear his requirements for the third-class candidate are too high, and under the general conditions which prevail *now* in the system of teaching apprentices their trade, he would, I think, have to travel far to find a shop where facilities are given for the apprentice to learn fitting, turning, pattern making, drawing, blacksmithing, and boilermaking.

The theoretical and educational requirements also are, in my opinion, too high for the third-class grade, and are as much as are required for the second class. I entirely agree that the marine engineer must be able and willing to wrestle with the bilges, expand tubes, &c., as required, but we must remember that we are not all admirable Crichtons, and it was with the view of our young friends learning their business as sea-going engineers that in my paper I suggested that two years should be spent at sea before the proposed third class certificate should be granted (after passing the examination).

Mr. Hawthorn has made many remarks in the course of this discussion, most of which are strictly to the point and shew in a very clear manner the means by which our young engineers could be benefited. He also has made remarks which, in my opinion, are uncalled for and unjustifiable, the most serious of which, as he has withdrawn them, I will not now comment upon. One remark of Mr. Hawthorn, relative to the lax discipline so often maintained in many engine-rooms being the fault of the chief engineers, I cannot agree with. In my opinion the fault is not universally theirs, indeed I may say it is very rarely so, and this lax discipline generally is caused by the insufficient powers placed in the engineer's hands and aggravated by the objectionable way in which the system of engaging and discharging the firemen is performed, and the manner in which the G marks are placed upon the discharge notes, in many instances owing to the engineers not being asked if a man's character for ability or conduct was good, bad, or indifferent; unless the man comes under the deck officers' notice through some offence against them, he may behave as indifferently and insolently in the engine-room as he likes, and carry off a V G discharge at the end of the vogage to repeat the tactics in his next ship with probably a like result.

Mr. Hawthorn asks what percentage of the chief engineers forty years of age could erect a pair of engines in a vessel or set the safety-valves of a pair of boilers to the proper working pressure from the build of the boilers, that is, I presume, the thickness of the plating, pitch of stays, &c., according to the diameter and length of the boilers.

On behalf of myself and brother engineers who come under the category named, I say emphatically yes, there are more than he reckons still amongst us who are capable of doing all that Mr. Hawthorn asks, and more.

Before leaving this subject, I may say that it would take a lot more theory to teach a man to erect a pair of engines in a ship than could be learnt in a school or college, and

that, while I agree that theory is indispensable to our profession, I cannot agree with Mr. Hawthorn's 50 per cent. theory and 50 per cent. practice. I agree with Mr. Wing when he says he would prefer the practical man as his mate in a gale of wind at sea, and would not give much for Mr. Hawthorn's man, who, by his own words, only requires to be half a mechanic and half a theorist. For myself, I would prefer as a colleague a man who was proficient in both branches, *i.e.*, 100 per cent. practice and 100 per cent. theory, which denotes that he is fully up in each.

I am sorry that the men with whom he comes in contact have given him such an opinion of our cloth, but think, as he is looking at it from one standpoint only, he, perhaps, has some reason for his statement and has advisedly put the age at forty to exclude those coming under his hands. He probably has more experience of the capabilities of younger men and possibly may have meant to say under forty, which would be nearer the mark I fancy. As stated in my paper, I am against the young engineers passing so soon as they generally do. They have no chance then to acquire all the details of their profession, of which the operations mentioned by Mr. Hawthorn are important items.

Mr. Hawthorn's remarks generally are obviously intended to raise the status of our trade, and remind me very much of the old fable that "there is nothing like leather."

On the remarks of Mr. Adamson I will not comment save to say that I heartily agree with him that education, either scientific or practical, should not be acquired for gain alone, but equally for the pleasure it brings its possessor. I am glad that he agrees with me that it is *possible for some* to learn the hand skill of their trade in three years; but as these would be exceptional cases, he agrees with me also that not less than *five* years is the proper term.

Mr. Nicoll, Mr. Brett and others are of the opinion that seven years should be served as an apprenticeship, and I am with them so far as the circumstances of the present day will allow, but, in my opinion, they will not allow of it. In the old days (when steamships were fewer and the demand for sea-going engineers not so great), a boy was usually put to his trade at fourteen years of age, and the seven years' term brought him to maturity; but now the boys are kept at school until they are fifteen or even sixteen years old, and it would be an impossible feat to preserve the seven years' apprenceship in this case, as the contract could not be maintained after the apprentice reached manhood without a supplemental agreement, and even then it would be a singular thing to see apprentices of twenty-two and twenty-three years of age.

Mr. Brett's proposition that, after serving five years, there should be two years' work as a journeyman, is, in my opinion, a very excellent one, as it is during those two years that he could, if so minded, acquire the theoretical part of his profession, as indicated.

I agree with Mr. Thomson that there are not sufficient facilities placed in the way of apprentices of the present day to acquire the hand skill necessary for a good workman ; but the two years' work as a journeyman proposed, would overcome this, provided, of course, that the man was sufficiently a workman to obtain and retain a berth as a journeyman.

The alternative would be a term of one or two years in a good marine shop as an improver

Mr. Anderson, in stating that Mr. Hawthorn was asking for too high a grade (I presume he means for the first certificate), is in accord with my own sentiments on the matter.

Mr. A. W. Robertson agrees with me as to the duration of a boy's scholastic education before being placed in the shops, and his remarks about the time in the drawing office are very much to the point ; but as to part of my paper appearing to savour of trade unionism, took me entirely by surprise, for I never have been and certainly do not now intend to be a member of any trades union. I can only say, that in spite of the remarks, I adhere to the sentiments expressed in the paper, that in my opinion it is not just to our profession and the members of it who are certificated as marine engineers, that so large a number of ships are allowed to go to sea without a certificated man in charge of the engines and boilers

We are all aware that the possession of a Board of Trade certificate does not make a man any the better engineer than he was before, but it is a proof that he has, at least, fulfilled the conditions prescribed, and has, at least, worked in a shop and been to sea as an engineer ; whereas under the present regulations these conditions are not necessary, and it is left to the owners to invest a ploughman, if they think fit, with the position of chief engineer. I am aware that there are many very worthy and capable men who, from some circumstance or another, are at the present day without certificates, and to these men, if beyond the age of 40, I would grant certificates of service available for the home and coasting trades, upon a verbal examination as to their knowledge of their duties, satisfactory proofs of their practical ability and conduct as at present are required, being also given.

The men whom Mr Robertson lauds as being "far better able to act in an emergency when it arose than many of our

much vaunted engineers, holding first-class certificates," are not the men that I complain about, but those who are not engineers, in any sense, who from a variety of circumstances creep into the trade and, in many instances, I am sure lower its tone and cause remarks to be made about us, such as have been heard, I am sorry to say, even in this Institute during the course of this discussion.

During my earliest sea-going experience, I have been shipmates with such men as are described by Mr. Robertson, and I am not too proud to say that I learnt much from them. They had been through a long and sometimes very painful training, and were, no doubt, fully qualified for the duties that were then demanded of them, and the kind of machinery under their charge. To their credit, be it said, that they did their duty manfully, very often under difficult conditions—conditions which the young engineer of to-day has no conception of and probably could not or would not tackle, but I say, that the conditions of marine engineering of to-day are vastly different, and the engineers of the old style (if indeed many of them now survive) would be the first to say "we are not in it."

I would not myself let imperfect education bar the way to any good practical man obtaining a certificate, and as the School Board has now been instituted for some years, there is no excuse for a man of middle age remaining uneducated to the extent of not being able, at least (with a little cramming) to pass the examination for second class.

Engineers of tug boats are necessarily a class by themselves, as the exigencies of the occupation of the boats render the posts distasteful to those who have been used to regular sea-going vessels.

Tug boats, therefore, are not coveted very much by the members of our trade, but there are many ships of large tonnage and horse-power where the engineer of one of these said tugs could sign on as chief.

It seems to me that an impression exists in this meeting that I am in favour of three years' apprenticeship, but this is as much an error as that I am a trades' unionist. I advocate in my paper that a boy should be bound at fifteen for five years.

At the completion of that time he should serve one year as improver in a marine shop and then go to sea for a further term, not having charge of a watch before he can pass as one who is certified as being able to take charge of one. This term would bring his probation beyond the requirements of Mr. Nicoll, and would bring him to the age of twenty-four before he could pose as second engineer, and I

maintain that, seeing the pitch to which marine engineering has arrived, it is not too much to ask.

Under the existing conditions what do we see? A young man completes his time at twenty-one—possibly before, and rushes away to sea, and it is a frequent occurrence, I believe, for young men to present themselves for examination (with their full twelve months' sea service completed) at and about the age of twenty-one, and before they are twenty-three go up for first class.

In my opinion this should not be. What chance has this young man had of obtaining experience of his profession? One shop, one or two ships, and there you are! He may be an excellent scholar, indeed he frequently is, but his knowledge of the practical part of his business is bounded by his experience, and that cannot be very large.

It is this class of men, perhaps, who have caused the remarks made at our last meeting to which I have already referred; and I do not blame the men so much as the system, and I think the efforts of us all should be directed to an endeavour to obtain an alteration in this system.

I am very well pleased that there seems to be a general opinion that the present regulations of the Board of Trade with respect to the number, grade, &c., of the engineers carried by the mercantile marine of Great Britain should be amended; and I trust I am not too old to live to see the day when it will be impossible for a ship to sail from London—with a valuable cargo and passengers, too, if any could be got, with a boiler carrying 100 lbs. of steam—for the port of Bristol with a complement of three men all told in the engine-room, viz., chief engineer, second engineer, and one fireman, the second engineer firing his own watch. This Institute is not a trade union, nor are its functions in any way approaching those of a trade union; but its aim is to elevate the engineering profession, and I sincerely hope that we as an Institute may be able to carry out those aims.

I will, with your permission, also read an extract from an article in the *Marine Engineer*, for February 1st, 1893, on an address delivered by Mr. J. R. Fothergill, at the distribution of prizes to the students at the West Hartlepool Government Science Classes. "From his own experience Mr. Fothergill states that in the present day it is most noticeable that the majority of artizans who join steamers as junior engineers have advanced far in technical education, but he fears that they are deficient in practical training. He considers that an intelligent education under the head of practice is equally important as that under the head of theory or science. Mr. Fothergill considers, which we fear is only

too true, that lads leaving school and entering, say, a large engineering works, instead of being systematically trained therein, are thrown very much on their own resources, or handed over to the tender mercy of some tyrannical charge-man in a restricted section of the works, the man directing his work not being interested in any way in the actual progress or disposition of the youth. Mr. Fothergill impresses this point earnestly upon owners and managers, and goes so far as to suggest that the lads 'going through' works should be under the supervision of a specially-trained and educated foreman, and subject to the supervision and personal recognition of the manager or owner himself. There is no doubt that this suggestion on the part of Mr. Fothergill is of the utmost importance to the proper training of young men of good education in works. There is necessarily so much tendency to the division of labour over the various details of engineering that there is great danger that a young man, hoping to be an engineer, may only, at the end of several years' practical experience in works, have come into practical contact with a single detail of the varied construction that goes to form marine equipment of sea-going steamers."

My attention has also been directed to another extract, which bears on the subject :—"Shipbuilder's views on the Apprentice Question" (from the *Steamship*, February, 1893). "Speaking on 10th January, in the Lecture Hall at Wallsend-on-Tyne, on the occasion of the annual banquet given by the firm of Messrs. C. S. Swan and Hunter, shipbuilders, to their foremen and official staff, Mr. G. B. Hunter, managing partner, said the apprentice question was at the present moment regarded as a burning question, but whatever turn events might take, the importance of the central point at issue could not be overlooked. It was of the highest importance that shipbuilders should do the most they could for their apprentices in the way of imparting to them a thorough knowledge of the practical as well as the theoretical sides of naval architecture. He was quite in touch with the hints thrown out by Mr. De Russet (chief of the designing staff), with reference to the desirability of teaching the apprentices. Such a scheme had in former years been turned to good account at their yards, and he was prepared to do more on the same lines in the future than had been done in the past. It would, he thought, in these days when so much depended on excellence of finish and stability in naval architecture, be of immense utility to employers and apprentices alike if the latter were instructed in drawing and calculations. With the view of advancing and putting into practice a scheme of the order named, he

was prepared to place at the disposal of the apprentices employed by the firm, a lecture room, and should they not fall in with the idea of spending their evenings in striving to acquire a professional knowledge of their business, he would in wet weather, when they were unable to work in the yards, give instructions to the designing staff that one of the chief draughtsmen give his time to the instruction of the lads."

THE CHAIRMAN.

I think we have all listened with great interest and pleasure to what has been read. These extracts show that not only we ourselves, but also others from different standpoints, have been considering this matter. There is a leading article in the *Steamship* this month (February) having special reference to the Board of Trade examinations as now conducted, and advocating a change in the system. I have received a good many written remarks from absent members to-night, but before reading them I think it would be well if we had some of the living voices. I propose, in order to concentrate our discussion as much as possible, and so as to gather up the threads of what has gone before, that we should as far as possible address ourselves to the various points that arise in the consideration of this subject. First, there is the preliminary education which boys should undergo before they begin to serve their apprenticeship, and before, perhaps, they have made up their minds as to whether they should adopt engineering as their business of life or not. After they have really made up their minds to be engineers, what form of education should be selected with a view to their future requirements? Then there is the apprenticeship, and the difficulties and dangers at present connected with the system. The extract which Mr. Sage read from the *Steamship* applies, I think, to engineers as well as shipbuilders. I daresay that many of us have come into contact with young men direct from the works who, perhaps, have done nothing but handle drills while they were serving their time. A lad really gets very little chipping or filing now, as compared with what used to be the case, owing to the multiplicity of machines. Then there is the technical education while the apprenticeship is going on. Then follows the education in the engine-room, and, I think, there is a responsibility resting on the chief engineer very much as it rests on the works manager, as mentioned by Mr. Sage. A remark made by Mr. Hawthorn when he spoke of a young junior engineer being threatened with dismissal because he wanted to see the inside of a valve box,

is an instance of what I have in my mind when I speak of the responsibility of the chief engineer. Then there is the question of a third engineer's certificate, and the majority of those who have taken part in the discussion seem to consider that it would be advisable to have a third grade certificate. Then there are tug boats, Mr. Robertson specially referred to last week. I think if we address ourselves to one or more of these several points we shall be most likely to arrive at a useful and practical result as the outcome of the discussion.

Mr. PILLANS SCARTH,

(Associate Member.)

During the discussion on this paper, I notice we have branched off on two points—namely, the training of young engineers and what are the best qualifications for a Marine Engineer. Mr. Sage's paper naturally leads us to this latter subject when he sketches the requirements of Holland and Germany; and I think we ought to satisfy ourselves first, what really is wanted in a marine engineer, before we point out the line of training to be observed in order to become one. That the examination a man has now to pass for a first-class certificate is not worthy of the occasion must be generally acknowledged; in fact one of our members (Mr. Robertson, I think) says that the engineer should not require to go to schools of instruction for his certificate, but should have all this worked up before he goes to sea. I agree with him that the junior engineer should have the knowledge at present required for a first-class certificate before he goes to sea. But is the certificate obtained after his several years at sea any indication of his experience and ability since going? Though I would not advocate such a severe examination as the Whitworth for a first-class engineer, still it ought to be an indication of the required amount of technical and mechanical ability wanted by a superintendent engineer in his chief, so that a man could be judged by his certificate and not by his appearance. Returning to the question of what is wanted by a marine engineer: Is it 99 per cent. mechanical and 1 per cent. technical, or 50 per cent. mechanical and 50 per cent. technical? This, I hold, is what the present debated qualifications of engineers hinge upon Let us put on one side the remarks upon cleaning bilge boxes, trimming coals and firing, as I consider that none of these subjects are either mechanical or technical. Any man without five or seven years apprenticeship can remove the covers and clean a bilge box or dive down and clear his strum. These matters, being the disagreeable

additions to the ordinary duties, can be generally attributed to the carefulness or carelessness of the engineer. I have been on a ship where I spent a considerable portion of my time in the bilges, and I have been twelve months on a ship where I never had occasion to go into the bilges in rough weather except at my periodical examinations. Now, given an engineer with good knowledge how to use and prepare his tools such as he can learn in the time specified for mechanical training, does he not want a good deal more than this to back him up as a marine engineer? He wants to reason out cause and effect; he wants to work out what is to be done in order to remedy defects safely. He wants to know if he can safely lift a thing with a certain gear, or if it is safe to risk it. In fact, many things that are done simply by experience and rule of thumb would be none the worse if they were backed by technical knowledge. To make my meaning clear I would refer to the case of the boiler explosion at Leigh, dealt with in *Engineering* of December 2nd, 1892, where a firm repairing a boiler had removed some of the bowling hoops and replaced them with plain iron bands. No fault could be found with the workmanship, but a little technical knowledge would have saved a disastrous explosion. If marine engineers are to go in for practice and leave out theory, then they will have to submit to another class rising above them and pointing out to them what they are to do. What shipowners demand of us is, to save expenses, and technical knowledge must be got to aid mechanical skill in this matter. Therefore, I say with Mr. Hawthorn, give us 50 per cent. of each. Mechanical skill is a great power to possess. Technical knowledge is a valuable director. Mr. Robertson (I think) says if engineering is not, as it were, born in the man he had better give it up. One of our great authors said if a man applies himself diligently for ten years to any subject he will obtain proficiency. What we want is proficient engineers, not born ones. I am afraid our large mercantile fleet would soon be short handed if we relied on the latter. I would suggest that this Institute might grant certificates to men who have satisfied a board of examiners of their ability by a more severe process, both practical and technical, than is at present required. Certificates thus obtained would soon have a high commercial value. As a means of arriving at the above position I would suggest the forming of a reading club under the care of a selected committee, which would in a short time be able to shape out what are the real points required by an average engineer in the mercantile marine. In conclusion, I would ask that some of our leading superintendents might give us

their views on this matter. We have heard some of the senior members, and it would be interesting to know on what grounds some gentlemen, who have daily to select engineers for their ships, make their selections.

Mr. J. WING.

(*Member.*)

I have listened very attentively to all that has been said at all the three meetings on this subject, and I still adhere to the opinion I commenced with. I like a good workman and I appreciate one. It is useless to send a young man to sea to learn engineering. With all due respect to Mr. Sage, I should like to ask him if the class of men who now go to sea from the workshop are equal to those who joined the merchant service as engineers 25 years ago?

Mr. SAGE: Not as workmen, possibly.

Mr. WING: And what is the reason? Because the mercantile marine is drifting in the same way as the navy. It really seems that when you compounded the engines you also compounded the engineers. You send young men to sea and if they get out of a ship nobody will employ them on shore.

A MEMBER: Why?

Mr. WING; They know nothing of work. Let every engineer serve a proper apprenticeship and, if possible, let him have a little experience as a journeyman. Let a young man be as good a scholar as you like, but above all let him be a good workman. One gentleman said that whenever there was a mishap it was always due to the fault of some illiterate man and was not caused by a scholar. I flatly deny that. There have been quite as many mistakes made by scholars as by the illiterate or ignorant; perhaps more. I remember that at the time when I was out of my apprenticeship I was eligible to go as an engineer in the navy. I would not be to-day.

THE CHAIRMAN.

I am afraid Mr. Wing takes a very pessimistic view of matters. There is no doubt, however, that from the causes which have been referred to, the apprentices do not come to our hands as they did formerly. This is mainly due to the fact that machines are now so largely used in workshops, and the apprentices do not get the handling of the tools to the extent they used to get 20 or 25 years ago. I think our present condition is probably largely due to that. But still,

speaking from my own personal experience, I have had several first-rate workmen among the junior engineers who have presented themselves for employment during the last few years, showing the aptness of some of Mr. Robertson's remarks. There is no doubt that many come who are not up to the mark, and owing possibly to the causes that were referred to at last meeting, some of them would never become of much use as engineers, and I am afraid even in the ten years noted by Mr. Scarth twice over they would still be far short of the requirements. But I can testify that I have seen some first-rate workers among our junior engineers lately, and I should be sorry to think that engineers as a class are going back as workmen. With regard to the navy, there are many points behind the scenes that we are not fully aware of, and there is risk of trouble being caused by business being discussed by those who can only see the fringe of the subject, thus basing conclusions upon a superficial knowledge of the circumstances; and my impression is that we may do wrong by venturing to express opinions as to the engineers of the navy and their qualifications. I have the privilege of knowing a few of them personally, and from that knowledge I can say that they are not above their work as engineers, in the sense that an engineer who thought more of his dress and position than his duties and knowledge of, and attention to, details might be said to be above his work, *i.e.*, self-conceited.

Mr. WING: At a dinner of a foremen's association last spring Lord George Hamilton, who was one of the guests, said: "I should like to press gang the whole lot of you." Of course they would like the engineers of the mercantile marine to be got into the navy. Another thing I should like to say with regard to the training of young engineers is, that I would recommend a young fellow to go to sea in a small ship first, where he would have the opportunity of handling everything in detail right throughout. In a large vessel there are not the same opportunities for learning as in a small boat.

Mr. J. H. THOMSON.

(Member of Council.)

With the view of bringing matters to a head, I think it would be well to ascertain the feeling of the members present with reference to the granting of a third-class certificate. Are we in favour of it or not? If we are in favour of it, what should be the qualifications and what the subjects of examination? Would it be advisable to test the

knowledge or ability of the candidate in the handling of tools. The Board of Trade might have a little shop and give each candidate some work to perform. But the first question is, would it be advisable to recommend a third-class certificate. Let us take a vote on that point.

THE CHAIRMAN.

I will put this to the meeting for a show of hands on the subject.

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It appears you are unanimous in favour of the establishment of a third-class certificate, and the further consideration of the subject may be left with the Council.

Mr. J. H. THOMSON : And now what are the qualifications which should be required for that certificate ?

Mr. F. W. SHOREY.

(*Member of Council.*)

He should have served at least five years in a marine workshop and one year at sea, and if he also bears a good character he should be eligible to go up for the examination for this third-class certificate. It would be a very difficult matter to find out whether a man was a practical man or not. How are you going to test him in a shop in those things which would have to be done at sea ? If he shows five years service in a marine shop and one year at sea, he should, I think, be eligible to present himself for examination.

The CHAIRMAN : You say " in a marine shop." Do you exclude service in a locomotive shop ?

Mr. SHOREY : I do.

Mr. WING : The law does not say that now. The law does not exclude service in a locomotive shop as a qualification for a second engineer. A mechanic is a mechanic.

Mr. SHOREY : Well, I will omit the word " marine." My proposal may stand to mean that service in a locomotive workshop, or even in an agricultural machine shop, shall qualify.

Mr. GREER.

(*Member.*)

Mr. Sage says that the possession of a certificate is a guarantee that a man has worked in a shop. I know of many men who hold certificates who never worked in a shop. At present there is no guarantee that the holder of a certificate has worked in a shop.

Mr. SAGE : I think service in a stoke-hold is not now accepted as service at sea.

Mr. GREER : No, the qualification is three years in a shop or four years at sea.

Mr. SHOREY : I think three years' service in a workshop not enough ; but five years, if a man has any brains at all, should be sufficient. Taking the ordinary man, with a rightly-constituted mind, who goes in for the trade in a proper way, if he serves five years in a shop and one year at sea, he should be eligible to go up for a third-class engineer's certificate.

The CHAIRMAN : Will you say that a certain portion of that five years should be served in a marine workshop ?

Mr. SHOREY : I think not. Where the difficulty arises is, I think, having engineers with a certain grade of certificate to take a boat under a certain power. Now, a pair of boilers in a small boat in unskilled hands is just as dangerous as a pair in a large boat in unskilled hands. I know of many steamers now going to sea—some of them triple-expansion jobs—without a certificated engineer on board.

MR. MELSOM.

(Member.)

I support Mr. Nicoll's idea of five years' service in a shop and two years as a journeyman. There should be seven years' service in a workshop before a young man is allowed to go to sea, and one year at sea after that should qualify him for examination for a third engineer's certificate. I do not believe in Mr. Sage's remarks about service certificates. We cannot do anything with regard to the schooling of boys, but managers and owners of ships should be approached and urged to give apprentices every chance. They have more chances now of going to evening classes during their apprenticeship ; and with regard to the best class of shop for the purpose, my opinion is that for preparing a lad for the sea service a locomotive shop is even better than a marine shop. The work is much neater in a locomotive shop, and you get to learn your tools better. I speak from experience. I served my time in a locomotive shop and went to a marine shop afterwards.

Mr. J. H. THOMSON : I think if you are going to have a third-class certificate you are seeking to put the standard a little bit too high.

A MEMBER : Higher than is at present prescribed for a second engineer's certificate.

Mr. THOMSON : The third certificate should work young men progressively up the ladder. The standard you talk about is too high—seven years in a factory before a man goes to sea. You would not get shipowners to go in for that. I should say, make the standard somewhat similar to that at present laid down for a second-class certificate.

Mr. SAGE : If we are to approach the Board of Trade with a view to establish a third-class certificate, we cannot attempt to impose rules that are more stringent than those at present in force for a second engineer. It is plenty strong enough to go for qualifications as high as those now required for a second engineer. To ask for what Mr. Shorey proposes would be attempting too much. We cannot revolutionize the whole thing at once, but we should in effect be seeking to revolutionize matters if we passed Mr. Shorey's proposition. A three years' apprenticeship, we all admit, is not enough generally, but it is all that the rules of the Board of Trade at present requires for a second engineer, and we should have everybody against us if we proposed a greater qualification for a third engineer. Let us accept the requirements of the present rules as the starting-point, and let us increase the qualifications for the higher grades as much as we can. We must be moderate if we expect to get any alteration from such a body as the Board of Trade.

Mr. SHOREY : The requirements are very different from what they were when the present rules were framed. A ship is now a mass of machinery. We want a better class of men than formerly, and it should be the object of this Institute to raise the standard. Let this third engineer serve an apprenticeship in the shop of at least five years. If we are going to let the third engineer walk through with an easy examination, he would be no better than before he qualified himself.

Mr. WING : I would suggest, adopt as the qualification for the third engineer the present requirements for a second engineer, and then raise the qualification for a second-class certificate.

THE CHAIRMAN.

Any expression of opinion on the part of this meeting will naturally come before the Council, and probably before a special committee, which would take care that the wisdom of the Board of Trade was not impugned in anything that we sent to them. Any resolution passed will be merely an expression of opinion from this meeting, and even if it goes beyond the mark it will be toned down afterwards, so that we do not clash with the regulations in force for the time being.

Mr. A. W. ANDERSON.

(*Member.*)

I have listened with great pleasure to Mr. Sage's remarks and I think he has answered the various speakers very satisfactorily. But, I think, there was a slight mistake when he was speaking about a three years' apprenticeship. I recommended five years service in a shop and one at sea. Mr. Wing has referred to the Royal Navy. I have had a little experience with regard to that matter. I have a brother who was twenty-five years in the navy and ten years out of it. He has been retired ten years. Most of the engineers in the navy now are figure heads. I know that the artificers in the navy are the men who do the work, and they can teach the engineers who have charge of them. The whole misfortune has been that they joined as artificers, and cannot rise to be engineers afterwards. They are men who have served their time in the workshop, and they are good scholars also. I know several of them very well. To come back to the question more immediately before the meeting, I know that when I passed for a second engineer's certificate I had learned all that I wanted theoretically, in a school before I went to sea. I do not object to young engineers getting all the theoretical knowledge that they want, but I believe in getting the practical knowledge. There are plenty of science and art classes where they can get all the theoretical knowledge they want, but I would not allow them to serve less than five years in a workshop, and I think you should keep them at school until they are over 14 or 15 years of age. I went to sea with a man who is now one of the head officials of the Board of Trade on the north-east coast, and I had with him two of the hardest voyages which I ever experienced during twenty-four years at sea. I was thirty hours in the engine-room without getting to my berth. In fact, I think, I have had as much sea-going as any gentleman present. I think myself that a good many of the questions that are put to some engineers when they go up for their certificates are quite foreign to the subject. They relate to matters that are of no earthly use to the men afterwards. I would rather that the Board of Trade put a few more practical questions and less of these conundrums.

Mr. NICOLL : Mr. Wing said that there were much better workmen going to sea twenty-five years ago than there are now. How long an apprenticeship did they serve twenty-five years ago ?

Mr. WING : Seven years was the general run.

Mr. NICOLL : And so it should be now.

Mr. ANDERSON : A seven years' service is more necessary now than formerly.

Mr. MELSOM : I agree that seven years ought to be the minimum.

Mr. R. LESLIE.

(*Honorary Treasurer.*)

I believe that there is now a necessity for youngsters to serve a longer apprenticeship than they did some years ago. With regard to a good many of our junior engineers going to sea now, I think that if they were called upon to use the chisel they would be in a great fog, and if a breakdown occurred I do not know what would happen if there were only men on board of that class. I think they ought to serve at least six years altogether before going up to pass their examination, which should be practical as well as theoretical. There are plenty of shops where the Board of Trade could try them. No doubt the Thames Iron Works, Limited, for instance, would be only too pleased to afford facilities for the purpose. I have known youngsters who could not weld two pieces of iron together to save their lives. But that was part of what I had to learn when I served my apprenticeship. I also dressed my own chisels and all that kind of work. I certainly hold that theory is a very nice thing and goes well with the other, but practical learning is an absolute necessity. I do not agree with the present rules of the Board of Trade. I think the system of examination a long way behind the times. I do not believe in that rule which allows four years service at sea to count as a qualification for a second engineer's certificate. All engineers applying for this third-class certificate should have served their apprenticeship in an engineering shop. There ought to be no back door by which a man can get in by serving four years at sea. Unless youngsters have a practical training they are absolutely useless. They may be able to talk well, but without practical training they are nowhere, and I would certainly be one in favour of laying this matter before the Board of Trade. If the case was put properly before them, I believe the Board of Trade would see it in the same light as we do. We have got to such high pressures now, and have to deal with machinery of so many different kinds, that a man must be something more than a marine engineer. He must also be pretty well up in hydraulics, electricity, refrigerating ; he must practically know the whole lot. I should certainly be very much in favour of

placing the whole matter before the Board of Trade and ask them to put the candidates for this third-class certificate under a practical examination. Let them take the apprentices to some place and ask them to do, say, six different pieces of work. We get a good many young fellows now-a-days who, I am sorry to say, are very deficient in their practical training.

Mr. WING : Allusion has been made in the discussion to service certificates which were established to meet a special condition of circumstances. When these rules for Board of Trade examinations were introduced, the question arose as to what should be done with regard to all those men that were then going to sea as engineers. If an examination had been insisted upon in every case, hundreds of these men would have been thrown out of work, and service certificates were introduced to meet the case. But the times are different now, and all men intending to go to sea should be called upon to prove themselves competent by undergoing an examination.

Mr. SHOREY: I move that we approach the Board of Trade in proper manner and suggest or recommend that, after an engineer has served at least five years in a shop, and also one year at sea in a boat of any power, he should be eligible to pass an examination for a third-class certificate.

Mr. SAGE : I do not disagree with anything Mr. Shorey has said as to what should be the requirements for a third-class certificate ; but I think we should consider what is practicable, not what we desire. The present rules as to service and other qualifications for engineers' certificates were framed many years ago, and the time has probably come when they should be amended ; but we cannot endeavour to insist that the requirements for this lower grade certificate should be of greater stringency than those for a superior class of certificate. If we want to see a third-class certificate established, we must not impose more stringent rules, especially as to shop service, than those which at present apply with regard to second-class certificates. We cannot, with any hope of getting our desires granted, ask the Board of Trade to stipulate that there shall be five years' shop service for a third-grade certificate when the present rules for a second-class certificate require only three years' service in a workshop. I do not dispute the desirability of what you are asking ; but the question is not what we should like but what is practicable. It is useless asking for that which we know we shall not get.

THE CHAIRMAN.

As I understand Mr. Shorey, he proposes : That it be urged on the attention of the Board of Trade that all candidates for a third grade engineer's certificate shall be required to have served five years in an engineering shop and one year at sea.

Mr. SHOREY : And also pass the prescribed examination.

Mr. WING : I do not think you will find any opposition from the Board of Trade.

A MEMBER : Make it three years' shop service for a third engineer and five years for a second-class certificate.

Mr. SAGE : How would you work it ? After a man has served three years in a shop and one year at sea and got his third-class certificate, is he to go back to the shop for another two years to qualify for the second-class certificate ?

Mr. LESLIE : When we apply for the establishment of a third-class certificate it ought to be stated that, in our opinion, the qualification should include five years shop service and nothing less than that. Let the examination for a second engineer be advanced a little, but in any case insist upon five years service in a shop as a first necessity.

THE CHAIRMAN.

Then would it not be as well to include in the motion an expression of opinion that the qualifications for a second engineer's certificate should also include at least five years shop service ? I would suggest that the motion read as follows :—

" That in the opinion of this meeting it is highly necessary to amend the present regulations as to the second-class certificate with regard to service in the workshop, where the minimum service should be five years, and that the attention of the Board of Trade should also be called to the necessity of creating a third grade engineer's certificate, which should be granted to those who have served at least five years in an engineering workshop and one year at sea, and pass the prescribed examination,"

Mr. SHOREY : I am quite prepared to accept this form of resolution.

Mr. LESLIE : I second it.

Mr. SHOREY : We should approach the Board of Trade and show them that the conditions were very different when the present rules were framed from what they are now. The standard of examination should now be higher.

* * * * *

The motion, as amended by the Chairman, was then put to the vote and carried *nem. con.*

Mr. J. H. THOMSON : That clause which allows four years at sea to qualify for a second engineer's certificate should be pointed out in the proposed memorial for consideration with a view to its deletion, as in my opinion it should be deleted.

Mr. WING : I second that.

Mr. H. C. WILSON.

(*Member.*)

With regard to the resolution just voted upon, the proposal may be construed that the shipowner shall provide another man in the engine-room and pay him. I am afraid you will find that the difficulty.

Mr. WING : Some owners or their managers would like to send ships to sea without engineers or anybody else. We can safely leave the matter as it stands, as the subject will come before the Council after it leaves this meeting, to be weighed in all its bearings.

THE CHAIRMAN.

There are many steamers which carry eight, ten and twelve engineers, and if the scheme which has been shadowed forth be carried out, it will give the juniors in these ships a chance of qualifying for this third-class certificate. In large companies young men may go to sea for years before they get a chance of going up for their second-class certificate, according to the present arrangement.

Mr. WARD.

(*Visitor.*)

If we attempt to enforce seven years' shop service as a qualification for this third-class certificate, I think we shall be going for too much, which in the result will probably kill our scheme. The shipowners will complain of the increased burden and the Board of Trade will not give it further consideration. How are we going to compete with the foreigner if you carry out all you propose ? These things may be all very desirable, but we must creep before we run. Let us put it, if you please, that in our opinion it is desirable for an engineer to serve five years in a shop, instead of three, before going up for his certificate, but do not let it be inferred that we wish to dictate to the Board of Trade. There appears to be a certain section here who, being very practical men seem to want to run down theoretical knowledge. I say that a practical man is better for being a theoretical man also, and the practical man who is also possessed of the theoretical knowledge is in a better position

than the man without the theoretical knowledge, to bring the engine down to its best economy. It is most desirable that every engineer should know what is the most economical speed for his ship to be driven at, but that is a thing which, owing to the lack of the necessary knowledge, a large percentage of engineers are unable to find out. The present regulations of the Board of Trade with regard to engineers' examinations and certificates are admitted to be inefficient. But I object to the idea that the theoretical man is of necessity the most unpractical man. The engineering required of the present sea-going engineer is not of a very high order, so far as the examinations he has to undergo are concerned, at least.

THE CHAIRMAN.

I think we are all agreed that a man is a better engineer if, besides being a practical man, he has also the theoretical knowledge, so that he may be able to apply his practical experience to the best advantage.

Mr. WING : Put the practical man first.

THE CHAIRMAN.

With reference to further discussion, as it is now time to conclude the present meeting, I would remind you of several communications which we have not yet had an opportunity of reading. Is it your wish that we should continue the discussion on another evening ?

Mr. SHOREY.

We ought to hear those communications. If gentlemen go to the trouble of writing out their remarks and sending them to us, I think the least we can do is to have them read. We ought to thresh the matter out.

THE CHAIRMAN.

It is a subject in which we are all interested, and there are several points which have hardly been taken up at all yet. The personal narrative should be kept out of the discussion as much as possible. There is another point which strikes me. We should not criticise too closely what is said, but rather what underlies it. I do not know if I make my meaning quite clear. The object of my remark is that we may avoid repetition, which is apt to be introduced if we discuss points of expression too much. I will now ask you to decide on the adjournment or the conclusion of the discussion by a show of hands. Mr. Shorey moves the adjournment. * * * I see the adjournment stands, so that we meet next Monday for a further consideration of this subject.

ADJOURNED DISCUSSION

AT

58, ROMFORD ROAD, STRATFORD,

On Monday, February 13th, 1893,

ON

"THE TRAINING OF YOUNG MARINE ENGINEERS."

THE CHAIRMAN.

(The Honorary Secretary.)

We hve met to-night to continue and probably to conclude the discussion on Mr. Sage's paper on "The Training of Young Marine Engineers." Perhaps before we resume the discussion, I may read the resolution that was passed at our last meeting. It is as follows :—

"That in the opinion of this meeting it is highly necessary to amend the present regulations as to the second-class certificate with regard to service in the workshop, where the minimum service should be five years, and that the attention of the Board of Trade should also be called to the necessity of creating a third-grade engineer's certificate, which should be granted to those who have served at least five years in an engineering shop and one year at sea, and passed the prescribed examination."

It was also considered desirable at our last meeting that we should, as much as possible, confine our remarks to the subject matter of the paper, and not fly off at tangents in detailing individual experiences. We should rather give the results of those experiences. If we keep that point before us to-night, I think we shall save a good deal of time, and perhaps come to some very desirable conclusions. There were several points specially pointed out last week. The first was as to the preliminary education of a boy before he really makes up his mind to be an engineer; secondly, there is the

special education of the lad in view of the trade to which he is to be brought up; thirdly, there is the apprenticeship in the workshop, the duty an apprentice owes to his master and the duty the master owes to the apprentice; then there is the sea experience, the duty that a junior engineer owes to his chief engineer and the duty of the chief to the junior; another point was, as to the men who had been advanced from firemen and greasers to take charge of tugs, trawlers and coasting boats.

Mr. J. H. THOMSON.

(*Member of Council.*)

The heads just mentioned have already been pretty well discussed, and I would propose to-night to include the question of the practical test which candidates for an engineer's certificate should be called upon to undergo. I have no doubt that at present the Board of Trade depend on the certificate they get from the firm to which the candidate was apprenticed. But in these days when so much machine work is done, I think it will be agreed that many junior engineers when they go to sea have not sufficient practical qualifications for the requirements of a sea-going engineer. What I would propose to-night is that, in addition to what we have already suggested, we should urge upon the Board of Trade the desirability of having some practical test of a young man's abilities in handling tools before he is allowed a certificate as a second or third engineer. With reference to trawlers and the like, I think as we are treating principally of sea-going engineers in the foreign trade, we may leave the trawlers and the tug boats out of the question in the meantime. One of the things which, in my opinion, ought to be pressed upon the attention of the Board of Trade is the necessity of having a test of the candidate's practical handicraft.

Mr. MELSOM.

(*Member.*)

With regard to apprentices, I will give you my own experience, and that will show pretty plainly that the usage of the present day might be improved. When I went into the trade I served my time in a locomotive shop without indentures. I served nearly the whole of my five years at one branch in the fitting shop. I was not allowed to go into the erecting shop, the smithy, or any other department. I afterwards spent two years as a journeyman and then went to sea. Now I think that employers ought to give their apprentices every chance, and I think they ought to be

approached in that matter. They should give their apprentices indentures, and on these indentures should be stated which branches the apprentices have been engaged in. That would give the Board of Trade an opportunity of knowing what a man had been doing, and I think that that point should be looked to first. When I went up for my second's certificate there was no proof whether I had served an apprenticeship or not.

Mr. THOMSON: Did you have no certificate from the railway company where you served your time?

Mr. MELSOM: No. I merely referred the Board of Trade to them. I think the apprentice should have a document to prove his service, and employers ought to give lads an opportunity of going through the different shops.

Mr. CHAPMAN.

(*Member.*)

I have not had the opportunity of being present at the previous discussion on this paper, but I have had something to do with this question of apprentices from time to time. One of the difficulties is to know, before he is bound apprentice, just what a lad will take to—what branch of the trade he will work best at. The fact is you have to see that they have some likelihood of ability in the general work, and then you have to bind them apprentice, if that is the practice, or take them without indentures, if that is the practice, and then turn them to whatever they are best adapted for. One man may be a good turner but no good at all at fitting, while another may be a good fitter and no good at turning. My own practice is to give them all as much chance as possible. As a rule, in taking apprentices, I state in the indentures that they are to be trained as fitters or turners, and as a rule they get both. When a lad gets both he is generally able to hold his own wherever he goes, and many lads who served their time with me are now holding good positions. The difficulty is to decide what the tendency of a lad is—at what branch of the trade he will do best. It is almost impossible for employers to take a lad and decide what he shall be before the lad himself shows what his tendencies are. It is really in the hands of the young men themselves to decide what they shall be. We know that many of them do not put their hearts into their work. If a young fellow puts his heart into his work and does the best he can there is hope of his making a bright man. But when a young man simply strives to get through the day as best he can and to get away as soon as possible,

there is not much hope for him whatever his tendencies may be. If the young fellows of the present day would only put their hearts into their work there would be very little difficulty about the training they would undergo.

Mr. F. W. SHOREY.

(Member of Council.)

Following up Mr. Melsom's suggestion that the employers should be approached in this matter, the question is, whether if we did so we should be likely to arrive at any good result. In these days of competition, an employer wants to get as much work out of a lad as he possibly can. He will consider what a lad is best adapted for. The lad may be a good screw cutter, and, if so, the employer will keep him at that job constantly. He would never do anything else. The employer would not care whether the apprentice was going to sea or not. With regard to indentures, employers are beginning to find out that it does not pay to bind boys. You get them and after they are bound they lose time and do just as they like. Whereas, if you take a boy into a shop in the ordinary way and use him for whatever he is best fitted, he pays an employer far better, and if he does not behave himself you can get rid of him. If the lad is attentive to his work the employer perhaps pushes him on, and that lad will often turn out a far better man than a bound apprentice. We have found from experience that the premium and bound apprentices are a great trouble. I think it would be much better if lads would follow out what was said at the last meeting. If they go into the trade at about sixteen they should have received a very fair amount of education and they should serve five years in a shop. Then let them get some lines from their foreman, signed by the manager or owner of the works, stating that they were very good at this, that, or the other. They should next serve twelve months at sea and afterwards go up for a third engineer's certificate. If we encourage lads to do that it will be much better than approaching employers. I am afraid we should not make much headway if we acted upon Mr. Melsom's suggestion.

Mr. MELSOM : Indentures binding the lad are good for both parties, and it is only a question of law to insure their being carried out.

Mr. CHAPMAN.

I may just state how I bind lads. My plan is to take them at fifteen years of age—not under fifteen—for five years and bind them. I give them certain wages, and in

addition, if they behave themselves, I give two shillings a week pocket-money. That pocket-money is payable at the option of the foreman. It commences when the apprenticeship commences and continues right on. If the foreman finds any great fault with the lad, he has his pocket-money stopped for a week or so. I have had once to stop a lad's pocket-money for a month. But they like their pocket-money, and I find that a very effectual way of dealing with them.

THE CHAIRMAN: Have you any system of probation for a time, Mr. Chapman?

Mr. CHAPMAN: I always have them a month before I bind them.

Mr. BURMINGHAM.

(*Graduate.*)

Even if a man goes through the fitting shop and the turning shop there is still much that he ought to know before he is qualified for a sea-going engineer, but which he has had no opportunity of learning. The question is, how is that practical difficulty to be got over?

Mr. MELSOM: The difficulty is got over by becoming what is called a gentleman apprentice. If you pay £500 you can go through the whole of it, and so it should be with the others. We had lots of them in the shop where I served my time.

Mr. SHOREY: We do not get many men at sea who paid £500 for their apprenticeship.

THE CHAIRMAN.

I think we all appreciate pretty well the difficulty that lies in the way of an apprentice who serves his time in a large shop, because there is so much machine work that a lad has very little chance of handling his tools at all. Those who have had a country training and served their time with a millwright get pretty well the all-round experience. Where I served my time, before I went into a marine shop, we had all kinds of work to do. We had not only to swing the hammer but also to fire the shop boiler. But these places are gradually dying out, and it is somewhat unfortunate. I have heard lately of two such places that were doing a very good business within fifty or sixty miles of London which have had to give way, being so hard pressed by the larger shops. That is very unfortunate for many young men who are serving their time in those shops, because there they had the advantage of an all-round experience much more so than in the larger shops. The trades

unions, too, press so closely upon each other's heels that it is very difficult for a young lad to go from one branch to another. These are matters that arise out of the discussion, but I apprehend that Mr. Sage's intention was, rather that we should consider what is the best way to train a young lad with a view to turning him out as an engineer, best adapted for going to sea—what shall be his training so that he shall be of the greatest service to his chief engineer? We came to the conclusion last Monday to approach the Board of Trade with a view to five years service in a workshop being rendered a necessary qualification, among others, for an engineer's certificate, and we also decided to urge upon the Board of Trade the desirability of establishing a third grade certificate. Those are two points that we have decided, but we are still a good deal at sea as to what the education and training of a marine engineer should be. How should a father set about training his son so as to make him a thorough engineer? With regard to the question raised by Mr. Melsom, indentures have been largely done away with all over the country. I think very few firms have indentured apprentices. It is, I believe, almost the universal practice now to dispense with indentures.

Mr. CHAPMAN: In the larger shops, but not in the smaller ones.

THE CHAIRMAN.

Of course it is quite open to be discussed whether indentured apprentices are not better than those who are not indentured. There is a good deal to be said on both sides of that question.

Mr. SAGE.

I think several Members expressed the opinion that a small shop is the best place for a boy to learn his trade, and I entirely agree with that opinion. The master receives a small premium with the boy, and, being in a small way, he endeavours to make that boy a source of profit by carefully teaching him his business. In the course of one or two years that boy becomes a fairly good workman, and is able to earn much money for his master because his wages are nominal. I have seen apprentices of this class who, if they have been properly trained, will in three years be equal in skill to any ordinary workman, and when put to it will do work that a fully paid workman has been doing. Although he may not do so much, he does it in as good a style. That is the reason the master teaches the boy, and that is the way I think it should be. A contract should be entered

into between the parents of the boy on the one side and the master on the other, and they should both carry out their contract. That, I think, is the system of indentured apprentices—for the master to teach the boy so that the boy becomes a source of profit to the master. I also believe that a small shop is the shop where a boy will learn the most, and where he stands the best chance of being put to the various branches. Perhaps a small shop may not keep a blacksmith, and then each man will have to dress his own tools himself. But in the large shops it is the universal experience that boys get into one department and are not allowed to move out of it. A boy becomes a very good hand in one branch, but he is all at sea in anything else.

Mr. SHOREY.

My experience is that it is the large shops which require indentured apprentices. In a big shop they have premium apprentices, because they can command good work. Most fathers, when they see a fine large shop, think "that is a first-rate place for my boy." I do not think with Mr. Sage that the little master tries to push the boy on. The little master tries to make the boy earn as much as possible. It is because of the fact that the jobs are so small and varied that the boy has a greater experience.

Mr. MELSOM.

I suggested some time ago that a lad intending to go to sea should serve five years as an apprentice and two years as a journeyman. That was not carried, but still if a lad wants to go to sea, his going for two years as a journeyman in a different shop from that in which he served his time will enable him to learn much more than he learned in his apprenticeship, and if the Board of Trade compel him to pass a practical examination, he would go about more, so as to get the information to enable him to pass that examination. With regard to the grinding of cocks, for instance, some men going to sea have an idea that in grinding a cock in, the more sand and water you use the better, whereas you should use as little sand as possible. They ought to be compelled to prove that they can work with their tools before they get their certificate, and they would find a means of obtaining the necessary information.

THE CHAIRMAN.

That is the point that Mr. Thomson advanced—that in addition to the present examination there should be a practical test, whatever that test may be. It is a point that

might very well be remitted to the Council along with the other resolutions.

Mr. MELSOM : I went to the Naval Dockyard at Devonport, and there we had all to pass a practical examination before we were taken on.

A MEMBER : What did you have to do ?

Mr. MELSOM : Mine was to face up a slide valve. Another had the touching up of a cock, and that I think would be a very good practical test.

Mr. NOBLE.

(*Member.*)

I have not heard the previous discussions on this subject, and therefore I do not know whether or not the point has been raised before, but I think that a great draw-back to young fellows serving their time is the system of overtime, which impairs their physical growth and retards their mental development. They should have time for attending science and art classes. With regard to this question of a practical test, there was a very good one laid down at Sheerness Dockyard when I served there. The first thing I got to do on applying for a job, was a cock, the gland and plug of which had to be fitted four ways. It was simply a test for accuracy of workmanship, but it was a difficult test. If you did not do that properly you would not be employed. Three days were allowed for the job, so that they gave you plenty of time. But, as I have said, the great draw-back to the young fellows of the present day is so much overtime and less opportunity for study.

Mr. THOMSON.

Before we come to any resolution, I think it would be well to have those papers read that the Chairman has before him, and then afterwards we can decide, if the meeting so determines, to approach the Board of Trade on the subject of a practical examination. I think we are all pretty well agreed that a young man should have the best possible education. With reference to overtime, a great deal of the overtime of young men of the present day seems to be spent on the football field.

Mr. SHOREY : They are both necessary.

Mr. THOMSON : Yes, they are both necessary, but you can overdo either.

THE CHAIRMAN.

The Institute of Marine Engineers has its annual dinner and conversazione, and I think recreation should not be discouraged. It is not good to be always grinding at the one mill. I propose now to read a few communications I have received on this subject.

Mr. T. W. FISH.

(*Vice-President.*)

The education and training of engineers is a very suitable subject for the Members of this Institue to discuss : and though its consideration may occasion many varying and conflicting expressions of opinion, these expressions coming from the lips of experienced and, in some instances, successful engineers, may prove of interest and value to persons charged with the education and training of embryo engineers.

The phenomenally successful engineer who has rapidly made his mark and his "pile," is not necessarily the most reliable authority on a question of this nature, but rather the reverse, for he is apt to be self-opinionated and overbearing in his views, which, being backed by all the irresistible force of recognised professional success and standing, are usually accepted as oracular and absolutely incontrovertible by persons interested in the best method of educating and training youths of engineering proclivities. Masters of technical schools and teachers of science generally are, in too many cases, not sufficiently practical in their ideas to impart instruction in a manner likely to prove of lasting benefit or real service to the majority of their pupils, whose attention is not given unreservedly, because they feel that the subjects taught are not invested with that practical value which they are supposed to possess. Boys and youths are not slow to discover any weakness or failing in the mode of imparting instruction, or the quality of that given by their teachers.

Assuming that it is the duty of the State to provide and equip institutes and schools of technical instruction in all engineering and manufacturing centres, their value to engineering students would perhaps best be assured by the course and quality of the instruction offered, being supervised by a local governing body or board of directors composed of men of light and leading in engineering and scientific circles, who, being in all respects thoroughly practical in their views and professionally interested in the efficiency of these institutions, would be fully alive to the grave responsibility of turning out youths furnished with knowledge calculated to aid them in their professional careers, and of a character likely to enable them to more than hold their own with foreign competitors anxious to wrest from this country her position of supremacy in the most important of all existing industries—that of engineering.

Dealing with the boy at school who is destined to become an engineer, it appears to me to be inadvisable to narrow down his subjects of study to those only which strictly bear on mathematical and mechanical science. It is unfair to deny him the solid lasting advantages of a sound general education (where such are available), for if he be made of the stuff likely to produce an engineer, his opportunities to acquire special knowledge will be found to be ample after his school days are ended. When he enters on his apprenticeship, then arises the necessity of applying himself seriously to the acquisition of special knowledge. Judicious encouragement and a little kindly interest extended to him by his employer will best serve to stimulate him in his effort in this direction.

It cannot be denied that it requires a very considerable effort on the part of the ordinary engine-fitter apprentice to take to study in his leisure hours, for he is usually required to commence work at 6 a.m. and remain at it until 5 p.m., and as one cannot reasonably expect to find "old heads on young shoulders," and, in too many instances, "youth will have its fling," he may incline to spend them in some form of recreation, which, in very exceptional cases, may mean a resolute effort at self-improvement. Once a youth or a man realizes his deficiencies and sets about their removal, he is on the right tack ; and in the case of the former, his future may be said to be assured.

Some employers contend that it is inadvisable to educate budding mechanics above the use of their tools, and that the present-day advantages—such as evening technical classes, which are attended by numbers of them—tend to distract their attention from the acquisition of purely mechanical skill, thereby making them less efficient and reliable craftsmen. This is a decidedly narrow, selfish opinion, also fallacious, for the person who profitably employs his spare time and embraces such opportunities for self-improvement as may come in his way, will gain in intelligence and general usefulness as a workman without, as may be reasonably inferred, detracting from his mechanical proficiency.

The energy and perseverance displayed by foreign competitors demand that our engineers should maintain their leading position by the exhibition of higher ability and resource ; and if the British artisan's education and training do not advance, how can we continue to compete successfully, much less demonstrate our superiority ?

The education and training of mechanics are not advanced, but rather the reverse, by the potent influences and far-reaching effects of the new trade-unionism, which

apparently, having other and less legitimate ends to serve than the conservation and promotion of its members, best interests, is unfortunately in a great measure responsible for the bitter relations presently existing between employees and employers. In the case of adult artisans—I only approach trade-unionism as affecting the education and training of mechanics—its effect has been to induce a dead level, regardless of individual merit and ability ; and by stifling laudable ambition in a man possessed of superior training and attainments, to render his life to some extent purposeless by extinguishing in him any desire for self-improvement. Employers are sometimes reproached for their lack of interest in the training of their apprentices. I am not disposed to admit the truth of this accusation, but for the sake of argument will assume that it is partially true. It must be borne in mind that apprentices are now rarely bound for a term of years, that there is now almost an entire absence of that old-time commendable loyalty on the part of an employee to his employer ; that even the apprentice, as he advances in years and usefulness to his instructor, is gradually falling under the tyrannous influence of trades-unionism, and that on the completion of his apprenticeship he is constrained to enrol himself a member of some union, and is then expected to join in any conflict which may ensue between that union and his employer. Under these untoward circumstances, it is greatly to the credit of many eminent firms that they evince a keen interest in the training and advancement of their apprentices. It will be said that they consult their own interests by carefully training apprentices and making efficient workmen of them, nevertheless, it is but due to them that their beneficent conduct in this respect should be at least acknowledged by the beneficiaries.

In order that a youth may undergo a thorough and comprehensive training during his engineering apprenticeship, his theoretical knowledge should steadily grow and keep pace with his acquisition of practical ability. I consider the course adopted by a few firms in dealing with a certain class of apprentices, whereby they are allowed, when engaged in the shops, to commence work at 8.30 or 9 a.m., instead of the usual hour of 6 a.m., a good one. The object of thus reducing the working hours is to give these youths the opportunity of applying themselves to theoretical study, without unduly taxing their physical powers, or encroaching on the requisite period of rest so essential for the proper building up of a growing youth's constitution. I see no reason why this arrangement should

not result well for the youth, who will undergo a more comprehensive course of instruction and training than falls to the lot of an apprentice engineer under the usual system of rigidly enforced attendance at the shop at the early hour of six; but, as it can only be said to be within the reach of youths whose parents or guardians are able to pay for privileges, I simply mention it *en passant*.

My remarks have been almost solely confined to the education and training of mechanical engineer apprentices, and I now propose to deal briefly with a paragraph which appeared in *Fairplay* of the 20th of January, and has for its subject:—Sea-going Engineers and their deficiencies.

The wide circulation and influence of that journal, added to my appreciation of the character and aim of the Institute, induce me to take notice of the somewhat remarkable statements contained in the paragraph, the reproduction of which in full, will the better serve my purpose:—

"A correspondent has kindly sent me a report in pamphlet form of the speech delivered by Mr. J. R. Fothergill, M.I.C.E., in distributing the prizes and certificates to the Government Science Classes on the 21st December, at the West Hartlepool Athenæum. Mr. Fothergill's address is a very able one; what he said to the assembled students on the value of knowledge must have made a considerable impression on them, for the remarks on this subject were original and well conceived. Speaking on the question of Practice (after dealing with Theory or Science) Mr. Fothergill said:—

> "'A large percentage of the students attending technical classes in this district become 'sea-going engineers.' My own experience in reference to this particular question may be of some interest. Speaking over a period embracing some twenty to twenty-five years, we find, at the present day, the majority of artisans who join steamers as junior engineers far in advance in technical education, but unfortunately very deficient in practical training. This is not difficult to understand, when we consider the system of sub-division of labour which has naturally developed in reducing the cost of production. Apprentices, instead of 'going through' the shops, become proficient in some particular department, with little or no useful knowledge of other departments. When they are 'out of their time' they go to sea, and at the present day it is not at all an uncommon experience to find a junior engineer, on joining a steamer, absolutely ignorant of the general details of the valuable machinery, for which, during his watch, he is more or less responsible. One individual is thoroughly at home when examining the pistons, but knows little or nothing about the pumps. Another knows all about the pumps, but the 'letting together' of 'bottom-end brasses,' or the overhauling of a safety-valve, has to be taught. In some cases we get a splendid machinist, one who can turn or plane anything, but the general details of the engine are a complete mystery.'"

Speaking as an engineer possessed of considerable sea-going experience, and addressing myself to many of more extended experience, the points which I shall touch will be well within the range of our practical knowledge. In the first place, it will be readily admitted that experience gained in the workshop is of a very different description to that derived from sea service, in fact the difference is so wide that the former can only be regarded as supplying the young artisan who elects to become an assistant engineer aboard a steamship, with the necessary credentials for obtaining this position with a view to learn, thereafter to efficiently discharge its various duties. "The system of sub-division of labour which has naturally developed in reducing the cost of production" must indeed be minute to be responsible for the remarkable *deficiency* or *proficiency* (if viewed from another standpoint, to be shortly considered) in the practical training of "the majority of artisans who join steamers as junior engineers." The deficiency of the junior engineer, as stated by Mr. Fothergill, lies in his being "*absolutely* ignorant of the general details of the valuable machinery, for which, during his watch, he is more less responsible." Against this deplorable *deficiency*, it is satisfactory to be able to place his singular *proficiency* in "knowing all about the pumps." To thoroughly sift the quality of Mr. Fothergill's experience and knowledge of present day junior engineers, and the justice of his sweeping condemnation of them, it will be as well for those amongst us, who are entitled to pose as authorities, to compare our experiences with his. The young artisan on the completion of his apprenticeship will be able to use his tools, and if he join a steamship as an assistant engineer with a full knowledge of the pumps, or, failing that accomplishment, he be able to examine the pistons, his chief will welcome him as a *good* man, and be quite content to excuse his inability to "let together" the bottom-end brasses and the top-end ones too, well knowing that the ability to execute this special work and much more will come in due course. I fear this same chief engineer would, however, strenuously oppose the advent into the engine-room of "the splendid machinist" who "can turn or plane anything," but to whom the general details of the engine are a complete mystery." To so splendid a machinist there should be a better living available ashore than afloat, but if his aim in life be the solution of that complete mystery (to him) of the marine engine—he will have the opportunity afforded him of unravelling it at sea in the time and at the expense of the shipowner, for—Mr. Fothergill "in some cases" gets him. Such unique

experience of the *deficiency* or *proficiency* in practical knowledge of young artisans destined to become junior sea-going engineers is, when found, worthy of being noted; and we are indebted to Mr. J. R. Fothergill.

Mr. GEO. W. BUCKWELL.

(*Member.*)

This is a subject which I hold to be fully as important as "Our Firemen." It is useless to think of regulating the one unless at the same time you instruct the other who is to have charge of him. Marine engineers are trained, not born; and although it is supposed that a boy should show an aptitude for the particular trade or profession he is to follow, evolution shows that it greatly depends upon the surroundings as to the direction in which our tastes will lie, and if a father trains a boy's thoughts according to what he wishes him to become, I see no reason why a lad of genius should not make an equally efficient engineer, doctor, scientist, musician, lawyer, or statesman. Bearing this in mind, it is evident that the training of a Marine Engineer should commence from the time that a child begins to take notice—say, at three years of age. He should enter a kindergarten school at this age, and whilst he is there learning things in general, at home his attention could be drawn to matters strictly appertaining to the engineering profession. He could be shown pictures and models of ships and machinery, and then the actual things they represent, so that even at this early age his mind would begin to connect representations and reproductions with originals. I know that many people strongly condemn the practice of allowing a child to learn anything before six years of age, and will not allow one to go to a school before then, but this is a great mistake. I think, with the author of the paper, that the drudgery of the first year's apprenticeship should be got over before the sixteenth year; this necessitates a lad starting at fourteen, and from three to fourteen is only eleven years, none too long to learn all the elements of education. At the age of eight or nine the boy should leave the kindergarten and enter a large public school, giving him about five years to run through the usual five forms. Indeed, from the good basis of instruction that he had received at the kindergarten, he might omit the first form and start in the second, thus giving him an extra year in the fifth form when he got there, where it would be of more advantage to him. During these last five years at school he should not be learning any one subject specially

connected with engineering to the detriment of others, but should be taught all that could be taught on all subjects, though instead of so much dead language there should be more physical and applied science. Of course at home his tastes and habits of thought should be directed to that profession which he is ultimately to adopt for a livelihood. I would recommend that during his last two or three years at school he should pass the examinations usual to public schools, such as College of Preceptors, Science and Art, City and Guilds, Oxford and Cambridge Local, &c. When he leaves school at fourteen he will thus be well grounded, besides being the possessor of several certificates. DURING THE WHOLE OF HIS ELEVEN YEARS AT SCHOOL THERE SHOULD BE NO SUCH THING AS HOME-WORK ; HIS EVENINGS SHOULD BE ENTIRELY FREE FROM THAT.

He should then be apprenticed for at least five years in some large engineering works, not necessarily marine, where he would be allowed to go through the whole establishment, having, say, six months in each branch ; longer would not be necessary, as he does not require to be especially skilful in any one particular branch, but to have a general knowledge of all, and the necessary handicraft skill will be as well gained whilst running through all the various branches as it would be by remaining in one. His evenings could be spent at some technical school or school of art, and I see no reason why he should not spend all six evenings in the week thus, as he could have an occasional evening off for recreation of some description. The subjects to be learnt should be those necessary to an engineer, preferably to those not necessary, but if he had one particular hobby, let him follow it up, as that in itself would be a recreation. An engineer's necessary subjects, of course, cover a wide ground, including, as it does, drawing, physics, mathematics, languages, naval architecture, &c., but a lad, earnest in his endeavours, should not fail under the curriculum proposed.

At the age of nineteen, being out of his apprenticeship, he should enter a marine engineer's and shipbuilder's establishment as an improver for two years, mainly for the purpose of picking up whatever there was to be learnt, and during which period he might have an opportunity of competing for some exhibition or scholarship. On arriving at the age of twenty-one, I think, he would be fully fitted to occupy a position as junior engineer on a steamer.

During the period extending from the time he enters the public school till he becomes a junior engineer, and, indeed, afterwards, I would counsel the taking and recording of

copious notes and accurate sketches on all things, and those note-books will save many a weary calculation and search through works of reference in the years to come.

As regards the examinations as a seagoing engineer, I will leave him in the hands of the Institute ; but I would like to say that with regard to steamers carrying ten or more engineers, as they are always large passenger vessels, with very valuable machinery, I think there should be a chief engineer, three seconds, three thirds, and three fourths, so that there would be a second, third, and fourth on each watch ; the designations should be senior second, assistant second, and junior second, and the same with the other grades. The chief engineer should hold an extra certificate, each of the seconds a first-class, each of the thirds a second-class, and each of the fourths a third class certificate. There would then be some regularity in the matter, and there should be no difficulty in obtaining engineers with the necessary certificates, as on one of our large Atlantic liners, carrying nineteen engineers, there were ten first-class and four second-class certificates. The method of calling engineers, below the rank of fourth, as assistant second, assistant third, &c., is, I think, a wrong method, as although an assistant second is practically a fifth engineer, a misleading impression is created, and he is popularly supposed to be of a higher grade than the third ; in fact, I know of one shipping master who persisted in the assistant seconds having certificates although the thirds and fourths (who were really in higher positions) did not in his opinion require to have them.

One of the speakers during the discussion argued that he did not think it advisable for engineers to be able to obtain their certificates so easily as they can do now, and that a third engineer had no right to put in time for a first-class. I hold this to be a mistaken idea ; and although I would increase the stringency of the present regulations, and the stiffness of the examinations, it would not be in that direction, as it is not often a man's fault that he occupies a junior position for a long time, but his misfortune.

Mr. THOMSON.

Now I propose we should take the feeling of the meeting as to whether we should recommend the Board of Trade to require, in addition to the other qualifications for a third engineer's certificate, that the examination should include a practical test. Leave the details to them, but say that in our opinion a practical test is necessary.

THE CHAIRMAN.

I apprehend that the resolution will be to this effect :—

"That in addition to what has already been recommended to the Council for representation to the Board of Trade, it is, in the opinion of this meeting, desirable that a candidate for a third engineer's certificate should also be required to give an illustration of his practical skill, leaving the details of the test to the Board of Trade."

Mr. MELSOM : Should indentures be required, to prove that a candidate has served five years ?

Mr. THOMPSON : They have to get a certificate to that effect now from the place where they served their time.

Mr. MELSOM : I put my own case. I might have said that I had served five years when I had only served three. There was no proof either way.

THE CHAIRMAN.

I understand that everybody who goes up for examination for a second engineer's certificate has to show a certificate or produce proof that he has served at least three years in an engineering shop. I have never heard of any case where a man was allowed to pass without proving his service.

Mr. MELSOM : In my case no indentures were given. I served my time at Slogget's Locomotive Works at Bristol. I gave the name of the works and the dates of my service, but did they verify them ?

Mr. SAGE : Some firms do not give certificates or testimonials to those who have served their time with them. When the candidates go up for their certificates they state where they served, so that the Board of Trade may refer to the firms and verify the statements.

Mr. A. W. ANDERSON.

(*Member.*)

When I went up for my second's certificate I had to produce my lines. There were no indentures where I served my time, but we had to get lines from the manager of the works.

Mr. PHILLIPS.

(*Member.*)

When I went up for my certificate I had also to produce my lines. They would not listen to me until I got a letter from my master where I had served my time, showing what service I had.

Mr. THOMSON : We can leave that to the Board of Trade. They will take care to have these lines verified. They will not take it for granted.

Mr. GREER.

(*Member.*)

The Board of Trade will take any lines that are sent them. They do not investigate the cases and verify the particulars.

Mr. NOBLE : I know of a young fellow who was in a pattern shop the whole of his time. He could not do a bit of fitting. Yet he was a sea-going engineer. In a case of that kind there ought to be a practical test.

Mr. MELSOM : One may say : "I served my time with a firm that has since failed." How can the Board of Trade test that ? There should be indentures to prove a man's service. I propose that the Board of Trade require proof that an apprentice has served five years.

THE CHAIRMAN.

As I understand the point raised by Mr. Melsom, the Board of Trade is charged with being not only lax but positively careless in finding out whether or not a man who goes up to pass the examination for his certificate produces papers which are forgeries.

Mr. MELSOM.

It is open to be done and the Board of Trade cannot prove the truth or otherwise of the statements presented to them. If indentures are drawn up according to law, then the Board of Trade could require the indentures to be produced, and the indentures would be proof of the candidate's service.

Mr. SAGE.

But then you would practically disfranchise all those young engineers who, although they had served the prescribed apprenticeship, had not had indentures, and who, because of their inability to produce indentures which they never had, would be disqualified from going up for the Board of Trade examination. The Board of Trade require evidence that a candidate for a certificate has fulfilled the obligation imposed by the rules—that is to say, that he has served three years—and if any man goes up and is unable to

produce some reasonable proof that he has served those three years he will not be accepted. It is very difficult and invidious for the Board of Trade to suggest that a document presented to them may be a forgery. If they are aware that any firm named is or has been in existence, and was competent to teach a young man, and the young man brings documentary evidence that he has been engaged with that firm for the stipulated time, I do not think the Board of Trade can go beyond that. A man may put forward a document that he has served his time with a firm that has become defunct, but he is generally able to produce his evidence on some printed form or the headed note paper of the firm, and that is some sort of guarantee that it is correct. It would impose a very large responsibility on the Board of Trade if when a proper document is brought forward they were required to investigate it, and make inquires with private detectives all over the country. If they have no reason to doubt the document they accept it, and they are obliged to accept it. If any of us were to go up with a document which we knew to be perfectly correct we should be very much offended to have its authenticity doubted. As for saying that indentures must be produced, that cannot be, because 99 out of every 100 young fellows of the present day are not bound by written agreement. They are bound by a sort of verbal agreement, and so it is with boys. Many of them after they have served three or four years get dissatisfied with the pay and go off elsewhere, when they get more money by working as journeymen.

Mr. SHOREY.

Mr. Melsom suggests that candidates for engineers' certificates should be required to produce indentures, but he would himself have been prevented from obtaining a certificate, if this rule had been in force, as he had no indentures, from his own showing.

THE CHAIRMAN.

The question of indentures is not for the Board of Trade but for employers, and I question very much if at the present day you will get employers to make a rule of granting indentures, seeing that they are now gradually dispensing with them all over the country. The question is, why has the principle of indentures been disestablished? There must have been some reason for it either from the employers' or the apprentices' point of view—probably from both.

Mr. SHOREY.

Premium apprentices are a great nuisance. They waste time, and if you speak to them they get saucy and you can do nothing with them. Employers begin to see that.

Mr. P. SCARTH.

(*Associate Member.*)

If we demand five years' apprenticeship as a qualification for a certificate, a man must have a means of proving that he has served five years. If an employer wanted to keep a good man in his shop, he might refuse to give him any lines to prove his service.

Mr. SAGE.

An employer is not obliged to give a character of any kind, and the most faithful of servants cannot demand lines or a testimonial from his master. I feel certain that the great majority of young men at the present day could not produce indentures, but they could all produce lines from their employers sufficient to prove their service.

Mr. SCARTH : Employers may refuse to give them. I know a man who went up with a letter refusing to give him lines for the time he had served.

Mr. SAGE : Did he pass ?

Mr. SCARTH : Yes. He produced practical proof of his three years' service.

THE CHAIRMAN.

The real point at issue is, do the Board of Trade get satisfactory proof that every young man who presents himself for examination has served the minimum three years in a workshop ? It seems to me almost absurd to doubt it. Personally, I am not in favour of only three years' service, as I do not consider the time adequate in the interests of shipowners, and would not accept a three years' service in these interests.

Mr. SHOREY : How are we going to compel an employer to give a certificate if he wishes to withhold it ?

Mr. SCARTH.

Well, the system of indentures ought to be started again. Under the present plan an employer can start a young man, and in a year or two, if he does not suit him, he gets rid of him, so that in this way the young man has wasted one or two, and perhaps three years of his life.

Mr. MELSOM.

In my own case the officials at the dockyard wrote and asked for lines, but the firm where I served my time refused to give them. I afterwards got them through influence, but, as I have said, when they were first applied for in the ordinary way they were refused.

Mr. J. H. THOMSON.

There are some Government places where they do not ask for your lines at all. They ask where you were last employed, and they make their own inquiries.

THE CHAIRMAN.

It is quite new to me that the Board of Trade do not get satisfactory references from those who go up for their certificates. I thought they were always most particular; in the cases which have come under my own notice I have found it so.

Mr. ROBERTSON.

Where I served my time I got lines on plain paper; this was accepted by the Board of Trade.

Mr. BURMINGHAM.

If, in any case, a firm refused to give lines, the Board of Trade could enforce it, because it would be for the general public good, They have the lives of passengers to consider.

Mr. SAGE.

The Board of Trade cannot proceed upon anything but the law of the land, and it will require an Act of Parliament to make the giving of a certificate or lines compulsory. The laws are framed for them as for other people, and they cannot act in any way except under an Act of Parliament.

THE CHAIRMAN.

Any resolutions which may be passed, and as much of the discussion as is pertinent to the subject, will be printed in our transactions. My experience is that those cases in which we do not get lines from employers are very exceptional. I can hardly recall a single instance where I could not get either the apprenticeship lines or a note from the employer to show what an applicant had served. I receive inquiries

regarding both engineers and firemen—inquiries from different parts of the country—on the lines indicated by Mr. Shorey. I think that is the general plan among employers of labour.

Mr. THOMSON.

Many firms have printed forms which they send out to the previous employers of men who may apply to them for work. They send out with each form a stamped addressed envelope for the reply, and the master or firm to whom it is forwarded has merely to fill up the form, stating whether the man enquired about was good, bad, or indifferent, and whether he was sober and steady. Even that might be quite sufficient if there was nothing else forthcoming.

THE CHAIRMAN.

The difficulty which I see in this matter is, that it is really an employers' question. If we begin to deal with it we shall be wandering into latitudes that we know very little about. Just at the moment I see a good many arguments on both sides of the question, both from an employer's stand-point and an apprentice's stand-point. Mr. Sage proposes to leave his reply until he has had an opportunity of going over the various manuscripts that have been sent in and of looking over the remarks of the various speakers.

Mr. SAGE.

It is best, I think, that I should not attempt to reply to the discussion at this evening's meeting. You may imagine if you like, what I would reply. In my opinion it is a subject that might be continued *ad infinitum*. We might go on almost for ever without really exhausting the subject.

THE CHAIRMAN.

There are one or two points on which I think some short papers might very naturally follow Mr. Sage's paper and the discussion that has taken place. There are many questions which yet want clearing up, as we have been wandering a good deal round about them, but there are some points that we have really never come to. If Members would only take up such of those points as they are specially interested in or have a special aptitude for dealing with, I think we might have one or two very good short papers—short and to the point—and let the discussions on those papers be of the same character.

Mr. SAGE.

I think that is a very good suggestion indeed. There has been a good deal of discussion on this subject, but much more might follow, and I think it an excellent idea that Members should put down in writing their observations on special points, particularly as to the recommendations that should be made to the Board of Trade for the alteration or amendment of the present rules. Those papers might be read on some evening to be set apart for the purpose, and they should be read by the authors if present. I am sure that all Members feel very strongly on this question of indentures, but it is impossible for us to revert to that. It was a good old system in my opinion. It was impossible thirty years ago to apprentice a boy to a trade such as ours without a consideration by the parents of £20, £30, or £40, but the boy was taken for that sum, and you could proceed against the master for not properly teaching the apprentice his trade. The introduction of so much machinery into workshops has prevented a great amount of hand skill being required, but if we could only revert to the system of apprenticeship for not less than five years, and have indentures as proposed, the boy would then go forward with a certain diploma. But at present masters have a right to refuse to have bound apprentices, and they refuse to have anything to do with indentures.

Mr. THOMSON.

I propose a hearty vote of thanks to Mr. Sage for his paper, which has given rise to so much interesting discussion during the past four meetings. Mr. Sage must have devoted a considerable amount of time to the preparation of his paper, and the attention which it has received, and the interest which it has excited, must have been very gratifying to him.

Mr. WILSON : I beg to second that.

Mr. SAGE.

It gratifies me very much that any feeble efforts of mine should have met with the approval of my fellow Members. I am sure that when it all comes to be collected together the discussion will be the best part of the matter ; but I sincerely hope, that either from the paper or from the discussion that has taken place, some means will be found of approaching the Board of Trade in a proper manner, so that

the alterations which we deem so desirable in the examination and passing of engineers for the mercantile marine may be brought about. I am sure we all feel that by those alterations the status of marine engineers will be considerably enhanced, and that, in the words of Shakespeare, is a consummation devoutly to be wished. We all know that the status of engineers has improved slightly, but not to the extent that it should, considering the important part they play in the mercantile marine. It rests with ourselves to place it as forcibly as possible before the Board of Trade and the Legislature of the land, that rules which did in 1854 and in 1860, when certificates were instituted, are not applicable to the circumstances of the present day. The engines of that day were very different from what they are now, and that which served as a standard in those times is not adequate at the present day. I only hope that if we do not get all we want we shall at any rate obtain a considerable portion of it.

BOMBAY CENTRE.

DISCUSSION

ON

Mr. S. C. SAGE'S PAPER,

At a Meeting held in Bombay, on Monday, February 28, 1893,

PRESIDED OVER BY

MR. W. W. WILSON (*Vice-President*).

THE CHAIRMAN.

In opening our proceedings this evening, I may say that the original paper, of which I propose to read a draft to you, was read by Mr. Sage at a meeting in London on Monday, 23rd January, 1893, and without further preface I will now proceed to read what is before me, hoping that Members present will enter into the discussion freely.

Mr. F. COOPER.

(*Member.*)

Mr. Sage's paper has brought to the front a matter which concerns all marine engineers, and will, I trust, be the means of eventually carrying a point which has long been thought of, spoken about, and growled at generally by sea-going engineers. I refer to the question of third engineer's

certificates. The safe navigation of a steamer of, say 5,000 tons, carrying mails and passengers, has, for all time, been considered of such importance as to necessitate the carrying of *three* certificated officers, a master, and a first and second mate. These three are personally and individually responsible to the Board of Trade and to their owners for their respective watches, the third mate usually keeping the captain's watch, but the captain being responsible personally for that watch in particular. But in the engine-room what do we find ? The Board of Trade only recognises *two* certificated and responsible men for the boilers and machinery of this same steamer of 5,000 tons and 5,000 horse power. Surely in these days, when the engine-room contains not only the propelling force, but all machinery for lighting, ventilation, sanitation, steering, refrigerating—not only the ship's stores, but the cargo as well—surely it will be admitted that the charge of a watch in the engine-room is of as much importance as the keeping of a watch on the bridge ; and yet there are only two responsible men for keeping watch over all this machinery. The second engineer keeps watch for four hours in every twelve, and has his hands quite full when off watch in carrying on all the work, so that he cannot be expected to be responsible for more than his own watch. Then the chief engineer must be responsible for all watches kept during sixteen hours out of every twenty-four ! I ask if this is reasonable, especially considering the multifarious duties devolving on the chief engineer besides the care of keeping watch, and if it is not time that steamers of over a certain indicated horse power should be compelled to carry three certificated engineers, who will "sign on" on their certificates ? Many, in fact, most, steamers of large tonnage already carry three, or more than three, certificated engineers ; but I understand the Board of Trade does not hold them responsible on their certificates unless they sign on as first or second engineer.

As Mr. Sage's paper is devoted in great part to the question of certificates, it will not be out of place here to draw the attention of marine engineers to the grave risk they run of having their certificates cancelled or suspended by incompetent men. Are marine engineers aware that a Marine Court of Enquiry, consisting of a magistrate as president, a commander of the Royal Navy and a shipmaster of the merchant service as assessors, actually sat to investigate a case involving the question of cancelling or suspending an engineer's certificate ? The president remarked that, as the investigation would likely involve the question of can-

celling or suspending certificates, he would advise the appointing of two additional assessors. And what did this court of wisdom and justice do? Why, appointed as additional assessors other two shipmasters. And the result of that enquiry (*sic*) was the censure of the engineer in question. This is not romance, neither is it exaggeration, but fact.

I ask you if it is not high time that this method of dispensing justice to an educated body of men should cease. A shipmaster is not any more competent to deal with the engineer's certificate than he is with the doctor's. One can imagine the outcry that would be raised if such an insult had been offered to the medical profession. A shipmaster is not considered competent to give a certificate to an engineer, and he cannot, therefore, be competent to take it away. We look to the Institute of Marine Engineers to see this matter righted—and soon.

Mr. W. M. ROSS.

(*Member.*)

This paper, I think, touches very little on the real education of engineers. If an alteration is necessary, I fail to see how another certificate for sea service (whether we may call it a third or fourth) would benefit us. This certificate is now in vogue with most of the continental powers; but no one can say a foreign engineer is superior to an English-trained man. If greater supervision were given by masters or their foremen during an engineer's apprenticeship we might get better men, but his education, as long as he lives, can never be called completed. The older he gets and the higher he rises in his profession the more he will find he has to learn.

No engineer should serve less than five years. At the end of that term, if desirous of going to sea, he should be required to pass a practical examination before a board—say of competent men from our Institute, or before the Board of Trade examiners—and no one without a certificate so gained should be allowed to sign on any ship as an engineer; and it should be compulsory that the person in charge of every steamer, irrespective of tonnage or power, should hold one of these certificates.

THE CHAIRMAN.

(*Vice-President.*)

It appears to me from the paper which I have read here to-night (and I may say it is the first time I have been able to read it through, although it has been in my possession

for the last fortnight), that there is but very little regarding the training or education of engineers. It is more of an attack on the system of Board of Trade certificates as at present in vogue, and the qualifications necessary for obtaining them.

There is not the slightest doubt that there could be considerable improvement in the latter, and I am inclined very much to side with the author in his proposal to institute a third engineers' certificate—in fact, I think it is a point which should be agitated for. It would, however, be necessary to see that none but engineers should be allowed to go up for examination. I think it is a great pity that such a qualification as that on which one of our Members founded his argument in the discussion on the paper read before the Institute in October last on "Our Firemen," in favour of advancing firemen to engineer's positions, should now be allowed to stand in the Board of Trade Rules. I am of opinion that we ought all to use our utmost endeavour to have that paragraph expunged, "He must have served at least four years at sea in the engine-room as an engineer on the watch in the foreign, home, or coasting trade."

What is the consequence of that paragraph? Why, we have on the East Coast no end of steamers, within the last few years, wherein the only engineers are firemen, and they are regularly shipped, and are granted discharge certificates bearing the imprint that they have served as engineers. I refer to the steam trawlers, now so common. On completion of four years (or, rather, six years, for coasting requires one-half more) they are entitled to go up for examination, and very possibly many do so, though I have no doubt that many, on the other hand, are unable; still, they are the parties whom we must look upon as being instrumental to a very great extent in tending to lower the standard of engineers.

I think that, no matter what length of service at sea can be produced, it should be one necessary qualification that every candidate should be able to produce certificates that he has served his apprenticeship in the shop for a period of not less than *five* years. The *three* years should also be expunged and five years substituted in the first rule, viz., "He must have served an apprenticeship to an engineer for five years at least, &c."

Altogether, however, I think Mr. Sage deserves credit for bringing this subject before the Institute, though its title may have misled us somewhat in our expectations, and I may add that it has given me very great pleasure to be able

to read it here ; and I hope, also, that this meeting may be only the first of many more, and that the discussions here of papers contributed to the Institute at home may form a very valuable portion of the transactions in future.

Mr. THOS. DREWRY.

(*Member.*)

I quite agree that an untried engineer on his first voyage to sea should not have charge of a watch. True, if he is intelligent and willing, he will pick up a lot of information in his first few watches, but it is during these first few watches that most of the risk is run—of collision, break-down, or trouble through unworthy firemen. It is very desirable that every engineer in charge of a watch should have a certificate, proving at least that he has been to sea before as engineer, and that he is efficient as a working engineer. At the same time, I think it undesirable that we should, as an Institute, show any appearance even of entering into conflict with the numerous societies of sea-going engineers, who have combined for the purpose of maintaining the rate of pay and the number of engineers to be carried. I believe they have a rule that if during a voyage with two engineers the owners decide to extend the voyage, then the engineers claim a third ; or, if during a voyage with three engineers the owners decide to extend the voyage, then the engineers claim a fourth, providing the extension requires it. At present, I believe, the donkey-man gets promoted ; it is a bad plan, but what are the alternatives—either introducing junior foreign engineers or losing the extra help already granted. If a certificate for third and fourth engineers is made compulsory, these extended voyages will lose their extra engineer. Again, how would the supply of engineers be kept up ? The fifth and sixth engineers of large steamers could not supply third and fourth engineers for the whole merchant service, and yet, if a man cannot go to sea as third or fourth unless he has been to sea before and passed an examination, that seems to be the only source of supply. What a hardship for young engineers living in ports where third and fourth engineers are the lowest grade. Probably two-thirds of our young engineers are so situated. There are several small passenger steamers, tug-boats, and the smaller class of fishing vessels, &c., that we cannot seriously expect to comply with a rule to carry duly qualified engineers ; and if a law were passed to that effect, duly qualified engineers would be more ambitious than accept such berths unless very hard pressed.

Mr. GEO. ERSKINE.

(Member.)

As the drift of the discussion on Mr. Sage's paper this evening has all been in the direction of condemning the present system of certificates granted by the Board of Trade to engineers, and of showing the urgent necessity of having a third grade certificate, especially in reference to the qualifications required by the Board of Trade from candidates, I would like to make a motion on the subject, viz.: "That the Institute of Marine Engineers approach the Board of Trade on the subject of certificates generally, ask them to introduce a third grade certificate, the *primary* qualification for which on the part of the candidate would be the having served a five years' apprenticeship at the making or repairing of engines; and secondly, proof of sufficient knowledge on his part of the working of marine engines and boilers in all their details to qualify him for taking charge of a watch at sea; and that the clause in the Board of Trade rules relating to four years service in the engine room being accepted as sufficient to qualify a candidate for examination for a certificate, be deleted."

We, as a body, are strongly of opinion that no engineer should be allowed to have charge of a watch in any steamer of any size whatever who is not in possession of at least a third grade certificate of competency granted by the Board of of Trade. Probably it might be found necessary or expedient in some cases to have even a lower grade certificate, but our contention is that no engineer should have charge of a watch unless he is a certificated man. Now, I think by a movement in the direction indicated above we would largely improve the status of marine engineers, and put a stop to the abuses which are very prevalent in many British steamers where donkey-men and firemen are put into positions, which, by the action of the four years' service clause already referred to, enables them to qualify in the eyes of the law for ranking as certificated engineers. It is high time that something was done to give practical effect to the intentions and principles of our Institute of Marine Engineers (which I take to be the placing of engineers on a higher plane), and I think we are much indebted to Mr. Sage for bringing this subject to our notice. No doubt, according to our worthy honorary secretary, Mr. Adamson, knowledge, like virtue, is its own reward; still we may go on improving the education and training of engineers, but unless this improvement is recognised in a practical manner by the powers that be our position is no better relatively

than it was before. I believe if our Institute, containing as it does such a number of men of light and leading in the engineering profession, was to take this matter up, its voice would be listened to with respect by our legislators or whoever may have the arranging of Board of Trade rules and systems, and not only listened to, but the ideas adopted and acted upon, to the very great benefit of all interested in marine engineers, their place and work.

The HONORARY SECRETARY.

Considerable delay having taken place in the printing of the paper and discussion on the "Education of Young Marine Engineers," owing to circumstances beyond our control, it has admitted of a copy of the letter which was forwarded to the Board of Trade on the subject of a "Third Engineer's Certificate and Workshop Service" being printed along with the paper and discussion. The letter, which follows, has been circulated by the Board of Trade amongst those interested in the subject in order to obtain the views of shipowners and engineers who are employers.

14*th September*, 1893.

To the Assistant Secretary, Board of Trade

(Marine Department).

Sir,

In the name of the Council of the Institute of Marine Engineers, I beg to bring before you the enclosed copy of a Resolution which was remitted to the Council in order that the result might be brought to your notice with a view to the subject matter being presented for the consideration of the Board of Trade in the most approved form.

In considering the terms of the Resolution at a recent meeting, the Office Bearers and Council of this Institute have had in view all the interests involved, and deemed it wiser to lay the Resolution, as remitted from the meeting of February 6th, before the Board without any alteration or amplification, but, at the same time, setting forth the points which were dwelt upon when the Resolution was considered at the recent meeting referred to, when the Council had the matter under consideration.

The following points were deemed worthy of special observation :—

(1) The Resolution was passed at a meeting of the Institute, held in the ordinary course of business, to read and discuss a Paper contributed by Mr. S. C. Sage on the "Education and Training of Marine Engineers." The title and scope of the Paper was such as to evoke a good deal of interest, and the disscussion extended over three evenings after the date of reading, the dates being Mondays, January 23rd and 30th, and Mondays, February 6th and 13th.

(2) The intention conveyed, or desired to be conveyed, by the Resolution is, that the engineers who join or seek to join the Mercantile Marine should be as efficient as possible ; and with this in view, it is considered that an experience extending over a period of five years at least is necessary to meet the requirements.

(3) The object to be attained by the insistence of the five years' apprenticeship is the assurance that the standard efficiency will be kept up and maintained.

(4) The desire at the back of these expressions is for the maintenance of the highest efficiency in the engine-room staff of our steamers, believing that only thus can we expect to cope with the ever-increasing responsibility and addition to the duties devolving upon the engineers of our Mercantile Marine as well as the engineers of Her Majesty's ships.

(5) In the interests of those who have shares in steamships, or who are steamship owners, it becomes the duty of an Institute such as ours to point out that the conviction is very strong among the members that while three years may have been a long enough *minimum* apprenticeship, when the present Board of Trade Rules were framed, for exceptional lads to obtain experience in the handling of tools and education in the theory of their business, the time has more than come when it is both expedient and necessary to amend the regulations in the direction sought by the Resolution.

(6) Especially should it be looked upon as expedient and necessary that the standard of efficiency should be maintained by all reasonable regulations from the facts that :—

a. Greater and increasing responsibilities rest upon the engineers of to-day as compared with those of the past.

b. Foreign competition is greater and increasing, and it rests largely with the most intelligent use of material in the engine department to gain the advantage in the competition.

c. There is less hand and more machine tool labour in our workshops now than formerly, and therefore all the more reason for an *extended* apprenticeship.

d. In our large steamers there are many young engineers who sail for years in a capacity junior to fourth engineer, and who have thus no opportunity of passing the examination for second engineer, but who might have granted them an opportunity of obtaining a third grade certificate as a means of encouragement.

I have the honour to be,

Yours faithfully,

(Signed) JAMES ADAMSON,

Honorary Secretary.

RESOLUTION.

"That, in the opinion of this meeting, it is highly necessary to amend the present regulations as to the Second-Class Certificate for Engineers with regard to service in the workshop, where the *minimum* service should be five years; and that the attention of the Board of Trade should also be called to the desirability of creating a Third Grade Certificate, which should be granted to those who have served at least five years in an engineering works and one year at sea, and pass the prescribed examination."

The above Resolution was passed at a meeting of the Institute of Marine Engineers held in the premises of the Institute.—JAS. ADAMSON, *Honorary Secretary*

SESSION,  1892-3.

LORD KELVIN, President

CATALOGUES

OF THE

Malcolm Campbell Memorial

(LOAN COLLECTION)

AND THE

INSTITUTE LIBRARIES,

WITH

REGULATIONS FOR THE

CIRCULATING LIBRARY.

CIRCULATING LIBRARY.

REGULATIONS.

I. The application for the loan of any volume in the library must be made at the Reading Room, in a book provided for the purpose, and duly signed by a Member of Council, the number of the Book, as per catalogue, to be entered. The Book required will then be issued, subject to the approval of the Council, as per Rule VII.

A Member of Council is present every evening, as a rule; but to prevent disappointment and loss of time, it will be well to communicate with one beforehand, naming the volume required.

II. No Book may be removed from the Reading Room without compliance with the foregoing rule.

III. Should it be desired to retain a volume for longer than a week, the application must be renewed, and the Book returned that it may be re-entered, when it will be re-issued for a second week, should there be no prior application.

IV. In the event of a Book not being returned on the day appointed, a fine of 6d. may be imposed, for a week or any portion of a week; such fines will be devoted to the Library Repair Fund.

V. The privileges of the Circulating Library may only be enjoyed by those who have fulfilled all the stipulated engagements in connection with their grade of membership in the Institute, as per Bye-Laws.

VI. All loss or damage to Books must be made good by the borrower to the satisfaction of the Council.

VII. While the Council is anxious to place all the Books within the use of everyone connected with the Institute, as far as possible, there are certain volumes, the right of which allowing to leave the premises is reserved by the Council.

VIII. On any volume being returned to the premises, notification and an entry to that effect shall be made in the Book provided for the purpose, and duly initialed.

INSTITUTE OF MARINE ENGINEERS.

LIBRARY CATALOGUE.

No.	Description.	Presented by
1	Useful Information for Engineers (Fairbairn) ...	J. M. Gray
2	do. do. 2nd series	do.
3	do. do. 3rd series	do.
4	The Steam Engine (Bourne	do.
5	Voltaic Electricity (Tyndall)	do.
6	Link and Valve Motions (Auchinclass)	do.
7	Once a Week, vol. 1 ...	do.
8	do. vol. 2 ...	do.
9	do. vol. 3 ...	do.
10	do. vol. 4 ...	do.
11	do. vol. 5 ...	do.
12	do. vol. 6 ...	do.
13	do. vol. 7 ...	do.
14	do. vol. 8 ...	do.
15	do. vol. 9 ...	do.
16	do. vol. 10 ...	do.
17	do. vol. 11 ...	do.
18	do. vol. 12 ...	do.
19	do. vol. 13 ...	do.
20	Marine Engines and Boilers, vol. 1	R. Leslie
21	do. vol. 2	do.
22	Malit's Construction of Artillery	J. M. Gray
23	Encyclopædia(Beaton's)vol.1	D. Greer
24	do. vol. 2	do.
25	do. vol. 3	do.
26	do. vol. 4	do.
27	March of the Strikers (J. Bevan)	A. Campbell
28	Madame Midas (Fergus Hume)	do.

No.	Description.	Presented by
29	Taken from Life (Henry Pettitt)	A. Campbell
30	The Crime of the Opera House	do.
31	Zeph (G. R. Sims)... ...	do.
32	Without a Home (E. P. Roe)	do.
33	Coral Pin	do.
34	Zoroaster (F. M. Crawford)	do.
35	Souls and Cities	do.
36	Two Years Ago (Charles Kingsley)	do.
37	Notes on Lilies (Dr. Wallace)	do.
38	Crime and Punishment ...	do.
39	India Re-visited (Edwin Arnold)	R. Leslie
40	All the Year Round, vol. 1	J. M. Gray
41	do. vol. 2	do.
42	do. vol. 3	do.
43	do. vol. 4	do.
44	do. vol. 5	do.
45	do. vol. 6	do.
46	do. vol. 7	do.
47	do. vol. 8	do.
48	do. vol. 9	do.
49	do. vol. 10	do.
50	do. vol. 11	do.
51	do. vol. 12	do.
52	do. vol. 13	do.
53	do. vol. 14	do.
54	do. vol. 15	do.
55	do. vol. 16	do.
56	do. vol. 17	do.
57	do. vol. 18	do.
58	Good Words, 1860... ...	do.
59	do. 1861... ...	do.
60	do. 1862... ...	do.
60a	do. 1864... ...	do.
60b	do. 1865... ...	do.
60c	do. 1866... ...	do.
61	Electricity (John T. Sprague)	H. Chisholm

No.	Description.	Presented by
62	Elementary Engineering (J. Sherran Brewer) ...	A. W. Robertson
63	Machine Drawing and Design (Ripper)	do.
64	Hydraulic Motors (G. R. Bodmer)	J. Lockie
65	Engineering Socially Considered (Haldane) ...	H. Hammett
66	Steam Boilers (R. D. Munro)	M. C. McKellar
67	The Steam Engine (W. H. Northcott)...	The Author
68	GeometricTurningSimplified (W. H. Northcott) ...	do.
69	On Lathes and Turning (do.)	do.
69a	Examples on Lathes and Turning (W. H. Northcott)	do.
70	Into all the World (John Scarth)	do.
71	The Life of William Denny (A. B. Bruce)	P. M. Black
72	Webster's Dictionary ...	Purchased
73	S. S. House Flags	do.
74	A Text Book on Steam and Steam Engines (Professor Jamieson)...	M. C. McKellar
75	The Engineer's Sketch Book (T. W. Barber)	do.
76	Mine Engineering Plates (G. C. Greenwell)... ...	A. McMurchy
77	Ditto do. do. ...	do.
78	Haddon Hall	Capt. Angove
79	Only a Butterfly	do.
80	Deux Parisiennes	do.
81	Adventures of a Phæton (Wm. Black)	do.
82	Leyton Hall (Mark Lemon)	do.
83	Barren Honour	do.
84	Under which King (William Johnston, M.P.)	do.

No.	Description.	Presented by
85	Against Wind and Tide (Holme Lee)	Capt. Angove
86	Roba Di Roma (W. W. Story)	do.
87	Devereux (Lord Lytton) ...	do.
88	Fortunes of Nigel (Sir W. Scott)	do.
89	Tales of Three Cities (Henry James)	do.
90	Dumbleton Common (Hon. E. Eden)	do.
91	Hostages to Fortune (Braddon)	do.
92	Frank Sinclair's Wife, vol. 2 (Mrs. Riddell)	D. Gillespie
93	Mandolinette	Capt. Angove
94	Prosper Randoce (Victor Cherbuliez)	do.
95	Mary Gresley (Anthony Trollope)	do.
96	Willing to Die (J. S. Le Fanu)	do.
97	In Pastures Green (Gibbon)	do.
98	The Cure of Souls (Cobban)	D. Gillespie
99	At Her Mercy (Jas. Payne)	do.
99a	The Woman in Red (Hayward)	do.
100	The Tropical Agriculturalist, 1881-2	do.
101	La Morte (Octave Feuillet)	Capt. Angove
102	Ready-Money Mortiboy (W. Besant and J. Rice) ...	do.
103	Henrietta Temple (Earl of Beaconsfield)	do.
104	Crownow's Recollections ...	do.
105	Dick's Wandering (Julian Sturgis)	do.
106	London: Its celebrated characters, &c.	do.

No.	Description.	Presented by
107	La San-Felice	Capt. Angove
108	Two Duchesses (F. P. Clark)	do.
109	The Girls of Feversham (Florence Marryat) ...	do.
110	Joan (Rhoda Broughton) ...	do.
111	Laurence Sterne, vol. 2 (P. Fitzgerald)	do.
112	White Chief (Capt. Mayne Reid)	do.
113	Bella Donna (Gilbert Dyce)	do.
114	Les Drames de la Forêt (Alexis Bouvier)	do.
115	The Disowned (Lord Lytton)	do.
116	Blount Tempest (Rev. J. C. M. Bellew)	do.
117	Austin Elliot	do.
118	Condoned (Anu C. Steele)...	do.
119	The Six Chief Lives—Poets (M. Arnold)	do.
120	L'Uscoque (Geo. Sand) ...	do.
121	The Gun, Ram, and Torpedo (G. H. Noal)	do.
122	Ravenshoe (H. Kingsley) ...	do.
123	How he won Her(Mrs.Eiloart)	do.
124	The Contemporary Review (January-June, 1882) ...	do.
125	The Fortnightly Review (1882)	do.
126	Island Life (A. R. Wallace)	do.
127	Spon's Dictionary of Engineering Div. 1	Purchased
128	do. do. Div. 2	do.
129	do. do. Div. 3	do.
130	do. do. Div. 4	do.
131	do. do. Div. 5	do.
132	do. do. Div. 6	do.
133	do. do. Div. 7	do.
134	do. do. Div. 8	do.
135	Burgh's Pocket Book on Compound Engines ...	J. H. Thomson

No.	Description.	Presented by
136	The Steam Engine, vol. 1 (D. K. Clark)	A. W. Robertson
137	do. vol. 2	do.
137a	do. vol. 3	do.
137b	do. vol. 4	do.
138	The Marine Engineer— vol. 1, 1879-80	J. W. Richardson
139	do. vol. 2, 1880-81	do.
140	do. vol. 3, 1881-82	do.
141	do. vol. 4, 1882-83	do.
142	do. vol. 5, 1883-84	do.
143	do. vol. 6, 1884-85	do.
144	do. vol. 7, 1885-86	do.
145	do. vol. 8, 1886-87	do.
146	do. vol. 9, 1887-88	do.
147	do. vol. 10, 1888-89	do.
148	Marine Engineering News, 1876	do.
149	do. 1877	do.
150	do. 1878	do.
151	The Foreman Engineer, 1877	do.
152	do. 1879	do.
153	do. 1880	do.
154	Handbook for Steam Users (M. P. Bale)	The Author
155	Marine Engines and Boilers (Geo. C. V. Holmes) ...	A. Lawrie
156	Theory of Heat (Maxwell)...	J. H. Thomson
157	Conversion of Heat into Work (Anderson)... ...	A. Lawrie
158	Heat a mode of Motion (Tyndall)	do.
159	A Practical Treatise on Heat (Box)	do.
160	The Engineer's & Machinist's Drawing Book	H. Prior
161	Imperial Cyclopædia of Machinery...	do.
162	Iron Ship Building (J. Grantham)	Jas. Adamson

No.	Description.	Presented by
163	The Shipping World, 1890	Purchased
164	Shipbuilding—Plates ...	James Adamson
165	The Graphic, vol. 2, 1889...	Purchased
166	Illustrated London News, vol. 2, 1889	do.
167	Year Book of Scientific Societies—1890	do.
168	Ditto 1891	do.
169	Hydro-Statics & Pneumatics (Magnus)	J. Taylor
170	Elementary Mechanics (Magnus)	do.
171	Naval Architecture(Thearle) Text	do.
172	Naval Architecture(Thearle) Plates	do.
173	Engineering, 1877... ...	Jas. Stewart
174	do. 1877... ...	do.
175	do. 1878... ...	do.
176	do. 1878... ...	do.
177	The Marine Transport of Petroleum (Little) ...	The Author
178	Shakespeare,vol.1, Comedies	Robert Adam
179	do. vol. 2,Tragedies	do.
180	do. vol. 3, Histories	do.
181*	From Keel to Truck ...	Purchased
182	Mechanical Graphics (G. Halliday)	James Phillips
183	Strength of Materials and Structures (J. Anderson)...	Henry Prior
184	Steam and its Uses (D. Lardner)	do.
185	Electricity (Ferguson) ...	do
186	Millwright and Engineer's Companion (Templeton)...	do.
187	Service Chemistry (V. B. Lewes)	C. A. Crook
188	Bell's System of Geography	J. W. Richardson
189	do.	do.

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No.	Description.	Presented by
190	Bell's System of Geography	J. W. Richardson
191	do. ...	do.
192	do. ...	do.
193	do. ...	do.
194	Engineering, July to Dec., 1884	R. W. Kingswood
195	Scientific American ...	E. H. Minns
196	do. ...	do.
197	do. ...	do.
198	do. ...	do.
199	do. ...	do.
200	do. ...	do.
201	do. ...	do.
202	do. ...	do.
203	do. ...	do.
204	do. ...	do.
205	Chairman's Handbook (Palgrave)	C. Noble
206	Electricity and Magnetism (Dunman)...	do.
207	The Effects of Liquids on Iron (Phillips)	The Author
208	The Relative Corrosion of Iron and Steel (Phillips)...	do.
209	The Steamship,vol.1,1889-90	The Editor
210	Once a Week, vol. 4, 1867...	J. M. Gray
211	Harold, the Last of the Saxon Kings	Captain Angove
212	Lizzie Lorton of Greyrigg...	do.
213	Electrical Dictionary (Houston)	P. Macphail
214	Great Industries of Great Britain vol. 1 ...	J. W. Smith
215	do. vol. 2 ...	do.
216	do. vol. 3 ...	do.
217	Institution of Mechanical Engineers Transactions, '87	C. A. Crook
218	do. 1888	do.
219	do. 1889	do.

No.	Description.	Presented by
220	Handbook of Engine and Boiler Trials (Thurston) ...	W. Hossack
221	Handbook on Direct Acting Pumping Engines... ...	T. Drewry
222	Lectures on Electricity (Forbes)	do.
223	The Steam Engine Indicator &c. (Beamont)	do.
224	From Keel to Truck ...	A. Black
225	Marine Encyclopædia ...	C. E. Hudson
226	Weale's Quarterly Papers on Engineering, part 1	H. W. Holman
227	do. part 2 } Vol. 1	do.
228	do. part 3 } Vol. 1	do.
229	do. part 4 } Vol. 1	do.
230	do. part 5 } Vol. 2	do.
231	do. part 6 } Vol. 2	do.
232	do. part 7 } Vol. 3	do.
233	do. part 8 } Vol. 3	do.
234	do. part 9 } Vol. 3	do.
235	do. part 12 } Vol. 3	do.
236	Sound, Light, and Heat (Wright)	John Whyte
237	Kitty Trevylyan	do.
238	The Steam Engine (Cotterill)	Purchased
239	English Magazine 1886	J. Y. Lowe
240	Scribner's do.	do.
241	do. do.	do.
242	Electrical Engineering (Slingo and Brooker) ...	
243	Engineering, vol. 14, 1862	J. W. Bryden
244	do vol. 15, 1863	do.
245*	Transactions of I. Mar. E., vol. 1	The Council
246*	Illustrated Marine Encyclopædia	Purchased
247	Solutions to Engineers First-class Questions (E. J. M. Davies)	do.

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No.	Description.	Presented by
248	Treatise on Future Naval Battles (Admiral Elliott)...	M. W. Ruthven
249	The Scottish Nation, vol. 1...	P. Boyd
250	do. vol. 2...	do.
251	do. vol. 3...	do.
252	do. vol. 4...	do.
253	do. vol. 5...	do.
254	do. vol. 6...	do.
255	do. vol. 7...	do.
256	do. vol. 8...	do.
257	do. vol. 9...	do.
258	Dynamo-Electric Machinery (S. P. Thompson)... ...	M. C. Storrar
259	Charter and List of Members Inst. of Civil Engineers ...	D. Phillips
260	Minutes of Proceedings of Inst. of Civil Engineers vol. 63 ...	do.
261	do. vol. 64 ...	do.
262	do. vol. 65 ...	do.
263	do. vol. 66 ...	do.
264	do. vol. 67 ...	do.
265	do. vol. 68 ...	do.
266	do. vol. 69 ...	do.
267	do. vol. 70 ...	do.
268	do. vol. 71 ...	do.
269	do. vol. 72 ...	do.
270	do. vol. 73 ...	do.
271	do. vol. 74 ...	do.
272	do. vol. 75 ...	do.
273	do. vol. 76 ...	do.
274	do. vol. 77 ...	do.
275	do. vol. 78 ...	do.
276	do. vol. 79 ...	do.
277	do. vol. 80 ...	do.
278	do. vol. 81 ...	do.
279	do. vol. 82 ...	do.
280	do. vol. 83 ...	do.
281	do. vol. 84 ...	do.

No.	Description.	Presented by
282	Minutes of Proceedings of Inst. of Civil Engineers	D. Phillips
	vol. 85 ...	do.
283	do. vol. 86 ...	do.
284	do. vol. 87 ...	do.
285	do. vol. 88 ...	do.
286	do. vol. 89 ...	do.
287	do. vol. 90 ...	do.
288	do. vol. 91 ...	do.
289	do. vol. 92 ...	do.
290	do. vol. 93 ...	do.
291	do. vol. 94 ...	do.
292	do. vol. 95 ...	do.
293	do. vol. 96 ...	do.
294	do. vol. 97 ...	do.
295	do. vol. 98 ...	do.
296	do. vol. 99 ...	do.
297	do. vol. 100 ...	do.
298	do. vol. 101 ...	do.
299	do. vol. 102 ...	do.
300	Knight Errant (Edna Lyall)	F. Colsell
301	In the Golden Days (do.) ...	do.
302	We Two (do.) ...	do.
303	Hardy Norseman (do.) ...	do.
304	Won by Waiting (do.) ...	do.
305	Donovan (do.) ...	do.
306	Steam Boiler Construction (Hutton)	C. McEachran
307	The Steam Engine (D. K. Clark) vol. 1 ...	Geo. Wells
308	do. vol. 2 ...	do.
309	do. vol. 3 ...	do.
310	do. vol. 4 ...	do.
311	Transactions, I. Mar. E., vol. 2	Property of Inst.
312	Outside the Class Room (W. H. Bailey)...	do.
313	Elements of Mechanism (Goodeve)	G. W. Buckwell

No.	Description.	Presented by
314	Steam Boiler Construction (W. S. Hutton)	C. J. J. Jones
315	One and All(Duty of Richard Tangye)	Jno. Nicoll
316	History of Steam Navigation	Geo. Buckwell
317	Marine Engineer's Drawing Book (Lockie)	Jno. Lockie
318	Practical Engineer's Handbook	The Editor
319	Trans. Hull and District Institution of Engineers and Naval Architects, vol. 1 ...	The Council of the Institution
320	do. vol. 3 ...	do.
321	do. vol. 4 ...	do.
322	do. vol. 5 ...	do.
323	do. vol. 6 ...	do.
324	Trans. N. E. Coast Institute Engineers and Shipbuilders vol. 1 ...	do.
325	do. vol. 2 ...	do.
326	do. vol. 3 ...	do.
327	do. vol. 4 ...	do.
328	do. vol. 5 ...	do.
329	do. vol. 6 ...	do.
330	do. vol. 7 ...	do.
331	Enginering Magazine ...	Horace See, New York
332	The Century Magazine 1890	J. Y. Lowe
333	The English Magazine, 1885	do.
334	do. do. 1887	do.
335	Trans. Institute Mechanical Engineers, 1889	The Council of the I. Mech. E.
336	do. 1890	do.
337	do. 1891	do.
338	Naval Architecture (Scott Russell)	E. B. Caird
339	do. do. ...	do.
340	do. do. ...	do.

No.	Description.	Presented by
341	Scribner's Magazine— vol. 1, 1890	J. Y. Lowe
341a	do. vol. 2, 1890	do.
342	Electric Lighting for Marine Engineers	S. F. Walker
343	Manual of Marine Engineering (Seaton)	D. McMillan
344	The Steam Engine (Rankine)	do.
345	Ainsley's Engineer's Manual	do.
346	The Practical Engineer's Handbook (W. S. Hutton)	do.
347	Magnets & Dynamo Electric Machines (Esson)... ...	do.
348	The Theoretical & Practical Boiler Maker (Nicholls)...	do.
349	The Steamship, 1892 ...	J. Lockie
350	Ruthven's Jet Propeller ...	J. R. Ruthven
351	Biographical Treasury (Maunder)...	G. H. Gordon
352	Treasury of Knowledge (Maunder)...	do.
353	Triple & Quadruple Expansion Engines (A. R. Leask)	C. Slater
354	Transactions North-East Coast Institution, vol. 8....	The Council
355	The Atlantic Ferry (A. J. Maginnis)	The Author
356	Alfred Lord Tennyson (Arthur Waugh)	J. McLachlan
357	Manual of Marine Engineering (Seaton)	A. Campbell
358	10 vols. of Fiction—various	J. Phillips
359	Portfolio of Photos of Marine Engines, Boilers, &c. ...	D. Greer
360	Minutes of Proceedings of Inst. of Civil Engineers vol. 47 ...	D. Phillips

No.	Description.	Presented by
361	Minutes of Proceedings of Inst. of Civil Engineers vol. 48 ...	D. Phillips
362	do. vol. 49 ...	do.
363	do. vol. 50 ...	do.
364	do. vol. 51 ...	do.
365	do. vol. 52 ...	do.
366	do. vol. 53 ...	do.
367	do. vol. 54 ...	do.
368	do. vol. 55 ...	do.
369	do. vol. 56 ...	do.
370	do. vol. 57 ...	do.
371	do. vol. 58 ...	do.
372	do. vol. 59 ...	do.
373	do. vol. 60 ...	do.
374	do. vol. 61 ...	do.
375	do. vol. 62 ...	do.
376	do. vol. 103 ...	do.
377	do. vol. 104 ...	do.
378	do. vol. 105 ...	do.
379	do. vol. 106 ...	do.
380	do. vol. 107 ...	do.
381	do. vol. 108 ...	do.
382	do. vol. 109 ...	do.
383	do. vol. 110 ...	do.
384	The Atlantic Ferry (A. J. Maginnis)	J. Girvan
385	The Apostle of the Indians (F. P. L. Josa)	W. J. N. Brett
386	9 vols. of Fiction—various...	
387	Electric Light (Urquhart)...	J. McClelland
388	Electric Ship Lighting (Urquhart)	Purchased
389	Transactions of Institute of Marine Engineers, vol. 3	The Council
390	The English Imperial Atlas (J. B. Bartholomew) ...	Purchased
391	Marine Boiler Furnaces (D. B. Morrison)	Leeds Forge Co.
392	do. do.	do.

No.	Description.	Presented by
393	Atlas of Physical Geography (W. & A. K. Johnston) ...	Purchased.
394	Proceedings Institution of Mechanical Engineers ...	Inst. Mechanical Engineers
395	Engineering, 1891	Transferred from Reading Room and bound in Vol. form.
396	do. 1892	
397	Engineer, 1891	
398	do. 1892	
399	Spon's Price Book, 1892-3	Messrs. Spon
400	Practical Electrical Engineering vol. 1	A. Robertson
401	do. vol. 2	do.
402	The Works Manager's Handbook (Hutton)	
403	The Steamship, vol. 4 ...	J. Lockie
404	Engineering, Jan. to June '83	Purchased.
405	do. July to Dec. '83	do.
405a	Revue Maritime et Coloniale [Jan. to Dec. 1892	The Director of The French National School of Naval Architecture and Marine Engineering.
406	do. do. ...	
407	do. do. ...	
408	do. do. ...	
409	do. do. ...	
410	do. do. ...	
411	do. do. ...	
412	do. do. ...	
413	do. do. ...	
414	do. do. ...	
415	do. do. ...	
416	do. do. ...	
417	do. Jan. to July, 1893	do.
418	do. do. ...	
419	do. do. ...	
420	do. do. ...	
421	do. do. ...	
422	do. do. ...	
423	do. do. ...	
424	Proceedings Institution of Mechanical Engineers, [Feb. 1893	The Institution of Mechanical Engineers.

MALCOLM CAMPBELL MEMORIAL.

(*Trustees* :—Messrs. A. LAURIE, J. TAIT, J. ADAMSON.

LIBRARY CATALOGUE.

LOAN COLLECTION.

No.	DESCRIPTION.	LENT BY
1	Boilers (Deterioration of) ...	Jas. Adamson
2	do. do. Report	do.
3	Marine Engines, Modern American	J. H. Thomson
4	Marine Architecture (Charnock ... ... vol. 1	J. Adamson
5	do. do. vol. 2	do.
6	do. do. vol. 3	do.
7	Shipbuilding (A.F.B.Craize)	do.
8	Naval Architecture(D.Steel)	do.
9	Screw Propeller (J. Bourne, C.E.)	J. H. Thomson
10	Mercantile Navy List ...	Jas. Adamson
11	Society of Engineers, Transactions 1876	do.
12	do. do. 1879	do.
13	do. do. 1880	do.
14	do. do. 1881	do.
15	do. do. 1882	do.
16	do. do. 1883	do.
17	Mechanics' Magazine (Glasgow ... ... vol. 2	do.
18	do. do. vol. 3	do.
19	do. do. vol. 4	do.
20	do. do. vol. 5	do.
21	Pattern Making (Foreman Pattern Maker)	Campbell Trustees

No.	Description.	Lent by
22	Civil Engineers (proceedings) vol. 87	Jas. Adamson
23	Dictionary of Arts, &c. (Dr. Ure's), vol. 1	J. H. Thomson
24	do. do. vol. 2	do.
25	do. do. vol. 3	do.
26	do. do. vol. 4	do.
27	Microscopic Objects (Davies)	Jas. Adamson
28	Steam Engine (J. Bourne, C.E.)	do.
29	Engineering, vol. 1 } 1869	do.
30	do. vol. 2 }	
31	do. vol. 1 } 1870	do.
32	do. vol. 2 }	
33	do. vol. 1 } 1871	do.
34	do. vol. 2 }	
35	do. vol. 1 } 1872	do.
36	do. vol. 2 }	
37	do. vol. 1 } 1873	do.
38	do. vol. 2 }	
39	Dictionary of Engineering (Spons') .. ... vol. 1	A. Beldam
40	do. do. vol. 2	do.
41	do. do. vol. 3	do.
42	Carpenter's Guide (Nicholson)	Jas. Adamson
43	Engineer, Surveyor, and Architect	do.
44	Steam Boilers (Peattie) ...	do.
45	Strength of Materials (T. Box)	Campbell Trustees
46	Physics (Ganot's)	do.
47	Applied Mechanics (Rankine)	do.
48	Steam Engine do.	do.
49	Rules and Tables do.	do.
50	Lives of the Engineers, vol. 1 Smiles)	do.
51	do. vol. 2 do.	do.
52	do. vol. 3 do.	do.
53	do. vol. 4 do.	do.
54	do. vol. 5 do.	do.
55	Practical Engineer (Hutton)	do.

No.	Description.	Lent by
56	Works Manager (Hutton)...	CampbellTrustees
57	Marine Steam Engine (Sennett)	do.
58	Marine Engineering (Seaton)	do.
59	Valve Gears (Zeuner) ...	do.
60	Hydraulic, Steam and Hand Power	do.
61	Modern Steam Practice (Winton) vol. 1	do.
62	do. do. vol. 2	do.
63	Shipbuilding (Rankine) ...	do.
64	Engineers' Drawing (Le Blanc)	do.
65	Nautical Magazine, 1836 ...	Jas. Adamson
66	do. 1837 ...	do.
67	do. 1838 ...	do.
68	do. 1839 ...	do.
69	do. 1840 ...	do.
70	do. 1841 ...	do.
71	do. 1842 ...	do.
72	do. 1843 ...	do.
73	do. 1844 ...	do.
74	do. 1845 ..	do.
75	do. 1846 ...	do.
76	do. 1847 ...	do.
77	do. 1848 ...	do.
78	do. 1849 ...	do.
79	do. 1850 ...	do.
80	do. 1851 ...	do.
81	do. 1852 ...	do.
82	do. 1853 ...	do.
83	do. 1854 ...	do.
84	do. 1855 ...	do.
85	do. 1856 ...	do.
86	do. 1857 ...	do.
87	do. 1858 ...	do.
88	do. 1859 ...	do.
89	Boilers, Construction of (Traill)	CampbellTrustees

No.	Description.	Lent by
90	The Indicator (Richards) ...	CampbellTrustees
91	Treatise on the Indicator (Graham)	do.
92	Marine Propellers (Barnaby)	do.
93	Metals (Bloxam and Huntingdon)	do.
94	Chemistry of Metals(Thorpe)	do.
95	Chemistry Non-Metals (do.)	do.
96	Lectures on Electricity (Forbes)	do.
97	Practical Electric Lighting (Holmes)	do.
98	Dynamo Electric Machinery (Thompson)	do.
99	Casting and Founding ...	do.
100	Extra First Class Examination (Reed)	do.
101	James Nasmyth (Smiles) ...	do.
102	Duty (Smiles)	do.
103	Thrift (Smiles)	do.
104	Scotch Naturalist (Smiles)	do.
105	Life and Labour	do.
106	Industrial Biography (Smiles)	do.
107	Self Help (Smiles)	do.
108	Invention and Industry (Smiles)	do.
109	Character (Smiles)	do.
110	Round the World (Smiles)	do.
111	George Moore (Smiles) ...	do.
112	Robert Dick, Geologist (Smiles)	do.
113	Human Physiology (Landvis and Stirling)	do.
114	Outlines of Geology (James Geikie)	do.
115	Geograghy (Physical) old issue	do.
116	The Steamship, vol. 1 ...	do.
117	do. vol. 2 ...	do.

No.	Description.	Lent by
118	On the Human Understanding (Locke)	CampbellTrustees
119	Deterioration of Boilers, &c., vol. 1	James Girvan
120	do. do. vol. 2	do.
121	do. do. vol. 3	do.
122	Merchant Shipping, History of (Lindsay) ... vol. 1	CampbellTrustees
123	do. do. vol. 2	do.
124	do. do. vol. 3	do.
125	do. do. vol. 4	do.
126	Engineering, vol. 17 } 1874	do.
127	do. vol. 18 }	
128	do. vol. 19 } 1875	do.
129	do. vol. 20 }	
130	do. vol. 21 } 1876	do.
131	do. vol. 22 }	
132	do. vol. 23 } 1877	do.
133	do. vol. 24 }	
134	do. vol. 25 } 1878	do.
135	do. vol. 26 }	
136	do. vol. 27 } 1879	do.
137	do. vol. 28 }	
138	do. vol. 29 } 1880	do.
139	do. vol. 30 }	
140	do. vol. 31 } 1881	do.
141	do. vol. 32 }	
142	do. vol. 33 } 1882	do.
143	do. vol. 34 }	
144	do. vol. 35 } 1883	do.
145	do. vol. 36 }	
146	do. vol. 37 } 1884	do.
147	do. vol. 38 }	
148	do. vol. 39 } 1885	do.
149	do. vol. 40 }	
150	Inst. of Engineers and Shipbuilders in Scotland Transactions	Jas. Adamson
151	Steam and the Steam Engine (Evers)	do.

No.	Description.	Lent by
152	Thomson's Engineering Guide to Local Marine Board Examinations	Jas. Adamson
153	The Clyde from its Source to the Sea (W. J. Millar)	Campbell Trustees
154	The Steam Engine (Holmes)	do.
155	Joan, the Maid (a story of the 15th Century) ...	Mrs. Campbell
156	Science in Sport made Philosophy in Earnest ...	do.
157	In New Granada (W. H. G. Kingston)	do.
158	Annals of a Quiet Neighbourhood	do.
159	Discoveries and Inventions of the 19th Century	do.
160	The Giant of the North (R. M. Ballantyne) ...	do.
161	Count Renneberg's Treason (H. E. Burch)	do.
162	London Society, vol. 2 ...	do.
163	do. vol. 4 ...	do.
164	do. vol. 5 ...	do.
165	do. vol. 7 ...	do.
166	The Sixpenny Magazine, vol. 5	do.
167	Little Folks, vol. 11-12 ...	do.
168	Cassell's Family Magazine, 1884	do.
169	Tit-Bits, vol. 14	do.
170	Cassell's Saturday Journal, 1883-4	do.
171	do. do. 1884-5	do.
172	Family Herald, vol. 42-43...	do.
173	do. vol. 46-47...	do.
174	Whitaker's Almanack, 1887	do.
175	Engineer's Magazine, vol. 2	Jas. Adamson
176	Rules and Regulations Lloyd's Register	do.
177*	The Steamship, 1889-90, vol. 1	The Council Inst. Mar. Engineers

*Presented to the Malcolm Campbell Memorial by the Institute, unbound; and bound by the Trustees for the Library.

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178*	The Bailie, 1889	The Council Inst.
179*	Illustrated London News, vol. 95, 1889	Mar. Engineers.
		do.
180*	do. do. vol. 96	do.
181*	The Graphic, vol. 40, 1889...	do.
182*	do. vol. 41 do. ...	do.
183*	Iron and Coal Trades Review, vol. 39 ...	do.
184*	do. vol. 40 ...	do.
185*	Industries vol. 7 ...	do.
186*	do. vol. 8 ...	do.
187*	do. vol. 9 ...	do.
188*	Mechanical World, vol. 5 ...	do.
189*	Fairplay vol. 1 ...	do.
190*	do. vol. 2 ...	do.
191*	Shipping World vol. 7 ...	do.
192*	Engineer vol. 68 ...	do.
193*	do. vol. 69 ...	do.
194*	do. vol. 70 . .	do.
195*	Forth Bridge	do.
196*	Pen and Pencil	do.
197*	Practical Engineer, vol. 3 ...	do.
198*	Industries vol. 10 ...	do.
199*	Iron and Coal Trades Review, vol. 42 ...	do.
200*	The Graphic, 1891	do.
201*	The Illustrated London News vol. 98 ...	do.
		do.
202*	Engineer vol. 70 ...	
203*	do. vol. 70 ...	do.
204*	Engineering vol. 47 ...	do.
205*	do. vol. 58 ...	do.
206	The Elements and Practice of Rigging and Seamanship...	do.
		J. Adamson
207	Scribner's Magazine, 1889...	J. Y. Lowe
208	,, ,, do. ...	do.
209	English Magazine, 1883-4	J. Y. Lowe
210	The Century Magazine, 1889-90	Mrs. Campbell

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211	Leaves of a Life (Montagu Williams)	Mrs. Campbell
212	Jack Hinton (Lever) ...	do.
213	Burns' Poetical Works ...	do.
214	Everybody's Lawyer (Beeton's)	do.
215	Man of the World, 1889-90	do.
216	Shipbuilding — Theoretical and Practical	do.
217	The Practical Draughtsman (W. Johnson)	do.
218	The Steam Engine (J. Bourne)	do.
219	Whitworth on Guns and Steel	do.
220	Dr. Ure's Dictionary of Arts, Manufactures, &c. vol. 1	do.
221	do. vol. 2	do.
222	do. vol. 3	do.
223	Hopkinson on the Indicator	do.
224	Chamber's Etymological English Dictionary ...	do.
225	Elements of Machine Design (W. C. Unwin)	do.
226	Strength of Materials and Structures (Anderson) ...	do.
227	Bourne's Catechism of the Steam Engine	do.
228	Lessons in Elementary Chemistry (Roscoe) ...	do.
229	Engineer's Guide to Royal and Mercantile Navies ...	do.
230	18 vols. of Fiction—various	do.
231	English Review	J. Girvan
232	do.	do.
233	do.	do.
234	do.	do.
235	do.	do.

No.	Description.	Lent by
236	English Review	J. Girvan
237	do.	do.
238	do.	do.
239	do.	do.
240	do.	do.
241	do.	do.
242	do.	do.
243	do.	do.
244	*Trans. Inst. (Scotland) Engns. and Shipbuilders, 1889-90	Jas. Adamson
245	do. 1890-91	do.
246	do. 1891-92	do.

* Transactions of the Institution of Engineers and Shipbuilders in Scotland.

THE

INSTITUTE OF MARINE ENGINEERS.

Session  **1892-3.**

CATALOGUE

OF

PROPERTY

BELONGING TO THE

INSTITUTE.

The Freehold Premises, 58, Romford Road, Stratford, Essex, were purchased in the month of January, 1892 ; fitted and stocked for occupation, and opened for the use of Members in February, 1892.—The third anniversary of the founding of the Institute.

THE PROPERTY OF THE INSTITUTE.

Description.	Presented by
Coal Testing Machine	J. M. Gray (Member
Copying Machine	L. P. Coubro' do.
Chest for Papers, &c.	do. do.
Model—Morton's Radial Valve Gear	R. Bruce do.
Model--Dewrance's Patent Safety Water Gauge, also Drawing Book Case and contents Lent by	Messrs. Dewrance
Blackboard	Campbell Trustees
Whittell's Patent Slide-Valve Indicator	Purchased W. W. Wilson (Member
Ballot Box	Purchased
Two Occasional Tables ...	do.
One set of Chessmen and Board	do.
One set of Draught Men and Board	do.
Two Charts of Reynolds' Geological Diagrams (Coal) ...	do.
Certificate of Incorporation (in frame)	do.
Two Photos of Patent Improved Balanced Quadruple Expansion Engines	Messrs. Fleming and Ferguson
Photo of Steel Crank Shaft ...	Jas. Stewart
Photo of Iron Crank Shaft ...	do. (Member)
Engaving of Paddle Steamer *Sea Horse* Lent by	Jas. Adamson do.
Model of Screw Propeller do.	G. W. Newall do.
do.	W. G. Winterburn (Member)
Model of Patent Lubricator ...	F. W. Shorey (Member)
Model of Piston Ring and Spring	M. Prior (Deceased Member)
Two Models of Pistons ...	Jas. Adamson (Member)

Description.	Presented by
Post Office London Directory...	Purchased
Specimens of Pins, result of wear	W. J. Craig (Member)
Writing Case (Library) ...	Purchased
Specimens of Scale	Jas. Adamson (Member)
Drawings and Tracings (various)	do. do.
Book Case	A. Beldam do.
Stratford and District Directory	Jas. Adamson (Member)
Letter Weigher	Purchased
Model of Propeller	H. Prior do.
Bust Terra Cotta of the First President Inst. Mar. Engs....	A. Beldam do.
Green's Patent Nozzle ...	Messrs. Blyth
Ventilator Top...	J. H. Thomson do.
Roller Bearings for Tunnel Shafting Lent by	R. Leslie do.
Four Bottles containing test plates in Sea-water	D. Phillips do.
Drawing of Wilson's Patent Safety Valve	Jas. Adamson do.
Case of Asbestos samples ...	United Asbestos Co.
do.	Bell's do.
Reading Desk	G. W. Manuel (Member)
Photo of Marine Governor ...	J. D. Churchill do.
do. S.S. *Massilia* ...	H. Prior do.
do. Steam Snow Plough...	J. A. White do.
do. S.S. *Industry* ...	W. Wright
Print of Hitt's Patent System of Propelling Ships ...	A. J. Palmer
Small Model of Propeller ...	do.
Tracing, Lifting Screw S.S. *Britannic*	do.
One Photo of Direct Steam Windlass	Messrs. Napier Bros
One Photo of Aft Steam Steering Gear	do.

Description.	Presented by
Two Photos of Angled Barrel Steam Steering Gear ...	Messrs. Napier Bros.
One Photo of "Henry Bell" Bill (*fac-simile*)	do.
One Propeller Certificate (*fac-simile*)	do.
Engraving of Peter Denny, LL.D.	Mr. P. A. Denny
Photo of Engines S.S. Aden ...	Mr. F. White (Member)
One Case of G. H. Chaplin's "Diamond Packing" ...	G. H. Chaplin
One Case of Beldam's Patent "Metallic Packing" ...	The Beldam Packing Co.
Photo—*Clacton Belle*, Paddle Steamer	Messrs. Denny Bros.
Photo — *Princess Victoria*, Paddle Steamer	do.
do. do.	do.
Photo—*Duchess of Hamilton*, Paddle Steamer	do.
One large frame Tracing of Weir's Feed Heater ...	Jas. Weir (Member)
One large framed Tracing of Weir's Feed Pump	do. do.
One large framed Tracing of Weir's Evaporator	do. do.
One large Portfolio	Purchased
Stuffed Albatross	W. A. Purvis do.
Two nests of Weaver birds ...	J. Stewart do.
Model of Piston Packing Ring (Lockwood and Carlisle)	W. Blakey do.
Framed Photo of S.S. *Ormuz*—Engines	J. McSweeney
Photo (Lithographic) of the Paddle Steamer *Persia*, with Sections and Cross Sections...	Jas. Adamson (Member)
Enlarged Photograph of the S.S. *City of Paris*	John Adamson & Son (Rothesay)
Aneroid Barometer and Clock (Council Room)	Messrs. Chadburn

Description.	Presented by
Aneroid Barometer for Hall ...	H. Hughes (Optician, Fenchurch Street)
Curtains, &c.	Purchased
Cupboards	do.
One Official Seal and Press ...	do.
One Letter Copying Press ...	J. Thomson (Hon. Member)
One Hand Bell	do. (Hon. Member)
One Electric Bell, fitted ...	E. G. McKenzie (Assoc. Member)
Cribbage Board (complete) ...	A. Robertson (Member)
Six Photographs (collision cases)	Rait & Gardner
Flag Pole	Mrs. Thos. Adamson
Greenhouse	do.
Electric Fan	Lent by The Blackman Ventilation Co., Limited
Photo S.S. *Escort*	J. Stewart & Son
Photo Engines S.S. *Cynthia* ...	do.
Six Photographic Views ...	J. G. Hawthorn (Member)
Oil Painting, G. W. Manuel (Past President)	Members who are Chief Engineers P. & O. S. N. Co.
Album (Photograph)	W. J. Craig (Member)
Test specimens of Iron and Steel	D. Phillips do.
Casts of do.	do. do.
Photo S.S. *Scott*	A. G. Crichton do.
Furnishings (Council Room)...	Purchased
do. 1 (Hall)	do.
do. 2 (Library) ...	do.
do. 3 (Reading Room)	do.
Photo of Paddle Engines ...	J. Jobbling (Member)
Case containing Specimens of large Barnacles from Colombo	W. Lamont do.
Flag with Crest of Institute ...	Messrs. Livett, Frank & Co.

Description.	Presented by
Notice Board	Purchased
Photo of Launch of Steamer, broadside on	J. McLachlan (Paisley)
do. S.S. *Wear*	do. do.
Photo of Steam Trawlers ...	A. W. Robertson
Planimeter	D. McIntyre (Member)
Tea and Coffee Service ...	Purchased
Large Oil Painting (North Sea Fishing Fleet in a Gale) ...	Peter Denny, LL.D. (Past President)
Sword, Spears, and Arrows, &c., from East Africa	J. Stewart (Member)
Sword and Bayonet from Crimea	do. do.
Case Lindsay's Patent Packing	Messrs. Lindsay & Co.
Specimens of Copper Steam-pipe fitted with Pope's flanges and Denny's binding rings...	D. Brown (Member)
Portfolio of Drawings of Boilers and Engines	Editor of "The Marine Engineer"
Large Photo of the late Malcolm Campbell	Mrs. Campbell
Model of Edmiston's Feed-water Filter	Glasgow Patents Co.
Photo of Shaft repaired at Sea	J. Simpson (Member)
Two Oil Paintings (landscape)	J. J. Lowe do.
Two Photos Thornycroft's Water Tube Boilers...	J. Wing do.
Photo of Weir's Pumps fitted on board S.S. *Campania* ...	J. G. Latta do.
Small case Barnacles from Bombay	J. Riddle do.
Photo Portrait of James Watt	G. W. Manuel (Past President)
Table Linen and Towels ...	Purchased
Silver	do.
Cutlery	do.
Four Tables, Museum	do.
Furnishings, 5 (Billiard Room)	Purchased

Description.	Presented by
Furnishings, 9 (Museum) ...	Purchased
do. 7 (Hon. Secretary's Room)	do.
do. 8 (Hon. Treasurer's Room)...	do.
do. 4 (Tea and Coffee Room) ...	do.
Framed Portrait of Mr. John Tait	A. Morison
Two framed Photos of Engine Room, "Empress of Japan"	E. O. Murphy
Seven Photos. of Engine Works, Colombo	W. Lamont
Seven Photos. of ss "Austral" in Sydney Harbour (framed)	W. Birkett
Three Photos. of Pumping Engine in oak frame	J. H. Irwin

READING ROOM TABLE.

Description.	Presented by
The Graphic	Purchased
The Illustrated London News...	do.
The Marine Engineer	do.
The Steamship...	do.
Industries	do.
The Shipping World	do.
The Shipping World Year Book	do.
The Shipping Gazette Weekly Summary	do.
Engineering Mechanics ...	The Editor
The Engineer and Iron Trades' Advertiser	do.
Railway and Shipping Contractor	do.
The Bailie	A Subscriber
Pen and Pencil	do.

Description.	Presented by
The Iron and Coal Trades' Review	The Editor
The Practical Engineer ...	R. Leslie (Member)
The Mechanical World ...	
The Engineer	L. P. Coubro do.
Engineering	do. do.
Iron	Various
Fairplay	do.
Invention	The Editor
Newspapers	Various
Revue Maritime et Coloniale ...	French National School of Naval Architecture
Pamphlets and Papers (various)	Various
Hazell's Annual	Purchased
Whitaker's Almanack... ...	J.H.Thomson(Mem.)
The Steamship	The Editor
Lightning	do.
Transactions of the N. E. Coast Institution of Engineers and Shipbuilders...	The Council of the Institution
Transactions of the Hull and District Institution of Engineers and Naval Architects...	do. do.
Transactions of the Institution of Engineers and Shipbuilders in Scotland	The Council of the Institution
Transactions of the Ship Master's Society	The Secretary
Scientific Society's Year Book	Purchased
Specifications	Various
Magazines	do.
Newspaper Press Directory ...	Purchased
Liverpool Journal of Commerce	Purchased
Home Life	F. W. Shorey
The Indian Engineer	R. Adam
Engineer	The United Asbestos Co. (per favour of Mr. J. A. Fisher)
Engineering	do.