

# INSTITUTE OF MARINE ENGINEERS INCORPORATED.

Patron : HIS MAJESTY THE KING.

SESSION



1919-20.

President: LORD WEIR.

VOLUME XXXI.

## The Education and Training of the Engineer.

LECTURE

BY MR. A. P. M. FLEMING, O.B.E.

*Tuesday, February 18, 1919, at 6.30 p.m.*

CHAIRMAN: MR. A. BOYLE (Vice-President).

The CHAIRMAN: This evening we have a very important subject before us in the form of a lecture by Mr. Fleming on the Education and Training of the Engineer. It is a subject which, I venture to say, our members are exceptionally well able to discuss, and it is one of the principal aims we had in view when we founded this Institution and, in fact, I think it is one of the most important functions that the Institute claims to fulfil. Now education is a very big word, and we must first of all have an idea of what we mean by it. Education has been defined as the strengthening of the mind and body according to the ideal of the old Romans, familiar to all of us, a sound mind in a sound body, *sana mens in sano corpore*. I would like to add that all the work done by the Institute, all the lectures that have been given, all the papers that have been read, all the transactions that have been published, have all had a tendency toward the training and education of the marine engineer, and have been a real means of education in the very best sense of the word, that is an education in this sense embraces everything which assists in the progress of mankind towards a higher and a better life. I will not detain you longer, and have very great pleasure in calling upon Mr. Fleming to give us his lecture.

No attempt is being made in this paper to outline a suggested course of education and training of Marine Engineers, since the writer's experience has been of a character not sufficiently related to marine engineering as to entitle him to outline a programme having reference to Marine Engineers only. There appears, however, to be a considerable amount of experience common to the training of the Industrial Engineer and to the Marine Engineer. A consideration of the requirements of education and training for industrial engineering is an enquiry which will consequently be of interest to the Marine Engineer.

Education and training may be considered as fulfilling a two-fold purpose. In the first place, it must aim at preparing a youth, irrespective of his ultimate station in life, to earn a competence sufficient to meet his requirements of living in whatever standard of comfort may be necessary, and the education and training in this respect must have regard to the changing industrial conditions and developments of industry. The second requirement is to ensure that a man shall adopt a right attitude towards his fellows and accept the responsibilities of communal life. In this second case, due account must be taken of the changing social conditions of an organised community.

#### DIVISIONS OF ENGINEERING EMPLOYMENT.

In considering any system of training and education, account must be taken of the ultimate character of the workers' employment. It is possible to classify engineering employment into three broad grades, namely:—

(1) The rank and file and non-commissioned officers of industry, this grade including unskilled, semi-skilled and skilled men, foremen, assistant foremen, charge hands, etc.

(2) The first and second lieutenants of industry represented by the junior staff in an industrial organisation, which may include those positions relating to technical, commercial, and research work and works administration.

(3) Industrial staff officers, namely, the senior positions of the four divisions indicated in class (2).

While it should and always will be desirable to make provision whereby a boy starting in the rank and file can rise to the position of field-marshal in industry, there must also be provision for the full training of boys who are enabled to start at a higher point than the very bottom. In illustration of this,

reference might be made to the recent Admiralty plan whereby it is no longer necessary for boys at the age of 12 or 13 to commence at Osborne, but may, if they obtain a suitable secondary or public school education, enter at a correspondingly higher level at the age of 17 or 18.

It will now be convenient to consider each of these broad grades separately.

#### RANK AND FILE.

Since the well-being of the community depends on industrial prosperity, it is necessary that the most intelligent youths and those inherently best fitted should fill the ranks of industry. Moreover, such youths should be suitably trained to be efficient producers. They should possess a knowledge of the economic principles which underlie industrial production and developments; appreciate the scientific laws pertaining to their trade or vocation, and be susceptible to intelligent supervision and guidance. This involves careful selection, and is followed by sound practical training in the workshops and a good continuation education. Finally, if the youth is to discharge the duties of citizenship in a desirable manner, opportunities must be provided which will enable him to obtain the largest measure of self-development, self-realization and self-knowledge.

#### SELECTION.

The question of selection is one which is too often settled largely by demand and supply. There has also been an unfortunate tendency on the part of those who often influence the choice of a boy's vocation, to direct the most intelligent and able youths into non-productive and non-industrial vocations. Probably the argument advanced on this point is that the intelligent boy does not make the best workman. However, this dictum is contrary to industrial experience, which shows that invariably the more intelligent the boy the more efficient is he as a workman, and always it is the best workman who makes the best citizen.

If the supply of labour is meagre, inducements must be provided to attract the best type of youth into industrial employment, and these inducements, wherever possible, should be opportunities for wide and substantial training. The inducements having been provided and a large number of juveniles consequently found, sound selection of these should be undertaken.

To a very great extent, selection can be undertaken on the educational record of boys and a full consideration of the views of those who have had him under supervision during his primary school education. Such boys usually enter works direct from the primary schools. There are increasing facilities whereby boys may continue their education until they reach the age of 15 or 16 in Higher Elementary, Junior Technical or Secondary Schools, and then enter industry at a later period. However, it will be noted that where boys reach the limit of their primary school education at the age of fourteen it is undesirable to debar them from entering works by a rule that boys should be at least of the age of 16. Such a policy would tend to debar many desirable youths from entering the ranks of industry.

At present, considerable importance is attached to the interviewing and supervising of juveniles, and in view of this fact, in each works there should be at least one member of the staff to undertake this duty. However, it is hoped that more scientific methods of testing a youth's fitness for a trade on psychological lines may be carried into effect. These scientific methods of selection of boys entering industry can do much to prevent misfits which always result in discontent and unrest.

#### PRACTICAL TRAINING.

Youths entering industry in the artisan class may be divided in a two-fold manner, namely:—

- (1) Semi-skilled or unskilled workers;
- (2) Those who have capacity to become skilled manual workers.

As regards the skilled trades, it is probably not over-stating the case to say that for some considerable time past the quality of training imparted to boys has been steadily decreasing, and apprenticeship has tended to become apprenticeship in name only. With the increasing tendency to subdivide operations and the increasingly intensive methods of production, it is very difficult to shape a wide and comprehensive training. Also in large works, it is very difficult to be sure that each apprentice is thoroughly grounded in the practice of his trade. Neither foremen nor workmen will undertake the training of apprentices as the former not only have administrative duties, but are, often not the best workmen themselves, and the latter are often unwilling to teach boys as they are paid on a piece-work basis.

To overcome these difficulties, it is the practice in some works to have skilled instructors, who deal with each boy in turn in the different trades. In America and on the Continent a good deal has been done in the way of establishing special works, in which apprentices spend the whole or part of their apprenticeship carrying on productive work, but doing it under instructional conditions, where output is not a determining factor. Notable examples of this are at the General Electric Company, Schenectady; Westinghouse Company, Pittsburgh; Siemens-Schuckert, and Ludwig-Loewe, of Berlin. Whatever the method, there are more or less distinct stages through which an apprentice's practical training proceeds. Firstly, the apprentice begins to adapt himself to his environment and learns to recognise the principal machine tools and trade terms. Then he begins to acquire knowledge of the use of these tools and processes, and attains a degree of accuracy and workmanship requisite to the trade. The next step is that in which he develops speed so as to give the requisite rate of production, and with growing experience, some fundamental operations become more or less automatic, leaving the mind of the worker free to consider the best sequence of movements which will effect economy in time and effort. The final stage is one in which the apprentice's training should be broadened by contact with other trades, and his experience enlarged with a wider range of processes and tools.

Considering the semi-skilled and unskilled workers, while not as much can be done to improve their training as in the case of a skilled worker, yet the principles of economy can be imparted, resulting in a reduction of effort on the part of the worker and an elimination of unnecessary fatigue. In the case of these occupations, youths should be of the best type available to carry out that work. Continuously during the progress of the youths who do not reveal any capacity for more than semi-skilled or unskilled work, a careful examination should be made of them with a view to discovering any late developments which may take place in them rendering it possible to effect their transfer into more responsible and more skilled work.

No scheme of practical training carried out under modern conditions can be successful unless accompanied by suitable instruction which embodies the scientific principles underlying trade processes. The possible applications of science in industry are continually increasing, and there is in addition an

ever increasing accumulation of trade knowledge which should be assimilated by the juvenile worker, and can only be absorbed through the channels of an organised system of continuation education.

#### CONTINUATION EDUCATION.

Up to the present time, the only type of continuation education available for young people engaged in industry has been that available from evening Technical Schools. Through the operation of these arrangements many young people who would doubtless have been manual workers all their lives have been enabled to rise to superior positions and undertake in many cases definite technical positions as a result of the training supplied in these evening schools. However, the only persons able to take advantage of technical instruction are those who have innate capacity to undertake technical employment. On the other hand, a large number of youths who enter industry, probably as many as ninety per cent. will remain manual workers all their lives. The instruction provided at Evening Technical Schools is not of distinct benefit to a boy who will remain a manual worker all his life, and there is practically no form of instruction hitherto available to young persons in industry to assist them to become good and capable workmen.

A system of continuation education must be provided for the benefit of the boy who will become and remain a workman.

Evening instruction will always stand condemned, as not only are the boys required to interest themselves in the instruction that is given at the end of a working day when they are physically fatigued, but the teachers themselves and for the same reason are in nowise fit to administer such instruction. Means whereby instruction is given in the day time would in all cases be provided. Such instruction should be designed to enable boys to appreciate all matters concerned in the organisation of industry.

Under the operation of the 1918 Education Act, it will become necessary to provide continuation education during forty weeks in the year for a period of eight hours per week for boys and girls between the ages of 14 and 16, unless they undergo full-time instruction during this period. It is therefore possible for instruction to be given by employers in works subject to certain conditions as to character and efficacy of the instruction, or on the other hand, as will be generally the case, the instruction may be given in Continuation Schools provided by

the Local Education Authority for this purpose. Many industrial firms in the kingdom who have realised the present deficiencies of education in relation to boys training as manual workers have inaugurated Continuation Schools attached to their works.

Perhaps the advantages and disadvantages of the works school can be best seen by giving an illustration of the general working of this plan of training, and for this purpose a description of a school such as that of the British Westinghouse Company will suffice.

This Company is engaged in general engineering manufacture, and has about 10,000 employees, of which number about 3,000 are women. Among the 800 or 900 youths under the age of 21 years there are about 400 bound apprentices engaged in 14 different trades. These apprentices attend the school on the works premises for about five hours each week. In the early stages their general education is continued, but with an industrial bias.

This instruction includes sketching and reading of blue prints, and some fundamental notions of industrial economics are put before the apprentices. Later they are taught the scientific principles underlying their different trades. Those who are entering the electrical trades are given a broad working knowledge of electro-magnetic phenomena. They are instructed in the characteristics and preparation of the materials they use, the manufacturing processes, and the development of shop tools. In the final stages of the school work, experts from the shop, including leading foremen, give trade demonstrations and lectures to the apprentices, each in their several trades.

The lecturers are drawn from the Company's staff, and most of them are university graduates. The future lecturing staff will, to a large extent, be drawn from leading apprentices who have shown some aptitude for teaching, and who are being specially trained as junior teachers, for ultimate use as senior lecturers.

One of the objects of introducing foremen into the scheme is not only to teach the foremen, but also to bring about a close contact between them and the apprentices. This contact removes the diffidence which many of the apprentices feel in approaching the foremen with their difficulties.

The boys are paid at their normal rate of wages during the time spent in the school, and all books, stationery, etc., are

provided. Each year 20 boys are sent to the Manchester Municipal School of Technology for the day-apprentice course; these youths being selected partly on their works school record and partly from shop records, and by such means provision is made for the upward mobility of able apprentices.

Much care is used in the proper selection of apprentices, not only in their initial admittance to the works as apprentices, but in allocating them to particular trades, for the importance of a scientific selection of workers is fully realised. To this end psychological tests are being carried out in order to obtain data upon which to base an ultimate psychological examination for the determination of inherent qualities and aptitudes of individual apprentices. It is believed that by such means much latent ability will be turned to account and workers will, to a greater extent than is often the case to-day, be used on that work which demands their maximum ability.

As might be expected, the inauguration of this scheme meant a certain amount of dislocation of industrial processes. These difficulties, however, have been surmounted quite well, and while some opposition was found at first from the foremen, the attitude is now quite reversed, and preference is given to those boys who have been in the school, partly because of the more intelligent interest they show in their work. Further, time spent in school is well distributed, and each boy returns fresh to his work.

The advantages of a works school over a central school—to which boys from a group of works could be sent—lie in the minimum dislocation of manufacturing processes; in the minimum of time lost in getting to and from work; in the effective hold of the lecturer on the boys' interest, by the knowledge of the details of each boy's work; in the incentive to learn from the use of examples all having a definite bearing on their work; in the establishment of the closest possible connection between the boy who will be the workman of to-morrow, and the instructor who will be the manager of to-morrow; in this direction ensuring the most promising possibilities of industrial peace for the future.

In realising the full development of an apprentice's education it is impossible, as has been earlier indicated, to separate his life as a worker from his life as a potential citizen, and the social side of his character must not be over-looked. In this



connection the works school serves as a natural focus for social-welfare development work. It constitutes the bottle neck through which all the apprentices pass, and one in which each apprentice can be studied and his characteristics appreciated.

In the case of the British Westinghouse Works School, a Trades Apprentice Association was formed, and in working out its programme every effort has been made to encourage apprentices to do as much as possible for themselves, this principle being one of the laws of good citizenship. To this end each class in the trade school elects its own representative to a Trade Apprentice Council, which, with a democratically elected chairman and secretary, carries out the details of the social programme of the Apprentice Association. This Association has planned and developed such activities as summer camps, football and cricket, boxing, lectures, whist drives, dances, concerts, amateur dramatic performances, the publication of a magazine, etc., and all expenses are met by the apprentices themselves, who make each week a small contribution to their Association. Apart from social activities, the Apprentice Association virtually serves as a tribunal for dealing with petty misdemeanours. A boy is dealt with much more effectively by his colleagues than in any other way.

The social side of apprentice life, just as the educational side, has the effect of bringing them into closer companionship with young men of the staff, who will be the future managers; and as has been shown earlier, this association between the future managers and the future workmen cannot fail to be the most beneficial means of establishing industrial co-operation.

#### THE HIGHER STAFF.

Considering the supply of suitable men for entry into works with a view to them being trained to ultimately occupy the higher staff positions in industry, it is essential that special importance be continuously attached to the fact that since they will ultimately occupy technical positions rather than positions where manual skill is required, technical training should be of primary importance in their career, and practical experience the second consideration. For the junior positions, men may come direct from the Secondary Schools and the Public Schools into works. In such cases a course of works training would on an average be of four years' duration, and would be spent in obtaining manufacturing, testing and office experience, and concurrent with this practical training, provision must be made

for a systematic course of technical instruction. At the outset of the course, technical instruction may be administered through classes held in the evening, but as the course advances, this procedure should be replaced by part-time day technical instruction. In such cases a distinct incentive to effort can be provided by holding out to the student the opportunity of day-time facilities upon the successful completion of an evening course of study. Men trained in this manner will ultimately occupy positions in industry as junior engineers, senior draftsmen, commercial correspondents and certain executive positions in the shop organisation. It is becoming more and more desirable to inaugurate the appointment of better technically trained men as shop foremen than is common practice to-day, and by a right ordering of the works and technical training of men from secondary and public schools, a suitable supply of possible foremen should be forthcoming.

In the case of men who will occupy the senior positions in industry, it is most essential that a sound technical training should be provided. This can be obtained by either a full-time university course or by sandwiching full-time university instruction with practical shop experience. The man who is trained technically at a university must then supplement such experience with practical shop training, and in general, a two year course of practical training is sufficient for the university trained man. In so far as ultimate employment in industrial engineering undertakings is concerned, the technical graduate will specialise in one or three main branches, namely:—

1. Engineering design and research, involving the design of apparatus and technical research incident to manufacturing methods and materials.
2. Works organisation, involving the administration of industrial enterprises.
3. Commercial engineering, involving the control and operation of the selling organisation.

For higher positions it is essential that in the above three branches of employment, a man should be possessed of a very sound technical training for the reasons which have already been enumerated.

No detailed ruling can be laid down for the system of selection to be applied in appointing the higher staff, but in general, selection should be based primarily upon the possession of staying power, good moral character and physique, and these

qualifications should be considered with no less earnestness than his academic scientific attainments.

CONCLUSIONS.

Reviewing the foregoing analysis of the education and training of engineers, certain points stand out primarily, and to these special importance should be attached. In the first place, neglecting any special requirements of the sea-going engineer, it is a matter of primary concern that a rigid selection should be made among the larger supply of youths applying for entry into the engineering profession, of only those boys who appear to have mental, moral, and physical capacity for availing themselves to the utmost of the course of training provided. While the methods of physiological and psychological selection are at present too obscure to permit of their widespread application, they may nevertheless be introduced from time to time by way of experiment. However, eventually, psychological methods may have a distinct industrial value. In the second place, sound selection should be the forerunner of systematic and suitable training. In this connection, continuation education should be specifically related to a boy's daily work, and it should become possible to build up a liberal continuation education on a boy's daily work as a foundation. If he belongs to the rank and file, there is ample scope for this education to be directed towards making him a better workman and worthier citizen. If he is suitable for training for higher positions, continuation education should bear on such subjects as industrial administration, management, and the underlying principles of commercial organisation. Furthermore, it is of the utmost importance that employers should take an enthusiastic interest in education and training, not only because it enables them to secure the best human material and helps them to turn it to best account, but it is a responsibility in a national sense. Hitherto the education of men for industry has been left largely in the hands of educationalists. In future, there must also be a strong co-operation of both labour and management.

It must never be forgotten that the primary aim of education is to develop the latent powers of the individual, and to turn these capacities to maximum account in training desirable citizens. While it is necessary to first teach a boy how to make a living before teaching him how to live, it is none the less important to ensure that he is educated so as to use wisely his opportunities for the development of his whole being.

The CHAIRMAN: I am sure we have all listened with the greatest attention and pleasure to the very interesting things that Mr. Fleming has had to tell us. There were many points that could be expounded at great length and which would take up a great deal of time to deal with at all exhaustively. I could not help being struck with the arrangements that are made now to give every boy, no matter what his position or that of his parents, a thorough training and education, and it makes me feel that I was somehow born fifty years too soon. In my days a boy was not trained properly speaking, at all, he was left to just pick up his knowledge when and where he could and was absolutely dependent on the kindness and goodwill of the journeymen or the foreman to get any insight at all into the whys and wherefores of things. There was no talk of an act compelling those in control to send him to school for eight hours a week for forty weeks in the year then, and the night schools which were in existence were greatly handicapped because the boys who attended them were already tired by a day's work. It is very hard on a lad to expect him to attend school after his day's work. Many did it of course and got no harm, but it was a lot to expect. I think it is one of the finest things imaginable that arrangements should be made whereby a boy can get instruction in his working hours by men who are thoroughly competent to teach him. I should like to hear what other members think of the scheme outlined to us by Prof. Fleming, speaking in the light of their own experience. We must constantly bear in mind that the boy whose training and education we are discussing to-night will be the men who must defend the British Empire in the future and, bearing that in mind, we cannot but realise the importance of the subject. Perhaps Mr. Hawthorn will make a few remarks, as he is well qualified to speak on these matters.

Mr. J. G. HAWTHORN: I must congratulate the Institute on the presence of Mr. Fleming to give us this lecture on the education and training of the engineers of the future. The Institute should be considered as the headquarters for the training work of the marine engineering profession. I remember twenty-seven years ago we had a paper on this subject, and our Hon. Secretary was in the chair. We had expressions of opinion from the late J. McFarlane Gray, and J. A. Rowe, and a very lively discussion ensued. That evening I outlined a scheme for the training and methods of education to be adopted for the profession of marine engineering. Like our chairman I feel

that I was born too early. In my youthful days when we joined the works in which I served, we were put in charge of the leading fitter, who received three shillings extra for the trouble he spent on us. We had first of all to learn the names of the different tools and materials and spent two years and six months in the fitting shop. Then we spent six months in the boiler shop, six months in the blacksmith's shop, six months in the foundries, and the rest of our time in the drawing office, getting an idea of the work there. During the whole period we were left pretty much to our own resources, and there were only two afternoon classes in the week and two in the evening—the latter being voluntary.

I have been engaged in the educational training of young marine engineers for the past thirty years, and have had over five thousand through my hands. From this experience I can endorse what the lecturer has said in regard to the folly of leaving the training of the young men solely in the hands of the foremen, as there is frequently a lack of sympathy between the foreman of a shop and the apprentice. The foreman regards the boy as a machine and thinks it is his duty not to teach him as much as possible, but to get as much work out of him as he can. A foreman is selected because he is a good workman, not because he is an educationalist, and the best workmen are not always the best teachers. In many instances the foreman is a man of no great education himself, so that often there is a want of sympathy between him and the educated boy. I have three sons who are engineers. I sent them to school with the idea of making them engineers, as I believe that this is the right principle. When the boys have got a hold of the rudiments of the education, associated with the business they intend to follow, it is important that they start training in their special branch as soon as possible. A boy can learn at school something of the materials he is going to use, so that he will be far more receptive when he comes into the works for the first time. It is obvious that it will do the bootblack no harm to know something of the composition of the blacking he uses, and that it will certainly be useful to the bricklayer to know the composition of the bricks with which he builds. We must educate and train our boys so that they are ready to become apprentices. The boys should be put together and the man who has charge over them should have a scientific as well as a technical training. We want to get as much out of the boys as possible, but in order to this end the relations between the employer and apprentice must be sympathetic,

and it is not always so. Many employers do not fully realise that their apprentices are the engineers of the future, and that work and money bestowed on their training is well invested. We must have ever before our eyes that it is the duty of the engineer of to-day to see to it that the engineer of to-morrow is a better man than he is. Do we not at the present day put too much value on mere work-shop training? My experience teaches me that the very best training that we can afford our boys consists of fifty per cent. pure practice and fifty per cent. theory, and we must make them see how the one is subordinate to the other. We must bring into close conjunction the one with the other, mind and matter. The boy who has not been taught the constituent parts of the materials he uses must lack the feeling of interest that he ought to possess for his trade. It is only by such teaching that we can give the boy an intelligent love for his job. Our young marine engineers ought to be trained more expressly for their special job in their time in the shops ashore. The young men should have a good notion of marine engines before they go to sea; the ordinary shop experience is not enough. A young man has only eighteen months at sea and then he can go in for his second certificate. I would have three certificates with eighteen months between each.\* In passing, I should like to pay a tribute to those who are endeavouring to raise the standard of marine engineers. I think it is a step in the right direction. While it is admitted that the Royal Navy engineer is as a rule better educated generally and technically, I will not go so far as to say that he is as highly skilled mechanically as the mercantile marine engineer, but do we not need men of better general education in the merchant service, so as to enable them to bring a greater fertility of resource to bear on the problems and defects that so often arise at sea. Who were the men who brought the marine engines to their present state of perfection? Not men trained only in the shops, but men who have also studied the theory of mechanism. The triple expansion engine, the turbine, all the great improvements of late years have come from the thoughtful and the educated engineers whose training has embraced designing and construction. The shop training is not sufficient to stimulate ideas for improvement and advancement without some knowledge of theory and established rules of mechanism.

We must instill a love of their work into our young men, and the only way to do that is to educate them in their work. Let

---

\* This was advocated by the Institute in January, 1893. See Vol. IV. of Transactions.

them understand the problems that have been solved and they will turn with a good heart to those that await their own energies.

MR. CARLTON SMITH: It is with some diffidence that I speak. I am indebted to the previous speaker for the information he has given us and the suggestions he has offered, and should like to know whether these have been embodied in any of the present schemes for the training and education of the marine engineer. At the works where I am employed at Bedford we have a scheme of apprenticeship extending over two years, and the lines our system follows are very much those outlined by Mr. Fleming. There are three classes of apprentices, very similar to those he has detailed, recruited respectively from the Universities and Technical Training Colleges, the Secondary Schools and the Elementary Schools. As regards the personality of the apprentices I would like to point out that our chairman of directors interviews each applicant for apprenticeship before he is finally admitted, and that a close watch is kept by the directors and managers upon his career throughout. There is a special tutor on the staff whose sole duty it is to look after the apprentices and this is, of course, a necessity, for naturally the director himself cannot afford the time. The tutor has quite sufficient to occupy all his time in looking after the lads and is helped by apprentices who come from the University. I should like to hear other examples of classes and schemes existing in connection with other mechanical engineering firms. What has been said about a council of apprentices is very interesting, and it is good to know that this scheme has been successful. The system followed by our own firm differs from that followed in many, in that, in their case, no money is taken for the instruction which is given to apprentices in the higher forms of engineering. In our works a premium has to be paid by the engineer-apprentice as in contradistinction to the ordinary, or trade apprentice. Much has been said against the premium system. It has been often said that the employer who takes a premium for training young men is neither a good patriot nor a good business man. To my mind there is much to be said for the system, and my experience of it has certainly been favourable. The premium system is a means of attracting a higher class of apprentice and is, in view of the contract between apprentice and employer, I think, only fair. It must be remembered that a conscientious firm is put to great expense by the training of its apprentices. In order to properly supervise and train them there must be a

specially appointed man who has himself had a sound training, then there is the loss of the foreman's time in the shops and the fitting up of the school. The premium has also a moral effect on the apprentice, for the lad knows that his apprenticeship has been paid for, and will therefore value it more highly and endeavour to get as much out of it as possible. If you are going to do away with the possibility of a man giving his son a better opportunity than others and are going to make concessions to everybody and start every one equal, then you are going to rob men of one of the greatest incentives to work for success in life, for surely the idea of gaining advantages for his family is one of the very greatest incentives. I think those who have had long experience of premium systems would agree that they would be ill-advised to give it up. I think that the two systems, the premium and the non-premium apprenticeship, can exist side by side as they do at present. I have been greatly interested in the lecture and should very much appreciate some remarks on the various systems by the marine engineers present.

Mr. F. M. TIMPSON: For the difficulty of getting the right class of apprentice, our present education system is to a very great extent responsible. Most of the education authorities have at their command scholarships which enable them to send a small percentage of the boys, the most intelligent of course, to the secondary schools. The ordinary average boy leaves school with just the ordinary board-school education and leaves at fourteen years of age. Now he is too young to enter a works, and so for two years he runs around, in most cases doing some odd job in which he learns nothing, and then at sixteen, having had two years in which to forget most of the little he did learn at school he comes along to the works. I agree that our boys should have some training before they even enter their apprenticeship. The L.C.C. are, I believe, experimenting with trade schools, which they run alongside the ordinary schools, but this is not sufficient. What we want is trade schools everywhere. We do not commence to train our lads for their trade or profession early enough. With regard to the different classes of apprentices, we have been told of the system by which the boy has a technical training and enters half-way-up so to speak. Personally I do not believe in the half-way-up system. Step by step is surely a better principle. If you will look around I think you will find that there are far more cases of people who have been stranded "half-way-up" than there are of those who began at the bottom. As regards the premium apprentice, I would



like to point out that in this case the master practically has to keep the boy whether he is good or not. Some of these apprentices break the heart of the foreman because he cannot get rid of incompetents. No, let us do away with the premium system, for what we all want is reward by merit, and that is not the way to set to work about getting it. There is a great deal of room and an increasing call for the trade school, and I am sure these are the lines we must follow if we are to make progress. Frequently parents come to me and ask advice as to leaving their sons at school, and I always say don't leave him too long or he will be too far on in years before he arrives at the journeyman stage. We certainly need better education and we need to have that education more specialised. First we want the mechanic and then the engineer. If you commence to train the boys earlier then you avoid the real hardship to them of having to attend classes at night.

Mr. W. G. TAYLOR: I was glad to hear Mr. Fleming's reference to the Education Act. When you examine what has been done in the past you can take credit to yourselves for being the framers of the Education Act. For when you look back at what has been done by engineers you see that they started the trade school long before the educational authorities took up the idea, and also that of the schooling in work hours. It seems to me that our job is to educate the educationalists. You now find all sorts of theories of the teaching of engineering and kindred subjects and most of this is due to Sir Joseph Whitworth, who appreciated the value of a training on these lines and so gave these subjects prominence and gave impetus to their discussion and teaching. With regard to the Education Act perhaps Mr. Fleming is not aware that it provides that within seven years of its enactment every apprentice must receive 320 hours technical instruction per annum. Many firms are building technical schools at which the apprentice must attend twenty-six weeks in the year, and in comparison to this the Education Act looks very small. Many great firms have made tremendous advances in training and education generally, and the small firms, which because of their size have lacked the initiative will follow suit when they see that it obviously pays to give the best training possible. A boy has two great interests in life, work and sport, and if these do not occupy him then along comes the inevitable alternative mischief. We must interest our boys in their work, and if they are interested then work becomes sport and the demon mischief will be scotched, but the ordinary

school curriculum does not appeal sufficiently to a boy. Keep him studying away at geography and all sorts of things he doesn't take an interest in and you cannot expect him to work. The best thing to do with the average boy between 16 and 18 years of age is to teach him at his work. Put the lad into a mechanical shop and let him follow his own bent. If he can hammer away he will be happy and his natural curiosity will lead him to nose round and ask questions, and he will learn far more in this way than he would do if he were kept at school. In consequence of the demobilisation there are many boys unemployed in London at present, and one of the conditions of their receiving unemployment benefit is that they attend the day schools and in consequence these schools are in a terrible quandary, for they are more than the teachers can manage, and I believe there have been several riots. Now when these boys were at the works there was not this difficulty with them. They were quiet and happy. What do they want to know about Shakespeare and history! What they want to do is to let off steam, and the best thing to do with them is to give them a hammer and chisel and let them let off their steam on some lifeless object instead of letting it off on the living teacher. In the Education Act I see no solution of this question, and I think we can take credit in the profession for what has been done in the past, and we shall find that before the Act can become a working proposition a revolution will have to take place in the minds of the educationalists, and I hope that the time will come when these gentlemen will realise what the boy of 14 to 16 years of age really wants. I am not a marine engineer and do not know how apprenticeship and sea training is arranged.

Mr. J. H. ANDERSON: Can the marine engineer be trained under the system put forward to-night? In a big works there are comparatively few skilled mechanics in the whole place, the majority are just labourers and semi-skilled workers. The apprenticeship serves his time in a shop in one of these big works and is limited to what he can pick up there and what he is taught like a parrot. Is this system going to turn out as good a man as the old one, where he had to do everything for himself and worry out for himself the principles of things, whereas to-day books and machines will do everything! With all the education you can give in the modern shops and the technical training, can a man who has been through it cut the body of the keyway of the shaft to get it home?

The CHAIRMAN: Of course now there is not so much manual work done, but any young man going to sea must have had some engineering training. A superintendent engineer would not accept a man who had had no training, and you must remember that when he does go to sea it is only as junior, and the efficient working of the ship does not in any way depend on him. Now turning to education generally there is one thing that we must bear in mind: education embraces technical training, but technical training does not embrace education. Whatever helps the progress of the race is important, and do not let us lose sight of the fact that the duty and function of education is not to turn out engineers but to turn out men. I am glad to learn that so much attention is being given by employers to the welfare of the lads, and that they are giving them opportunities of learning things which in my time they could only have learned with the greatest difficulty. An engineer must have some mechanical aptitude, but far and above that he must know the scientific side of his business. It is quite amazing how ignorant men can be of the materials with which they work. I remember talking to a man who had certainly had no technical training, but was supposed to have had a good general education, and when I told him that cast iron, wrought iron and steel were all different treatments of the same material he would not believe me and held that they were different elements. Now the possibility of such ignorance does not say much for the education system under which he had been brought up. I don't suggest that any engineer could be as ignorant as that, but you would be amazed at the ignorance that engineers do display sometimes of technical details.

Mr. HAWTHORN: This is a big subject, and when we see the lecture in print and can digest it at our ease many points which might well serve for discussion will doubtless occur to us, and so I suggest that we adjourn the discussion.

Mr. FLEMING: As our Chairman has said the tendency toward efficiency is evidenced everywhere. We must not, however, forget in our schemes the present reduction of hours of labour. Such reductions can result, if properly realised, in increased efficiency if work is properly organised and if the longer hours of leisure are rightly employed. The shorter hours place on us the responsibility not only of teaching the boys in their working hours, but also of giving them a lead as to what to do with their leisure. I was very interested in what Mr. Hawthorn said, but I think the day of the very broad character of apprenticeship

training that he outlines are over. There will always be lack of sympathy between the boys and their foremen unless some very active steps are taken to counteract this tendency: even then the trouble will be mitigated rather than completely removed. The introduction of foremen as demonstrators in a works-school helps to remove the barrier between themselves and the boys to a great extent. I quite agree with Mr. Hawthorn where he says the desirability of having a highly educated man to take charge of the boys. A suitably qualified apprentice-master should be appointed by every works employing a large enough number of boys to justify this official. Mr. C. Smith raises the question of the premium apprentice. Personally I am not in favour of the premium system of apprenticeship, but I realise that it is a matter that every firm must settle for itself. We are opposed to it in our firm because we do not want to exclude any boy just because he cannot pay for his training. On the other hand a maintenance allowance is paid during apprenticeship, and a scholarship system is in operation whereby suitable boys are enabled to proceed to whole-time University education. These young men will ultimately occupy the higher staff positions, and the firm will be well repaid for their training. Mr. Timpson does not want the boy to start half-way up the ladder. I would agree with him provided every boy could obtain a sound scientific training during the day time and not have to receive it in the very unsatisfactory way of attending evening schools. With regard to the boys wanting an outlet for their surplus energy we find that the Apprentice Council can very adequately deal with all such matters. Educationally it is much more desirable to control boys by a system of self-imposed discipline than by any outside source of control no matter how carefully designed the latter may be. Mr. Anderson enquired if the scheme of training outlined in the paper could be applied to the training of marine engineers. I think it can be applied, and with very little difficulty, provided a sound and comprehensive training is administered, any such scheme can be readily adapted to suit special needs.

Mr. A. F. CORNS: I should like to move a vote of thanks to Mr. Fleming for the way in which he has illuminated this very wide subject for us. There is certainly room for improvement in our training. In the case of apprenticeship the master or foreman is usually blamed if it was not a success. I had fifteen to twenty premium apprentices under me, and I offered to give them regular evening instruction. They accepted eagerly, but

they soon lost interest and dwindled away until in a week or two they were all too busy to attend. I know of other firms which have organised night classes, but the boys will not attend. I think the boys should be compelled to attend classes and to pass examinations in their work every year. I do not think in the ordinary shop they pay sufficient attention to the scientific side of engineering. The apprentice seems to think that all he has got to do is to become a good fitter.

Mr. A. H. MATHER: I have pleasure in seconding the vote of thanks. I am sorry Mr. Fleming's scheme provides for three classes of apprentice, because I hate the water-tight compartment idea. What we want is for every boy to have an opportunity of passing out of one class into a higher one.

---

### Awards.

We have been notified by the Board of Trade Marine Department that the Silver Medal for gallantry in saving life has been awarded to Mr. John Nicol, the chief engineer referred to in the December issue of Transactions, pp. 279-280.

Mr. JOHN A. CRAIG (Member) who was awarded the Royal Society Medal in 1916, was specially commended for his devotion to duty and received an award in recognition of this, on the occasion of the torpedoing of the *Szechuen* (China Navigation Co.).

---

### Election of Members.

Members elected at the Meeting of the Council held on 4th March, 1919.

#### *As Members.*

Thomas Ambler, 30, Redcliffe Gardens, Ilford, E.

Archibald Edwin Boyd, 67, Claremont Road, Sefton Park, Liverpool.

Frank Coles, "Windrush," Oak Tree Road, Silehurst, Berks.

George Elliott, 54, Copthall Gardens, Twickenham.

Neil Lang, c/o Douglas S.S. Company, Hong-kong.

George Manson, Stafford House, 28, Trinity Road, Birchfield, Birmingham.

Albert Edward Millward (Ch.A.E., R.N.), H.M.S. *Hind*, G.P.O., London.

#### *Graduate.*

John Ford, 36, Brownhill Road, Catford, S.E.6.

#### *From Graduate to Associate-Member.*

A. F. C. Timpson (Capt., R.E.), 4, Coventry Road, Ilford, E.

