EDUCATION GROUP DISCUSSION

The Marine Engineer

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INTRODUCTION

In this short paper the author is concerned with the examination of three main aspects relating to the marine engineer, namely training, status and prospects of advancement.

The paper consists of two sections.

The first section considers the above aspects prior to the year of 1950.

The second section reviews these aspects in more detail from the year of 1950 to the present time, and further attempts to analyse possible trends for the future.

Of late the subject of training has received considerable attention, but it is felt that a more overall picture embracing the related subjects of status and prospects, with particular reference to past progress and future trends, may provoke interest and could be of value.

The author fully realizes that many of the later views put forward are highly controversial and may receive some considerable criticism. In this respect there is no apology offered save to emphasize that all statements and suggestions made are the personal observations and views of the author only.

In this paper the main object is to stimulate interest and provoke discussion with the ultimate aim of improving the three given aspects for the marine engineer of the present day and the future. The subject of the marine engineer as chosen is not to be judged on strict definition but rather on the necessity of keeping within the sphere of personal experience and is, therefore, limited as such to the merchant service engineer officer.

Section I

Training

It is sufficient for the purpose of this section if one considers these aspects in relation to this century. The fine record of engineering progress is fully appreciated from the early nineteenth century and this early era of marine engineering receives, and fully deserves, honourable record.

In the early part of this century training consisted almost solely of practical workshop training. The normal apprenticeship of five years duration was in the main served in the workshops of the marine engine builder and the journeyman fitter then went directly to sea.

At this time the marine propulsive plant consisted of steam reciprocating engines and Scotch type boilers. The journeyman fitter had to receive a repair and watchkeeping training to supplement his practical training, in all probability achieved on the construction of this very machinery. By diligent application to a short course of study in elementary mathematics and the like, together with engineering knowledge, the engineer could, in most cases, satisfy the Ministry of Transport (then Board of Trade) examiner and eventually obtain the First Class Certificate of Competency.

The introduction of the marine oil engine almost coincided with the commencement of the National Certificate type courses in technical education. From this point complexity of engine rooms increased rapidly and the standard of theoretical knowledge required increased in proportion.

The ten years after the first world war saw big industrial changes in the industry on shore and at sea. On shore the increasing use of electricity and power machinery helped to improve efficiency and working conditions of shops and yards which were busily engaged on replacement of the severe war-time shipping losses. At sea the development of the steam turbine, watertube boiler and oil engine continued together with the application of oil fuel burning equipment and the increasing usage of electricity and refrigeration plant. The effects of such progress were advantageous in reducing manual labour immensely and improving working conditions, so that the engineer could develop skill at the expense of brawn, and show thereby a marked increase of status.

The years preceding the second world war, so aptly called the ten lean years, produced almost total stagnation for the whole marine industry. Training development more or less remained static, as indeed did almost everything else. Apprenticeships in marine engineering were very difficult to come by in the great shipbuilding areas which were gripped in depression. The Juvenile Instructional Centres and Industrial Estates served only to keep some young men occupied and off the street corner. The impending war and restart of work with the new contracts exposed the first real shortage of apprentices and hence potential seagoing marine engineers. The shortage of marine engineers was very grave during most of the war years and meant many an untrained marine engineer in service at sea.

The first post war years saw a sudden surge of the tide which had built up for some fifteen years and production, technical advances and educational standards accelerated rapidly.

The intake engineer in these latter years now varied considerably in ability. On the one hand a good practical fitter with little theoretical knowledge, and on the other a proven engineer possessing the Higher National Certificate and having some drawing-design office experience to supplement his workshop service. In the latter stages a certain few marine engineers were the product of "sandwich courses" often being trained theoretically to degree standard.

Considering then the training of the marine engineer prior to the year of 1950 the following main factors emerge:

1) The shipowner was supplied with a sufficient quantity of trained practical engineers of various standards of theoretical and practical ability, for most of the period under consideration.
2) The shipowner contributed no direct financial assistance towards the training of his future engineering personnel.
3) Practical training of the future marine engineer was the sole responsibility of the shore employer.

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4) Theoretical training of these engineers was based almost wholly on National Certificate schemes having a mechanical engineering basis. Study and theoretical development was largely voluntary on the part of the apprentice and often depended in addition on the outlook of the shore employer.
5) In the main the subjects of electrotechnology, naval architecture and basic engineering knowledge (particularly from the aspect of safety at sea) had not been broached to the intending junior engineer officer.
6) The Ministry of Transport (formerly the Board of Trade) conducted the qualifying examinations for marine engineers, the regulations being subject to revision and amendment as was found necessary.

Status

In the earliest days the status of the marine engineer on shipboard was exceptionally low. Improvements in every respect have served to raise that status until by the mid twentieth century the standing of the engineer on shipboard was fairly high in most cases. The author feels that in this respect the marine engineer of today owes a tremendous debt of gratitude to his predecessors and other persons who fought a long, and sometimes bitter, battle to effect the improvements that are clearly evident in more recent times.

However, this consideration of status is not to be judged by comparison with shipboard personnel but should be viewed from the aspect of engineering as a whole, in all its branches.

In the earlier part of this century there was a continuous supply of seagoing engineers. The shore employer, usually ship and engine builder, had no desire to retain the services of the young keen journeyman fitter and the only outlet for these young men was a sea career. There was no restriction on numbers of apprentices and it was also common practice to terminate employment on completion of apprenticeship. The constant intake of young men to the industry thus assured at the completion of apprenticeship a large exodus to sea service.

On completion of qualifying sea service there were insufficient openings and little prospects for the first class engineer who had a desire to leave the sea save a return in most cases to the fitting bench or erecting bay. The pay differential between sea and shore employment was sufficient to keep men, both certificated, and frequently uncertificated, in service at sea, irrespective of status and conditions on board ship. Thus the status of the marine engineer in comparison with other qualified engineers was deplorably low and Certificates of Competency were in most cases of little value to a prospective shore employer, except as testimonials to a number of years sea service. Shipowner and shore employer continued to receive this large influx of personnel up to almost ten years before the second world war. The depression years restricted development and retention of a post was the first requirement. Apprenticeships were rare except for the lucky ones and no intake or wastage problem was present to the shipowner.

In the thirties standards were slowly rising and some few young men of good education were serving apprenticeships with the object of embarking on a sea career. Some shipping companies required prospective employees to have a proven record of successful part time technical education. The scope of shore employment widened very slightly at this stage and these marine engineers were sought after by a limited number of shore employers. The so called wastage from the Merchant Service was no real problem up to the second world war! What wastage there was, was taken up in the majority of cases by the industry for a small variety of posts ranging from a return to fitting bench work, supervisory and maintenance posts, etc., and in the minority cases of better qualified technical men to certain few technical staff posts.

The first post war years saw a big improvement in status on shipboard and some steady improvements in shore trends. The shore employer now had a desire to retain the services of his "bright young men" for drawing and design office work The shipowner had taken to promotion, with staff authority, of his engineers to superintendent type posts. Status showed a pronounced rise as theoretical standards of marine engineers continued on the up grade. National Service requirements thrust a fairly large number of young men of Higher National Certificate standard into the Merchant Service who would otherwise perhaps have remained ashore. Many engineers who had served throughout the war at sea now moved ashore in large proportions to a variety of better class posts in a developing shore industry, such as drawing offices, power stations, certain classification societies, etc. The release of engineers from the Merchant Service in the years just after the war following the wartime conscription again produced a renewed shortage of seagoing marine engineers. The number of certificated men in service declined considerably from the pre-war state and this trend continued. The effect of post-war National Service conscription was difficult to assess. It seems probable that recruitment into the Merchant Service and short term service was assisted by the call-up of the young journeymen, more especially in the case of the better technically qualified young men.

Thus, status, at least in the main, had reached a better level than previously, and at this stage the following points emerge:

1) The supply had definitely become less than the demand and the well qualified journeyman had no real desire to leave his good post in shore employment.
2) The requirement of obtaining and retaining a good class of marine engineer for the complex engine plants had become more difficult to meet.
3) Wastage back to shore employment of qualified personnel after completing some five years service, and reaching the end of National Service commitments, had started to become serious.
4) Improvements in accommodation, pay rates, holidays, status, etc., did not appear to offer incentive for staff to enter, or remain, in sea service.
5) A slightly wider range of better class posts had become available and there was a little more recognition of the marine engineer by shore industry in general.

Prospects of Advancement

Most points relating to this aspect have been covered when considering the status of the marine engineer. Prior to the Second World War the choice available to the marine engineer was, in the vast majority of cases, fairly clear. Either (a) to remain at sea with a reasonable environment and a high standard of living, or (b) to leave sea service and accept a lower standard of living dependent on the post available. The post available to the marine engineer with the First Class Certificate was usually a return to the type of post held previous to sea service. In this respect, in the period from the twenties, a National Certificate held prior to embarking on a period of sea service, which was a rare case, seemed to be more advantageous than any Certificate of Competency on the return to shore employment. The Extra First Class Certificate was the aim of a number of ambitious engineers both before and after the war. Such qualified men entered the Ministry of Transport, classification societies, management or superintendent type posts, etc., to serve with great credit and often to occupy key positions in the marine industry today.

It is certain that a large exodus of qualified personnel to a great variety of posts took place in the latter stages of the period under consideration. The first requirement for most better class posts with prospects ashore was the possession of a National Certificate. Sea service and possession of Certificates of Competency as a marine engineer were required for a small proportion of posts in the vast engineering industry. The majority of prospective employers were largely ignorant of such certificates and therefore did not assess much value to them; this was possibly due to a new generation of employers.

CONCLUSIONS

The method of training had remained more or less standard from the practical viewpoint over the half century.

The more complex machinery of 1950 with the more varied types of propulsive designs meant that the journeyman engineer might not have seen any such equipment whilst serving his apprenticeship. It was evident that this was a democratic profession where there existed a large differential in theoretical ability, varying from a small proportion of degree standard intake to a large proportion of intake of no proven ability. However, the general average intake in the latter stages was disappointing from the two considerations, practical and theoretical. The practical training had either been neglected altogether, resulting in a poor class of craftsmen, or the new intake had no knowledge whatever of the equipment on board. The theoretical training of the intake was below standard considering the increasing scope of technical educational part time study schemes.

Status on shipboard had risen steadily so that by 1950 the engineer commanded respect and was, in most cases, in a position of authority. However, comparison with shore standards for similar professional engineers, e.g. civil, mechanical, electrical, etc., showed that the marine branch was still very much the poor relation in the engineering family tree.

Prospects of advancement depended largely on training and status. Whilst the range of intake into the profession remained with such a variable quality factor, the judgement from external sources could only be, at best, the general average, which did not compare with intake into other similar branches.

Advancement and vacancies on shore were still very limited and proven ability at comparison level with other branches, i.e. National Certificate type work carried out during apprenticeship, was more advantageous than the possession of marine qualifications and experience. Some so-called wastage after completion of sea service was, and presumably always will be, inevitable in this profession.

For the purpose of this paper, status and prospects of advancement must for comparison be broadly judged from the viewpoint of the engineer leaving sea service. This would not imply that it need be the majority or that this considered engineer leaving sea service would in any way be superior to the engineer who remains at sea.

Both aspects must be good for those at sea and for those leaving the sea. Leaving the sea service should not entail any reduction of a drastic nature of status or prospects below the other equivalent shore professions. Consideration of the factors involved in this trend towards leaving sea service is shown later in the paper. Vast industrial change and technical advance has been evident in this half century; the coal fired Scotch boiler to the nuclear reactor and the steam reciprocating engine to the gas turbine and rocket. However, it would seem that the development of the marine industry has lagged behind the general development somewhat and a little less conservatism and a little more imagination could improve efficiency and accelerate progress.

Section II

Training

This commenced on the same lines as previously but in 1952 a major change was introduced with the Alternative Entry Scheme involving engineering cadetships direct with the shipowner. Thus any discussion in this section must now be related to what shall be classed as Basic and Alternative Schemes.

Basic Scheme

The scheme continued as it had in the first part of the century but the standard of intake after reaching a peak tended to fall rapidly. Shore employers now made every effort to retain the services of their best apprentices and the number of National Certificate type journeymen proceeding to sea tended to decline. Also the standard of practical training of the intake appeared to have fallen to a low level. It may be summed up that while the best of this scheme was very good indeed the worst was very poor, which with the limitation of good quality intake lowers the overall standard theoretically and practically, so that by the late fifties the standard was not high. Coupled with this trend, the wastage of certificated officers from sea service continued, and personnel was at this time a very critical problem for those engaged in the staffing and maintenance of engine rooms. The number of engineers with the First Class Certificate in sea service has shown a continuous decline from the pre-war condition over twenty years ago. Men in service with the Second Class Certificate are still at this time in very short supply. The intake of junior engineers had continued to be unsatisfactory especially in quality factor. With the ending of conscription in sight it seems very probable that numbers will decline even more and what is equally disturbing is that the better qualified young men of National Certificate type will now not come to sea and the intake quality will be poor indeed.

A big improvement from the practical viewpoint may be the full acceptance by the industry of a compulsory form of pre-sea training. This scheme of training has been applied for about two years and should be of definite value.

Every Basic Entry, irrespective of theoretical ability, should receive some form of pre-sea training of about one hundred and fifty hours duration. This course of training should be concentrated on factors of safety, such as fire on shipboard and similar subjects, combined with a simple overall explanation of the basics of elementary engineering knowledge.

The ideal course syllabus includes a short fitting course on small marine machinery, running laboratory experience on engines and boilers, blackboard type instruction of different machinery types and typical circuits and a strong grounding in safety at sea. For those students with no other study commitments in the last year of apprenticeship such a scheme could operate on a thirty week basis of evening or part time day release of about five hours duration per week.

A preferential arrangement would probably be a full time concentrated course of five weeks at thirty hours a week just before the apprentice takes up his sea appointment. With advantage any such course can combine the technical instruction with visits to marine engineering works, dockyards, fire stations, etc., with the object of seeing the machinery at first hand. Any such courses must require a high standard of attendance and qualifying examinations on course completion may be regarded as essential.

In the above respects it may be relevant here to make a plea for a more definite contribution by the prospective sea employer to the training of these Basic Entry apprentices. The industry in general should also attempt to collaborate more closely with the local technical colleges. Facility for inspection, supply of information and recognition are still not what could be desired. The pre-sea training scheme for example, is not regarded with any degree of status by shore employers. Certainly there is room for much closer liaison between technical college, industry on shore and shipowner, to improve training and assist in possible research.

Alternative Scheme

The scheme since introduction has been a source of much controversy and discussion at all levels in the industry. Opinions as to merit and de-merit seem to be closely divided. One thing is certain, some positive step had to be taken to improve training technique as the marine industry developed. This scheme whilst possessing faults was at least such a step in the right direction. After some eight years' experience, and at the time when the first of this intake is about to take the

First Class Certificate examination (M.O.T.), it is now possible to analyse the advantages and disadvantages. In this respect the author wishes to state that he is in favour of this scheme and the criticisms offered are intended to be constructive and not destructive and are intended to put the subject in proper perspective. First, considering the students personally, the following three main points emerge:

1) The intake is largely of matriculation (General Certificate of Education) standard and the student is in the main good material of high potential. In the interests of the industry this high intake standard must at all costs be maintained.

2) The sea service introduction as Phase Two in the middle of the training scheme does not seem a good idea in retrospect. Many of the apprentices (or cadets) show a marked change in mental attitude in this period at sea. Reversal of conditions between sea and shore produces an adverse effect. The students return having picked up bad habits from various sources, both practical and social. Seemingly this is too early an age to send these students to sea in the engineering department of a ship. Workshop service appears to need extension at the expense of this sea service which could with advantage be re-phased to the end of the scheme.

The apprentice is not popular at sea mainly through no fault of his own but as the result of a total lack of fitting type of experience and also a not too surprising reaction from the staff of older basic trained engineers on board against this form of student training. In many cases this results in a very poor standard of training being effected during this period. The student himself often adopts a "know-all" attitude of theoretical superiority which aggravates the situation and is most disturbing as the student often quickly develops along these faulty lines. A number of the student apprentices return to Phase Three of the scheme with the one fixed object of finding an easy way out of their commitments to their employer, and to leave the sea. Phase Three in the workshops of industry is often not successful due partially to the aforementioned reasons and also due to the fact that the shore employer has no direct interest in the apprentice's future. This latter point possibly, has been the most serious factor, more especially in this period of little shipping activity.

However, it may be pointed out that the student apprentices who survive these difficult periods without change in their mental attitude of approach have presented themselves at technical colleges and the Ministry of Transport for the Second Class Certificate and in many cases have left an excellent impression.

Be this as it may, the final product of the scheme is too often disappointing and in view of the initial high potential the decay cannot be blamed solely on the apprentice but on a fault in the training scheme. Attention to, and correction of, this fault is essential now before the senior serving engineers and the marine industry regard this new personnel as "too clever" and take steps accordingly.

3) The initial student intake largely has a schoolboy outlook and must be moulded very carefully with sufficient discipline at the start, otherwise they are easily tempted along wrong paths. Any attempt to foster the ego of these young men, in the sense that they are in any way superior to other marine engineers, is seriously wrong and must be drastically avoided.

Considering next the precise training of these apprentices the following three main points emerge:

1) The overall pass rate for diploma is usually good being over 60 per cent. Every attempt must be made to stiffen the course against a lower intake standard. The general standard of the diploma must be maintained and assessors must make every effort to keep this standard at such a level that it will be received with full status by all grades of the engineering industry. Quality should always be the deciding factor and numbers should not be judged as vital. A high quality intake ensures a good quality output in the long term and flexibility here can only produce detrimental results. Some opinion appears to favour a reduction of standards and a rise of numbers in a lower grade stream. However, in the opinion of the author there are quite enough standards, at least at the present time. The industry has great difficulty in coping with the practical training of the two present schemes and any flooding of the market could produce highly detrimental results. When the present schemes are adequately covered a further alternative may be considered, but if a lower grade course is considered it would require to be divorced from the present Ordinary National Diploma level. Large numbers of lower grade apprentices are not likely to do the industry any real credit in the long term view.

There seems to be a weakness in mathematics in a greater number of cases than would be expected in view of intake quality, and perhaps in this respect a little more attention to applied rather than the pure mathematics, without lowering the standard, may be considered. There seems to be a general weakness in the subject of English language in engineering students of all types. The Alternative Entry students are no exception, which is disappointing and this weakness is deserving of particular teaching attention.

2) There is a definite danger of teaching these students as operators and not engineers. This is insidious and can undermine the profession. A tendency to train these students in the most advanced engineering subjects such as advanced metallurgy, fluid treatments, automation, etc., in the apprenticeship stage is very apparent. This is all very well but engineering knowledge, like any other subject, should be study-graded so that the student should be firmly and concientiously grounded in engineering basics and the advanced work should flow in a natural gradient at a later date. This type of training is first and foremost as an engineer in the widest sense and not a particular ship specialist training.

It is advisable to remember that every ship is not as yet a fully automated super tanker and yet each and every ship, no matter which type, presents much knowledge to the searching engineer. The author is all for advanced type machinery installations and training accordingly, and does not wish to stand still or step back. However, teaching during apprenticeship should be based on the student receiving a thorough understanding of engineering knowledge principles rather than the erroneous but undoubtedly more glamorous idea of teaching advanced prospective machinery and plant. A uniform engineering knowledge gradient is advisable with the ultimate standard fixed by the ships in service and the requirements of the Ministry of Transport qualifying examinations. There are more triple expansion steam reciprocating engines still in service than gas turbines and this point should be borne in mind during the early part of the basic training at least and should be kept under review.

3) The exemption from M.O.T. certificates is an excellent idea which has in the past worked in a most satisfactory manner. The problem of how much exemption to give was difficult to assess in every respect and a compromise solution of so much, but no more, appears best. The question is posed that this scheme of Alternative Entry has too much share of exemption and one certainly feels that this is indeed the case.

Remission of practical sea service should, it is felt, not be decided by the candidate's pre-sea theoreti-

cal ability. Every equally trained practical journeyman engineer, no matter what his theoretical proven ability, should have an absolute minimum of eighteen months fixed sea service to qualify for each certificate, and Alternative Entry trained engineers should be no exception to this rule. Lack of practical sea watchkeeping experience today is often rightly stressed and eighteen months seems a reasonable minimum.

Exemption from a section of Part B of the M.O.T. examinations has never been given to any student before the introduction of this scheme. Electrotechnology and naval architecture taught during apprenticeship, irrespective of standard, is largely forgotten by the age of twenty-three and it is felt that this exemption given to the Alternative Entry Scheme should be withdrawn. It is also felt that the exemption from Part A of the Second Class Certificate on a subject for subject basis for National Certificate and National Diploma holders is fair to all students. There should be no exemption from Part B of the Second Class Certificate and no exemption at all from the First Class Certificate for each and every candidate. In this respect there is a very unfair comparison at present whereby O.N.D. does exempt from the First Class Part A, where as O.N.C. does not. Some opinion considers that failures in O.N.D. should almost automatically be awarded the O.N.C. on the basis that O.N.D. work at certain levels reaches A.1 standard. In the author's opinion this is wrong and it is considered that the external O.N.C. is a very difficult syllabus and examination which is often falsely under-rated in comparison with internal O.N.D. Any Alternative Entry student who does not qualify for the diploma should have the initiative and ability to take the Part A Second Class Certificate without stretching the regulations to suit the case.

Many eminent people in the marine industry may agree or disagree with the latter points relating to qualifying sea service and examination exemption. However, while exemption is recognized as proven incentive, it is felt that exemption from half the Second Class Certificate is adequate. It is time for further discussion and possible amendment to the M.O.T. regulations to produce equality between the two training schemes. Both Basic and Alternative Schemes have points for and against, but both deserve continued attention and improvement. Each scheme it seems, is to operate from now on, and this is as it should be, but no prospective marine engineer should receive undue advantage by his initial choice of training.

Before ending this section on training it is felt that it would be in order to introduce at this stage some short comment on the system of examination, method of study, etc., and attendant problems relating to the Certificates of Competency as viewed from the teaching aspect:

1) The marine student is in the main a good student. Considering the long lapse from theoretical work and the varied theoretical standard the student usually shows great determination and application to study to what must be to him, most difficult work. With the long course of study now required it would seem advisable for the student to register for tuition between early September and early May so as not to clash with holiday commitments of colleges and M.O.T. examinations. In the engineering knowledge subject the students are very keen. Lectures in this subject have to adopt a compromise, firstly to prepare the student for examination and secondly as the less important factor, to encourage the student to learn a little about the more modern trends in engineering practice.
2) The Ministry of Transport examinations receive considerable criticism from some of the people concerned with the teaching of engineering. In this respect these criticisms come from those persons who have little detailed knowledge of the candidates, examinations or attendant problems. The Ministry of Transport does, in practically every case, an excellent job of work and few people realize that some forty-six examinations a year are set and marked, a most difficult task compared with any other examination authority.

   One minor criticism offered in good faith is that there appears to be a creeping rise of standard in the engineering knowledge papers which would appear to be based on the better class student rather than the general average student ability.
3) The present system of study leave and unemployment benefit arrangements is in need of reconsideration. There appears to be little realization of the study time required for the preparation of students for the certificates. For those taking the whole Second Class Certificate the normal study time required is four months for Part A and three months for Part B, the time required for the First Class Certificate is three months for Part A and three months for Part B. Above average students may require less preparation time but again, other students require longer; the aforementioned times are a general average.

   An unfair comparison at present is that one student receives the same time limit for one subject as another receives for the full examination. Some correlation being shipping companies, unemployment authorities and technical college time requirements, is indicated to reduce confusion and correspondence involved. It is appreciated that the shipowner cannot be expected to support any such long full study pay rate agreement. It is regretted that in the interests of the industry that the scheme has to be allied with unemployment at all.

   As a possible basis for discussion it is suggested that a graded scheme of half pay for a maximum of six months should be studied with no unemployment consideration, if possible. Three months could be allowed for one part of the examination only and less time for one subject attempts. Any student qualifying in less time would have the incentive of a balance payment and those students taking longer would have to rely on their own resources.
4) Some Alternative Entry candidates show a pronounced weakness in the subject of engineering knowledge and also in their understanding of their own ship equipment. As has been already stated, the qualifying sea service seems a little too short. A second factor is also apparent, that of too rapid promotion on completion of apprenticeship. Each junior grade of engineer on board ship usually has a specific duty or responsibility allocated to him. These specific duties in gradual promotion constitute a valuable training and source of knowledge. If, as appears the case, the Alternative Entry engineer is missing or being hurried through these junior grades, it will probably have a detrimental result in the senior grade. The textbook cannot be a total substitute for practical experience.

Status

Status has continued to rise slowly over the last ten years and the trend is certainly in the right direction, although there is still some way to go to achieve a completely satisfactory position. This Institute has done much towards improving status and the sharp rise in membership of such a professional body is most encouraging. However, this effort by the Institute should be maintained and increased at every opportunity. It is disappointing to note that the Institute appears to take insufficient interest in examination assessments and status thereby. The problems of the O.N.D. (Alternative) from the examination viewpoint, etc., seem to have been left largely to the Institution of Mechanical Engineers which

on face value seems a surprising fact, and an opportunity missed.

The Alternative Entry Scheme presents engineer cadets on board ship for the first time. This poses a new problem of training, status and discipline on board ship for the engineers in charge and progress is being watched closely. It is hoped that serving engineer officers in the senior grade will do their utmost to maintain and improve shipboard status with this new introduction. The associated problems however, are many and varied, and regrettable present indications in too many cases are not too favourable in this respect, this requires close attention.

The shipowner too, at this time has many problems and in these difficult times a little more loyalty and service from sea staff is definitely needed. The pendulum of equality has swung a little too far, and a sense of proportion is needed by employees. Many points in this paper have been advocated with a view to improving the service conditions of engineer officers, but it has been assumed throughout that a spirit of collaboration exists between staff and employer. On these latter points a fully applied compulsory company service contract scheme may be of benefit to employer and also to status and outlook of staff. Status of the marine engineer compared to his equivalent chartered engineers, using shore employment comparison, still requires improvement. The status-time graph for this profession must, by our efforts receive a sharp upward trend. It may be in order now for this Institute to stiffen the professional requirements for corporate membership somewhat so as to improve status, etc.

Prospects of Advancement

Wastage into industry ashore has continued at a high rate over these latter years. Staffing problems became critical for most shipping companies about 1954. There are a fairly large number of shore vacancies for staff leaving the sea but vacancies in senior professional type posts in marine engineering are not usually abundant and the scope for the well qualified ambitious marine engineer coming ashore is still limited to lower grade posts. It would be an advantage if the general engineering industry would adopt a more realistic attitude to a qualified marine engineer and realize his possible potential and capabilities. Shipping companies should encourage the training of their personnel financially and also make a greater effort to achieve a more personal touch in any relations with the sea staff. Refresher courses in industry and technical college should be encouraged and some attempt made to create a greater number of consultative type posts on the shore staff on a direct time-ability promotion basis. Very shortly some of the first of the Alternative Entry Scheme engineers will qualify for the First Class Certificate. This will submit the scheme to its most crucial test. If these men are content to stay at sea, which appears to be doubtful, will conditions in engine rooms and the status of the engineer be improved or the deficiences of practical experience be exposed? Most shipowners seem prepared to accept a very high wastage factor in return for some five years useful service, a costly experiment it is thought. Should these men come ashore, then how will the engineering industry accept them? These men are marine engineers, trained and taught explicitly to that end, and opportunities may be very limited for them on shore. For perhaps the first time these young men who have been guided in every step may now receive the cold shoulder from the hard world of industry and it is wondered what their reactions will be.

This scheme at present appears to produce about ten per cent of intake requirements, but this number is expected to rise rapidly. The danger is a wide inlet and a restricted outlet and until facilities for a gradual increase to a nominal figure of high quality are adequate, it would be far better to restrict intake, otherwise the profession may suffer. It is hoped that this point received full discussion and attention by the originators of the scheme and that the stream as at present can continue along its way without harm to anyone and with maximum advantages to all.

FUTURE TRENDS

Training

It seems reasonable to accept that there will continue to be two schemes for entry into the engineering section of the Merchant Service, namely Basic and Alternative. Thus both schemes should aim at producing good marine engineers and neither scheme should deviate too much from the other or have undue advantage over the other. The Alternative Scheme may be expected to develop until the two schemes eventually reach a par and supply proportionate intake. When this stage is approached it may be considered advisable to separate intake streams into two levels of ability. The extra study hours available to the Alternative Scheme student compared to the Basic Scheme student should be utilized to present a slightly broader field of study without greatly increasing the standard of the work.

The Basic Scheme has served well in the past, particularly in the case of engineers who have a late development but show marked improvement theoretically and keen interest when presenting themselves for the Second Class Certificate. No theoretical attainment achieved at an early stage should entitle the individual to reduction of practical sea service some five years later. Also exemption from qualifying examinations as a marine engineer should be reduced to a reasonable minimum while still offering some incentive. Both schemes should ensure equal exemption and level sea service for the best student from either scheme.

Whilst considering training perhaps in these more complex engine plants of today some degree of interchangeability and specialization could be encouraged. The idea of one "engineer" being trained and examined over such a wide range of different subjects is difficult to envisage in modern times. This limits the standard of the work as a whole and it is thought that to allow for later interchangeability it would be better to train all students basically over a fairly wide general range and then to encourage specialization in one particular branch of marine engineering. The increasing use of electricity on board ship make it almost essential that this becomes a specialist field in the engineering branch. Other subjects which quickly come to mind are refrigeration, fuel technology, electronics, instrumentation, etc.

This consideration at present is viewed with a blind eye by shipping companies, training boards and the like. By necessity uncertificated electrical and refrigeration engineer officers now serve the company, in most cases most satisfactorily; these officers are given no opportunity to prove their ability with a relevant Certificate of Competency. On the other hand, engineer officers, as such, are examined theoretically and practically to an increasing standard on a subject, or subjects, for which they have little training, interest or knowledge. Theoretical knowledge gained in examination preparation is then quickly forgotten as the officer has neither time, opportunity, nor indeed, encouragement in the majority of cases to apply theory to practice. Surely these facts should not escape the attention as shipping moves into a nuclear age? By insisting on a fairly high standard over such a wide variety of subjects the modern marine engineer with such an array of equipment and theory to master is in danger of becoming a "Jack of all trades and master of none".

Bearing these observations in mind the following probable line of training for the future is put forward for the two schemes based on their operating experience to date.

Basic Scheme

The present five year apprenticeship (preferably reduced to four and a half years for prospective marine engineers) would continue roughly as at present. The theoretical and practical skill developed by the apprentice would largely depend on the student's ability and the outlook of the employer with whom the apprenticeship is served. Most employers are very progressive in arranging schemes of study on a part time day release basis and little criticism can be given. However, the practical workshop training is often neglected by the employer.

More attention to comprehensive training over all sections of the trade is needed. Ideally the apprenticeship period would include eighteen months machine shop work, eighteen months fitting work and eighteen months heavy erecting type work. Included in these main training sections should be interspaced short periods in toolroom, pattern shop, foundry, welding shop, etc., and in the case of successful theoretical students in the higher grades, some later drawing office work.

The scheme presents many problems from the employers' viewpoint and may in fact require some segregation of marine apprentices from standard fitter apprentices, turner apprentices, etc. However, some improvement in trade skill is fairly obviously needed by the definite indications of present day intake into the Merchant Service. The apprentice cannot be held altogether responsible for arranging his training movement progress in the factory. At the same time, his employer cannot bear the full brunt, and more consultation between shore employer, shipowner and training boards is definitely needed to improve the present scheme. Endorsements to the O.N.C. in the S.4 year as now operative could be utilized to secure complete exemption from the proposed Part A of the Second Class Certificate for prospective marine engineers.

On completion of indentures the journeyman would be required to take up a two year service contract with his choice of shipping company or preferably that company that had sponsored him to some extent during apprenticeship. The journeyman would now attend a full time five weeks course in the fundamentals of safety and engineering knowledge from the marine viewpoint. The journeyman could now proceed to sea in whichever branch of marine engineering, i.e. marine propulsion, electrical, refrigeration, etc., which bore particular relationship to his apprenticeship and in which vacancies were available.

Alternative Scheme

The main criticism offered is lack of practical training and specialization. It appears that the sea service phase could be reduced and re-phased in favour of practical workshop training. The present two year O.N.D. full time course including workshop work could continue broadly as at present; the main subjects to be mathematics, applied mechanics, heat engines, engineering drawing and electrotechnology assessed at O.N.C. plus level. Other subjects could be taught as at present with workshop training to broaden the field of training, but at a somewhat lower standard. Based on proven ability and choice, the specialist career of the prospective officer could now be selected.

The apprentice would now be seconded into industry in the selected field for a full period of two years. During this time evening class study could be utilized to bring referred or failed students up to standard. The third and last phase would be a six month sea service apprenticeship completion.

Some difficulty is being experienced at present in placing students in industry, and workshop training is to be largely carried out at the technical college. Some college workshop training and facilities are very good but in the author's opinion there is no adequate substitution for industrial training. Too much time spent in a technical college at the expense of work in industry produces a wrong mental attitude in the apprentice and restricts the value of his contact with industry. In keeping young men at school until the age of twenty without experience of industrial problems on shore, there is a danger of spoon feeding them for too long, with bad results.

On completion of Phase One the technical colleges should undertake a three to six months course in workshop training in the basics of tool and machine technique before the phase in industry. It is, however, felt that eighteen months in industry is the absolute minimum for any engineering apprentice and this period must be fully carried out in industry to the extent of seventy-eight full working weeks. The above suggestion would give to industry an apprentice who was partly trained and an almost fully trained apprentice to the ship's chief engineer which would appear to be more satisfactory than the present arrangement.

Thus at the end of four and a half years apprenticeship the journeyman has two years theoretical training (including some workshop work), two years industrial training and six months sea service training. The student of least theoretical ability should by this time be at least of National Certificate standard and the better student at Higher National Certificate standard. This would more or less give identical results with the best of the Basic Scheme, and the worst Alternative Entry would certainly be well above the worst Basic Entry standard. The engineer would then proceed to a sea appointment as junior marine engineer officer in his selected-chosen branch of marine engineering.

SUGGESTED EXAMINATION AMENDMENTS

The proposed specialist training would require a gradual modification to the M.O.T. examinations. The following suggested amendments may be considered:

Second Class

Qualifying sea service: Eighteen months (no remissions).

Section A

Mathematics
Applied Mechanics
Heat Engines
Machine Drawing
Electrotechnology

Requirements: five passes. Standard approximately lower Ordinary National Certificate level.

Exemptions: O.N.D. total exemption.
O.N.C. subject for subject exemption.

Section B

Engineering Knowledge (General)
Naval Architecture
Theoretical advanced specialist paper
Practical advanced specialist paper
Oral examination

No exemption to this section.

First Class

Qualifying sea service: Eighteen months (no remissions).

Section A

Mathematics
Applied Mechanics
Heat Engines
Electrotechnology

Requirements: four passes. Standard approximately upper Ordinary National Certificate level.

No exemption to this section.

Section B

Engineering Knowledge (General)
Naval Architecture
Theoretical advanced specialist paper
Practical advanced specialist paper
Oral examination

No exemption to this section.

The above amendments may be regarded as essential if full coverage of the chosen field is to be achieved. The main aim of the examinations should be a high standard of papers in Section B of both examinations. A more noticeable overall increase in standard for the First Class Certificate above the Second Class Certificate is desirable. The standard of mathematics in First Class could be raised slowly to almost O.N.C. standard. The author does not wish to over emphasize the subject of mathematics which can be over done, but feels that

a knowledge of this subject of lower O.N.C. level is desirable so as not to restrict other subjects and to allow students to keep level with technical advances. The subjects of applied mechanics, heat engines and machine drawing could be kept more or less as at present in standard, possibly raising the standard slightly for first class, but electrotechnology standards should certainly not be raised any further than the present level. It would be advantageous in all student preparation to specifically teach the student to think rather than the often practiced cram preparation training involving parrot fashion memorization of specific questions.

Status

The ultimate object of all training methods is to produce the best grade of engineer and by selective intake and raised standards the final product will bring credit to the profession. In the age of the huge super tanker and prospective nuclear propulsion a highly efficient staff is a necessity and this staff will only be achieved by continued improvement in every aspect of ship life and status. Shipping companies express surprise at the alarming leaving rate of engine department personnel. Loyalty and service is hopefully expected from the Alternative Entry engineers but these hopes may not materialize, indeed wastage of these men from service could even be more rapid, unless a quick solution is found to this problem.

The blame is mainly laid at the door of the young wife compelling the husband to leave sea service; a possibility certainly, in the early stages of married life which may change later. This is an easy solution but one wonders if this is indeed the real prime cause. It must be appreciated that the primary reason for an engineer going to sea is to broaden his experience, and the only reason to remain at sea is the improved living standards possible. With the vast improvement and change in social conditions and amenities on shore and the greater scope of shore employment, incentive to stay at sea is lacking. Consider the following points relating to sea service which must be obvious to the really intelligent young journeyman:

1) There is no marked increase in salary initially.

2) The spending of some five years at sea and success in the Certificates of Competency give no preference over a fellow worker who had stayed in the original job, probably the reverse.

3) Salary and status of the senior engineer do not seem in proportion to complexity and cost of ship, machinery and cargo.

4) The senior engineer has considerable responsibility in relation to the above and also problems of crew discipline today on shipboard.

It would appear that to reduce wastage, accepting some wastage in these times as inevitable, the incentive could be provided on the following lines:

1) A fairly marked increase in salary throughout. Financial differential between sea and shore employment must be so great that no young man would contemplate the sacrifice of leaving sea service. This differential existed in the past but is not nearly so marked today.

2) A marked reduction of hours. Very few young men are prepared to sacrifice a thirty-seven hour week in a drawing-design office in favour of a fifty-six hour watchkeeping week at sea, plus every possibility of extra duty such as night work in port, relief duty, emergency repair time, etc.

3) Continued improvement of standards such as accommodation, port working hours, wife travel facility for senior officers, etc.

4) Greater recognition of sea staff by the company. There is often a bad fault of personnel relations in many companies which often produces unsettlement and bad feeling.

5) Opportunity for senior officers to take refresher courses in industry and college to enable them to keep in close touch with more recent technical developments.

6) Promotion prospects to a greater degree made available to competent staff and more consultation on new tonnage, equipment and machinery between management and senior sea staff.

7) More adult treatment. These problems are familiar to us all, visitors passes, company correspondence methods, accommodation differential, etc. Childish outlooks perhaps, but in need of a change.

In the above respects the author has no axe to grind. The problem is there, a vital problem, to which there should at last be a partial solution. Coupled with these trends it should be the constant effort of the whole profession, especially through this Institute to raise the status in the field of marine engineering. Some recognition of the Certificates of Competency must be made at an early opportunity. Reciprocal exemption from the O.N.C. and Part 1 of the Professional Institution examinations on a subject for subject basis for the First and Second Class Certificates of Competency should be aimed at and achieved. A renewable fifteen year short service commission, as applied in H.M. forces, with a good pension on completion together with useful qualifications acceptable on shore, may be the ultimate answer to the wastage problem.

Prospects of Advancement

Prospects in the marine industry are getting progressively better at this time. Improvements in status and training will eventually lead to much greater overall recognition and demand. Specialization, in the marine field, provided it is not carried too far, could lead to a very high grade engineer. The services of such an engineer would be appreciated and sought after and in every sense the marine engineer would be a professional man.

CONCLUSIONS

Schemes of training appear at long last to be approaching a more modern realistic trend in the marine engineering industry. It is now the responsibility of owner, builder and college to train and maintain qualified engineers for the job in hand. It then becomes the responsibility of the shipowner to raise the status and improve conditions so that his engineering staff are permanent, progressive and efficient officers. The shipowner has awakened to the fact that with the approach of a new era, a more intimate personal approach to engineering staff and collaboration at all levels, management included, could be advantageous. He can no longer rely on a supply of well trained engineers from the shipbuilding and ship repair industries. The time of unlimited supply of personnel, trained free of charge or obligation, who serve at sea then slip back to shore industry almost unnoticed, is coming to an end at this time.

Eventually the author visualizes the owners representative, at high level in company management, in full charge on board ship. This special civilian would be qualified in the aspects of maritime law, ship's business, cargo legalties, personnel relations, etc., and responsible to him, senior ship's officers of about equal status from the various departments such as cargo/navigation, radar/radio, marine engineer (propulsion), marine engineer (electronics), marine engineer (refrigeration), etc. The day of the engineer in blackened overalls, reporting cap in hand, to the master of the ship is surely at an end.

The builder on shore must be prepared to offer every possible facility for training in his workshops in co-operation with shipowner and technical college. It is surely in the builder's interest to assist fully so that his machinery is correctly understood, maintained and handled.

The need is rapidly tending towards a general all purpose

engineer further trained as a specialist in one branch and it is felt that the whole industry should recognize this fact and prepare training techniques, etc., accordingly. It is clearly apparent to most progressive marine engineers that there is a "wind of change" in the era before us, and this country, as a leading maritime nation, cannot, as it has often done in the past, close its eyes to the rapid development in the field of marine engineering. The nuclear vessel of the future will require specialists of high quality as engineers to take their place in all departments. All connected with this industry should see that all our steps and efforts are directed towards this need. There is, today, a very encouraging interest, not only by educationalists, superintendent engineers and the like, but also as some may not realize by the average marine engineer in the aspects presented in this paper. The author apologizes for the liberal repetition at times, but feels that many of the factors considered are worthy of clarification, constant reminder and emphasis.

Discussion

MR. H. S. W. JONES (Associate Member) said that he had had twenty-three years experience of teaching marine engineering, and he did not wish to join issue with the author on any point except one.

On page 179 under "First Class—Section A" he would like to see machine drawing included in the First Class Certificate. Apart from that, it was a most stimulating paper upon which the author was to be congratulated.

MR. S. G. READ referred to the Basic Scheme and said that the author pleaded for a more definite contribution by the prospective sea employer to the training of the Basic Entry apprentices. It would be of interest to know what sort of contribution he had in mind.

MR. JACKSON, in reply, said that he had had nothing specific in mind. He suggested however that the onus on the engine builder to direct the path of a marine apprentice around each particular section of the trade was too great. If the marine industry financed the apprentices to a certain extent, so that they were not looked upon as earning their own living, they could be circulated around the factory to a greater degree, and possibly do something along the lines of personal interest work, welding, brazing and foundry work. There should be some form of encouragement by way of a grant to give the apprentice assistance in purchasing books, and so forth.

MR. READ said he wondered whether the payment of a certain amount of money to a lad would help him to push round the shipyard and pick up greater knowledge. One could understand the question of assistance in the purchase of books, but it was doubtful whether it would help the apprentice to pick up greater knowledge in the shipyard.

MR. JACKSON said there were organizations such as Imperial Chemical Industries, who would take a young man and put him through a degree course. Money was of relatively little object; yet the shipowner made no contribution whatever. Let the shipowner have some share in it. The shore employer could not be expected to train a marine apprentice exactly as he required training. He depended on the apprentice to show some slight financial return; but if the apprentice were in receipt of some assistance, the shore employer would feel less dependent on the boy to show such return, and he could then be circulated through the works. It was not intended that the apprentice should receive money directly, but rather serve as an indentured apprentice with part of the indenture and wage bill compensated by the shipowner.

MR. H. J. HETHERINGTON (Member) said that according to the author, the shipowners had no financial interest in their engineer apprentice except so far as the Alternative Scheme was concerned. When he served his time, there were in London at least three companies which had their own workshops. In those days there was no organized system of training but, after a period of instruction on the various machines, etc., when the apprentice had a job in the shop he did the fitting, and any necessary machining for making pins, bushes, etc. He had six months at least in the drawing office, and a considerable portion of the time was spent in the ships on overhaul and repair work, including tests after overhaul. After overhaul to refrigerating machinery the second engineer would ask that those responsible for the work should run the plant to prepare for receiving stores. Thus an apprentice sometimes had a list of instructions as to temperatures required and had to run the plant to obtain the required conditions. Due to the war and the necessity of having to pay engineers overtime, apprentices in their fourth and fifth years used to spend nights and weekends on board in charge of the machinery as substitutes for junior engineers.

Mr. Hetherington recalled that when he was in his third year as an apprentice, he was on one of the company's ships going down the river when the second engineer put him on one engine to help manœuvre the ship. That was one of the ways in which companies trained their own men. It was comparable to the present Alternative Entry scheme. Had the idea of sponsoring apprentices by arrangement with the firms which had replaced the company shops been considered? In his day it was possible to serve some time with the tinsmiths, coppersmiths and blacksmiths. He did not know whether this could be done nowadays; the trade unions might object.

With regard to the question of status, he did not agree with the idea of putting a specialist on board ship to take charge. The owners' representative who had a knowledge of marine law and ship management was the master. It was perhaps rather revolutionary, but it was difficult to see why the master should be chosen from one department only. In the days of sail the captain of a warship was a military man and did not necessarily have any knowledge of navigation, and the master was in the same relationship to him as the chief engineer in the Merchant Navy was to the master nowadays. For example the master was the highest paid man in the ship after the captain. Everyone had their own ideas on the question of status, but most people, including the marine engineers of his generation, would say that it was the pay which measured the status. According to Lindsay's History of the Mercantile Marine both the chief engineer and the second engineer received higher pay than the chief officer, who had the same rate of pay as the third engineer and this state of affairs continued up to about 1914. It would therefore appear that the status of the engineer compared with that of other officers on board has declined somewhat! It is also interesting to compare the accommodation for the various ranks on board and to note the usual clause in ships articles regarding salvage, from which it would seem that the tendency is towards equating the chief engineer and chief officer in matters other than pay, where the equation was 2nd engineer—1st officer, 3rd engineer—2nd officer and so on.

PROFESSOR G. H. CHAMBERS, D.S.C. (Member) recalled that the author stated that shipowners seemed reluctant to help people at universities. From the academic touchline it would be unfair if an effort were not made to correct that, because he had a good deal of experience of shipowners who were quite ready to help people at universities although a very small minority were not. At the university stage people could

get help from all sorts of sources, and the real concern now was the recruiting of seagoing engineers. They were the people in aid of whom the Institute existed. The spirit in marine engineering required certain qualities which were fulfilled in fairly adequate numbers some time ago. Now it seemed either that adequate numbers did not exist or that recruiting was missing some section of the schoolboy population. He wondered whether the author's experience could throw any light on that. Those boys who passed the eleven-plus and went to grammar school were probably all right, but those who just missed that grading contained some good material, and he would like to know whether everything had been done to ensure that the best was obtained from that section of the school population and, if not, whether anything concerted in the way of recruiting could be done by the Institute in co-operation with the industry.

MR. JACKSON agreed that some help was given, but in his view it was not sufficient. He would prefer to see more degrees in marine engineering. Admittedly that did not deal with the question of intake. There appeared to be a large pool of secondary modern school boys available, but that defeated the main argument to a certain extent. He had emphasized that the industry wanted the best, and if other industries could get grammar school boys, why not the marine engineering industry? That pool could be tapped, but efforts should be made to get the intake standard up by popularizing marine engineering a little more. It was appreciated that some excellent potential was available from the secondary modern schools.

MR. P. J. HOWARD, B.Sc.(Eng.) (Member) said he desired to take the author up on one or two points. First, it was stated in the paper that exemptions from Part B should not be given on the strength of O.N.D. One would not quarrel with that when talking about the First Class Certificate, but he was by no means sure that exemptions from the Second Class Certificate should not be given on the strength of the O.N.D.

With regard to the Alternative and the Basic schemes—he preferred to call the Basic Scheme the "Traditional Scheme", there were not enough of the three or four subject G.C.E. boys waiting to be picked up to bring into the O.N.D. scheme and thus to bring the numbers in the O.N.D. up to the numbers in the Traditional Scheme. There might be parity, because the Traditional Scheme was tailing off, but it was doubtful whether there could be any great increase in the Alternative Scheme.

He did not altogether agree with the author's statement that there was no substitute for industrial training. The Royal Navy did fairly well with their engine room artificer training, and those men were not sent into industry. They were trained in the Royal Navy schools and the results were very good. The practical training of the Alternative Scheme engine room cadet could be carried out on a wider scale in technical colleges than it was at present. The shipping industry appreciated that fact, but it was not possible to increase the practical training in a technical college over-night. In most technical colleges it would mean that before they were ready to provide Phase 3 training, new buildings would be needed, and the Ministry of Education had authorized building programmes up to 1963. If additional Phase 3 training in colleges were wanted by 1964 or 1965 it must be asked for now.

With regard to the unsatisfactory training of the Alternative Scheme engineer cadet when he went to sea, if that were correct then the difficulty might be got over by selecting an engineer officer on the ship who, in the not too distant past, had passed some certificated examination, and putting him in charge of the cadets, giving him some sort of responsibility allowance for training them.

On the question of the frequency of the Ministry of Transport examinations, he agreed that there were far too many of them. Forty-six a year seemed to be a fantastic number of examinations, and the Ministry should issue medals to their examiners for keeping up so many! They should be complimented on their work, but there were still far too many examinations.

One wondered whether there was a misprint in the section dealing with the suggested examination amendments on page 179. It stated that the standard of Section A of the First Class examination should be upper O.N.C., whatever that was, but later on the author wrote that mathematics could be raised to almost O.N.C. standard. There might be a mistake there.

The author mentioned the possibility of exemptions from the O.N.C. by virtue of the Certificates of Competency. It was not possible of course to speak for the Institution of Mechanical Engineers, but his experience was that it would be rather difficult, because for one thing the O.N.C. scheme required course work and laboratory work whereas the Certificate of Competency did not. Therefore, to obtain exemption might be difficult. It might perhaps be possible to get exemption from S2 but it might be impossible to get exemption from S3. He was somewhat doubtful also about exemption from the Joint Part I. Surely the standard of the Joint Part I was higher than that of the Certificates of Competency, at least First and Second Class, so that it would probably be difficult to get exemption from Joint Part I.

MR. JACKSON answered that the only complaint he had concerning exemption from Part B of the Second Class Certificate was that it had not been given before. If it had been given before and was not correlated with the engineer cadet of the Alternative Entry Scheme, little objection would be raised. His only objection was that the exemption had never been given before in those particular subjects.

As regards parity between the two schemes, if it was not possible to get parity by keeping the intake standard of the Alternative Scheme up, then parity should not be aimed for. Let there be 15 per cent of good material if it was not possible to obtain 50 per cent.

On the question of practical training, he still maintained that there was no adequate substitute for practical workshop experience. Technical colleges might move towards that end; but if one group of students took down an assembly and then reassembled it, the next group were working with 90 per cent correct material, and when they had finished with it, it was 99 per cent correct material. It was not possible to totally substitute experience in the technical college for actual repair experience.

Mathematics was a dubious subject so far as the engineer was concerned, so it was perhaps better to say upper O.N.C. in all subjects but lower O.N.C. in mathematics.

The idea of an engineer supervising cadets was a good one, although he would prefer cadet ships, as some people were advocating. All the cadets should be together under supervision.

As to correlation between Joint Part I, and Certificates of Competency, the difficulties were great, but an effort should be made. The Second Class Certificate Part A was almost O.N.C. standard now except in mathematics. By raising slightly the First Class Certificate Part A standard and by bringing each syllabus more closely in line with the O.N.C., Joint Part I subject for subject exemption, which was O.N.C. standard, was attainable. Laboratory work was a problem. S.2 seemed a poor reward!

He agreed that the examiners did an excellent job in dealing with forty-six examinations yearly. This number was certainly high but any reduction under the present set-up could cause hardship and personnel shortages.

MR. A. LOGAN, O.B.E. (Vice-President) congratulated the author on his controversial paper. Looking back over the years the Alternative Scheme was a fairly good effort, for if it had not been conceived, where would shipowners today be getting the engineers to man their ships? It was true that the originators of that scheme had possibly failed in some ways to look ahead as far as they might have done, but it could be said that those young men who had come forward under the

scheme were being trained to meet the requirements of modern machinery, particularly in the tanker field.

On page 176 of the paper there was the statement "The apprentice is not popular at sea mainly through no fault of his own but as the result of a total lack of fitting type of experience and also a not too surprising reaction from the staff of older basic trained engineers on board against this form of student training". That was possibly the case when the first boys started, but it had to be borne in mind that the senior engineers today in many ships were products of the Alternative Training Scheme. They had been through that course, and who could be better to guide the young men coming forward?

Furthermore, there was a tendency in some companies to go in for maintenance gangs. In such ships the apprentices were able to carry out overhauls under the supervision of senior engineers.

With regard to the question of the specialist, he felt that the chief engineer of the ship must be the chief engineer, and while there might be the electrical staff and so on, the chief engineer must be the man who is competent to take charge of all that machinery and be responsible for it. When his own company purchased a number of turbo-electric ships, he decided that marine engineers alone would run them. These engineers accepted their responsibilities and, gradually over a period, a type of man had been built up who was electrically minded and able to handle the a.c. machinery in ships today.

The help in basic training which the schoolmasters and the colleges gave, was very much appreciated. He had discussed training schedules with young men who had sat for their Second and First Class M.O.T. Certificates, and there was little doubt that the training and help which they received at the engineering colleges stood them in very good stead when they came along to take the senior engineer posts in ships.

MR. JACKSON agreed that there was a need for the Alternative Entry Scheme, and although by and large he had criticized that scheme, the scheme was a positive step in the right direction. If the boys could be taught ship repair work on the ship, well and good. There was no substitute for that!

He disagreed on the question of the specialist. It had been proud history that the marine engineer had handled everything on board ship, but it was now getting out of hand. The chief engineer was not responsible for the electrical work. He relied on a group of competent electricians. In his view the marine engineering profession was limited because there was no specialization. All other professions specialized.

MR. LOGAN said that if there was a sound shore-based team of electrical engineers in the design stage, and they more or less ensured that the electrical machinery put on board was within the scope of the average marine engineer, it met the point.

MR. JACKSON said that if any design team told him that the machinery would not go wrong between Liverpool and Montreal, he would not be prepared to believe them!

MR. LOGAN pointed out that there were a great number of ships to his knowledge with a.c. installations which carried no electricians, and as far as he knew, they were running satisfactorily.

MR. JACKSON said that Mr. Logan was doubtless speaking of the better companies! It was now necessary to depend on electrical engineer officers, and to a large extent some chief engineers were fully dependent on refrigeration engineer officers in a number of merchant service companies.

MR. G. VICTORY (Member) suggested that several years sojurn in the rarefied and ecclesiastical atmosphere of the County of Durham had had its effect on the author who, as a consequence, had his head somewhere in the clouds! Many of the aspirations of his paper were noble, some were worthy, some were a little confused and conflicting, but too many were impracticable in present conditions. He appeared to have ignored the fact that through all the shouting and the tumult the day to day work of the shipping industry must go on. Ships must sail and be properly manned. The examination requirements must be tied to a minimum standard for the safety of life at sea, not to an idealistic standard which even if it raised the status of the marine engineer to the forefront of the professions, would cause such a shortage that half the merchant fleet would be laid up either because persons of such calibre were not available in sufficient numbers, or else because British shipping had been priced out of the world's trading circles.

The author envisaged the day when a ship would require three specialized engineers instead of one chief engineer. What a conflict would go on in that ship, as each tried to establish the relative importance of his own section. This and many other of the suggestions in the paper would make the present shortage of certificated engineers even more acute.

There were few suggestions in the paper for increasing the number of certificated engineers, and that was the big problem today. The author agreed that there was difficulty placing Alternative Training Scheme entries in industry for the one year required at present, and in the next breath said that service in industry should be increased to two years at the expense of the Phase 2 sea service. It must be borne in mind that many shipowners would like to see all the training done at sea, and the Alternative Training Scheme was a compromise in an attempt to balance conflicting interests and to get a quart into a pint pot.

The reasons why the sea service in the Alternative Training Scheme was performed before the workshop service appeared to have been missed. There was general agreement that the best possible use must be made of the limited time available for workshop service in the scheme. Surely, if the apprentice were put into the works after having spent fifteen months in an engine room, he would put his Phase 3 time to better use, as he would know what to look for in order to learn the methods and operations which could only be absorbed in the workshop. He would also go into the works as a man and not as a child straight from his teacher's apron strings. The advantage of having sea service before workshop service offset any minor disadvantages such as were mentioned. True the apprentice was not so much use to the chief engineer—as a trainee he was not supposed to be—and if he came home looking for a way out, it was just as well for him to be able to get out early. The author had ignored the apprentice who entered the scheme with a love for the sea, and who might give up if he had to wait four years before he even got on a ship.

In one place the author stated that the drain of certificated engineers to industry must be reduced, and in another place he asked for a qualification which would give greater prospects of advancement in shore industries. That surely would increase the turnover to shore employment. The statement that before the war an O.N.C. was considered by shore employers to be preferable to the B.O.T. certificates and that since the war the reverse had been the case must be challenged. He did not think that was true. He would have said that if anything the B.O.T. certificates were more highly thought of in industry before the war by comparison with O.N.C.'s than they were at present. Some false conclusions had been reached because the author had almost ignored the natural functioning of the law of supply and demand. Wastage from the merchant service took place before as well as after the war, just as rapidly as the labour markets permitted.

He agreed that Section B exemption was a mistake. Apart from the engineering knowledge questions at present being included in the electro-technology and naval architecture papers, they were a more specialized marine type of paper, and the content was such that a great deal of the knowledge required was gained at sea in the 18 months sea service. If exemption was allowed, it was tantamount to considering them

as Part A subjects which could be taken before a person went to sea. Sea service was asked for before the engineering knowledge papers were attempted, because the young men had to show that they had knowledge and competence which was obtained at sea. The same applied to an even greater extent in the case of electro-technology and naval architecture papers for which he felt there should be no exemptions.

Mr. Victory agreed that the standards of entry and training into the Alternative Training Scheme should be maintained. Yet some shipowners and some educationalists were only too willing to look for easier ways and lower standards. He agreed that something could be done to raise the number of certificates obtained from the Basic Entry. Starting from the present pre-sea course, if the shipowners were sufficiently hard pressed, it might be possible to get something like a six months pre-sea course combining the present practical features with a theoretical grounding which could be carried on by correspondence courses at sea to somewhere near Part A standards. This would save some of the money spent on successive study leaves at present. Apprentices might be permitted to start such a course after 4½ years in the works if they opted to join a company. That might be better than the fully sponsored apprenticeship which certainly had many snags.

In those matters it was necessary to "make haste slowly". Only by the test of time would it be found whether certain changes were for the better, or whether they were panic measures which eventually reduced the overall efficiency of the product. In the meantime the business of ships must go on, and he felt sure that for many years to come the chief engineer would need to be that most useful of persons "Jack of all trades and master of some".

MR. JACKSON, in reply, said that he had certainly come down from County Durham, but the people in that county were usually assumed to be below ground. Rarely did they have their heads in the clouds!

With regard to increasing the number of engineers, especially certificated engineers, he felt he had made a fair number of suggestions, the main one of which was to stop wastage, and he had outlined a number of points in that respect which might be applied to see whether the men could be retained. Surely it was not idealistic to want high standards and progressive employment? There was no shortage of doctors or lawyers, professions with the most severe intake requirements and the highest status. He did not agree that wastage must be related to qualifications and status improvements.

On the question of Phase Two and Phase Three, Mr. Victory disagreed almost on every point relating to the change over, but it must be recognized that a number of apprentices were coming back after their sea service, and were having, through no fault of their own, to stand around in the marine engine works and were not being given suitable work. They were men of twenty and not of eighteen. In his view it was between eighteen and twenty that practical workshop experience was required. If they had been to sea they had a tendency to lose rather than to gain from it. It was better to keep them away from sea until they were ready to go, at about the age of twenty. It was difficult to place these boys in industry for any time period but it was nevertheless vital that this period in industry was covered. Numbers of intake should be restricted to the vacancies that were available in the workshops and a two year period had the same difficulty as a one year period in this respect.

With regard to the comment relating to people waiting for four years to get to sea and their love of the sea, he did not accept that in this age of television and other attractions there was such a thing as love of the sea. In the sailing ship era it might have been the case, but not today!

He fully agreed that Board of Trade certificates were thought more of before the last war than they were today, but that should not give any ground for pleasure, indeed this was one of the very factors that needed attention.

He noted that specialization had caused conservative concern to Mr. Victory.

With reference to wastage, admittedly it was tied up with supply and demand. However, it was generally agreed that wastage was very severe at the present time and had been for the last ten years. Mr. Victory's comments regarding the reduction of the time spent on study leaves were appreciated. If prospective marine engineers could gain some engineering knowledge and get some part of their certificate before they went to sea, it would be of advantage. Correspondence schemes, however, did not really show very successful results.

As to his later comments about moving slowly, there was a danger of moving too slowly. Marine engineering had always been guilty of moving very slowly. Admittedly it was necessary to keep ships at sea, but that did not mean that it was necessary to be ultra cautious. If he had gone to one extreme it seemed as if Mr. Victory had tended to go to the other.

MR. VICTORY suggested that in order to establish his case, the author had taken a particular as opposed to a general case, in that he had said that boys came back at twenty years of age and stood around in workshops. They did in some, and that was one of the weaknesses; but in other workshops they did not stand around. There was no evidence to show that if they went into certain workshops at eighteen they would not still stand around. In good workshops they would get a good training at eighteen or at twenty. The point was whether it was beneficial for them to have served a period at sea before they went into the works, or was it better to go into the works still tied to their educationalists and mothers' apron strings?

He agreed, of course, that wastage should be reduced; but efforts to do that had been made for a long time. Wages had gone up and conditions had improved. It was only possible to compete to a certain extent, and so far all the ideas put forward by the author had been tried, but none had reduced wastage to any appreciable extent.

MR. JACKSON answered that the crux of the matter appeared to be in the sending of "men" back to industry. They had done 18 months at sea and they were sent back to industry. They had the ideas of men, but still had a period of training to complete. They had been almost in charge of ships' engine rooms and felt as if their training was adequate, and if they went back to industry they felt that the average fitter had nothing to tell them.

It was never his intention to tie these boys to any apron-strings, quite the reverse, but the boys were more receptive at eighteen than twenty to the type of knowledge offered by the workshops of industry. He was very disturbed by the low grade practical skill shown by many entrants into the Merchant Service today.

Wastage was a vital problem. He had merely tried to make suggestions, some of which were perhaps good and some bad, but in his view the problem had not been approached as fully and as realistically as it might have been.

MR. D. M. REID (Member) thanked the author for his provocative paper. Speaking as a member of the marine engineering department of a technical college, he suggested it was unrealistic to concentrate such a large proportion of considerations on the Alternative Scheme as against the Traditional Scheme, although in his view the Alternative Scheme was a good one and produced good men. The hard fact was that the great majority of the boys came from secondary modern schools and in his view there was not going to be a sufficient number of boys armed with the G.C.E. in the right subjects to man the Merchant Service engine rooms completely. Therefore, greater attention must be given to the present traditional system. In his opinion it had not been given anything like the attention which it should have been given.

A great deal of that which later made a marine engineer

really valuable was learnt when he went to sea. Whatever sort of apprenticeship was provided, it would not be the same as operating ships' machinery, and a great deal of his future value came from what he learnt when actually at sea.

Coming to actual marine departments, it was probably not sufficiently recognized that a great deal of training value came from those courses, particularly Part B. There was so much talk about Part A subjects. He agreed they were important, but it must never be forgotten that the marine engineer had to be a good all rounder; over specialization was unrealistic. In the Part B course he learnt a great amount about machinery, its operation, its design, development, and so on, far more than was generally realized even in the industry itself. The large marine engineering department provided an adequate system of training for the certificate, although he agreed that improvements could be made. For example, the time ashore should be increased, particularly in Part B rather than in Part A. He disagreed entirely with the plea for turning marine engineers into specialists. Professionally it would be wrong, and, in addition, it would raise great difficulties of promotion and so on. That would be particularly true of small fleets and possibly not quite so true of very large fleets.

Mr. Reid pleaded for some reciprocal exemption arrangements with respect to the First-Class Certificate. It was not generally realized that there was a very good case for making such arrangements. At the moment, for example, the O.N.D. would exempt from the First-Class Certificate Part A. If a man, however, went to sea without the O.N.D. and eventually came ashore again (it would be foolish to ignore the fact that large numbers did eventually come ashore) and had no exemption from the O.N.D. or O.N.C., he naturally felt that had he not given a certain number of years to the sea, he could have attained the other certificate. The emphasis on the O.N.D. and O.N.C. all the time was wrong in marine engineering; but they were not the only grounds for making a plea for reciprocal recognition. In the certificate there was a very wide range of subjects in Part A. The field was considerably wider in his view than that of the O.N.D. although one would agree that there were certain points in which the O.N.D. went to a higher standard than the certificate in Part A subjects. However the certificate also had the Part B section, and he submitted that it was the Part B section of the certificate which was the most important as far as the marine engineer was concerned. It seemed on that ground that it should not be impossible to arrange reciprocal recognition.

MR JACKSON said that if there were not the number of people of the right material available then the Alternative Scheme should be kept down to the number which was available. It would be necessary to concentrate on the Basic Scheme, and he agreed that not enough had been done in connexion with that scheme. There was still great potential in the Traditional Scheme—traditional seemed the preferred word "south of the border".

He disagreed that the sea was necessarily the best place to learn. The young man learnt repair experience which was very necessary, but as to tool manipulation, in his view, there was no substitute for an apprenticeship. There must be some ability to use machine and hand tools.

Mr. Reid's remarks with regard to the importance of Part B were accepted. Part B could certainly be extended a little to broaden the student's knowledge.

The point made in the paper about specialization had been condemned from yet another angle. However, he remained adamant. If such a wide range were to be insisted upon, the standard must drop. There must be some form of specialization otherwise the industry would be left behind.

As to First Class Certificate exemption from the O.N.D. and O.N.C., it was a difficult problem, but it was difficult to see how engineering knowledge would be accepted by the Institution of Mechanical Engineers, the Institution of Civil Engineers or the Institution of Electrical Engineers as a subject in its own right irrespective of standard. In his view the O.N.C. should be awarded to someone with a First Class Certificate, but it was doubtful whether that would happen.

MR. D. CARMICHAEL, M.B.E. (Member) said the author of this paper had to be congratulated on bringing before this Education Group a paper which mainly dealt with the difficulties facing the industry at the present time in regard to personnel. He was particularly interested in the reference the author had made on page 180 of the paper on his proposals for reducing wastage. Many of his proposals with a view to retaining personnel, were based on incentives, a number of which had already been negotiated on the National Maritime Board, with some success. Some of the statements were a little misleading and at variance with the facts.

It was realized that those on watchkeeping duties were called upon to work for 56 hours in a week, but he had not given any indication of the fact that as a result of negotiations on the National Maritime Board last year, the principle of the 44 hour week was accepted. A day's pay or leave was granted for every Sunday spent at sea, and a half day's pay for every Saturday afternoon. He suggested continued improvements in accommodation, and again the industry, in his view, had achieved some success in providing a standard of accommodation which was as good, if not better, than any other country in the world. There must be, of course, a number of older ships in service where it was not practicable to bring the accommodation up to the standard of the present crew accommodation regulations.

The author's paper had provided a great deal of food for thought on the question of entry and training, the industry was inclined to be hidebound by traditional methods, and it was not until 1952 with the introduction of the Alternative Training Scheme that a change in this direction came about, and the results, he thought, had been excellent. Many chief and second engineer officers who sailed with boys trained under the new scheme spoke most highly, not only of their high technical qualifications, but also confirmed that their practical work was of an accepted standard.

He was most interested in Mr. Jackson's suggestion of shipowners sponsoring boys from the age of 16 serving a full apprenticeship in workshops ashore. He would like to see something like this come about, but some snags would have to be overcome to ensure that the boy served in the shipowners' vessels on completion of the apprenticeship.

MR. JACKSON, in reply, agreed that conditions had improved vastly at sea, but not before time, and not without considerable pressure. 56 hours and more were still worked at sea, but the question was whether young men were prepared to work 56 hours. He did not think so! It would be necessary to pay them more to work extra hours or preferably to carry extra staff.

Accommodation was admittedly much better. However, not all of it had improved and a great deal of differential still existed. *A* got an armchair but *B* did not, and so on.

He would not put forward the engineer cadet as being the very best theoretical and practical man. Such apprentices, as a rule, would compare unfavourably with an apprentice who had served a full five year apprenticeship and had taken the O.N.C. or H.N.C. at evening or day-release classes. He agreed that there were many snags to the sponsored apprenticeship. The question of guarantee, with young boys, was always a difficulty.

MR. D. L. MORGAN (Graduate) said that he had just completed the Alternative Training Scheme. As to practical training, he had only done six months sea service during his course, and he would have liked to do more, because both he and his colleagues could confirm that it was during those six months that they learned more than at any other time during their apprenticeship, particularly from the point of view of the manipulation of tools and confidence in their use. During the diploma course they learned under instruction at college

how to use the lathe, shaping machine and various hand tools, but they were very slow in their use. When they went to sea, the second engineer saw to it that they got the job done, and as a result they gained confidence. They were always brought in on any maintenance job which was required to be done. In that way first hand repair knowledge was gained. He could only speak from personal experience, but the senior engineers on the two ships in which he had served were always willing to give help and encouragement, particularly in the case of practical problems.

As far as the question of standing around in the works was concerned, the onus was definitely on the shoulders of the apprentice. Once he made a move and showed some interest in the work, he would receive every assistance particularly from the older fitters. If the apprentice showed an interest in the work being done, the fitters would spend hours showing him how the job was done. That went for the foreman also. On return from sea to the works there was an added incentive, in that having seen the job running at sea the man knew exactly what to look for. He spent ten months in marine engineering workshops after sea service, and during that time he felt that he had learned more than when he was first in the workshops before going to sea.

Reference had been made to love for the sea. He had been to sea and was returning to sea the following week. He still had a love for the life at sea. He had no illusions about it, and knew what he had to give up in regard to shore life. As far as television was concerned, that was the motivation in his case to go to sea! Basically, sea service during the apprenticeship brought home the facts of life at sea, but if the man did not have his head in the clouds he realized that it offered an incentive to remain at sea.

MR. JACKSON, in reply, said that Mr. Morgan's views were extremely interesting as they came from one of the members of the Alternative Scheme, and it was very gratifying that he spoke so highly of it. It would be interesting to know whether Mr. Morgan held the same views in ten years time. Perhaps television would become a greater draw!

On the question of practical experience, he had the impression that Mr. Morgan did not seem to know exactly where he did get the best experience—at sea or in the workshops! During the diploma he felt as though the tools were taking too long to manipulate, and that speed came with sea experience. Speed at sea was a first requirement, but was the ability to manipulate the tools correctly necessarily related to speed? In his view there was no substitution for at least 18 months in industry. Some technical college practical training and some sea service certainly, but before and after the industrial phase respectively, seemed most logical to him. Putting the training onus on the apprentice was not good practice. Not all apprentices exhibited the same degree of interest as Mr. Morgan, nor all factory personnel the attentiveness that he had so fortunately received.

The CHAIRMAN pointed out that Mr. Morgan's total workshop service was in the region of 18 months.

MR. J. MCAFEE (Member of Council) said it had been suggested from time to time—sometimes in this very room—that the path towards a First Class Certificate and towards membership of this Institute should be made easier. He was pleased indeed to note that Mr. Jackson did not speak with this voice, but even went so far as to suggest that towards improvement of status, the Institute might now stiffen the professional requirements for corporate membership.

On a previous occasion here, attention was drawn to the large number of students who failed to qualify for O.N.C., and it was suggested that this should be met by introducing an alternative and lower standard. Mr. Jackson, however, was evidently of the opinion that there are quite enough standards at the present time. Mr. McAfee agreed entirely. If the right type of educated youth was attracted into the marine engineering world, then there would be no need to lower examination standards. On the other hand (alternative training schemes apart), how many boys today of good education and background will be willing to face the conditions still prevalent in far too many heavy engineering workshops, where the general amenities have advanced nothing in the last forty years. On the Continent he had frequently seen workshop training schools for apprentices where washing facilities, canteens and other amenities showed clearly the management's appreciation of the effect these have on morale. He could, however, think of one advanced engine works in this country where even the colour scheme in the fitting out and machine shops was chosen for its psychological effect on the workpeople. However this was something rare. Stand outside any Continental shipyard as the employees leave at the end of the day and it was usually impossible to distinguish between the manual and the clerical workers. Here the distinction was all too clear and yet it was still expected that amongst the ranks of unwashed, overalled mechanics streaming out of the gates would be found the future chief engineers of ocean liners, superintendents and surveyors. Perhaps it was a reflexion of the way in which a man was called an engineer, irrespective of whether he was a power station designer or repaired the W.C. cistern.

There were more school leavers fighting for university places today than the universities could take. There was no such clamouring by boys of good education at the gates of marine engine works, yet in recent years those of them entering the marine engineering world could expect to find, if only by virtue of the lesser competition from their own kind, more rewarding posts than the Pass degree arts or economics graduates now flooding the market. The reason was surely the lack of status which, in the final analysis, often meant more than financial reward.

It was for this reason one felt that the Alternative Training Scheme was going to produce the better type of all-round man. In discussing this, as Mr. Jackson did, it was right that some, but not too much, emphasis should be placed on craftsmanship. It was, after all, important to know how a thing should be done without necessarily being able to do it oneself. Many people could tell when a welded joint had been imperfectly made, a violin played out of tune, or a letter badly typed, without being efficient with the appropriate tools. Mr. Jackson was also emphatic about sea-time and the need for at least eighteen months before being eligible to sit for a Second-Class Certificate. Surely it depended on many factors. He (Mr. McAfee) remembered having once spent a year leisurely sailing around the world with a ponderously slow running Diesel engine and reliable auxiliaries. Nothing required overhauling and nothing ever went wrong and, although he became aware of certain aspects of life not included in the certificate syllabus, he doubted if his engineering knowledge was at all extended.

Given that agreement could be reached on the right curriculum in the college, the right amount of workshop training and the appropriate sea-time, was it not appropriate to ask what it was the industry was trying to produce? The answer usually seemed to be simply a man with a First-Class Certificate. In other words, there would be a common end product to fill either the post of chief engineer of the *Queen Elizabeth* or a humble tramp vessel. He was not sure if there was not something wrong here, but perhaps this was neither the time nor place to raise the matter.

The CHAIRMAN said that in his view it was necessary to be realistic. The marine engineer's qualification was one which existed to ensure safety of life at sea. His record in the Merchant Navy would illustrate that the standards had been maintained irrespective of the pattern of training. It was a wise move to have informal discussions where there was a great freedom of expression, because it was important to amalgamate ideas and to progress.

It was with great pleasure that he proposed a hearty vote of thanks to the author for his most interesting paper.

The vote of thanks was carried by acclamation, and the meeting then terminated.

Correspondence

MR. A. J. S. BENNETT, M.B.E. (Member) wrote that he wished to congratulate the author on the catholic aspect of his paper, embracing as it did the past, present and future of the marine engineer, but regretted that he must challenge one section.

His business was limited to Mr. Jackson's remarks on the present Alternative Training Scheme, which he said he did not favour but treated in a manner which left room for misunderstanding.

In the Marine and Technical College, South Shields, 570 Phase Three Cadets (excluding Part A) have attended so far, and he had been to a minor extent liable for almost all of them. More than twenty lecturers, all selected and some specially engaged for this class of work, were working on and developing these rapidly expanding courses, and it was as one of those that he gave some facts on the Alternative Training Scheme as well as some of his own views.

Mr. Jackson expressed some specific criticisms, but many were of a general nature, and there were astonishing omissions which must give a different impression from the one which he had good reason to believe was given by the attitude prevailing on these courses. Actually the atmosphere was one of alert confidence as it was bound to be with new courses, fresh equipment and new buildings: also, this was the college centenary year.

Regarding the centenary, there was an historical incident of 100 years ago which he thought had a relish just now. It concerned marine engineers' certificates, which were on a voluntary basis until 1861, but were made compulsory by law in 1862. These certificates were issued by the boards of Local Pilotage Authorities for a number of years until trouble arose due to the large discrepancies in standards arising between the various boards. In 1886 the Dublin board for instance failed 12 per cent of all candidates, while the one at South Shields, for some reason failed 59 per cent. As a result, control of all local boards was vested in a local Chief Examiner in London and the power of the port boards was withdrawn.

The original planners of the Alternative Scheme created the finest opportunity for improvement in the history of sea-going engineers. Selected grammar school boys from inland towns who passed the O.N.D. were to be the new raw personnel for this opportunity, and many entire classes in this category have materialized. This must represent a large gain even if a poor advantage was being taken of the opportunity, and this latter point was likely to be judged by results. With the Scheme in practice, some of the young men did pass the course, the 100 per cent up country element has changed locally to about 50 per cent, and there were modifications of many kinds; all of these items representing a great deal of activity by interested parties, which each, in his own way, considered to be an improvement.

This was the first integral plan for sponsored marine engineers, it was not entirely borrowed, it anticipated the new deal for technical education and indeed the new workshop training modification led similar trends elsewhere. Only eight years ago seventeen shipping companies tentatively adopted the new agreements, and very few of those sponsored the initial experiment. Today twenty-seven companies have sent sponsored cadets to South Shields alone.

The main focus of attention now appeared to be the full time workshop training modification which was not mentioned in the paper, but was, for the original sponsor, a step as bold as the original scheme itself. For this purpose training was distinguished from education, teaching, or preparing for examinations. Training was rather more personal and was confined to the individual performance of tasks, as distinct from learning how or even watching how they were done. This was a very elaborate and expensive business.

The training set-up, machines, electrical and plant maintenance consisted of a good two hundred tons of graded equipment, some of which had been supplied by generous donors of the sponsoring company and companies, and what was even more encouraging by completely non-committed well wishers. There was a control system, specially designed for ship maintenance work performed under shop conditions which incorporated task control, tool control, and the movement schedule. But to keep within the limits of the paper there were only two relevant points: firstly, there were no less than twenty-one steam reciprocating engines in regular use and two boilers in partial use: secondly, it was expected to receive a Bailey automatic combustion control system from an obsolete tanker which was now being scrapped on age. He mentioned these points as a reassurance that there was not a complete deficiency in reciprocating practice, nor in his opinion unrealism in attempting to teach controls to young men who were mainly going to, or had already been on board large modern tankers. Not that much progress had been made as yet but this was because all the modern items tended to be squeezed out by the time limit. He understood however, that the "Electricals" were rather more fortunate in breaking new ground, as there had been favourable reports on the confidence exhibited by the young men in tackling electrical repair work at sea.

Regarding the cadets: as the early groups were from non-traditional sources, it was not surprising that on first going to sea they were lacking in fitting experience. Some companies briefed their staff on training requirements: others it seems did not. But despite any snags, the environment was logical. The real difficulties arose during the Phase Three shipyard period wherein about one third of the placings were not logical. He had reported this point in the Education and Training Symposium, four years ago when the difficulty was first apparent, and had suggested bringing the cadets inside the college.

As this was now being done, and in some cases the phases were being reversed, the usefulness of the young men on first going to sea should be much improved, if that was what was wanted.

As for their weakness in engineering knowledge, it should be realized that the Phase Three work was not intended to be M.O.T. certificate work, since if it was the cadets would eventually be doing a similar course three times over. The early cadets knew this and he had also referred to this in TRANSACTIONS*. Mr. Jackson might be right, but he had omitted to mention that South Shields ex-cadets alone had already won the W.W. Marriner Award, three Lloyds Awards and other distinctions and that they were repeatedly at the top of the Part B examinations.

Something in addition to workshop training was actually being done which might help, and that was the inclusion of another subject in the syllabus, namely "Marine Engineering Technique". This had been working for the past eighteen months at the request of one company, but even this was not in line with certificate examinations, but rather with planned maintenance tasks to reduce talking time in training periods. The same thing applied in electrical engineering.

A dominant feature of the paper was taken to be the withdrawal of the exemptions which had been granted. This was certain to be popular for several reasons, one of them being human nature itself. Now these exemptions represented the faith of the original planners in the kind of stuff they expected and were entitled to get, and the courses had not been built at any point on a lower level. They were an incentive, a recruiting aid and were limited to those fulfilling

* Pounder, C. C. 1960. "Human Problems in Marine Engineering", Trans. I.Mar.E., Vol. 72, No. 3, p. 117.

all requirements throughout, which was at present only about 50 per cent. One hope of raising the status of the marine engineer, if that was desired, was by engaging the type of recruit who would reject a scheme which was not what it used to be. Speaking domestically, exemptions went to "other departments" which were doing a great job from a new angle and knew it.

For a "proper perspective" as claimed in the paper, he imagined that both sides of a case should be considered. Why not, for instance, extend the exemption to include all candidates who had amply covered the requirements in one or both subjects? This would alleviate the very heavy examination schedules referred to in the paper, by cutting out unnecessary parts. After all, what was the Institute supposed to be doing?

The quality of the entry as originally laid down was just right for success in the courses. O.N.D. failures which mainly came from below this level were not happy on subsequent courses but eventually passed their M.O.T. examinations and some might even manage to obtain certificates in line with the others. This latter aspect could be interpreted according to taste: either the standard courses were going too far, or else a broader view than an examination result was possible with young men who were undergoing supervision for four years or more. If exemptions were cut and if the entry were lowered, this would not stifle the courses but would more likely increase the numbers, as it would give control of quantity, and would be a realistic step towards stability in the problem of manning ships and keeping them manned. Quite an attractive proposition all round, and easier to manage too!

At present the cadets on main courses were up to standard and to expected strength. What other organization anywhere could even contemplate O.N.D. level apprentices by the hundred? Whatever the doubt, fear, or prejudice which must accompany something new, nobody who knows the case was ever likely to accept excuses if the marine engineer did not make a significant step forward here.

MR. JACKSON, in reply, wrote that the views expressed were apparently closely related to his own, indeed there was little specific dispute on any definite points, but in view of the long contribution he would attempt to cover each point raised.

He regretted that the contribution was less catholic than the paper, such restriction to a short section of the paper seemingly prevented comment on really controversial items, particularly specialization, comment which would have been of value in view of Mr. Bennett's training and service in the Royal Navy.

The remarks relating to development at South Shields would, it was felt, be of interest to others, naturally less well informed than himself, in outlining a mutual pride in local marine history, training growth, personnel problems, etc. The comments relating to this centenary year were most interesting and he felt sure that Mr. Bennett would be interested to learn that the first First Class Engineer (1863) was a "Geordie", regrettably, only by residence! The engineering capital was certainly on Tyne, Clyde, Mersey or Lagan but he for himself tactfully declined to be more explicit in geographic location.

Let there be no misunderstanding, he supported this Alternative Entry Scheme, the industry certainly needed a fresh new approach to marine training technique. He did however demand a useful product, definitely required improved status and felt that this costly scheme should certainly produce distinctive students.

The definition given for training was elaborate, it was thought that a teacher often tended to forget that he ever was a student and too much attention to one detail could easily cloud the more general overall picture.

Regarding the paper and discussion, it was thought that his views on full time technical workshop courses in lieu of industrial training, examination exemption, etc., has been forcibly expressed with clarity. He did not agree that all scheme modifications were necessarily improvements, that engineering knowledge teaching should deviate greatly from M.O.T. standards, reciprocating practice or otherwise, or that he was guilty of general criticisms or making astonishing omissions.

MR. F. M. L. BUNGENER (Member) in a written contribution wished to thank Mr. Jackson for his paper, and expressed his admiration for the way in which he had answered some of the, what appeared to him, loaded questions.

The main reason why Mr. Bungener had attended the meeting, after reading the advance copy of Mr. Jackson's paper, was that he was still interested in the education of marine engineers, though no longer at sea, and also to help the Director of the Amsterdam College of Marine Engineers in comparing the British and Dutch systems of training and education.

Many of the British problems, like those Mr. Jackson enumerated also existed in Holland and it was Mr. Bungener's intention to ask Mr. Jackson some questions during the meeting, but, as the evening wore on he decided to write instead.

He had meant to ask Mr. Jackson, with regard to the last paragraph of section 3 on page 5, was there no longer a bonus system in existence like the one the Anglo-Saxon Petroleum Co. used to have before the war? The marine engineers in the Dutch fleet used to receive £40 if they passed an examination during the 3-months leave with pay, after a 3-years contract. Also, was there in the British Isles no college of marine engineers who were subsidized by a shipping company or by the State?

He also asked what the college fees were, including those for refresher courses and their duration?

MR. JACKSON, in reply, said he was appreciative of the complimentary remarks of Mr. Bungener regarding the paper and subsequent answers to the discussion.

He did not know of any present day British shipping company that offered an examination success bonus for the Second or First Class Certificate. A small monthly bonus existed for all junior engineers possessing exempting qualifications from Part A of the Second Class Certificate. Increase of this bonus was advisable now to encourage O.N.C. type men to come to sea. Examination bonus was an idea, especially for full examination success, but where the present regulations allowed over 75 per cent exemption it seemed too generous an idea. However, since the time of writing this paper the shortage of intake had steadily become even more acute, every means of incentive needed consideration.

All technical colleges were subsidized by the State under the present educational system. Subsidy from shipping companies had not, it was thought, been given before, but at least one college, possibly more, had recently received a direct grant to run a specialized apprentice marine engineering practical course. It was thought that the Shipping Federation had similar ideas.

Marine engineering colleges did not as a rule offer refresher type courses at present. General fees for Second and First Class Certificate courses vary with the college but average about eight guineas.

MR. STEWART HOGG, O.B.E. (Member) wrote that he wished to join all speakers by thanking Mr. Jackson for reading his paper. He could not make up his mind, whether or not, Mr. Jackson was in earnest about all he said, or whether he just wanted to start his audience talking for his own benefit.

He would have thought it essential in such a paper to start with a resumé of the history of the seagoing engineer from say, 1860 to 1960, to gain some appreciation of why he had any educational status.

It was in 1862 that Parliament, to assuage public opinion in the interests of "safety at sea", passed a short Act empowering the Board of Trade to make Regulations and conduct examinations for 2nd and 1st Class Certificates of Competency; that was the framework within which the profession had grown.

He could not recollect ever having read of the shipowners

wanting examinations for their engineers although he felt that the better class of shipowners welcomed the introduction of examinations although the majority had, he believed, always maintained that they could look after their own property.

Much had changed since 1862, but basically the examination system had remained relatively constant, i.e. it had followed the progress of engineering advances. Without an official examination system he wondered how the superintendents would like to shoulder the responsibility of selecting officers?

The supply of good well-trained engineers has been difficult since the end of the First World War. Conscription since the end of the Second World War somewhat eased the supply position until recently. In modern times however he felt the Unions might make themselves heard if the Government Department concerned relaxed or discontinued the examination system and did not keep standards reasonably abreast of progress. On the shipowners' side it must be appreciated that their business was to transport cargo/passengers from A to B and earn a maximum return of their services to enable them to pay dividends to their shareholders or they would soon be out of business. It was quite understandable that management should want an ample supply of cheap labour which had been fully trained. The questions of status, pay and privileges would then not arise to the same degree but remain more or less as they were 50 years ago when too many hungry skilled men were chasing too few jobs.

Possibly, he had said enough to allow Mr. Jackson to set the Alternative Training Scheme in its correct background and to enable him to understand why it was not just an ideal scheme from the educationalist viewpoint. In his opinion it was a good scheme at the right technical level costing a minimum as it fitted into the existing educational system of the country. The fact that it should cost anything at all, not unexpectedly, riled some shipowners who had always enjoyed a supply of cheap skilled labour. In another decade or so, he suggested all shipowners would accept the need to budget for the training of their engine room crews. It would be fully recognized by them that fewer men would stay at sea for their working lifetime and deprive themselves of the ammenities of the "welfare state" and further that the petticoat continued to gain ascendency over us weak males. It would also be appreciated how necessary it was to train numbers to make good the high wastage rate.

He had hoped the author might have been looking ahead to the time when machinery in all ships would be much more reliable, though more complex, requiring the services of one or two technicians for the senior positions of 2nd and chief engineer for preventive maintenance. Those officers would be supported by a lower grade of engine drivers as watchkeepers. The technicians, fewer in numbers would be worthy of professional membership in this Institute, the watchkeeping drivers might be recognized possibly as Associates according to their technical qualifications and experience.

MR. JACKSON expressed appreciation for the contribution from Mr. Hogg whose wide personal experience fully covered most of the aspects presented in the paper. He agreed with practically everything Mr. Hogg had said and was grateful for just the right amount of historical background information outlined. In this respect he had himself deliberately refrained from considering the nineteenth century which he felt had been well covered, by more qualified persons than he, although such a fascinating history could certainly do with more advertisement.

The views and problems from the shipowners angle were appreciated but it seemed as if the shipowner, normally so shrewd and far sighted, had been guilty of a very slow realization of changing trends and impending shortages.

It was certainly agreed that the examination system, Ministry of Transport, classification societies, and engineer surveyors and examiners, had been almost fully responsible for any degree of status achieved today. The examination system had, it seemed, lagged behind to some extent, and now needed adjustment. For Part A some correlation of theoretical standards with other examining authorities was needed and for Part B no exemption and less sea service remission, some "sub-contracting" out by the M.O.T. certainly, but it defeated the very object when carried too far as at present.

The Alternative Scheme certainly seemed ideal and was a good introduction. His only complaint was that it seemed to have been "got at" even further, by attempts to reduce quality and standards, both practical and theoretical. This scheme should be improved now, in the light of ten years experience, so as to maintain attraction to the best material.

He had contented himself to a glance into the future but was glad that Mr. Hogg had given them his novel and informed glimpse behind the curtain.

MR. E. A. STOKOE (Associate Member) thought that the author had written a paper which was both historical and speculative. Throughout the paper the status of the engineer was discussed and it was stated that in the earliest days his status was low. While this may have been true for the major part of this century, the writer believed that originally the status of the engineer was particularly high and declined only with the increase in numbers.

Section II of the paper discussed the Alternative Scheme and the following points became apparent.

a) The popularity of the apprentice should increase when ex-cadets reached positions of responsibility and prove their worth.

b) Exemption from Part B was a useful goal for those studying for endorsements on O.N.D. in naval architecture, electrotechnology and power plant and the writer believed that this exemption should be continued, especially for the Second Class Certificate. It was suggested that those companies running the Re-phase scheme leave their apprentices at a disadvantage since no endorsement or exemption was obtainable. It was also suggested that all apprentices should be required to complete the correspondence course before the end of their apprenticeship as part qualification for exemption from Part B.

c) It was a decided advantage to apprentices and lecturers alike if the former were familiar with ships and their equipment.

d) Those apprentices who were referred in their O.N.D. should be given the opportunity to re-sit the examination before proceeding to sea. Thus all apprentices at sea would have either passed or failed O.N.D.

The proposals made by the author for re-organization of examinations might prove useful, but it was found in practice that there was much duplication of work. The study times required for Second Class Certificate and First Class Certificate respectively were about 7 months and 6 months compared with 2 *weeks* and 3 *weeks* 50 years ago. Much of the work completed for the Second Class Certificate was repeated when students attended for the First Class Certificate. While such repetition was necessary for academic work the writer suggested that this might be obviated in the descriptive subjects (e.g. ship construction) by having a more rigid definition of syllabus.

An alternative method could be considered:

It was estimated that the work required for both Second Class and First Class Certificates, which now takes approximately 52 weeks, could reasonably be covered in a period of about 40 weeks if studied concurrently. In fact it would probably be possible to raise the standard in this time. Since most colleges work on a 40 week year it would be necessary for the student to attend for a complete year, but the actual time taken would be considerably reduced. Such a course could be attempted by engineers after a reasonable period (1½ to 2 years) at sea. Two grades of pass could be obtained "A" equivalent to First Class and "B" equivalent to Second Class. Those engineers who had obtained their "A" or "B" pass would be regarded as having their Second Class Certificate, and after a further period at sea those having obtained an "A" pass would be regarded as having their First Class Certificate. There

would naturally be several difficulties such as exemptions and failures, but it was suggested that such a scheme had decided possibilities.

MR. JACKSON, in reply, agreed with Mr. Stokoe on the question of status, also on points a, c and d.

Under the present regulations he was prepared to yield agreement to some Part B Second Class exemption although he objected to any examination which allowed six out of seven subjects exemption. Regarding his own suggested regulations he remained adamant, surely every course of value did not have to offer a goal of examination exemptions? Re-phasing under these regulations also presented no real problem as electro-technology would be in Phase 1 and naval architecture and power plant could be at a lower standard during apprenticeship and at a higher standard in the Certificate of Competency. If correspondence is part of a course of training it should be compulsory to complete same.

Any new idea was worthy of discussion and consideration. The combined Second and First Class course was novel and he believed a similar principle was successfully applied in the Scandinavian Mercantile Marine. Personally he preferred the previous suggestion of amendment to the syllabus and more rigid definition. A greater differential between Second and First Class requirements and a more detailed syllabus to combine the two together to constitute a course would reduce repetition and allow increase of standard.

The objections offered to the combined course were:

a) The average marine engineering student had almost reached saturation point after 3 months in Part A of the Second Class Certificate course and extension to ten months seemed beyond their capabilities.

b) In such a concentrated course there would be high wastage and many failures as the student could not adjust his pace to suit his capabilities as he could at present.

c) The Part B subjects, particularly engineering knowledge, were extended to be in line with sea service and a candidate was expected to show a developing knowledge with sea service from Second to First Class Certificates over a period of at least three years.

d) Pay difficulties and wastage, immediately after obtaining the theoretical attainment, were very apparent problems.

Marine Machinery Failures

H. N. PEMBERTON (Member of Council)

Author's Reply

Paper and Discussion published in October 1960, issue of Transactions

Mr. Pounder's contribution added considerably to the value of this paper, especially since he devoted the major portion of his remarks to crankcase explosions, a subject on which he was most qualified to speak.

Mr. Pounder referred to thermal stability in testing of turbine rotors and the need for some authoritative guidance as to the extent to which such tests were necessary. After extensive inquiries into turbine practice, Lloyd's Register had now adopted a rule which required at least one thermal stability test for H.P. steam and gas turbine rotors intended for main propulsion service where the inlet steam or gas temperature exceeded 750 deg. F. (400 deg. C.). The test was to be carried out at the forge or turbine builders' works: (a) after heat treatment and rough machining of the forging, or (b) after final machining, or (c) after final machining and blading. Full details of a recommended thermal stability testing procedure were now given in the Society's Rules.

In regard to laminations in mild steel plates, there was no doubt that welding has caused greater attention to be focussed on this type of defect, largely because their presence in plate edges affects the quality of welding. In general, this type of defect was no more prevalent to-day than it had been in the past.

In regard to the failure of threaded connexions, Mr. Pounder had pointed out that loss of pre-load (tightening) might be due to the flattening of the many small ridges to be found on ordinary machined surfaces, and which were no doubt present in the locking faces of nuts and the surfaces in which they were in contact. Care taken in the preparation of these surfaces before tightening would diminish the possibility of subsequent failure. Equally, there was need for the development of techniques for controlling the amount of pre-tightening in bolted connexions.

In reply to Mr. Stewart Hogg, the British Internal Combustion Engine Research Association had carried out some research and development work on oil-drenched gauzes which could be fitted internally in way of crankcase explosion doors. Such gauzes were a useful contribution to preventing the emission of flame. The author agreed with Mr. Hogg in discouraging the practice of seal welding riveted seams in boilers. The only sure way of preventing caustic corrosion in such seams was by using a carefully controlled feed water treatment. Indifferent workmanship and excessive riveting pressure could not induce caustic cracking unless the boiler water itself was excessively alkaline.

The author agreed with Mr. Bunyan's suggestion that some form of fretting inhibition could, with advantage, be applied to the large end of a propeller cone, but a statistical analysis had indicated that the ingress of sea water into the propeller boss—generally through a badly fitted rubber ring—was the predominant cause of screwshaft failures due to corrosion fatigue. Mr. Bunyan's remarks on the failures of dynamically stressed bolts and the effect of worn claw couplings on the whirling critical speeds of turbine rotors were welcome. Those represented problems on which he had had considerable experience and his remarks merited careful study.

Mr. Jackson's remarks on crankcase explosions and the provision of oil-wetted gauze to prevent the passage of flame into the engine room were of great interest and value. With reference to the fractured crankpin, Figs. 19 and 20 in the paper, the author accepted the opinion of Mr. Atkinson and Mr. Jackson that the forging was clinked. Since the quality of the steel was unsatisfactory, it was considered that the clink could be associated with metallurgical defects in the steel. In other words, had the steel been of good quality, it was possible that the forging would have survived heat treatment without clinking. The failures of the connecting rod referred to by Mr. Jackson were not due to original defects in the steel. Each originated by fatigue at the lip of the oil hole and propagated under dynamic stress along the length of the rod. It was possible that corrosion fatigue might have initiated the failures and whilst the author was aware of other cases in which connecting rods had split, the incidence of such failures was small in proportion to the number of rods in service.

In reply to Mr. McClimont, twenty-five years ago Professor Coker stated "It seems that in addition to a difference in dimensions to ensure sufficient pressure under elastic conditions, it is of prime importance to have absolutely clean and well polished mating surfaces for all force, shrinkage and expansion fits which are subjected to heavy loads likely to produce relative motion between the parts". This "moral" expounded by Coker was equally true to-day.

Examination of the components of the gear wheel referred to in the paper and illustrated in Fig. 7 showed what could only be described as a rough turned surface of the spheroidal graphite iron centre which, combined with the relative softness of this material, mitigated against an effective shrink grip.

The author wished to draw Mr. McClimont's attention to another "moral" which had been proved over many years' experience with welding, that was, that good welds demanded good "fit up". For stressed components welding should never be used to bridge gaps between badly fitted components. Fig. 6 illustrated a boiler stay which was badly fitted prior to welding. Root cracking could usually be associated with this kind of defect.

In regard to oil holes, it was agreed that the bigger the lip radius the better, but a radius of one-quarter the diameter of an oil hole was common practice and had been found to be adequate for crankshafts.

It was agreed that coatings of molybdenum disulphide might only alleviate fretting for limited periods. The efficiency of any method adopted for alleviating fretting depended on the particular conditions and especially on the degree of slip between the mating surfaces. There could be no hard and fast rule but hard types of coatings containing molybdenum disulphide appeared to be superior to other anti-fretting lubricants.

Other remarks made by Mr. McClimont were welcome in a discussion of a paper on machinery defects. Some of the examples given in the paper were bound to give rise to varying opinions on cause and cure. It was for the precise purpose of stimulating such discussion by competent engineers and thus alerting them to breakdowns which continued to occur in marine machinery that this paper has been presented.

Author's Reply

With reference to Commander Tyrrell's plea for the publication by Lloyd's Register of Shipping of statistical information on which "failure rates" could be established for marine machinery, Lloyd's Register was always prepared to assist engine builders by giving information, statistical and otherwise, concerning failures in their own particular engines on request. There could, of course, be no general publication of such information; moreover, in many cases the true causes of failure were not established beyond doubt. Statistical records could therefore only be used for guidance. When repeated failures of a particular type occurred, it was the Society's practice to take the matter up with the engine builder concerned, who usually valued the information. In the case of failures of a general nature, statistical information could be, and frequently was, published, a typical example being the paper dealing with screwshaft casualties, presented by the author and Mr. Smedley in March 1960 to the North East Coast Institution of Engineers and Shipbuilders.

The author wished to emphasize, particularly in the light of some of the criticisms of the research efforts of the shipbuilding and marine engineering industry, that the investigation work of Lloyd's Register of Shipping and the advice given by the Society to owners and builders based on a worldwide survey experience, represented what could be regarded as full-scale research aimed at improving the design of marine machinery. In general, shipowners were not reluctant to adopt new ideas provided they could be assured of reasonable reliability. It was a practice of Lloyd's Register to facilitate and guide technical innovations, and to keep a careful watch on them until they were thoroughly proved in service.

Mr. Victory asked what precautions the author would suggest in the welding of boiler main stays. The question was largely hypothetical so far as marine Scotch boilers were concerned. Not only were fewer of those being made nowadays, but most manufacturers who adopted the welding of main stays had abandoned it because of welding defects which were very difficult to avoid. Since main stays secured in the orthodox manner give very little trouble, the author would strongly discourage the use of welding for these parts. Mr. Victory's comments relating to the breaking of bolts were both relevant and helpful.

Regarding persistent trouble with top end bearings, if alignment, bearing surfaces and combustion loadings were satisfactory, then the explanation was to be found in lubrication. Attention must be given to oil supply, oil pressure and oil distribution to the bearing surfaces.

Mr. Jacobs raised the question of access for the tightening of nuts, particularly in reference to the failure of the studs securing the piston cooling surface assembly to the engine crosshead described in the paper. In practice, the nuts of many bolted assemblies were difficult of access with a normal spanner, and this was something which designers and draughtsmen should bear in mind. Mr. Harry Hunter had written privately to the author about this particular type of failure, pointing out that in certain wartime-built ships, in the interest of economy of material the distance over the flats of standard nuts had been reduced and it might well be that such failures could be attributed to a deficiency in bearing surface under the nut. Mr. Jacobs had also made a written contribution in which he offered a number of useful comments on several of the failures mentioned in the paper. In regard to his question about the cold rolling of the fillets of crankpins and journals, it was well known that this surface treatment could increase the fatigue strength of crankshafts. The practice, however, had not been adopted in marine engineering and it was doubtful whether the incidence of crankshaft failures would justify the introduction of this process.

Mr. Fowle's remarks about carbonization of lubricating oil were interesting, and it was agreed that a temperature of 275 deg. C. at the turbine oil gland was excessive. In the cases quoted in the paper, it was not possible to effect a modification which would provide a free flow of air between the oil baffle and the end of the labyrinth gland and it was necessary to achieve a reduction in oil temperature by other means.

In answer to Mr. Gooch, radiography was unsuitable for the examination of large heavy steel forgings. Ultrasonic testing was being used increasingly and successfully for this purpose by forgemasters and engine builders. Experience in interpretation was necessary for full advantage to be derived from ultrasonic testing.

In reply to Mr. Adam, hot spots in oil engines usually occurred in running gear, bearings, pistons, thrusts, etc., where there was friction between two rubbing components. It was agreed that crankcase explosions had also occurred due to the seizure of a piston skirt in a trunk-type engine. Mr. Adam's closing remark to the effect that proper attention to lubrication and care in the maintenance of running gear was the best way of ensuring trouble-free running was worth noting.

Mr. Cromarty had underlined the need for engine builders to profit by the operating experience of shipowners. There was, in the author's opinion, room for better liaison between those responsible for operating ships' machinery and those responsible for the design and construction of that machinery. Lloyd's Register, with the concurrence of the shipowner, was always prepared to feed back to an engine builder information concerning defects and breakdowns occurring in his particular machinery, but it must be understood that the primary causes of defects and breakdowns were not always clearly established.

In regard to the fitting of taper coupling bolts in intermediate shaft couplings, those were acceptable to Lloyd's Register, whose records showed that they were no more prone to failure than bolts of the parallel type. It was agreed that coupling bolts, whether tapered or parallel, should be a very good fit in the bolt holes. As pointed out in the paper, inadequate pre-tightening was a frequent cause of failure in bolted connexions. There was a need for some simple device for indicating the amount of pre-tightening obtained.

Thanks were due to Mr. Ellison for adding to the interest of this paper by describing an incident of broken piston studs in a Diesel engine and the measures taken to avoid a recurrence.

Dr. Ingvar Jung had advanced a theory which took into account the creep of shrunk-on gear wheel rims. This was based on a local deformation of the rim and predicted slip at a low tangential force. Without information of the values of the constants used in the formulæ, the author was unable to comment on the actual merits of those equations for typical shrunk rims. However, for normal gear wheel rims the author considered that the influence of local deformation on the tangential force for slip was probably within the range of error of μ in equation (1). He also agreed with Dr. Jung's second conclusion, which seemed to be good design practice.

Mr. Pluys had shown how he had made use of ultrasonic testing and Magnaglo methods for the examination of some important machinery parts during service. Experience in interpretation of ultrasonic testing was, of course, essential if the full value of this technique was to be achieved, and it was observed that Mr. Pluys made the proviso that the instrument should always be used by the same operator dealing with similar engine parts.

The author agreed with Mr. Pluys that the use of ultrasonic method in examining tailshafts *in situ* was a useful safeguard against the possibility of a fracture remaining undetected.

Magnaglo was a most sensitive method of detecting cracks in gear teeth but the method might fail if cracks were very fine and short.

In reply to Mr. Vlassopulos, service failures were rarely found to be due to unusual causes. The causes were usually straightforward and practical but often involved a good deal of patient investigating work in order to get rid of the "red herrings" and arrive at the solution.

The author would hesitate to ask one of his staff to write a text book on marine machinery failures. Perhaps a more useful effort could be directed towards writing a text book on good design, taking into account the lessons learned from the record of failures contained in papers based on practical experience.

INSTITUTE ACTIVITIES

Minutes of Proceedings of the Ordinary Meeting Held at The Memorial Building on Tuesday, 11th April 1961.

An Ordinary Meeting was held by the Institute on Tuesday, 11th April 1961, at 5.30 p.m., when a paper entitled "Experience With Hardened and Ground Gearing in the Royal Canadian Navy" by D. K. Nicholson (Associate Member), was presented by the author and discussed.

Mr. B. P. Ingamells, C.B.E. (Vice-Chairman of Council) was in the Chair and 82 members and visitors were present.

Ten speakers took part in the discussion which followed.

A vote of thanks to the author, who had flown from Canada especially for the occasion, proposed by the Chairman, was greeted by acclamation.

The meeting closed at 7.40 p.m.

Mr. Nicholson's paper "Experience With Hardened and Ground Gearing in the Royal Canadian Navy" is published in the June issue of the Canadian Supplement.

The Summer Golf Meeting at Moor Park Golf Club

The Summer Golf Meeting took place at the Moor Park Golf Club on Wednesday, 17th May 1961. The morning and afternoon competitions were enjoyed by 38 members in fine sunny weather.

In the morning the Singles Medal Competition for the Institute of Marine Engineers Silver Cup was won by Mr. A. Walker (9) with a net score of 76. There was a tie for second place between Mr. J. Shanks (22) and Mr. H. P. Jones (12) who had net scores of 79, the prize was awarded to Mr. Shanks who had the best score over the last 9 holes.

The Greensome Bogey Competition in the afternoon was won by Messrs. A. Bartholomew and J. E. Bowell, one up, Messrs. S. I. Jones and I. M. Mees were second, all square.

Mr. Stewart Hogg, O.B.E., Chairman of the Social Events Committee presented the prizes and thanked the Committee and catering staff of the Moor Park Golf Club for their hospitality. It was announced that the next meeting would be the Autumn Meeting at the Berkshire Golf Club on the 27th September 1961 and that the Summer Meeting 1962 would be held at Sunningdale on the 7th June.

Section Meeting

West of England

By courtesy of the Esso Petroleum Company Limited, a party of members of the West of England Section, together with their ladies and guests made a visit to the Esso Refinery at Fawley near Southampton on Thursday, 18th May 1961. They travelled from Bristol and Bath by coach and on arrival were welcomed by Mr. G. E. Pratt of the Public Relations Department who, after escorting the party to the lecture room, gave a most intesting introductory talk on refinery operations which he illustrated with numerous coloured diagrams. The talk lasted for about forty minutes and was followed by a short question period.

The party was then invited to lunch as guests of the Company and during the luncheon Captain W. R. Stewart, R.N. (Chairman of the Section) took the opportunity of proposing a vote of thanks to the Esso Petroleum Company and also to Mr. Pratt for what had so far been a most enjoyable visit and said that he felt confident that the tour of the refinery which was to follow would be equally enjoyable. The proposal was accorded with acclamation and Mr. Pratt replied suitably.

Because of the vast area covered by the refinery it was necessary for the party to make the tour by coach, and members were first of all taken down to the terminal where up to eleven ocean going tankers were handled each day to maintain the refinery's throughput of about seven million tons of crude oil a year. It was understood that the refinery was the largest of its kind in Europe, and supplied about one-quarter of the country's petroleum requirements from Middle East oils. It was also understood that many of the petroleum products made at the refinery were shipped from the same oil jetty, which was almost a mile in length, by tanker to storage depots situated at strategic points around the coast, from which subsequent deliveries are made inland. The road up to the refinery from the oil berth was lined on each side by great silver painted pipes connecting the tank farm with various processing units. Members were interested to learn that many of the storage tanks were fitted with a floating roof which actually floated on the liquid contained in the tank; with the elimination of the air space, breathing losses disappeared and the fire risk was greatly reduced. By means of the public address system installed in the coach, Mr. Pratt was able to describe the functions of the more important units as each was approached, such as, the atmospheric and vacuum distillation units, the catalytic cracking unit and also the copper chloride sweetening, stabilizer and catalytic polymerization plants to name but a few of the many complex installations that were seen. During the tour the party was given the opportunity of seeing inside one of the control rooms and were intrigued by the way in which the recording instruments were diagrammatically arranged on the wall panels. Time would not allow a visit to the central maintenance building and the party returned to the main office block where they were given afternoon tea before starting off on their homeward journey at 4.45 p.m.

Election of Members

Elected on 7th June 1961

MEMBERS

Frank Cooper Adams, Eng. Lieut. Cdr., R.N.
Bernard Brown
Christopher Clement Connolly, Cdr., R.A.N.
Wilfred Arthur Cordin, Lieut., R.N.
John Cromby
Hugh Llewelyn Davies
John Albert Dickinson
Joseph Donoghue
Robert Penrose Dudgeon
George Foster
Oliver William Geering
William Douglas Cairney Goldie
Arthur Harvey Hignett
Thomas Michael McAnelly
Donald John McEwan
James Noble Mackenzie
Brian Drummond McLaren
William Hall Manderville
Henry Edward Morgan, Instr. Lt. Cdr., B.Sc.(Eng.) (London), R.N.
James Alexander Noble
Richard Geoffrey John Peaver, Cdr., R.N.
James Richard Penrose
E. Thomas Reilly
Ronald John Sansom
Daya Shankar, Rear-Admiral, I.N.
Antony James Richard Smith, Lieut. Cdr., R.N.
Edward Alexander Thornton
Hereward White, D.S.C., Capt., R.N.
Lawrence Tait Williams
William Wilson

ASSOCIATE MEMBERS

Khan Mohd. Jalaluddin Akbar, Lieut., P.N.
Joseph Henry Aubrey, B.Sc.(Hons.)
Henry George Colin Bethell
Patrick Brennan
Thomas James Butterworth
Dimitri Capaitzis, B.Sc.(Eng.)(Hons.)
Reginald Joseph Felician Colaco
Pestonji Hormasji Dubash, Sen. Cdr. Eng., I.N.
George Edward Farrar
Gordon Fenwick
David Sage Ferry, Lieut., R.A.N.
David Fitchet
George Philip Garroch
Mauli Bhushan Ghosh, Lieut., I.N.
Prabhakar Gupta
Ian Meekley Head
William Hill, Junr.
Michael Roderic Bentley Hilton, Lieut., R.N.
Roy Lloyd Hughes
Ismail Ali Khan, Lieut., P.N.
Archibald Alfred McQueen, Lieut., R.A.N.
Kanai Lal Mondal
Shankar Narayan, Sen. Cdr. Eng., I.N.
Matthew Sampson Newton
Francis James Phillips
Harry Thomas Phillips
Michael Hugh Piper, Lieut., R.N.
Venkataraman Radhakrishna
Maurice Charles S. Rahman, Lieut., R.N.
Paida Janardhana Reddy, Lieut., I.N.
Neville Anthony Rendall
Dennis Arthur Rowe, Lieut., R.N.
Tulsidas Mohanlal Sanghavi
William John Simpson
Richard Edgar Stone, Lieut., R.C.N.
Lawrence Thackstone
Kevin James Thompson
Graham Mark Tostevin, M.E.(Adelaide)
Samuel John Van Haeften
James Wilson
Ronald Wortley

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Peter Kaye Brighting
Peter Michael Wilson Cook
Peter Edmund de Waele
William Lennie Gilchrist
Ronald Thomas Lewis
Gerald P. McCarthy
Herbert James Marrion
Robert M. Maust
Cecil Patrick Mitchell
E. A. Tawab Mohamed
Peter Brown Morgan
Vittal Uggappa Shetty, Cdr. Eng., I.N.
Patrick Brian Watson

GRADUATES

Colin Elmo Graham Bateman
Robert George Beveridge
Allan Carmichael
John Walter Dalrymple
John Syme Duncan
John Noel Edgar
Ronald Arthur Johnstone
William Frederick Kidd
Vinod Kumar, Sub. Lieut., I.N.
David Noel Lipscomb
William James McClintock
Selvaras Mudaliar
P. K. Ramanathan, Sub. Lieut., I.N.
Nelson Sargood Webster
John Sheldon Whybrow
Vernon Val Wilson
Robert Yarr
Brian Yoxon

STUDENTS

David Frederick Barrett
Alexander John Costello
James Thomas Doyle
Jack Gregson
Patrick Joseph James Kelly
John Anthony Lee
Jagjit Rai
Robin William Rowstron
S. J. Singh

PROBATIONER STUDENTS

James Cameron Jelly
David Henry Thompson

TRANSFER FROM ASSOCIATE MEMBER TO MEMBER

Alfred Leon Rodney Bligh
William Simpson Harper
Joseph Edward Hughes
William McQueen
Donald Walter Mitchell
John Prince Vickery

TRANSFER FROM ASSOCIATE TO MEMBER

Donald Alexander Middleton, Lieut. Cdr., R.N.

TRANSFER FROM GRADUATE TO ASSOCIATE MEMBER

Joseph Robert Cleworth
James Dennis
Donald Inglis
Stanley John, Lieut., I.N.
Francis George Jones
Antony Bruce Marshall
Geoffrey Mitchell

Bryan Pacey
Trevor Raylor
Ravi Shankar Shukla, Lieut., I.N.
William Russell deWinter Stenhouse
Frederick Cecil Taylor

TRANSFER FROM STUDENT TO ASSOCIATE MEMBER

Peter Mervyn John Llewellyn

TRANSFER FROM STUDENT TO GRADUATE

Harold James Arnold
Roger Josiah Brunton
Alfred William Bryce
William Osborne Gray, B.Sc.
John Laurence Hutchinson
Geoffrey Knowles
Geoffrey Lambton

TRANSFER FROM PROBATIONER STUDENT TO GRADUATE

Richard Arthur Jones

TRANSFER FROM PROBATIONER STUDENT TO STUDENT

Anthony George Green
John Hesketh Heywood
Robert Hudson
John Charles Stocker
Alan Prescott Ivens
Owen Clive Whiteaker

TRANSFER FROM GRADUATE TO ASSOCIATE MEMBER

Jayaram Madhavan