

# The Impact of the Sandwich Scheme on the Training of the Marine Engineer\*

MR. F. S. GANDER, B.Sc. (Chairman) said that they were very fortunate in having Mr. H. E. Dance to speak to them on the impact of the sandwich scheme on the training of the marine engineer. Mr. Dance was very well known in the educational world. He was, as some members of the Group might not be aware, the Chief Senior Staff Inspector of Her Majesty's Government on technical matters.

MR. H. E. DANCE said he could tell them about sandwich courses, and they could tell him about their impact on marine engineers. It was only by exchanging views that one could progress.

The sandwich course was not new. The Sunderland Technical College had had one running for over fifty years, and Cincinnati had had one running for a few years less, but very few sandwich courses were developed, and it was only since the war that real extension of the scheme had taken place. There was some pre-war development—for instance, a group at the Constantine Technical College, Middlesbrough. Since the end of the war about forty-five such courses had begun.

The essence of a sandwich course was this: large blocks of time were spent in a technical college, interleaved with large blocks of time in systematic training in industry. The length of the blocks might be varied to suit local needs.

A very common balance of time was six months in the year in the college and the other six months in industry, with periods lifted out here and there for the usual holidays. Experience had moved a little away from that; colleges which began with that arrangement found at a later stage that a more practical arrangement was to have about five months in the college and seven months in industry.

Another important point about sandwich courses was that usually they should be works-based. Some of them were run by the colleges which made arrangements with industry for the students in the intervening periods. When a sandwich course was described as works-based, it meant that all, or nearly all, the students were in the employment of a firm from the start. Whether they were paid by the firm for the whole of the period, in college or not, depended on the firm, and on the area. That raised some very complicated questions. No doubt they would remind him of them in discussion.

Some firms employed apprentices with the intention of sending them to sandwich courses and paying them while they were in the college, at normal apprentice rates. Other firms employed apprentices and paid them as apprentices while they were in the works acquiring experience; but they did not pay them while they were in the college. Some local authorities paid subsistence allowances for that period. The practice varied very much in different parts of the country and in different industries.

These variations in practice presented a problem which had to be solved in a consistent way. The differences arose because the development of sandwich courses was experimental and they created quite difficult questions which would take time to solve.

\* Discussion following the Annual General Meeting of the Education Group on 21st March 1956.

In the ideal type of sandwich course the boy should have had industrial experience of some kind before going into the course at all and should be selected by the firm and the college in consultation. This was important, because it implied co-operation between the two parties to his education. The kind of apprentice who was likely to be selected for a sandwich diploma course was one who would normally be exempt from the first year of an Ordinary National Certificate course. On leaving school, he would enter apprenticeship at sixteen plus. He would have four suitable G.C.E. "O" passes and he would enter the second year of an Ordinary National Certificate course, and after one or two years he would be chosen for the sandwich course.

Before he was selected for the sandwich course he would have served one or two years in industry; the college would have got to know him and so would his employer. The selection was then made on the basis of combined experience; with the firm and the college acting in consultation it was unlikely that an apprentice would be selected if he were not suitable for a sandwich course. Consultation between the two was an important factor.

Consultation between the college and the industry went further, and extended to the planning of the course and the industrial training as an integrated scheme.

There was another way into the sandwich diploma course. A boy might have the choice at the age of sixteen of leaving school and entering apprenticeship or staying at school for two years. If he stayed on, he would stand a chance of qualifying for entry into a university. If he could get the necessary qualifications and there were no economic difficulties he might secure admission. One must assume that unless there was some very strong preference for the sandwich course as such, or there were economic factors that favoured it, a boy who remained at school for two years would not enter a sandwich course unless he had failed to qualify to enter a university.

He believed that under the more favourable conditions of a sandwich course these entrants, who were often first-class in many human qualities, could reach a high standard in a satisfying course. They wanted those boys in engineering and the sandwich course was a way to get them. Only experience could show whether this belief in the sandwich course would be fulfilled. It would depend largely on the skill of teachers in seizing the new opportunities which sandwich courses provide.

Now let them consider the boy who left school at eighteen years. Usually, he would be required to spend about six months in industry, or perhaps a year, before he entered on the sandwich course. There were variations to suit local industries. Sometimes it was convenient in the organization of a college, in which there was more than one group of sandwich course students, to interleave the groups so that one began in September and the other in February. The February group enabled the secondary-school leaver at the age of eighteen to get some industrial experience for a few months before he entered the college.

The sort of variations one found in Higher National Diploma courses were these. The lowest level of entry that

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was adopted was the satisfactory completion of the S.2 year of an Ordinary National Certificate. In Mechanical Engineering Sandwich Diplomas there had been a move towards the Ordinary National Certificate as the starting level. The reasons were mixed. First, it was a higher level. The man was a year older and had a year more of part time study behind him and a further year's contact with industry. These were all favourable factors. The Ordinary National Certificate was a level at which there was an externally assessed examination. There was not as much variation of standard as there was in an S.2 examination which was not assessed. Local education authorities did not usually award scholarships until the Ordinary National Certificate level was reached.

For the secondary school leaver the requirement was that he must have taken an advanced course to eighteen years of age in the secondary school and gained at least an "A" level in the General Certificate Examination in mathematics or physics and some "O" level passes, depending on the course. Some courses required two "A" level passes.

The length of the course was sometimes three years, sometimes four, and occasionally five. The three- and the four-year courses might run from the end of S.2 or the Ordinary National Certificate. The five-year courses starting from the Ordinary National Certificate catered for those students and industries who liked to add some work in management to the technical content.

In this context, "management" meant the history, the terminology, the current situation, mathematical methods, and the special techniques of management such as method analysis, method improvement and work study which had been shown to have at any rate some basis of science and logic and could be tested in a reasonable way. The number of students taking five-year courses was quite small and probably would never be very large—they were for hand-picked students for whom industry was willing to provide the time and the means.

There were courses for diplomas, full time and sandwich, at Ordinary National Certificate level and some of a special type had been set up, but they were so few that they were regarded as experimental. There was no reason why the sandwich idea should not apply at the Ordinary Diploma level, if it were considered to be advantageous. But those who had experience of the alternative entry scheme, which was a very successful scheme, knew that it was already sufficiently crowded with studies. If it were made into a sandwich diploma course including as much material, the same results could not be achieved in two years. Three would be needed. There seemed to be no clear demand at present for that kind of course.

The examinations in sandwich diploma courses were governed by the Rules for the award of National Certificates and Diplomas. The Joint Committee for National Certificates and Diplomas in Mechanical Engineering had taken an exceedingly flexible view. "If there was a demand which was evident in industry and it satisfied the minimum educational standards, it would approve the course, at any rate as an experimental measure". There were courses in mechanical engineering which covered three or four years from S.2 and three years from S.3. Recently it had been thought that the three years from the S.2 course was overcrowded, and none had been approved in recent years; but a few were still running.

In recent years, the Joint Committee for the National Certificates in Electrical Engineering had not approved sandwich diploma courses covering less than four years from S.2.

Something must be said about the Diploma of Technology, but as he had not brought his crystal-gazing ball with him, he could not say much, nor could anybody, until the Hives Council announced its standards. Experience had shown that the Ordinary National Certificate was a convenient starting point. Many colleges were working Ordinary National Certificate schemes; it was the level at which local education authorities normally made awards for higher courses and at this level there was an assessed examination. They might guess that this was the level from which the Hives award might start.

They did not know what the duration of the Hives

courses would be. Probably not less than four years. Whatever the standards of the Hives award might be, there would probably be some industrial demand for sandwich and full-time courses at a lower level. They could not afford to miss any student or fail to educate him to the limit of his potential ability and to achieve this they must have courses at all levels to match the various potentialities of the students. The moment they failed to put the student first, they would begin to have an inferior educational system. Courses had to be governed to some extent by immediate industrial needs and teaching was influenced by the examination system, but the effectiveness of the education of today would be measured by the ability of the men it turned out to meet the unpredictable requirements of a quarter-of-a-century ahead.

How did this fit into education for marine engineering? It would be no use trying to fit the developing scheme of technological education to the old methods of recruitment to marine engineering. What they had to consider was whether the sandwich courses were likely to attract boys from marine engineering who would otherwise have entered it. This was not entirely an educational question. The firm that spent £1,500 to educate an apprentice was not likely to let him go to marine engineering except for experience; and from the apprentice's point of view, the firm would offer an assured future with good conditions and a pension at the end. What was going to decide whether a boy went into an industry was how hard the industry tried to get him and keep him. If an industry did not try hard enough it would lose him to other industries. He feared that unless very strong measures were taken, boys were going to be attracted away from marine engineering because other industries offered more advantageous conditions.

The advertised conditions under which industries would accept apprentices for special training were well known. Even better conditions would be offered to outstandingly able boys—even payment of the whole cost of a university education. Where were the men to come from for the top engineering administration of the Mercantile Marine if the industry did not breed its own? How could this responsibility be shared between the shipbuilders and the shipowners?

The sandwich course, as outlined, seemed to have no simple place in the present pattern of education for marine engineers. The boy who went into the sandwich course had already been selected by industry, and often industry would have picked him out and paid for his education in the sense that they paid for his upkeep while he was at college for three or four years. Industry was not likely to have picked out a boy they would willingly lose later. Some shipbuilders were sending apprentices to higher sandwich courses, but not all, and few shipowners were using them. Unless the marine engineering industry could compete with others in this, he wondered what was going to happen.

Did it mean that they had to recruit from those who were not taken for sandwich diploma courses? They should preserve a proper sense of proportion in this. Although there were some forty-five sandwich courses running now, he did not suppose the number of students was much more than seven or eight hundred. Much larger numbers were going through part-time day courses for Higher National Certificates.

The number of all those who entered industry by university degree, university diploma and technical college diploma had about doubled since 1939. The number entering by Higher National Certificate had gone up five times since 1939. The percentage of the total entry into industry (the sum of the two numbers) who had taken part-time courses had risen from 41 per cent in 1939 to 62 per cent in 1955. *Proportionately*, therefore, they had more students taking part-time courses today than ever, but the top level was "creamed off" both for university courses and for sandwich courses.

That suggested that the whole tempo of education had increased, and that for certain industries two levels of recruitment were wanted. The higher level went through the sandwich diploma course. The other level would come from the

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part-time course, from the 60 per cent which was still the major part of the entry.

The part-time engineering student was still the salt of the earth. He was a fine man; but could the shipping industry get him at the end of an apprenticeship under modern conditions? The alternative entry scheme had been set up and was a first-class arrangement to supplement the older type of recruitment and where outstandingly able men were discovered in it they should be encouraged and aided to higher studies, perhaps by transfer to sandwich diploma courses. But would the industry get enough top engineering administrators unless it looked after itself and adopted methods—such as sandwich courses—which other industries had found to be necessary?

MR. STEWART HOGG (Member) said he had hoped to hear how the great expansion in higher technical education would be matched by the increased numbers entering engineering as the sandwich courses developed. He agreed with Mr. Dance that the better types would avail themselves of the new opportunities of higher technical education. He could not see therefore where the supply of good quality marine engineers would be found in the future, as the engineering industry in its broader sense was expanding, unless automation made available more men for seagoing employment.

In industry today the old type of craft training was disappearing. Specialization was becoming the order of the day; many time-served apprentices were not really the type the shipowners were seeking. He had recently been invited by a large engineering firm to see how they trained apprentices and in order to convince him that they were not suitable for marine engineering. These apprentices were given a good basic training on the use of hand tools and small machines for the first six months. From then onwards they specialized on a limited range of work of the firm's products only. In other words they were being well trained for the firm's work. That was not the type of all-round training most suitable for a youth who wanted to be a junior seagoing engineer.

Mr. Dance had told them something of the rise in National Certificates gained yearly since the end of World War II. That increase, or at least the rate of increase, was not reflected among the new entrants to the Merchant Service.

MR. DANCE said that the total entry into the sandwich diploma courses was a comparatively small proportion, and was additional to the National Certificate output. The total for the whole country might, at a guess, be seven or eight hundred, including some electrical students.

The essential problem was that none of these people—and he was putting it strongly because he thought it was true—who went into sandwich diploma courses would transfer into marine engineering, not one of them, while marine engineering was doing nothing about it for itself. He did not see any escape from that situation. If some industries said they were going to support students, in one way or another, when they had been selected by industry jointly with the colleges, to enter a sandwich course, the probability was that those students would stay in that industry. They were selected men from the start.

What could be done? He assumed that the marine engineering industry wanted more men of that type. They would be pretty good men, they would have a qualification roughly equivalent to a degree—in some ways better than a degree, because they had better industrial experience while they were getting it.

MR. C. H. TAYLOR-COOK, B.Sc.(Eng.) (Member) said it seemed to him that the requirements of marine engineering generally could be divided into two fairly broad groups. The type of person Mr. Dance had been describing tended to take the Higher National Diploma course and would be more suitable for the administrative or design or shore job. The seagoing engineer would be in the lower grade. He felt sure from all he heard that this was where some of the major difficulties were occurring in recruiting and retaining sufficient staff.

He doubted whether the type of man who was required for the seagoing engineer's job was also the type of man who would qualify or be suitable for a diploma course. One was not primarily concerned here with facility in academic learning. Undoubtedly the possibility of attending a sandwich course was an attractive one—the idea of having consistent periods in school and in industry. He had been wondering whether it would not be possible to adapt the sandwich course idea to a lower qualification. At the moment it was intended only for the Ordinary or the Higher National Diploma. Was it not possible to start lower down in the sandwich scheme and have it going more at Ordinary National Certificate level, even if it did mean that the shipping industry had to recruit their boys at an earlier age, in the same way as every shore industry was doing, and pay them during the time that they were attending the sandwich course? The sandwich might be thinner. It might be three months in college and nine months in industry, during the normal apprenticeship years.

MR. DANCE said that the Alternative Entry Scheme was working all right. Would a sandwich diploma offer any advantages over the Alternative Entry?

He assumed that the Alternative Entry Scheme was not providing a man better qualified than was wanted. It was giving a good man but not a man better than was wanted. To produce the same standard a sandwich course would have to be three years instead of two.

Having regard to the increasing technical complexity of the engineering of ships—and it would become even more complex—was it not necessary to get away from craft skill to achieve higher technician skill? A skill in the operation and maintenance of highly complex plant, in which there was considerable diagnosis.

What was wanted in marine engineering? Was it craft skill or was it this broader-based technician's skill? If it was the second kind of skill, what field had it to cover? Would it be necessary to change one's ideas and say that a man had to go into a first-class, specially planned, industrial apprenticeship in order to get some of that skill?

Perhaps he should go into industry for one or two years and then have three years of a sandwich course. Probably it should be a sandwich course to keep the close association with industrial practice in which a technician's skill was acquired over a wide range. He was wholly with Mr. Taylor-Cook that the course need be no higher in standard than the Ordinary National Certificate, but much wider in content.

MR. D. G. ALCOCK (Member of Council) said that the present Alternative Scheme of training was no doubt producing a good man but as he saw the demand for manpower in general, there was a need for a very narrow stream of good quality personnel for positions as superintendents and in similar appointments and also a demand for a wider band of people who would eventually become senior staff at sea. There was an even wider requirement for men with a good deal of craft skill.

Mr. Taylor-Cook's idea of a diploma of a somewhat lower order of content was excellent. The Alternative Training Scheme might assist in meeting future demands for certificated officers but they appeared to be missing a good source of recruitment from applicants who were not quite fitted to meet the existing entrance standards of the Ordinary National Diploma course.

Last year he had sent a number of applicants of this type, as an experiment, to a London College, not really to see whether they were suitable for the Diploma course, but to get a second opinion as to their capabilities. The general finding was that they were sound material who, with adequate training at an appropriate level and given something different from the existing Ordinary National Diploma content, some lower qualification, would fit into the normal ladder of promotion at sea and then develop into satisfactory marine engineers.

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MR. DANCE said he might perhaps be allowed to take something from another setting. He had attended a meeting on the previous evening at which Mr. Hogg was also present when the use of graphics in engineering teaching was discussed.

War-time experience in training radar mechanics showed that people could be educated in terms of equipment, cutting out the mathematics and with careful presentation of ideas experimentally and graphically, by using graphs and symbols and vector diagrams freely. If plenty of time were taken, much progress could be made. There were men who could be trained as first-class technicians who could not take a mathematical course and a technical course with little mathematics should be planned for them.

MR. T. W. LONGMUIR (Vice-Chairman of Council) thought it might be possible to run a sandwich course with twelve months at sea and twelve months at college. An engineer first going to sea, unless he had had his training in a very good workshop, was a slight menace. An apprentice going to sea would have five years' half time to be taught the dangers and what happened if he did certain things. Accidents such as boiler explosions were generally due to ignorance on the part of somebody who did not realize the consequences of certain actions.

The Alternative Training Scheme, as he knew it, had too many subjects in the curriculum and too much classroom work in some subjects to give a boy a chance to develop the faculty of clear and quick thinking. For two years the apprentice was crammed to enable him to pass an examination. He (Mr. Longmuir) was now in a position to see some of the effects of the cramming and was a little frightened by the result. Not 20 per cent of those who obtained the Diploma could think for themselves, the majority just repeated certain statements from a book or notes without question.

One solution was a slightly lower standard and he would define his lower standard as a smaller number of subjects taught more widely to the present level of student. At least 50 per cent of the time given to the subjects of heat engines and strength of materials and applied mechanics should be spent in the laboratory. The boy who was going to sea as a marine engineer should be able to see the effects of all he did in the laboratory; he would then learn to think quickly and at an early stage in his training, develop that sense of feeling that things were not running quite rightly and be able to take corrective measures on his own initiative.

In his opinion, the shortage of marine engineers was partly due to the short time engineers stayed at sea. It was not that recruitment was not the same as before the last war. In those days, although a number wanted to stay ashore, they stayed at sea for five, six, seven or even ten years after obtaining their First Class Certificates. Their experience was passed on to the juniors and the juniors were thus better trained. Now, as soon as an engineer obtained his First Class Certificate, even with very limited experience, shore industry wanted him. The result was that it got only half-trained men.

Not long ago a member of the Institute holding an Extra First Class Certificate and Higher National Certificate stayed ashore and received £1,350 a year. If he had gone back to sea, he would not have been paid that amount. This had nothing to do with education but the shortage of marine engineers had been mentioned, and it was one point to remember.

MR. DANCE said one had to face the realities of life. He was not sure what reply he could make to the question raised by Mr. Longmuir.

The intention of the National Diploma and the National Certificate schemes was to enable the college to present the subject in the most effective way and to set its own examinations. In fact, colleges did not take full advantage of this freedom. The curse of engineering education, whether for marine engineering or almost any other branch, was that one

taught students to pass engineering examinations, which was not quite the same as teaching engineering. Examinations were governed by both economic and academic considerations. They could not last more than about three hours and they had to be marked in reasonable time (i.e. at reasonable cost). This affected the type of question.

These were real factors, but it was open to a college to say: "Here is a bit of work which we ought to teach and will teach in our own way, so that the boy really understands it". Nobody was forcing them to teach it in any particular way. He did not think full advantage was being taken of the academic freedom available to colleges.

MR. C. W. TONKIN, B.Sc. (Associate Member of Council) said he had never yet met the Principal or Head of Department who did not devise his National Certificate scheme to meet the possibilities of exemption, subject for subject, from institution examinations. While institution education committees insisted on more and more going into the syllabuses for their examinations and nothing coming out, syllabuses would continue to be overcrowded, with the net result that on the basis of three evenings a week the present state of affairs would continue where it was simply a matter of trying to get more information into a given time than was really possible.

The colleges would not teach, as he was pleased to hear Mr. Longmuir suggest they should, through the laboratory equipment. They would teach in the way that was so very common—by notes dictated, by books, by some use of the blackboard, but by little intelligent use of the laboratory.

They would continue to hand out to the students sheets on which everything to be done in an experiment was written down. Practically all that was required was to fill in the numbers at the end, and if they could read a scale and a number they were all right. The method of applying these numbers was very easy, so they filled them in. They were grounded in simple equations fairly thoroughly, and they could write up a relatively good report.

That was not teaching. They would know very little more about it when they had finished than they had known before. His scripture was a little rusty, but he thought there was something about "with all thy wisdom get understanding". He was sure they were getting a lot of wisdom in the form of information rammed in and not too much understanding. It was the fault of educationists, not of the students. It might also be the educationist's fault in a different sphere if they were connected with institutions. But as educationists they ought to have the courage to say, "Stop!" at some point, and the time for that had gone by, he thought, rather than being in the future.

Another point that occurred to him was that surely they were up against an even bigger problem than what to put in and what to leave out, what kind of course to give the students and what not. The demand for technicians and technologists had increased so tremendously that they were attempting to get a very much bigger number of relatively high calibre people out of the same proportion of that calibre in the population. Overall, the levels of intelligence in the population were not going to alter greatly over the years.

Some people tried to depress one by saying that the general level was going down; but even if it were not, the proportion of high calibre people would not increase very much. The problem was to make use possibly of lower calibre people by giving them the kind of training that would result in their being available in the kind of service that was wanted.

This raised the question of recruitment. It was a very disturbing thought that of the total number of major county awards given by one particular authority which should be nameless, more than 50 per cent went into arts courses. At sixteen-plus a lot of youngsters left school who, fortunately or unfortunately, had attended a secondary school where the emphasis had been on arts subjects. He was not prepared to believe that because they had not taken science they were any

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less intelligent. Nor was he too ready to agree that they were more intelligent. The point was that they were going to be told that unless they had G.C.E. at "O" level, or possibly "A" level, in one or two science subjects they would not be accepted. This tended to throw away a lot of valuable material. A sixteen-plus lad might have given up physics or chemistry at fourteen and perhaps done Latin or Greek for his pains, but he should still be accepted into a course of this nature. Mathematics was probably essential, but he himself would certainly not insist on one, two or three science qualifications.

They should face up to the fact that they ought to try to get some of these people. The general level of intelligence indicated by having reached a certain stage in arts was as good as any other indication, for what it was worth. It was as good as having got through one or two science papers at a similar level. They must be prepared to take some of these people and start with them where they left off at fourteen or just before. Science must be taken more realistically, not in the textbook secondary school laboratory style with little bits of wood and aluminium and practically no friction, for instance. Not only would it be worth while with these people but also with those who had taken their Ordinary level science papers.

The net should be spread a little more broadly, taking a broader selection of young people and starting from something more realistic.

THE CHAIRMAN observed that there still remained the problem of getting these people to go to sea after that.

CDR. A. F. SMITH, R.N. (Member) said that as the remarks had covered such a wide field he was sure he was not able to sort them all out at the moment.

Starting with the Alternative Scheme, it seemed to him that one proposal had been that there should be a second stream in that scheme—that was virtually what the suggestion amounted to. His own view was that if there was that stream, it could certainly cater for the enthusiastic boy who was keen to go to sea and who did not like the idea of spending five years in a shipyard or engineering establishment, but who might not make the grade in the G.C.E. or possibly the S.1, to start with.

He did not know whether it was possible to run two streams at the same time. He did, however, consider that there were many boys—boys with character—who, possibly due to the war years or for other reasons, were a little backward for their age but who would make first-class engineer officers in due course though they were unfortunately not up to the educational standard to come into the Alternative Scheme at the moment.

He would like Mr. Dance to clarify, if possible, his remark about the marine industry not doing anything about the sandwich course. He was in the north-east district recently when a friend described the sandwich course he was running for some of his trade apprentices. That was a start, at any rate, in the marine industry. But the answer to the impact of the sandwich course seemed to be to encourage the marine industry to do a bit more about it.

[Cdr. Smith had since written to say that in view of the advantages and attractions of the sandwich course over the workshop training with day release for educational studies, he thought it would be worth while considering a sandwich course system for the final part of the training of marine engineer apprentices recruited under the Alternative Scheme.

The present Phase III training of these apprentices had involved many engineering firms, technical colleges and shipping companies with difficult administrative problems, due mainly to the remoteness of some engineering firms from the very limited number of technical colleges approved to take these apprentices for their day and evening release educational studies. If a slightly reduced amount of sea time during their Part II training were found to be acceptable it should be possible to arrange for the September-entry apprentices to put in about six months' full time workshop training on completion of their

sea time and follow this with three months' full-time educational studies, say, from April to June. On completion of these studies and the necessary examinations, the apprentices would serve another period of about seven months' full-time workshop training without the danger of having to extend any apprenticeship beyond 4½ years.

The January-entry apprentices, with very little reduction to their sea time, could also join the April to June full-time classes on completion of their Part II sea training and follow this with twelve months' full-time workshop training.

Such a sandwich course should avoid many of the present difficult administrative problems and enable a wider distribution of apprentices to be made among marine engineering firms. Provided, of course, that technical colleges could meet the commitment of the three months' classes during the summer term, this period of full time study would enable most technical colleges to complete the technical education of these apprentices whom they had guided through the Ordinary National Diploma course, which would probably be a happy arrangement for both the college authorities and the apprentices themselves.]

MR. DANCE said that if people were admitted who for some reason had not made as much progress as would normally be expected in the Alternative Scheme, more time had to be allowed them. He believed a good job could be done with them then. He did not think any sort of a job could be done by admitting them and expecting them to do it in the same time, but it might be useful to have another opinion on that.

There were people in the three-year Diploma courses at some colleges who were employees of marine engineering firms. He believed that their prospects of going to sea were diminished when they got the higher qualification because they would be beset by greater attractions to stay ashore.

The shipowners were not selecting boys and providing for their higher education in the Higher National Diploma sandwich course. They were doing it in the Alternative Entry course but not significantly at higher level in the sandwich course. Could nothing be done? It was a difficult problem, one on which he had not the necessary experience to give an answer.

MR. D. A. EATON, B.Sc.(Eng.) (Member) said that he was not clear concerning the method of operation of the Government-assisted course. What he understood from Mr. Dance's remarks was that a boy would commence training as a craft apprentice and provided he entered the National Certificate course and was successful at each examination, he could obtain that Certificate after a period of two to three years. It also appeared that one of the conditions relating to the issue of a Government grant, which was equivalent to a county major scholarship, was that the applicant should be in possession of the Ordinary National Certificate or its equivalent.

Having already completed three years' workshop service and being selected for the grant, the applicant must now serve a further period of four years on the sandwich course, the time being divided into alternate periods of five and seven months at the college and works respectively.

If his impression were correct, what salary was it proposed to pay these apprentices or what inducement would be offered to them over the extended period of seven years in order to make the scheme attractive?

At present, firms now operating sandwich schemes selected boys who had reached the G.C.E. advanced level or some stage between the advanced and ordinary level in science subjects. These boys were only expected to serve the normal five-year term of apprenticeship which would consist of alternate periods of six months at college and works.

Would the appropriate Government department consider the possibility of giving financial assistance to suitable applicants without the necessity of being obliged to serve three years' workshop service while obtaining their National Certificate?

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MR. DANCE explained that a boy was first employed as an apprentice by an engineering employer. He was then a part-time day student at a technical college. At the end of two years, if he had exemption from S.1, or three years if he had not, he would enter a sandwich course on completion of the Ordinary National Certificate course. In some schemes he did not go to ordinary level but entered the sandwich course at S.2 level.

The other way was for a boy to remain at secondary school until he was eighteen years of age. He was employed by an engineering employer and began, after a short industrial experience, on the sandwich course.

As to the award, a boy might get a technical state scholarship for a sandwich course of the Dip.Tech. type, but not for a shorter course. It was the rule that a technical state scholarship could be given only for honours degree level courses. He might, however, get a local education authority award to maintain him while he was at the college; or if he were lucky with his employer, he might be paid a sufficient allowance, anyway.

MR. HOGG said the discussion seemed to indicate a slow strangulation of good quality marine engineers from industry. Additional educational facilities meant, for the reasons given by Mr. Dance, fewer well trained youths for the shipowners. Little had been heard during the discussion from the shipowners' representatives present regarding their contribution to training, apart from a comment in passing on the Alternative Training Scheme.

MR. H. N. PEMBERTON (Member of Council) said that was a difficult but very important question. His own conclusion after listening to the discussion was that the higher the standard of training of the engineer the less likely was he to take up a seagoing career. This position might lead them to a new conception of the manning requirements for the engine rooms of merchant ships.

MR. HOGG remarked that there were fewer and fewer people available to go to sea with what had been regarded by shipowners as the right type of training. Modern methods of production and conditions limited the opportunities of many apprentices in acquiring the skill of their forebears.

MR. DANCE said that was part of the picture that had just been painted. If a boy had had that training and had somehow high-class skill, he would command so much higher a salary and be less attracted to the sea. If he had the qualities the marine engineering people were asking for, he would be kept ashore.

This raised one other question. Was any attempt being made to re-assess the real qualities needed to staff a ship at sea? Who, in future, for example, was going to look after the gear which would give automatic navigation and do various other things which were not being done now? Before they knew where they were there might be atomic power at sea. Who was going to look after it? They must face up to these issues. The situation was changing, and while it was essential to recognize that the old ways might not do, the real problem was to find out what really would be wanted in the future and to define the requirements. One could then face the issue of how to train for it.

THE CHAIRMAN said he would like, if he might, to say a few words from the Chair.

He would like to hear about the actual working of the sandwich scheme. He had an awful feeling on hearing that five months would be spent in school and seven months in a works, because in seven months a boy would forget completely what he had learnt in the other five. Then he would go back for the next five months and it would be necessary to start at the beginning again. He did not know whether that was a fair criticism but it might very well occur. That would answer

Mr. Longmuir's point about twelve months at sea and twelve at the college. The boy would forget what he had learnt in twelve months at the college if he was at sea for twelve months. He felt sure that if he left his books for a period himself, he would grow very rusty very quickly. As he told his students, it was a fact that book work evaporated much more quickly than it was absorbed.

Perhaps Mr. Dance could reassure him on that point. Did the sandwich system really work as distinct from the Alternative Training Scheme, for which he had great admiration, if he might use that word? It seemed to be a far safer scheme. It trained the boy while his mind was ready for training and in addition he got a little experience in the workshop of the college. It produced a better result in the end.

There was one other point to which reference had already been made. What were these boys being trained for? Twenty-five years ago, they had to pay their own way. They had to stay at school as long as their money lasted and to get a certificate in that time, or else return to sea to recuperate their fortunes against another try. He had a cry from the heart at that time from a student studying for a First Class Certificate, who asked what did he want with quadratic equations? What good was it to him? He hoped Mr. Dance would approve of the answer he had given: it fell into two parts, first, that quadratic equations were included in the First Class Certificate examination, and, if one wanted that, one had to do them, and secondly that if one could do quadratic equations one was a better man in an emergency than if one could not. Was that right or wrong? Was it true that one only wanted the man to be trained to be capable in an emergency? The trouble was that the operation of a ship was becoming more and more automatic. Eventually it would be operated from the shore. Unless these people were to be given fabulous sums of money the picture was gloomy; and that had been accepted already. He was sorry about this because he had been a marine engineer, and he was a marine engineer at heart. He would like to see the status and quality of the marine engineer remain as high as possible. But the fact was that in spite of what Mr. Longmuir had said the moment a man got an Extra First Class Certificate, he ceased to go to sea, and that was wrong because he was the very man who ought to be at sea.

MR. LONGMUIR said that that was an economic factor which had nothing to do with education.

THE CHAIRMAN, while agreeing, said that it was suggested that their education should be taken to a terrific pitch, but the moment one did that they ceased to go to sea.

MR. HOGG asked what pitch was suggested and how were people measured as suitable for an emergency.

THE CHAIRMAN replied that that was a question to which he did not know the answer.

MR. HOGG said he had no doubt that examinations as they were known at present would be discontinued if a new yardstick for measuring men were devised that would throw up all the desired qualities a marine engineer should possess.

THE CHAIRMAN said it was not degree-standard people who were needed at sea.

MR. HOGG observed that, by and large, they were certainly not degree-standard people.

THE CHAIRMAN replied that it was going that way. The Higher National Certificate was close to degree standard.

MR. DANCE said that one of the technical developments which had recently occurred in marine engineering was the gaining of perhaps a couple of thousand tons more cargo-carrying capacity through the use of improved water distilling gear. Whether it were possible or not depended on a rather narrow margin of cost. The ways in which the cost could be

## *The Impact of the Sandwich Scheme on the Training of the Marine Engineer*

reduced were by using multi-stage distillation and other methods. These were pretty tricky things to deal with. The engineers had to understand the working of that equipment. But to understand it involved more time, more careful teaching—not the solving of quadratic equations; he did not defend that at all, unless they were shown to have a useful application. Experience showed that general ability was general. One did not find that one boy could not do simple mathematics but could do good engineering and another boy who could do mathematics but could not do engineering. Nobody was defending the thesis that a boy who passed in mathematics would therefore be a good engineer.

Nevertheless, if a boy were given a wider course and if teachers would consult one another—which was by no means as common as one might expect, for they were very often isolationists—the whole business of education would seem to that boy to have more common sense behind it, and he would make more progress and be more adaptable to future developments.

On the question of memory, he did not think there was any real evidence one way or the other. There *was* evidence that if a man was taught something and ceased that activity but took it up again in five years' time, it would only be necessary to revise it for a couple of weeks to reach the former state. The memory forgot to the extent of not wanting to be busy with too many things at once, but it did not forget altogether.

MR. TONKIN observed that the staffing of the course would be interesting. A useful method would presumably be to start in January at the college and run until July. That would constitute the half-year in the college. Then there would be a period in the works for the remainder of the year until the following January. The college would be staffed for the first two terms of the year, and there would be a term in which staff were not employed unless courses were duplicated.

It would be interesting to know what the reactions would be on both sides of the fence to two terms of teaching and one term back in industry. It would not provide what was generally accepted as full-time teaching hours.

MR. DANCE said it would not work out as badly as that, and he did not think the Ministry would have any objection at all. A pamphlet had been issued about teaching hours and research, and it would not be a bad thing at all if the teaching staff went into industry with the apprentices.

THE CHAIRMAN thanked Mr. Dance, on behalf of the Education Group, for his contribution to a very controversial and interesting discussion and for so patiently answering the questions that had been raised. He also thanked the audience for their enthusiasm.

MR. DANCE, on seeing the report of the discussion, added the following note: They tended to think of the education of marine engineers as something that could be planned to fit clearly defined requirements but marine engineering was itself a changing branch of technology and they had to plan for an uncertain future. Education was part of their economy and it should be taken into account as part of the economic design of ships. It was possible that the equipment of ships would become so complex technically that it would be wasteful to carry engineering crews capable of maintaining it in a full sense; and the equipment might be designed so that first stage maintenance and adjustment only would be necessary at sea. This might affect the education and training of marine engineers. Again, education could not be isolated from the political and economic factors which determined the time when an engineer went to sea and how long he remained in sea service and this set a difficult problem in a competitive economy, of how he should be trained and how the costs should be shared. These factors were sensed in the discussion but not examined in detail; they were for a future occasion.

## INSTITUTE ACTIVITIES

### Minutes of Proceedings of the Ordinary Meeting Held at the Institute on Tuesday, 13th November 1956

An Ordinary Meeting was held at the Institute on Tuesday, 13th November 1956, at 5.30 p.m., when a paper entitled "Reheating as a Contribution to the Economy of the Marine Steam Turbine, with Special Reference to the Installation in t.s.s. *Empress of Britain*", by Mr. A. W. Davis, B.Sc. (Member), was presented and discussed. Mr. T. W. Longmuir (Chairman of Council) was in the Chair and 146 members and visitors were present. Ten speakers took part in the discussion that followed.

A vote of thanks to the author, proposed by the Chairman, was accorded by acclamation. The meeting ended at 7.50 p.m.

### Section Meetings

#### *British Columbia*

A dinner meeting of this Section was held in the Terminal City Club, Vancouver, on 26th October 1956, at which thirty-four members, two visitors and the guest speaker were present. Mr. J. Brydon, Local Vice-President, was in the chair.

After an excellent dinner and the usual loyal toast, Mr. Norman Turner presented the Chairman with a suitably inscribed gavel and sounding block for the use of the Section. The Chairman conveyed the thanks of the members to Mr. Turner.

The speaker of the evening, Professor W. O. Richmond, Head of the Department of Mechanical Engineering at the University of British Columbia, was introduced by Mr. T. Morgan. Professor Richmond's lecture on "Stress Analysis" with particular emphasis on the use of strain gauges, was very much appreciated, and an interested discussion followed.

Mr. G. E. Hirst proposed a vote of thanks to the speaker on behalf of the members.

#### *South Wales*

At a meeting of the South Wales Section at the Institute of Engineers, Park Place, Cardiff, on Tuesday, 20th November 1956, at 7.15 p.m., Mr. J. Wormald, B.Sc. (Member) gave a lecture entitled "The Carriage of Edible Oil and Similar Bulk Cargoes". There was a very fair and representative audience consisting of members, chemists and shipping agents when the meeting was opened by the Chairman, Mr. H. Gordon Wickett, M.B.E., who stated that his task was a simple and pleasant one as the lecturer needed no introduction, being one of their own popular members.

Although the paper had been presented before it had lost none of its value; in fact, very little had been written about the subject. The paper had been published in the April 1956 TRANSACTIONS and therefore no report on its content was required but those present remarked on the fact that Mr. Wormald had given them "food for thought" on a fascinating subject which was shown to provide more problems than at first seemed likely, and also that his lecture revealed a little more about the many branches of science that contributed to the complicated subject of marine engineering.

A lively discussion followed the lecture, during which the speakers expressed their appreciation to Mr. Wormald for the interesting and profitable evening. A vote of thanks was proposed by Mr. H. S. W. Jones, seconded by Mr. R. G. Turnbull.

### *Annual Dinner*

The eighth annual dinner of the South Wales Section was held at the Royal Hotel, Cardiff, on 9th November 1956, at 7.0 p.m. Mr. J. Wormald, B.Sc. (Vice-Chairman of the Section), deputized for the Chairman, Mr. H. Gordon Wickett, M.B.E., who was abroad on business, and received Mr. T. W. Longmuir (Chairman of the London Council) and approximately two hundred members and guests. It was a lively and spirited gathering.

After the Royal Toast, the "City and Port of Cardiff" was proposed by Mr. Raymond Gower, M.P. (Secretary to the Ministry of Transport and Civil Aviation), who traced the history of the city, its rapid growth as a port, with the capacity to take any size of vessel, its easy access to the industrial Midland towns, the short sea lanes, all of which, with improved road and rail services, gave the City an unique position. In reply, Councillor H. Ferguson-Jones endorsed all that had been said but stated he would always push for better road, rail, crane and dock facilities.

"The Shipping Industry" was proposed by Mr. A. R. Cann, F.I.C.S. (Chairman of the Cardiff and District Shipbrokers' Association), who stressed the point that shipping was international to some countries which were therefore bound by International Law. Improvements had to be carried out, taxation had to be met, yet trade had to be fostered against foreign competition that was not so handicapped. Mr. Howard L. Emery, F.I.C.S. (Chairman of the Cardiff and Bristol Channel Incorporated Ship Owners' Association) agreed, also stressing that taxation was slowly strangling the "Goose that lays the Golden Egg".

The toast to the South Wales Section of the Institute of Marine Engineers was proposed by Mr. Longmuir who, in a very witty speech, praised the work of the Sections and gave a synopsis of the many important innovations that were being introduced, giving figures to show the growth of the Institute and the progress and cost of the new building. Mr. Wormald replied suitably and assured Mr. Longmuir that he could rely on the Sections to do their best.

It was generally agreed to have been an excellent function and the Section was once more in debt to Mr. T. G. Thomas and his committee for having organized a right royal evening.

### *West Midlands*

#### *November Meeting*

At a General Meeting held on Thursday, 22nd November 1956, at the Birmingham Exchange and Engineering Centre and attended by fifty-four members and guests, Mr. J. A. Kendall presented a lecture entitled "Nuclear Engineering". The Chairman, Mr. H. E. Upton, O.B.E., was in the Chair.

Mr. Kendall stressed the importance of the closest liaison between the physicist and the design engineers and showed how closely the practice of nuclear engineering followed that of general engineering. He then described the operation of some types of reactor and ancillary equipment already in use and in particular the methods of fuel handling and the complexity of the remote controls for this equipment. The author concluded by commenting upon the relative merits of various types of reactor and cooling media and advanced some interest-



## Institute Activities

ing information concerning the application of nuclear energy for marine propulsive purposes.

Some fifteen members took part in the ensuing discussion. The Chairman thanked Mr. Kendall for an enlightening lecture and the meeting closed at 9.15 p.m.

### *December Meeting*

A General Meeting of the Section was held at the Birmingham Exchange and Engineering Centre on Thursday, 13th December 1956, at 7.0 p.m.

The Section Chairman, Mr. H. E. Upton, O.B.E., was in the Chair, and there was an attendance of forty-four members and guests.

Mr. W. H. Falconer (Associate Member) presented a paper entitled "Some Aspects of the Application of Planned Maintenance to Marine Engineering". The author introduced his paper by showing a number of slides illustrating graphs and other data representing liner and bearing wear compiled over a number of voyages and giving positive indication of rate of wear and the approximate date of renewal. He concluded by describing how planned maintenance could be applied, the many advantages which could result and, more particularly, how this could be accomplished without overburdening the ships' engineers and office staff with volumes of paper and reports.

Ten members took part in the very interesting discussion which followed. The Chairman thanked Mr. Falconer for an enlightening and absorbing paper and the meeting closed at 9.15 p.m.

### **Junior Meetings**

#### *Barrow-in-Furness*

On Friday, 30th November 1956, a Junior Lecture was given at the Central College of Further Education, Barrow-in-Furness, when Mr. Ll. Young, M.I.Mech.E., M.I.F., read his paper entitled "Automatic Boiler Control". Approximately twenty-five students and eighty members of the Barrow Engineering Society attended. The very interesting paper was followed by a lively discussion.

Mr. R. McVie, B.Sc. (Local Vice-President), the Principal of the College, was in the Chair.

#### *Falmouth*

##### *October Meeting*

In connexion with the Junior Lecture programme, a films evening was arranged by Mr. C. Moffatt at the Falmouth Technical Institute on the 10th October 1956.

An instructive and interesting series of sound films showing and explaining the drilling of an oil well, underwater exploration of the sea bed, distillation of oil and the principle and manufacture of a watertube boiler, was presented to an audience of more than one hundred senior engineering students, apprentices and members.

Thanks were expressed to the Governors and Principal of the Technical Institute for their valued co-operation and the appreciation of the audience was voiced by a senior student in a vote of thanks to the Council which was carried with acclamation.

##### *November Meeting*

A lecture entitled "Metallurgy in Marine Engineering" was given by Dr. J. E. Garside, M.Sc.Tech., on the 20th November 1956, at Falmouth Technical Institute; the Principal, Inst. Capt. H. C. Kelly, B.Sc., R.N.(ret.), introduced the speaker.

Unfortunately, inclement weather was largely responsible for a meagre attendance amounting to about fifty senior students, who were rewarded with a most interesting and informative lecture illustrated by slides and a film.

Mr. C. Moffatt (Local Vice-President) addressed the students on the merits of membership of the Institute and also proposed a vote of thanks to the lecturer.

#### *Kingston upon Thames*

A Junior Meeting was held on Wednesday, 28th November 1956, at 2.30 p.m., when the paper by Mr. A. G. Arnold

(Member) on "Marine Diesel Engines" was presented by Mr. D. B. Stables. The Chair was taken by Mr. K. J. Tolley, B.Sc., and there was an attendance of seventy-five. The lecture was well received by the students, who found the paper interesting and instructive.

#### *Southend on Sea*

A lecture by Mr. R. D. Tiere, B.Eng., entitled "Gas Turbines" was presented at the Southend on Sea Municipal College on Wednesday, 12th December 1956, at 7.30 p.m.; the Principal of the College, Mr. T. L. Morgan, M.Sc., was in the Chair, and there was an attendance of eighty students and three members of the lecturing staff. Most of the students were of post-Ordinary National Certificate standard and were extremely interested in the lecture.

The last three-quarters of an hour was reserved for questions. Many questions were asked and capably answered and the vote of thanks at the end of the lecture was carried unanimously.

#### *South Shields*

##### *October Meeting*

On Monday, 22nd October 1956, at 4.0 p.m., a Junior Meeting was held at the Marine and Technical College, South Shields, for the presentation of a paper on "Boiler Water Treatment" by Mr. J. F. Colville. Mr. A. J. S. Bennett, M.B.E. (Member) was in the Chair and there were eighty marine engineer cadets present. The author was thanked by the Chairman for his interesting lecture and the vote of thanks was carried by acclamation.

##### *November Meeting*

A Junior Meeting was held at the Marine and Technical College, South Shields, on Tuesday, 13th November 1956, at 4.0 p.m., when Mr. J. F. Colville repeated his paper entitled "Boiler Water Treatment" to ninety-five marine engineering apprentices and students. Mr. William Embleton (Member) was in the Chair. An interesting discussion followed the lecture and the vote of thanks proposed by the Chairman was carried by acclamation.

#### *Sunderland*

A Junior Meeting was held at the Technical College, Sunderland, on Thursday, 6th December 1956, at 4.0 p.m., when Mr. J. H. Gooch, B.A., presented a paper entitled "The Modern Steam Turbine". Mr. Douglas Tagg was in the Chair and there was an attendance of 107. The lecture and an accompanying film were greatly appreciated and were followed by an interesting discussion.

#### *Swansea*

A Junior Meeting was held at Swansea Technical College on Thursday, 25th October 1956, at 2.0 p.m., for the presentation by Mr. J. N. Cairns of a paper entitled "Engine Room Equipment" by Mr. D. C. Hagen (Member). Mr. George Thompson, M.Eng. (Vice-President) was in the Chair and the lecture room was full, with an attendance of over eighty. Mr. J. Wormald, B.Sc. (Vice-Chairman of the South Wales Section) attended as Council representative.

The lecture was amply illustrated, keenly followed and well discussed. A vote of thanks to the author was proposed by one of the students.

### **Student Meeting**

A meeting of the Student Section was held at 85 Minories, London, E.C.3, on Monday, 5th November 1956, at 6.30 p.m., when the following films were shown: "The Diesel Story", "Mail Boat", "Diesels Afloat" and "Fire at Dukhan".

Eighty-three students were present. The meeting ended at 8.10 p.m.

## Institute Activities

### Election of Members Elected 9th January 1957

#### MEMBERS

Frederick Thomas Axten  
Thomas Gray Boys  
Ernest James William Cox, Lieut.(E), R.N.(ret.)  
William Victor Edley  
Samuel William English  
Henry Carl Fairbank  
Edward Wilfrid Forster  
Leslie Johnson  
Richard Alexander Wynford Mayes, B.Sc.(Belfast)  
Henry George O'Kane  
Thomas Stuart Robinson  
Robert Stewart  
Cyril Thomas Taylor  
Peter Francis John Trollope, Cdr., R.N.  
Arthur George Turner, Lieut., R.N.  
William Henry Whalley

#### ASSOCIATE MEMBERS

Albert Aitken  
Alan Beattie  
Roy Berwick  
Robert Bird  
Peter Chew  
Kenneth Thomas Disley  
John Sloan Farlam  
James Hamilton  
James Jackson  
Robert King  
William Scowen Walker Lee  
Robert Love  
Donald McKinlay  
Bryan Bennett Maddocks  
John Brodie Meldrum  
John Mullins  
James McGeachy Munro  
Peter John Newbery  
Leslie Kenneth Norman  
Arthur Charles Parkinson  
John Allan Mackay Ramsay  
Iain Archibald Sinclair  
William Arthur Stewart  
David Arthur Taylor  
Sidney Riddell Thomas  
John Thompson  
Colin Thorp  
Peter Sinclair Wainwright  
Lionel Clarence Weedon, B.Sc.(Eng.)S'ton.  
John Trevor Woodford

#### ASSOCIATES

Ram Krishan Adlakha  
Robert William Fergusson  
Macdonald Green  
Colin Miller  
Alfred Templeman Riley  
Anthony Sammut  
David Walker Stenhouse  
Barrie Montgomery Strang  
Joseph Edet Akinwale Wey  
Archibald Blue Crawford Wilson

#### GRADUATES

Frederick William Best  
Martin Chalmers Bovell  
Eric George Bromby  
Peter William Chandler  
Colin Clement Cooke  
Alexander Richard Ramon de Larringa, B.A.(Cantab.)  
Alexander Lawrie Drysdale  
Herbert Raphael Egozi

Clifford Holder  
Prabhakar Vishwanath Karandikar  
Peter Maxwell Low, B.Sc.(Marine Eng.)Durham  
Andrew Frost Mackie  
John Stanley Pumphrey, B.Sc.(Durham)  
Owen Joseph Rooney  
Elijah John Stevens  
John Harrington Yates

#### STUDENTS

Keith Bloomfield Cross  
Keith Davies  
Anthony Charles Davis  
Alexander Focas  
David Charles Ernest Gardner  
James Hector Frederick Mosedale  
Richard Hugh Pearce  
Geoffrey Alexander White

#### PROBATIONER STUDENTS

Thomas Keir Balfour  
Michael John Beale  
Norman Lowrey Bell  
Matthew Telford Brigham  
Alan Elliott Chadwick  
Michael John Clarke  
Brian Stanley Edwards  
Michael John Gasken  
Anthony John Howard  
Alan Howe  
David Harold Martin  
Guy Nettleship  
Kenneth Gordon Peake  
John Roberts  
Keith James Taylor  
Richard John Verrall  
Colin Frederick Waterhouse  
Michael Lewis White  
Timothy Francis White  
David Stephen Wiggins

#### TRANSFER FROM ASSOCIATE TO MEMBER

David Athol Coull  
Thomas Hamilton  
Randall Lewis Howard  
Franz Uri Levy  
Subramanya Muthu Swamy, Lieut., I.N.

#### TRANSFER FROM ASSOCIATE TO ASSOCIATE MEMBER

Alan Leslie Hunt  
Bruce Hutchinson  
Thomas Amos Lamb  
John Alexander Smith  
Herbert Victor Spawls  
Jack Wetherell

#### TRANSFER FROM GRADUATE TO ASSOCIATE MEMBER

Sigbjorn Johan Birkeland, B.Sc.(Durham)  
Frank Cresswell  
Frank Hipson  
James Ronald Jamieson  
Anthony George Lucas  
Donald William McLean  
Colin Francis Schneider  
Arthur Dudley Thomas

#### TRANSFER FROM STUDENT TO GRADUATE

Harry Flottiland de Vos

#### TRANSFER FROM PROBATIONER STUDENT TO STUDENT

Geoffrey Graham Sarjantson  
Ralph Wardley  
Alan Roger White