Paper read at the Institute on Tuesday, 13 March 1973

TRAINING IN SHIPBUILDING

G. Sivewright*

Mr. Sivewright

This paper outlines the work of the Shipbuilding Industry Training Board under the Industrial Training Act, 1964, and the changes likely to take place in the training board system. It discusses the training of professional engineers, with particular reference to marine engineers, technician engineers and technicians, and craftsmen in the shipbuilding and shiprepair industry.

INTRODUCTION

The Shipbuilding Industry Training Board was set up in November 1964 under the Industrial Training Act, 1964. There are now twenty-eight statutory training boards covering industries employing about 15 million people and also two non-statutory boards, one of which is the merchant navy training board.

The Act was passed because experience had shown that if training was left wholly to individual firms, the quantity and quality of the training that was generated was inadequate to meet the needs of the economy. The primary purpose of all training boards is, therefore, to increase the quantity and improve the quality of the training in firms within their scope.

Boards are answerable to Parliament through the Secretary of State for Employment. They are constituted to represent the employer, trade union and educational interests of their industry. Professional bodies are thus represented indirectly and their representatives are co-opted when training for professional or sub-professional occupations is under detailed study.

Two major activities for every training Board are, firstly the preparation and publication of training recommendations covering every occupation, and secondly the provision of a training advisory service whereby a service of information, advice and assistance is provided by the Board's training staff to the firms within scope.

Boards finance themselves by raising a levy on their industries. After the deduction of running expenses this income is returned to the industry in the shape of grants for training which meets approved standards. Training levies are usually a percentage of firms' pay rolls. In recent years the Boards have increasingly adopted a policy of disengagement from the levy/grant system whereby their levies are progressively reduced as the industry reaches acceptable training standards.

The Shipbuilding Industry Training Board (S.I.T.B.) covers shipbuilding, shiprepair, some marine engineering, boatbuilding and a variety of associated activities. Engine building firms are within scope of the Engineering I.T.B. while shipowners work to the non-statutory merchant navy training board. In May 1972, when the last statistical survey was made, the Board had 992 registered establishments and about 115 000 employed persons within scope; the latter represents a decrease of 15 per cent in the period 1965–70, a change paralleled by the halving of the U.K. share of the world shipbuilding market during the same period.

Some 95 per cent of the employees were concentrated in 30 per cent of the establishments within scope of the Board and the employees were distributed as between 73 000 in shipbuilding, 28 000 in shiprepairing, 10 000 in boatbuilding and 3500 in eighty-five marine engineering establishments.

In the early years of its existence the Shipbuilding I.T.B. was mainly concerned with craft and technician training but latterly the primary emphasis has been on management and supervisory training. While good progress has been made in improving craft training in the industry the Board regards the attention being given in the industry to management and supervisory training as seriously inadequate.

The Shipbuilding I.T.B.'s levy during the last three years has been:

1970/71 – 1·75 per cent
1971/72 – 1·7 per cent
1972/73 – 1·1 per cent

Of the grant disbursed in 1970/71, 77 per cent was for craft and technician training and only 3·5 per cent for management and supervisory training.

CHANGES IN THE TRAINING BOARD SYSTEM

As a result of the experience gained since the passing of the Industrial Training Act, 1964, the future arrangements for industrial training were reviewed by the Government during 1970–71 and its proposals were published in February 1972 in a consultative document entitled "Training for the Future".[1] Following extensive consultation with all the interested parties, the Secretary of State for Employment made a statement, on the future of industrial training, in the House of Commons on August 8, 1972. In regard to the future of the levy/grant system the Minister announced that the 1973/74 training levy would be the last in its present form. From August 1, 1974, firms will fall into three categories: either they will be excluded from levy altogether on grounds of their small size, the cut-off point to be decided for each industry; or they will be levied by up to 1 per cent of pay roll; or they will be exempted from levy on the grounds that they are carrying out such training as is reasonable to meet their own needs.

Boards will be able to grant-aid firms which are levied, to provide an incentive for better training performance. In addition the Government will provide funds for grants to encourage certain key training activities. The activities concerned have yet to be decided but generally these special grants will relate to training which is over and above a firm's own needs.

The original proposals had also included the setting up of a National Training Agency whose duties, among others, would include co-ordinating the work of the Boards, meeting their administrative expenses from Treasury funds, and providing training services in areas not at present covered by Boards. The Minister announced the setting up of a Training Services Agency as an interim measure to carry out the functions of the proposed National Training Agency. It complements the Employment Services Agency set up in 1972.

* Shipbuilding Industry Training Board

On 22 November, 1972, the Minister announced that he intended to set up a Manpower Services Commission to be responsible for and to co-ordinate the Training Services Agency and Employment Services Agency. It is expected that the Commission will be operational early in 1974.

THE TRAINING OF PROFESSIONAL ENGINEERS

The definition of a professional engineer agreed by the Conference of Engineering Societies of Western Europe and the United States and by the Commonwealth Engineering Conference and adopted by the Shipbuilding I.T.B. is given in Appendix 1. The Board published its recommendations for the training of professional engineers[2] in June 1972. The recommendations are concerned with the training of naval architects and marine engineers, as with mechanical, electrical and production engineers, up to the point at which they take up their first posts of responsibility. Although the Engineering I.T.B. has responsibility for engine building firms the Shipbuilding and Engineering Boards have adopted the same philosophy towards the training of professional engineers and this paper can, therefore, effectively be regarded as applying to the training of all shore-based marine engineers.

The approach to the training of professional engineers has been transformed in recent years. The advent of the Council of Engineering Institutions (C.E.I.) and the developing work of the training boards have coincided with the result that this training has been given a new impetus. Formerly the setting of qualifying standards for professional engineers rested almost exclusively with the various professional institutions. The role of C.E.I. in training is to provide guidance to its member Institutions on which they can base their training requirements so that a common doctrine and common standards can be progressively developed. C.E.I. published "Guidelines on Training"[3] in 1969.

The training boards, for their part, see their work as being in partnership with the Institutions to assist firms, universities and polytechnics to provide the best possible education and training. When a training board prepares recommendations for the training of professional engineers the guidance given by C.E.I., already referred to, and the standards set by the Institutions concerned are important considerations.

RECRUITMENT OF PROFESSIONAL ENGINEERS

Before discussing the education and training of shore-based marine engineers it is appropriate to refer to the employment of graduates and other qualified people in shipbuilding in more general terms. The paucity of graduates so employed has for some years now been a source of considerable concern and the position is deteriorating despite the fact that advances in technology, the need for higher productivity and increasing demands on management are calling for the employment of more highly qualified staff.

A report published by the Royal Institution of Naval Architects in 1966[4] indicated that the industry then considered the number of staff qualified (by degree, H.N.D. or H.N.C.) in all disciplines should be doubled and that about one-quarter should be graduates. Despite this, however, Shipbuilding I.T.B. statistics show, for example, that the number of graduate scientists and engineers employed in the industry declined in 1969/71 by 24 per cent per annum while the total employee strength of the industry declined by only 2 per cent per annum.

International comparisons are also disturbing though exact comparisons are not practicable. The R.I.N.A. report referred to concluded that the proportion of graduates per 1000 employed in British shipyards was lower than most of the principal shipbuilding countries and considerably lower than the leaders.

On the evidence, therefore, the corps of qualified engineers employed in the industry has contracted to a dangerously low level and there is a compelling and immediate need for the industry to increase the recruitment and training of qualified engineers.

In regard to graduate marine engineers, only two universities in the U.K. provide degree courses. These are the University of Newcastle-upon-Tyne, which provides a three-year course, and the University of Surrey, which provides a four-year mechanical engineering course, the third year being devoted to industrial training, in which the options in the final year include marine engineering technology.

The annual output of British graduate marine engineers from these two universities is about eight and twelve respectively, i.e. twenty in all. The first course at Surrey was not completed until 1971 but the position to date is that, taking both universities together, only one graduate each year is likely to enter the shipbuilding and shiprepair industry. This is far from adequate and reflects the general situation in regard to graduate recruitment already mentioned.

THE TRAINING PROGRAMME

It is important, first, to emphasize the value of integrated courses of education and training in the preparation of the professional engineer. Such schemes include the 'thick sandwich' or 1:3:1 arrangement, in which industrial training precedes and follows a full-time degree course, and a full-time degree course followed by post-graduate training or 3:2 scheme. For the marine engineer both these schemes can be followed by taking the marine engineering course at Newcastle; alternatively the 2:1:1 course at the University of Surrey is also a sandwich course. Another well known type of sandwich course, not available in marine engineering, is the thin sandwich, in which education and training alternate.

The Shipbuilding I.T.B. (like the Engineering I.T B.) has adopted a flexible approach in its recommendations within which the different needs of firms and students can be met. It has taken careful note of the C.E.I. guidance that "Training should emphasize the complementary nature of theory and practice, be interesting, challenging and relevant to the future work of the student engineer; it should stretch his intellectual powers and not be a period of merely 'going through the shops' ".

The practical training to be followed in all the different types of scheme referred to earlier in this paper consists of a number of elements: induction, shipyard practice, design, management services, training with associated organizations and objective training. Appendix 2 to this paper contains examples of the application of 1:3:1 and 3:2 schemes to the training of marine engineers in the shipbuilding industry.

Induction

Induction training provides a link between the differing environments of school or university, on the one hand, and industry on the other. It should aim to provide:

a) information about the organization and activities of the firm and about the industry as a whole;
b) information about the training programme to be followed and the subsequent opportunities;
c) guidance and advice so that the student engineer can obtain the maximum benefit from the training.

Induction is a continuing process and should not be confined to the beginning of the training programme.

Shipyard Practice

Shipyard practice should aim to provide a sound appreciation, through practical experience, of the skills required, the techniques employed and the materials, tools and processes used and in prospect in the yard. As part of this, but depending on his experience and needs, a student engineer should attend a craft training centre to learn the basic machine shop and metal forming skills and a drawing office school to learn the fundamentals of draughtsmanship. Shipyard practice should also cover experience of steel preparation, machinery installation, electrical systems and testing and trials in their various forms.

A total of six to nine months can usefully be devoted to shipyard practice, the training being reinforced by projects and assignments.

Design

Training in design should provide the student engineer with:

a) an appreciation of the design process;
b) an understanding of the methods of communication between design and production functions;
c) an appreciation of the importance of cost, reliability and

quality with particular regard to proprietary items of equipment, materials, appearance, function and production methods.

Three to six months should be allowed for this period. Design training calls for teaching and guidance, mainly through attachment to the design office, by professional engineers with a record of successful design work. The treatment of design in the education course should in turn be related to its implementation in the shipyard design function. The training should include the analyses of existing designs and the preparation of alternative, improved designs using a value engineering approach, and individual or group design projects. During his design training the student engineer can also be introduced to the use of the computer in design and to critical path techniques.

Management Services

Student engineers in shipyards need to have an insight into the way the work is organized and into the human and commercial factors which bear on efficiency. For this purpose they should spend part of their training obtaining an appreciation of some of the management services and related activities which support the production function. These activities can be grouped under: buying; commercial; industrial engineering; personnel; planning.

The Shipbuilding I.T.B. recommends that this phase should cover three to six months, involving the most appropriate activities for each student engineer. The training should be supported by lectures, tutorials and projects, in association with a polytechnic or technical college where necessary.

Training with Associated Organizations

Professional engineers in the shipbuilding and shiprepair industry are closely concerned with ships in service and with a number of other organizations external to their own firm, including Lloyd's Register of Shipping, National Physical Laboratory, British Ship Research Association and engine builders. The Shipbuilding I.T.B. recommends that student engineers spend about six months on attachment to a ship in service and a further period with one or more of the organizations listed.

During his sea service the student will be able to obtain an understanding of the operating conditions and problems associated with marine engines and equipment and will be able to relate what he learnt in design and shipyard practice to operational service. It is important that such attachments are used constructively, involving active participation rather than passive observation.

Objective Training

In the final stage of his training the student engineer should prepare for a specific first post of responsibility through objective training. This period should aim to develop the skills and knowledge he needs to make an effective start. Some of the likely fields of first appointment for an engineer in a shipyard are: research and development; design; industrial engineering; machinery installation; machine shop.

The objective training programme should be obtained by drawing up a job description for the student engineer's first appointment, from that identifying the principal initial needs for effective performance and from that preparing a programme to help the student engineer to meet the needs.

Full use should be made of all resources, including universities and polytechnics, and the programme should include provision for projects and short courses of a specific nature. Three to six months should be allowed for this stage of the training.

TRAINING ARRANGEMENTS

Professional engineers have an important part to play in organizing and supervising the training of student engineers. While the detailed work of preparing the training programme and advising on its implementation will usually be the responsibility of the training officer concerned, it is essential that he receives the support of top management and professional engineers in doing so.

Industrial Tutors

Student engineers should have access to a professional engineer who will act as his industrial tutor. Such a tutor must be interested in training and be reasonably accessible; he can have a considerable influence on the quality of the training.

Training Records

Training records should be kept to assist in evaluating the effectiveness of the training given and to ensure that the overall plan is followed. Such records should include the results of assessments of progress and the reports made by the student engineer himself. Student engineers should keep workbooks to record and comment on their experience and learning. Workbooks are a useful aid to departmental managers and the industrial tutor when discussing and assessing a student engineer's progress.

Projects

The project method of training, whereby an individual student engineer or group of student engineers is set a specific objective to achieve and is responsible for bringing it about, is a most effective teaching technique for the training of professional engineers.

Projects are generally of two types: design and make, and investigation. The former, which are most suitable for groups of student engineers, require the design and production of an engineering product and the student engineers are set a time for the completion of the work within a given budget. To achieve the best training value, the projects should be capable of solution within the set time and money available, the facilities provided must be adequate for the work entailed and the final product should have a definite use. In an investigation type of product the student engineer is set an analytical task and presents a written report of his findings.

Communicating

The ability to communicate clearly in speech and writing is an essential attribute for all professional engineers. Students should be encouraged to become proficient in the use of the spoken and written word and be given opportunities to develop expertise through practice. Professional engineers should also be reasonably proficient in at least one foreign language and be given opportunities for language study during training. The continuing growth of international trade and of multi-national companies and co-operation makes it more important than ever that executives should have some command of at least one foreign language.

THE TRAINING OF TECHNICIAN ENGINEERS AND TECHNICIANS

The Shipbuilding I.T.B. will not be publishing its recommendations for the training of technician engineers and technicians until the end of this year. This part of the paper does not, therefore, carry the authority of Board policy but is based on the draft recommendations for such training prepared by a representative sub-committee. These recommendations are very similar in principle to those of the Engineering I.T.B. and it can be said with assurance that the recommended training for technician engineers and technicians in the shipbuilding and engineering industries will be basically the same.

The definition of an engineering technician which has been adopted by the Conference of the Engineering Societies of Western Europe and the U.S.A. (EUSEC) is given in Appendix 3. It describes the range of technician activity, at the upper end of which lies the work of the technician engineer.

It is only in recent years that the technician has finally emerged into his own in industry at large as belonging to a distinct and important occupational group between the professional engineer or technologist on the one hand and the craftsman on the other. With the exception of the draughtsman, in shipbuilding he has, however, still to emerge in this way and

one of the Training Board's tasks is to help the change to come about.

A job title or the educational qualifications of the holder are of themselves poor indications of the technician character of a job which must be decided on the basis of the work being undertaken; this may in turn call for job analysis. A distinction is now being made in industry between the technician engineer and technician. The fundamental difference between the two has been found by the Engineering I.T.B. to be not so much the kind of activities being undertaken as the breadth of knowledge required and the range of activities covered. A clear difference can be identified between the technician engineer, who is required to have a much more extensive range of technical knowledge and to be able to apply this over a much broader area of activities, and the technician, whose job tends to be more narrowly defined. This difference is also reflected in the higher educational attainments of technician engineers, which enables them to take on the wider range of activities.

Employment of Technicians

The Training Board's returns indicated that on 16 May, 1971, there were 5135 technician engineers and technicians employed in shipbuilding and shiprepair including 3248 design draughtsmen or draughtsmen. Recruitment in shipbuilding is from three categories: upgrading craftsmen; transfer from inside and outside the industry; recruiting trainees from school. The majority of draughtsmen are recruited to apprenticeship direct from school. In regard to technicians as a whole a sample survey in 1969 indicated that the majority had either been upgraded from craftsmen or were former draughtsmen. Very few were recruited from school to be trained as a technician, other than as a draughtsman.

The posts of responsibility which technician engineers and technicians occupy require them to possess qualities of integrity and conscientiousness, a capacity for developing skill and knowledge, and an adaptability to new techniques, working as they do in an environment of changing technology. Other personal qualities considered relevant, and which should also be considered during selection, include:

a) scientific curiosity, i.e. a natural interest in practical and scientific matters;
b) mathematical ability, i.e. some facility for mathematical manipulation and application;
c) manipulative co-ordination, i.e. an ability to use tools, measuring equipment and controls effectively;
d) logical ability, i.e. an ability, for example, to diagnose or locate faults by a systematic analysis of problems;
e) communication, i.e. an ability to present clear and concise accounts of a situation either orally or in writing.

The Training Programme

The policy which is being proposed for the training of technician engineers and technicians in the shipbuilding industry provides for entry by three routes: adults, trainee craftsmen and school leavers. It recognizes that there is a span of jobs involved ranging from the master craftsman to the sub-professional. The proposed scheme, which follows closely that already adopted by the Engineering I.T.B., is given in Fig. 1.

School Leaver Trainee Technicians

The scheme for school leavers involves three distinct stages: basic training, general training and objective training. Basic training would last a year and be carried out in a first year shipyard training centre. It would involve three components: common basic training, specialist basic training and training in planning and diagnostic skills, the proportion of time spent between these three being roughly in the ratio 1:2:1. Common basic training would provide an appreciation of the craft skills involved in shipbuilding and shiprepair; specialist basic training would be carried out in three groups—hull construction and outfit, mechanical engineering and electrical—and follow the relevant craft training programme; planning and diagnostic skill training is included because of its importance to the technician group.

General training seeks to develop the abilities required for a technician engineer or technician and to impart the background knowledge and understanding essential to all first posts of responsibility and subsequent career development. For the potential technician it would include design appreciation, shipyard practice and communication; for the potential technician engineer it would additionally include training in control techniques such as work study and quality control, and commercial matters. General training would probably take somewhere between nine months for a technician to fifteen months for a technician engineer. It takes account of the selected area of specialization—hull construction and outfit, mechanical or electrical—and the type of post for which the trainee is being prepared, e.g. production, technical, commercial.

Objective training is that part of the training designed to develop expertise in a particular function. It is therefore necessary that it is carefully identified and planned to meet the needs of a particular individual in preparation for a specific job. In drawing up an objective programme it is necessary to prepare:

a) a job description outlining the job;
b) a job specification, resulting from job analysis, listing the skills and knowledge required for the various elements that make up the job;
c) the training programme itself, including the aims of the training.

Objective training is likely to take at least one year for those recruited direct from school, but less for others.

Ex-Trainee Craftsmen Trainee Technicians

A trainee craftsman who demonstrates the ability to undertake technician work may be transferred to technician training at any time after the end of his basic training, the sooner the better. If his technician training starts at the end of the first year he can follow the same type of programme recommended for school leavers. At any later stage it would be necessary to prepare bridging training programmes, as shown in Fig. 1, depending on the stage which his craft training had reached and his anticipated employment. There might be an advantage in a trainee craftsman who is selected for technician work and who is in a late stage of his craft training obtaining the Certificate of Craftsmanship before starting his technician training.

Adult Trainee Technicians

Adults for technician employment are likely to be selected for a particular post. They could be journeymen craftsmen or in a staff job not of a technician nature or be recruited from outside to fill the vacancy. It will be necessary to prepare an objective training programme related to the requirements of the job on the one hand and an appraisal of the trainee's skill and knowledge on the other. In doing so it will be important to ensure that the trainee gains or already possesses a sufficiently broad understanding of shipbuilding or shiprepair so that he can undertake technician responsibilities with confidence and has the ability to learn quickly from experience.

Further Education

Further education and industrial training are complementary aspects of the same process, for both the technician engineer and the technician. The day is happily long past when further education could be regarded as an optional extra. There are two principal educational routes, the O.N.C. and H.N.C., which should take four years and the technician's course route involving the examinations of the City and Guilds of London Institute. These latter are in three parts, taking six years if all parts are followed, and include such courses as Shipbuilding Technician's and Fabricating and Welding Technician's. There is also a College Diploma at Sunderland Polytechnic and an H.N.D. in Naval Architecture and Shipbuilding at Southampton College of Technology, both suitable for technician engineers.

Accepting that evening classes are now a last resort, the further education of technicians has been changing in recent years from day release to block release attendance. Day release does not provide an appropriate balance between education and training; block release courses of fourteen weeks, usually in two

parts, have been extensively adopted in the shipbuilding industry.

A major study of the further education needs of technician engineers and technicians in England and Wales was completed in 1969 by the Committee on Technician Courses and Examinations of the National Advisory Council on Education for Industry and Commerce (the Haslegrave Committee). The proposals of this Committee are now being implemented; they include the setting up of a Technician Education Council to co-ordinate and rationalize the provision of technician courses and examinations. The structure of technician education is expected to change considerably during the next few years but the Committee's proposals will take some time to develop and for the present the O.N.C./H.N.C. and Technician Course routes will remain in use. Similar arrangements apply in Scotland.

THE TRAINING OF CRAFTSMEN

The shipbuilding and shiprepair industry is craft-based to a greater degree, relatively speaking, than any other substantial industry in this country. The shipbuilding labour force contains twice as many craftsmen as all other manual workers together, a far higher proportion than is found in any other industry. It follows, therefore, that craft training is a matter of considerable importance to the industry; this also helps to explain why it was the Shipbuilding I.T.B.'s first priority in the early years of its life and why it will always be a major feature of the Board's activities.

To appreciate the full significance of the Board's work in the field of craft training it is necessary to consider it in the perspective of history. The 19th century saw the development in British industry, and particularly in the shipbuilding industry, of the economic principle of the division of labour. This principle provided for a high degree of specialization within the labour force as the most economical way to use labour. It was reinforced and complemented by the rise of the trade union movement in the latter part of the 19th century and the multiplicity of craft unions which resulted.

A 19th century principle it may have been but it has been expensive to the shipbuilding industry in the 20th century. All the problems of demarcation and restrictive practice which have beset our shipbuilding industry in modern times, and which have in turn affected the productivity and international competitiveness of the industry, had their origins in the division of labour. The Shipbuilding I.T.B. has sought to contribute through training to a solution of the problems created in this way by the evolution of the industry. In doing so the Board has recognized that training and productivity are closely associated and that training can, therefore, contribute to a more competitive industry.

A Training Board provides a forum in which employers and unions can consider together training matters in which they have a mutual interest. By this means the Board has been able to rationalize the craft structure of the industry as it is reflected in the training arrangements for apprentices and to develop flexibility and interchangeability by appropriate training, notably within the metal-using group. Flexibility involves men undertaking auxiliary work to progress their own jobs and interchangeability involves men transferring to work done by other trades.

Before outlining the present craft training policy of the Board the distinction between training and apprenticeship needs to be made clear. Apprenticeship has been a familiar feature of industrial life in this country for several hundred years and through it generations of craftsmen have learnt their skill. It has survived the change from domestic to factory production and two industrial revolutions and today it still continues to be the primary way through which a young person becomes a skilled man. But with the advent of the Training Boards the situation has changed greatly.

Apprenticeship means attaining skilled status by serving for a fixed period of years; the end-standard is, or was, not the primary consideration though this is not to say that the end-standard was necessarily unsatisfactory. This was a tolerable situation while there were no national standards for trainee craftsmen to aspire to but the I.T.B. are standard-setting and certificating bodies for their industries and can therefore divorce training from apprenticeship. Industry is now moving into an era when apprenticeship will serve other purposes than as a training contract and as far as the S.I.T.B. is concerned it is an outmoded concept. It is too early to say as yet how differing periods of training and apprenticeship will be reconciled, though the training period is rarely likely to exceed the period of apprenticeship.

Craft Training Policy

The Board's policy for the training of shipyard craftsmen was reviewed in 1971 and a new policy was published in the middle of 1972. The Board now recommends that the training should be in two phases, both with associated further education:

a) a full-time course of "basic training" off-the-job, normally of forty-eight weeks, until at least the basic training performance standard prescribed by the Board has been reached;

b) "planned experience" on-the-job until the terminal performance standard prescribed by the Board has been reached.

The reference to the Board's standards means those standards of performance which in the Board's view must be reached before a trainee can be awarded the Certificate of Craftsmanship. It is for each yard, together with the Classification Societies, owners' representatives, etc, to decide on the standard to be adopted for any particular job. The standards are to be assessed through phased testing and this is discussed in more detail later in the paper.

Basic Training

The policy of giving trainee craftsmen their first year's training off-the-job was unknown in the shipbuilding industry when the Shipbuilding I.T.B. was set up in 1964. A small proportion of first-year trainees received a few weeks off-the-job training but that was all. Like the Boards for other skill-using industries, the S.I.T.B. quickly decided that the best way to start training a craftsman was to give him a broadly-based first year off-the-job in a training centre or technical college. The justification for this policy is that during his first year a trainee is least productive and requires most supervision. By giving him a concentrated course in a separate place under expert and continuous supervision a trainee will reach far higher standards in a much shorter time than if he was trained wholly on-the-job; he will also be introduced at the outset to proper standards of safety and discipline. Experience has shown that off-the-job training enables a trainee to reach in one year a standard formerly reached on-the-job in two to three years or even more. Employers have shown increasing enthusiasm for this arrangement with the result that over 95 per cent of the first-year entry of about 2500 boys is now trained off-the-job.

Having prescribed off-the-job training, the Board, in conjunction with the industry and the further education service, had to provide the facilities that were thereby required. The Board provided capital loans; most of the shipbuilding and shiprepair industry is in Development or Intermediate areas and the industry was also able to draw extensively on the capital grants provided by the Government for creating off-the-job training facilities in these areas. During the period 1968–71 eleven Training Centres providing 1988 places were established in the principal shipyards of the country; the capital cost was normally divided as between 60 per cent Government grant, 30 per cent Board loan and 10 per cent company investment. First-year trainees who do not attend first-year training in a shipyard centre do so either in technical colleges, which provide some 370 places in nine colleges, or in the Board's Centre at Southampton, which can train seventy-five first year woodworkers, primarily for the boatbuilding industry.

It is in the training of metal-using craftsmen that the rationalization of the craft structure and the development of flexibility and interchangeability referred to earlier are most apparent. When the Board started life there were nine separate metal-using trades, today there are five—caulker/burner/driller/riveter, plater/shipwright, welder, blacksmith and loftsman. Few young blacksmiths enter the industry nowadays and full size lofting is much less common than formerly, so most of the work

of hull construction is done by the first three trades. Metal-using craftsmen are a homogeneous group in the first year and all receive the same first year's training. To this is added training in supplementary skills when they are on-the-job to enable them to carry out self-servicing operations. Metal-users are now trained to a much higher degree of flexibility and interchangeability than five years ago, although this does not yet necessarily mean that full advantage is taken of it in the yard.

Planned Experience

Planned experience, or on-the-job training to the Board's standards, will take varying times between one trainee and another and is no longer a matter of serving a fixed period of time. There has been a great improvement in the organization and supervision of planned experience in the last five years and the days are happily long past when training came a long way second to production and when many trainees did repetitive work covering a limited range of skill because it was economical to employ them in this way.

Phased Testing

It is one thing to set standards and to provide the means whereby they can be achieved, it is another and equally important matter to establish whether or not the standards have been reached. At appropriate intervals throughout the training period trainees are given phased tests to assess the standard of performance they have reached. During the first year the tests are administered by the Centre instructors but during planned experience the tests are carried out in the course of production work and the assessment is made by the production supervisor. Phased tests serve many valuable purposes, for example, they help to establish national standards of craftsmanship, motivate the trainees to better performance and indicate where remedial training is required.

Further Education

In this day and age it should not be necessary to say that practical training and further education go together and are indispensable to each other. A complete new range of further education craft studies courses has been designed for shipyard trainees on the assumption that they will follow the training recommended by the Board. Trainees are expected to continue with their further education until at least Part II stage, i.e. for three years. The more able trainees take technician courses such as the Shipbuilding Technician's Course or the O.N.C. in Naval Architecture and Shipbuilding. In recent years the industry's record of attendance by trainee craftsmen at further education courses has been as good as that of any industry in the country.

Safety Training

The shipbuilding industry has one of the worst accident records in British industry and the Board has given a great deal of attention to improving this situation through training. Young people are impressionable and the best time to inculcate the right attitude to safety is during their training. A high priority is therefore given in the training of craftsmen to instruction in safe working and the development of safety consciousness.

Conversion Training of Craftsmen

To accelerate flexibility and interchangeability in the adult labour force the Board has encouraged firms to give their journeymen conversion training on the same lines as the training being given to the new generation of craftsmen. The amount of conversion training which can be given will depend to some extent on the industrial relations climate in a yard. In recent years many yards have carried out extensive programmes of conversion training, mainly for the metal-using work force, and have "converted" the journeymen concerned as much as the industrial relations climate allows. In the three-year period 1968–71 over 6500 craftsmen undertook conversion training.

Manpower Planning

In the main this paper has concentrated on the qualitative aspects of training in the various categories. The quantitative aspects of training are also of great importance and in recent years the Board has given increasing attention to manpower planning. For several years running the Board obtained from firms within scope an annual return of their manpower and training situation. When the various first year Centres were set up the yards concerned had to carry out eight-year manpower forecasts of the skilled labour force to obtain loans and grants. The Board is now examining with the industry the possibility of adopting a standard procedure in the industry for manpower planning.

CONCLUSION

This paper has indicated some of the ways in which the training boards are contributing to the national training effort and will continue to do so in the future. As far as the Shipbuilding I.T.B. is concerned the Board's main purpose is to provide a training service to the industry. In doing so it can make a contribution to the efficiency and profitability of the industry which the Board believes is well worthwhile. Much useful progress has been made in the last six years and the Board looks forward to continuing this progress in the years to come in partnership with the industry.

REFERENCES

1) Department of Employment, 1972. "Training for the Future".
2) Shipbuilding I.T.B., 1972. "Recommendations for the Training of Professional Engineers".
3) Council of Engineering Institutions, 1969, Statement No. 6, "Guidelines on Training".
4) Royal Institution of Naval Architects, 1966. "The Higher Education and Training of Naval Architects".

Appendix 1

DEFINITION OF A PROFESSIONAL ENGINEER

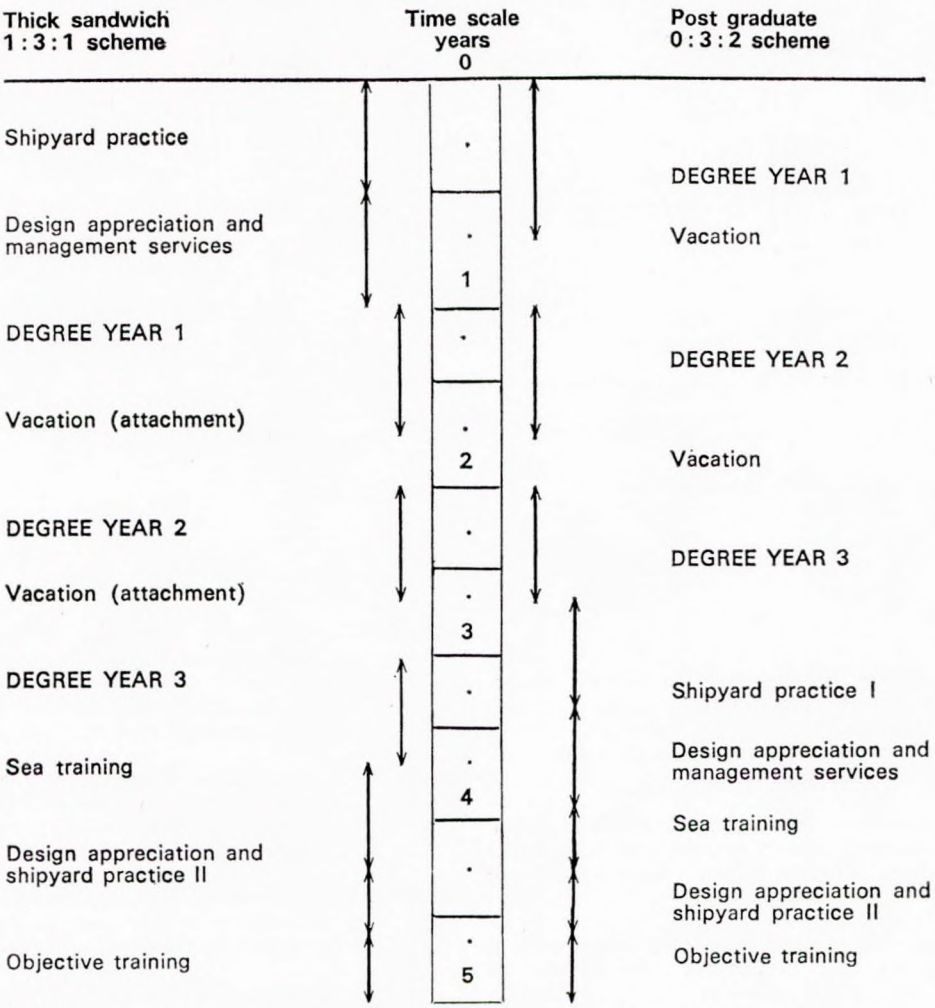
The following definition has been agreed by the Conference of Engineering Societies of Western Europe and the United States (E.U.S.E.C.) and by the Commonwealth Engineering Conference.

"A professional engineer is competent by virtue of his fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He is able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, designing, construction, manufacturing, superintending, managing and in the education of the engineer. His work is predominantly intellectual and varied, and not of a routine mental or physical character. It requires the exercise of original thought and judgement and the ability to supervise the technical and administrative work of others. His education will have been such as to make him capable of closely and continuously following progress in his branch of engineering science by consulting newly published work on a world-wide basis, assimilating such information and applying it independently. He is thus placed in a position to make contributions to the development of engineering science or its application.

His education and training will have been such that he will have acquired a broad and general appreciation of the engineering sciences as well as a thorough insight into the special features of his own branch. In due time he will be able to give authoritative technical advice, and to assume responsibility for the direction of important tasks in his branch."

Appendix 2

EXAMPLE ARRANGEMENTS OF TRAINING FOR MARINE ENGINEERS



Note :
a) Induction is a continuing process during the early part of the industrial training programme.
b) For 3 : 2 students the arrangements for the long vacation periods and post-graduate training are interchangeable.

Appendix 3

DEFINITION OF AN ENGINEERING TECHNICIAN

The following definition of a technician in the engineering industry has been adopted by the Conference of the Engineering Societies of Western Europe and the U.S.A. (E.U.S.E.C.).

"An engineering technician is one who can apply in a responsible manner proven techniques which are commonly understood by those who are expert in a branch of engineering or those techniques specially prescribed by professional engineers.

Under general professional engineering direction, or following established engineering techniques, he is capable of carrying out duties which may be found among the list of examples set out below.

In carrying out many of these duties, competent supervision of the work of skilled craftsmen will be necessary. The techniques employed demand acquired experience and knowledge of a particular branch of engineering, combined with the ability to work out the details of a task in the light of well established practice.

An engineering technician requires an education and training sufficient to enable him to understand the reasons for and purposes of the operations for which he is responsible."

The following duties are typical of those carried out by engineering technicians in the shipbuilding and shiprepair industry:

a) working on design and development of ship's structure and shipborne machinery and equipment;
b) building and commissioning ships and shipborne machinery and equipment;
c) hull, electrical and mechanical engineering drawing;
d) inspecting and testing ship's structure and shipborne machinery and equipment;
e) use of surveying and other instruments;
f) surveying and repairing ship's structure and shipborne machinery and equipment;
g) maintenance of yard services and location of defects;
h) activities connected with research and development;
i) testing of materials and components;
j) estimating and purchasing;
k) planning and production control.

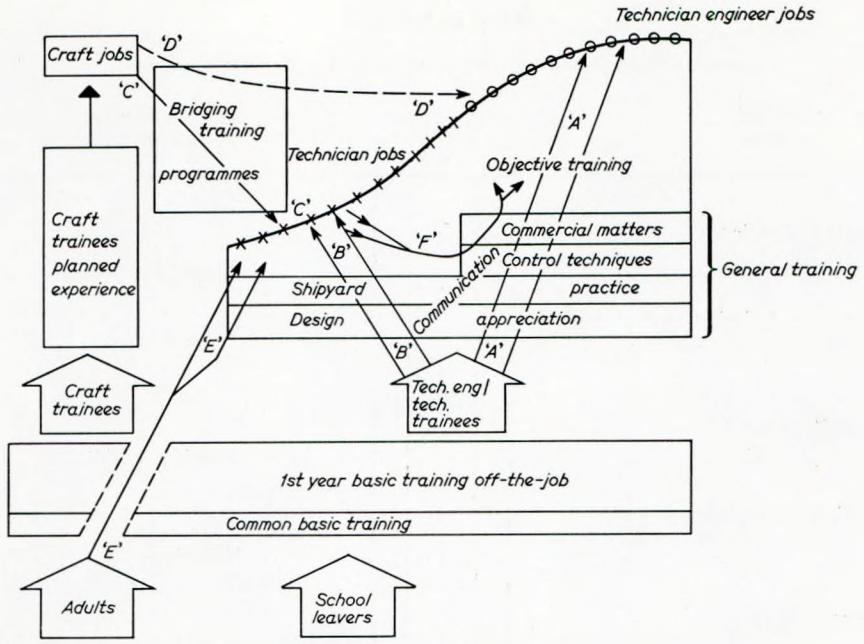


FIG. 1—*Technician engineers/Technicians—Diagram of training*

Key to Fig. 1:

Route 'A' — On completion of first year basic training off-the-job, technician engineers receive general training (design appreciation, shipyard practice, control techniques, commercial matters, communication), followed by objective training.

Route 'B' — On completion of first year basic training off-the-job, technicians receive general training (design appreciation, shipyard practice, communication), followed by objective training.

Route 'C' — Craftsmen appointed technicians undertake a bridging training programme which includes general training and objective training. A training needs analysis of the individual appointed will identify the content of this bridging training programme.

Route 'D' — Craftsmen appointed technician engineers will undertake a bridging programme deeper and wider in content than Route 'C' which will again depend on the individual's skill and knowledge compared with the technician engineer job content.

Route 'E' — Technicians recruited from outside the firm will receive general and objective training as appropriate to the individual's needs; some may benefit from a period of basic training.

Route 'F' — Technicians appointed technician engineers receive further general training (control techniques, commercial matters) and objective training.

The curve shows a number of technician and technician engineer jobs and attempts to indicate the greater depth of training required by technician engineers.

Discussion

PROFESSOR G. H. CHAMBERS, D.S.C., Vice-President, I.Mar.E., reminded those present that the Institute was vitally interested in the marine engineering content of shipbuilding and in the training of people at all levels to execute it. The Institute could not do this properly unless it had an overall picture of the shipbuilding industry training, including those parts which were not its direct concern, but with which it had to dovetail.

He had worked with Mr. Sivewright's organization on some aspects of graduate training and, confining his remarks to this, would first of all offer what were effectively marginal comments, and secondly would make some more general remarks.

The graduate training programme followed closely recommendations made by the Education and Training Committee of the Institute in the early 1960's. The inclusion of sea training had been thought to be very important, but, at that time, difficult to achieve.

The reduction in the proportion of graduates employed in industry had been virtually world-wide, affecting countries as widespread as the USA, Japan and Scandinavia. He agreed with the author that the intake of graduates by the British shipbuilding industry was relatively tiny, though to some extent compensated over recent years, by an increase in the flow of graduates to shipping and classification societies. It was perhaps fair to mention the efforts of this Institute and other organizations in encouraging graduates into the industry by means of supplementary grants and scholarships, without which this flow might be even smaller.

Turning to more general comments, the industry did not owe graduates a living, but there was a long lead time in graduate training and good graduates could not be suddenly recruited when there was a rush of orders. In times of considerable unemployment and financial stringency, firms inevitably looked for economies in areas including graduate training. At such times firms might also look for further qualifications apart from a degree. It was here that the graduate who entered the university from school was at a real disadvantage and, in relation to this, he would turn to training systems. A thick sandwich course 1-3-1-, was now rare. This was a pity because the year between school and industry was invaluable in both its introduction to hardware and its maturing influence; he knew of only one large organization which now employed it.

As to the author's postgraduate 0-3-2 scheme, graduates experienced great difficulty in finding a firm to take them for the two years training after graduation. There was, however, an important further alternative which had been operated for many years. It was based on leaving school at 16, being recruited to industrial training, taking an industry based Ordinary National Diploma or Certificate, and entering a degree course on the strength of this; it could be seen as an extension of Fig. 1. The associated degree courses might be taken at the local Polytechnic or Technical College in Mechanical Engineering. In this case, the industry provided its own marinization. A major group in the North East expected to provide nearly all their graduate staff in this way. Employers would have to be satisfied that the advantages of this system outweighed the dangers of inbreeding. When this was a firm's main source of graduate personnel, it was not surprising that it was difficult for an independent ex-sixth form graduate to enter the firm.

With such a background, it would be of immense help to ex-sixth form graduates if the Shipbuilding Industry Training Board were able to pay grants for training.

This paper referred to the shipbuilding industry, but, for the sake of completeness, he would like to refer to the shipping industries' variant of the O.N.D. approach. Good candidates entered the degree course on the strength of their O.N.D. performance in the related "alternative" scheme for the training of seagoing engineers. Such students formed the majority of British students in his department. They were motivated and relatively mature. With a degree and the industrial and seagoing experience included in the alternative training scheme, these young men were in a good position to seek employment. It was a sign of the times that shipping companies and classification societies might look for even further seagoing before they would offer employment on ashore staff basis. This was understandable in that such seagoing carried with it responsibilities similar to those of a foreman in industry which were recognized as a useful preliminary to responsibilities exercised in a professional capacity.

This alternative approach to a degree was mentioned partly for its own interest, but chiefly because at present, it appeared to be the largest single source of engineering graduates to British shipbuilding, shipping and classification societies.

It might be inferred that the surest route to professional status in the marine industry was to leave school at sixteen, enter shipbuilding or shipping as a trainee technician, and take national diploma or certificates instead of "A" levels for entry to the university, but this would tend to exclude those who quite intelligently wished to keep their options open and go on to sixth form. It was encouraging that some of these were determined and persistent enough to succeed, and fully deserved any help Mr. Sivewright's organization could give them. It would be interesting to hear to what extent this was possible. This could be only supplementary to action by industry, however, and it would be interesting to hear industry's views on recruitment of such graduates.

MR. H. D. HARDIE said that the paper was an interesting record of the Shipbuilding Industry Training Board's work since its inception in 1964. As one who had been employed in the industry for 33 years in a variety of fields embracing technical and design work, production, personnel and, more latterly, training, he could state that during the first eight years of operation the Board had accomplished a great deal in promoting better training throughout the industry, especially by way of acceptable and well defined training schemes for trainee craftsmen and draughtsmen, and by assisting in setting up the separate training centres during the first year.

His company prided themselves on having established internal schemes of training (although on a much less formal basis than they were now) for many years prior to the 1964 Industrial Training Act. With the assistance and co-operation of the Board, these had now been re-shaped and refined, on a fairly flexible basis, to meet the special needs of a company traditionally involved in the building of sophisticated naval vessels rather than in the broader context of merchant shipbuilding.

However, throughout the industry generally, little training, or even none at all, was carried out prior to the setting up of the Board. The small amount of training then undertaken had been very formal and had followed the old-fashioned principle of learning expressed by the term "sitting by Nellie". Fortunately these attitudes had now virtually disappeared, perhaps, in the first place, as a result of the levy/grant sanctions applied but, more latterly, because management was now more enlightened and had realized that long-term benefits could be derived from carefully planned training, whether in an "off the job" or working situation.

As a result of the earlier review by the Government into industrial training and the wide consultation which had followed the publication of *Training for the Future*, the Department of Employment had announced that during 1974 the levy exemption would be granted (against criteria yet to be determined) to firms who could satisfy the Board that they were carrying out training adequate to their own needs.

This could be on the basis of total or partial exemption, or even no exemption at all. Whilst he could not express the views of the industry as a whole, he felt sure that those firms who had devoted time and effort to improving their training standards, from both the standpoints of quantity and quality, and in accordance with the policy statements issued by the Board, would expect to be considered for total or partial exemption. It would seem unfair to continue to apply the rate of levy to a firm's total emoluments if it could be shown to have performed satisfactorily in establishing soundly based training in a majority of activities. It would be equally unfair to give total exemption in a case where there were known deficiencies. There would be immense difficulty in determining an acceptable cut-off point which would satisfy the standards of efficiency reached by firms of varying activity and size.

In the introductory section of the paper the author had made reference to the excellent progress which had been made in improving craft training, but also mentioned the inadequate attention given to management and supervisory training.

In fairness to the industry (who, in conjunction with the unions and educationalists, were deeply involved in producing the appropriate training policy statements) it should be appreciated that the original training policy statements for trainee craftsmen had been issued to industry four and a half years ago. Those for supervisors had been issued three and a half years ago, but those for management were only issued a year and a half ago. It was, therefore, to be expected that more progress would have been made in craft training because of the longer period of involvement by the industry. Furthermore, the industry, having had time to adapt itself to the earlier recommendations for craft training had been able to play an active part in their review, in the past year, especially regarding standards of performance, duration and content of training, and effects of technological growth and change in shipbuilding practices.

Supervisory training had been continually processed in his own company since the early 1960's and it was disturbing to note that this was not receiving such a high priority in some of the other large shipbuilding groups. He thought that this was because the industry was rather averse to applying the time consuming technique of individual supervisory job analysis as a means of determining the training need. In his experience, a formal system of job analysis had not yet produced any results that one was not already aware of, simply by possessing an intimate knowledge of everyday business and by having a personal feeling for the situation. It had only served to produce a voluminous amount of paperwork to meet the criteria laid down by the Board—paperwork which was seldom scrutinized to see if people had done their homework properly.

Formal management training was obviously off to a slow start, but he was sure that in another three years time, when reviewing and taking stock of achievements in this field (as with craft training) it would be found that a good deal of progress had been made. However, to instil some confidence into firms, the Board must be more flexible in their requirements and not determine grant allocation on evidence of the number of job descriptions produced, or by the number of managers despatched to business schools.

A successful firm must know its managers by maintaining close and personal contact with them in their daily work, by understanding their problems and frustrations, and arranging their training rotation and further development according to the needs of both the individual and the job. An over formalized management development programme could rapidly degenerate into a massive recording exercise with meaningless and mounting paper work accruing as a result, until everyone within the system became a number on the roll rather than a personality within the organization.

A middle of the road course could provide a solution to the problem; a mixture of informal and formal methods, with emphasis on the effective use of short selected modules of training according to individual need interposed at exactly the appropriate time.

A highly sophisticated approach to any scheme of management training (especially where it was introduced for the first time) might be rather cumbersome and frightening to those firms who had no full time management development adviser; they would probably prefer to carry on as before rather than face up to the complexities of the new situation confronting them.

No guaranteed successful system for choosing a manager had yet been found and no doubt the best were those born with such ability, for whom selective training and further development could be applied advantageously as a means of polishing their performance.

On the subject of recruitment of professional engineers, the Report published in 1966 by the Royal Institution of Naval Architects had indicated that there were 197 graduates employed in the shipbuilding industry; the ratio to total shipyard employees being 1:232. Over the 33 shipbuilding establishments then included in the survey, each with an average work force of slightly more than 1400, the report showed that there was an average of only six graduates per establishment.

The author had referred to a decline of 24 per cent per annum in the two years from 1969 to 1971. On the assumption that there would then be about 200 graduates in the industry, this yearly percentage decline would mean that there were less than 100 graduates in the industry today, an average of only three per establishment (assuming that the Geddes recommendation for geographical grouping of shipyards had not since taken place). The validity of this could not be accepted, for in his company alone they employed 118 graduates. So, in effect, this meant that the rest of the UK shipbuilding industry had none. He was sure that the author's estimates were based on a recent S.I.T.B. survey of directors and managers employed in the industry and did not take account of graduates in non-managerial positions. Nevertheless, even a slight decline was disturbing, especially since the Report indicated that the optimum staffing by graduates, particularly in naval architecture, should be more than doubled throughout the industry as a whole.

In regard to the annual output of 20 marine engineers from the two universities referred to in the paper, and the likelihood of only one of these entering the industry each year, he thought the author should appreciate that the modern sophisticated ship with all its advanced technical equipment, could be broadly classified under the heading of systems engineering, and sight must not be lost of the fact that the industry tended to employ more graduate mechanical, rather than marine, engineers.

On the subject of training student engineers and the S.I.T.B. recommendation that these young men should spend about six months on attachment to a ship in service, it should be noted that shipowners were not generally receptive to this idea, also it was seldom feasible to include all the ideal situations in an average curriculum.

MR. A. PAXTON said that he was concerned with the production and labour relations side of the industry, as well as being a director of a training company. Consequently, he had an interest in both camps. His remarks would tend towards picking up points in the paper that might cause day to day problems in the shipyard. Anything he said was meant to be helpful and not critical, because he thought the Board had done a good job since it had started in 1964. He thought it would be agreed that the effect of the Board's activities in the industry had been dramatic and had caused everybody to take a hard look at training, and to introduce improvements which, but for this intervention might never have taken place.

He noted that the Board's emphasis had now shifted from purely craft and technical training to that in the manage-

ment and supervisory field. Management and supervision in each shipyard had largely grown up individually, to take cognizance of established practices of the yard and areas which, in many cases, would be extremely difficult to alter. It was suggested that this type of training should be sufficiently broadly based that it might be adapted to such individual needs.

It would be interesting if Mr. Sivewright could say which criteria would be adopted when deciding whether a firm should be excluded from levy because of its satisfactory training arrangements, or whether it would still be levied up to one per cent of its payroll.

While, in the training of professional engineers, it was probably rightly considered that students should become proficient in a foreign language—as this would appear to be an ideal situation—it must be remembered that there were many competent engineers and naval architects who were proficient in no language but their own and still played a valuable part in the industry. It was hoped that such a contribution would not be excluded by the mere fact of lack of a foreign language. In this field the Board should be guided by the universities, some of which required no provision for foreign languages whatsoever, while the remainder only required a minimum of a pass at "O" level, which no one could claim represented fluency. He did not think that the Board should require more.

He noted Mr. Sivewright's remarks on demarcation. In this field patient negotiations carried out amongst the parties concerned, under the agreed procedure of the industry and without any extraneous assistance or pressures, would solve the problem more quickly than well-meaning intervention by outside bodies who could not be aware of the deeply held feelings of the parties concerned, and who might offer a solution that satisfied nobody and was a source of constant friction. There was no doubt, however, that by the breadth of its initial training, the Board was making its contribution in this area.

The difference between apprenticeship and training was noted, and also the thought that apprenticeship was now considered to be an outmoded concept. It would be interesting to know if this was a personally held view of Mr. Sivewright or if it was the considered view of the Board as a whole.

It was true to say that the training in metal trades had been reduced from nine schemes to five, but the shipbuilding industry was not, alas, quite down to five trades. The Board, by their training schemes, was undoubtedly helping the flexibility arrangements which had been progressively developed in the industry over many years; some as long ago as the early 1960s.

Although full size lofting was rare, the demand for loftsmen was still as great as ever, but some of them might now be engaged in the preparation of tape for tape control for burning machines or on 1:10 drawings rather than on full size template work, but the loft still played a major part in the industry.

Phased testing and further education were probably the most difficult problems to be considered by the Board. In most crafts there were different degrees of skill, and while one would wish to train everybody to the same standard, the question of over-training, both at practical and further education level, should be considered. The phased test should not be set at too high a standard for the apprentice of average or slightly under average ability, as there were many tasks in the industry that these lads would undoubtedly be well able to perform. It would be unfortunate if they were to be denied a certificate of craftmanship because the standard of testing was too high. There were also some people who made excellent tradesmen but would never do well in further education, and if the firm or the Board forced them to attend such classes, in cases where no aptitude or enthusiasm existed, this could create a sense of inferiority and frustration if they found they were struggling and, in some cases, failing to keep up with their classmates. There were others who benefited from and revelled in further education, and clearly should be given the opportunity of partaking in it.

It was, therefore, very difficult to set up a nationally universal standard for each and every apprentice, and he proposed that training should be left on a more flexible basis, to be agreed either at district or firm level with the Board's local people, to fulfil the needs which were most apparent in the area. The question of flexibility in this field of further education and phased testing could not over overstressed.

He referred to Mr. Sivewright's remarks on the training for safety in the industry. This, too, could not be overstressed, but it was perhaps unfortunate that the impression was conveyed that the shipbuilding industry record was a black one. It was difficult to compare like with like, and the record of the shipbuilding industry did compare favourably with that of the construction industry, where many of the problems were similar and, indeed, it was better than some sectors of the mechanical engineering industry. He agreed, however, that safety training was of paramount importance, particularly the education of apprentices in care and use of their equipment, and in the use of safety helmets, shoes and other items which would protect them from serious injury and were, alas, too often treated with contempt.

It was not Mr. Paxton's intention to be critical, although it might appear to be so; the intention was to be helpful to the Board and to Mr. Sivewright in performing the valuable task which they had undertaken.

MR. T. BALMER, Member of Council, I.Mar.E., thought that the paper described the constitution and the activities of the Shipbuilding Industry Training Board very well, but in order to describe these activities in a meaningful way, it had been necessary for Mr. Sivewright to outline the objectives of the Board, and Mr. Balmer wished to question the reasons for some of these objectives.

Under the heading "Recruitment of Professional Engineers" it was claimed that there was a shortage of graduate marine engineers in the shipbuilding and ship repair industry, and that the situation was deteriorating. This might well be so, and he said he was in no position to refute the claim, but respectfully suggested that the evidence offered in support of it was not convincing. His criticism of this evidence was that it was completely unqualified by any information or argument against the case presented.

Information which he believed to be highly relevant was that the intake of graduates to the industry did not consist entirely of that from the two universities mentioned, and therefore the case had been somewhat overstated. There were graduate naval architects and graduate mechanical engineers from other universities. Some 20 or so graduate mechanical engineers found seagoing employment each year, and some of these must filter back to the industry, together with other graduate mechanical engineers who did not go to sea. Additionally, about ten Extra First Class Certificates were issued by the Department of Trade and Industry each year. These examinations were of degree standard, and some of the recipients could enter the shipbuilding and ship repair industry. The intake to the industry was, therefore, not nearly so low as had been implied.

It was stated that the Royal Institution of Naval Architects thought there was a shortage of graduate marine engineers, and that the Shipbuilding Industry Training Board thought there was a shortage of graduate marine engineers. But did the employers also think so? He gathered that they did not since 19 out of 20 graduate marine engineers from the Universities of Surrey and Newcastle were expected to find work in other industries. He was therefore not at all sure, on the evidence presented, that this stated shortage did exist in the shipbuilding and ship repair industry; at least, not in the sense that vacancies for them existed and could not be filled for want of such men. He was persuaded that a shortage existed only in the sense that there were a

few in number because only a few were considered necessary by the employers. In the present situation it might be that the Board should be directing its attention more to the training of the employers than to the education of the unemployable.

It seemed to him that if a young man was committed to marine engineering by virtue of his early training, then there was a great deal to be said for providing facilities for his advancement to a marine engineering degree, but he thought it morally wrong to encourage school leavers to train for a profession in which it was known that only one in twenty of them would find employment.

MR. G. MCNEE, B.Sc., Member of Council, I.Mar.E., (Chairman), on the question of a marine engineering course, said he agreed with Mr. Hardie and Professor Chambers that it was not really necessary to have a degree in marine engineering. A mechanical engineering degree was quite sufficient, and there were quite enough of these available to cope with anything that was required by the industry.

He too was rather startled to see that there were no thin sandwich courses, because he believed that was a better way of doing it than the other methods shown.

One of the major difficulties in the operation of ships was the improvement of design of components. In the majority of cases insufficient attention was paid to feed-back. In the paper, the author had said that three to six months should be allowed for this important aspect of engineering training. His opinion was that it should be six months without any argument and, even at that, it was far too short. One of the things that should be remembered was that although there was three to six months training it would only be after a considerable period in commercial work that a man would be anything like a designer, because he had to see all the variants that designers built into the machinery.

It was difficult to see the justification for such a short period of sea training—as for this period the man had to change his life entirely. As ships became more complex and the number of engineer officers was reduced, there was less opportunity to provide the right type of training for these students. He was all for people going to sea and suggested that this should be a form of post-graduate training. Then the men would get reasonable pay.

Turning to the rather touchy subject of projects, he said that his firm got quite a lot of students writing to them saying they had projects to do and asking to be provided with information. Few firms could spare the time to produce the information for which the students asked. He suggested to his educational friends that if they gave students projects they should make sure that the students could find the information in the library or do the work themselves.

The paper set out very clearly the initial training of the future chartered engineer, but did not say what would happen at the end of the formal training. In most cases the people involved would go on to the open market, and depending on their luck they might fare well or ill. Was it not time that more attention was given to the first two or three years after a man was qualified, so that one could ensure that all the good work that had gone into teaching in the first stages was not wasted?

Correspondence

MR. P. R. SALISBURY, M.I.Mar.E. in a written contribution referred to the author's statement in the Introduction—"The Shipbuilding Industry Training Board covers some marine engineering". He would suggest that the dividing line between the S.I.T.B. and the Engineering Industry Training Board required further clarification. His company had one subsidiary where certain apprentices were dealt with through the S.I.T.B. and others through the E.I.T.B.

In Appendix 2 sea training was recommended and he agreed that this was highly desirable. The facilities for such students to obtain this experience were very scarce, however, and he wondered if the Board had any proposals to overcome this problem.

Under the heading "Basic Training" rationalization of the metal using trades was described, and in this field the Board had made a worthwhile contribution to progress and productivity amongst this group. However, it was disconcerting that fully trained apprentices, capable of carrying out a group of trades, were still forced by their union to select only one such function. As journeymen they were then restricted from fully employing the skill they had acquired.

Mr. Salisbury asked if there was any expectation that this procedure would be changed in the near future.

MR. D. J. LOCHHEAD, M.I.Mar.E., wrote that the author had many interesting points, but the one which gave most cause for concern was the deteriorating levels of graduate employment in the shipbuilding and allied industries. It was unfortunate that standards could not be maintained although there were more opportunities for higher education than ever before, and the Shipbuilding Industry Training Board had made careful provision for training. In some other countries there appeared to be an entirely different situation. A Japanese author* at IMAS '69 had said that one half of the total new entrants at all levels to their shipbuilding industry were graduates. Possibly the difference had arisen, in part, from the development of British shipbuilding from a traditionally craft intensive industry. This was equally true for engine building and seagoing marine engineering, where time-served apprenticeship was an essential first qualification for an engineer officer in the Merchant Navy. Here again the attitudes toward graduate employment were probably very similar.

A few years ago this Institute had studied the annual requirement for marine engineering graduates and decided that just over 100 were needed. This number, compared with the 20 actual graduates quoted by the author indicated a serious condition. Fortunately, the situation was not as bad as it appeared to be, as no reference had been made to the Department of Trade and Industry Extra First Class Certificate. This qualification provided an extremely valuable supply of educated and experienced marine engineers. At least three colleges offered courses for this examination, the most strongly supported being Poplar Technical College and South Shields Marine and Technical College. Enrolments were limited through financial as well as educational complications, although the Institute was able to offer some assistance. The economic deployment of available marine engineering expertise at all levels, together with a steady inflow of mechanical and electrical engineers and naval architects augmented the supply of much needed technologists. Nevertheless it was difficult to see how the UK could continue to compete with other countries in shipbuilding and ship operation unless the opportunities for high level education were increased.

The policy on the shipbuilding side had already been discussed. The engineering branch of the industry had several problems peculiar to the design, manufacture and operation of seagoing machinery. It was too much to expect that these might be solved by gratefully accepting any mechanical and electrical engineers who developed a post-graduate interest in ships. The Institute was very concerned about these matters and at present two working parties were reviewing the situation, one looking into the general problem of marine engineering at graduate level and the other specifically concerned with the industrial training of chartered engineers.

Several educational establishments were also looking at their own higher level marine engineering courses and

* Yamashita, I., 1969. Proc. Imas '69, pp. 12/1 to 12/10—in Discussion.

attempting to devise schemes which would incorporate advanced theoretical studies, workshop practice training and sea service requirements to enable ambitious young men to qualify academically and legally, with the minimum of delay, for the highest engineering posts ashore and afloat. Fig. 2 showed such a scheme consisting of a C.N.A.A. B.Sc. degree in marine engineering sandwiched with the training requirements of DTI plus the appropriate industrial experience for a chartered engineer. This gave an example of what might be possible; obviously there were many variations, all requiring careful study.

DR. P. A. MILNE, B.Sc., A.M.I.Mar.E., wrote that the author had commented on the low number of qualified staff recruited by the shipbuilding industry each year and illustrated the problem by suggesting that, of these only one graduate marine engineer was recruited from the United Kingdom universities. In Dr. Milne's company there were over 40 student apprentices and, on average, 12 of these qualified each year—four with either a B.Sc., or H.N.D. in engineering. In addition, six post-graduate students were reading for either an M.Sc., or Ph.D. at present. The qualified engineers came from C.N.A.A. Courses at Polytechnics or the Mechanical Engineering Department of Universities. He thought it would be interesting to study the distribution of qualified staff in British Shipyards because in the design departments of his company over 50 per cent of the staff were qualified with a B.Sc., H.N.D. or H.N.C. It would seem that, in general, the industry did not employ a sufficient number of qualified staff in the production management services such as production control or quality control.

There was obviously some interaction between the Shipbuilding Industry Training Board and the Merchant Navy Training Board and it would be interesting to know more about these links. For example the shipowners' Alternative Training Scheme usually required some shore based training which might be provided by a shipyard and it was not unusual to find such staff joining shipyards later in their career after obtaining D.T.I. Tickets. The shipbuilding industry had always recruited a certain number of staff with seagoing experience, as a matter of policy, to ensure that design and other work was realistically based. A further link was the continued practice of technician engineers and certain craftsmen spending a period of time at sea at the end of their training in a shipyard. These links formed an important part of the training in each industry and no doubt required co-operation between the training authorities.

The training programme for professional engineers could be arranged in a different sequence so that shipyard experience was followed by a period in management services, such as production control or quality control, before entry into the design and drawing offices. The final period of training could then be concerned wth the commercial aspects of either purchasing or contracts together with a period of sea training in selected cases. The advantage of this particular sequence was that the trainee would progressively accumulate experience in the reverse order of the total production cycle and enter each stage with sufficient background to understand its contribution to later stages. It would also give a better appreciation of production practices by providing an understanding of some of the control systems appropriate to the area. His own company tried to recruit a percentage of school leavers with sufficiently high academic qualifications to allow them to progress to either an H.N.D. or B.Sc. course later in their training. They would then have a good basic training and a clear understanding of the manufacturing departments. Appendix II of the paper showed this type of training. The method suggested was an extension of Fig. 1 of the paper—with some of the trainees ultimately becoming technologists.

Most of the work undertaken by technician engineers in the industry was closely related to information or systems which were central to the operation of the technical departments. If the programme for the training of draughtsmen were flexible enough it should be possible to provide the range of skills required from the one programme. This might involve a certain amount of streaming towards the end of the second year of the training, depending on the aptitude and inclination of the employee. It was difficult to see the justification for separate courses for technicians (technical assistants) in the industry as most of the jobs required an understanding of a small range of skills and were limited to a particular area, usually in the production departments.

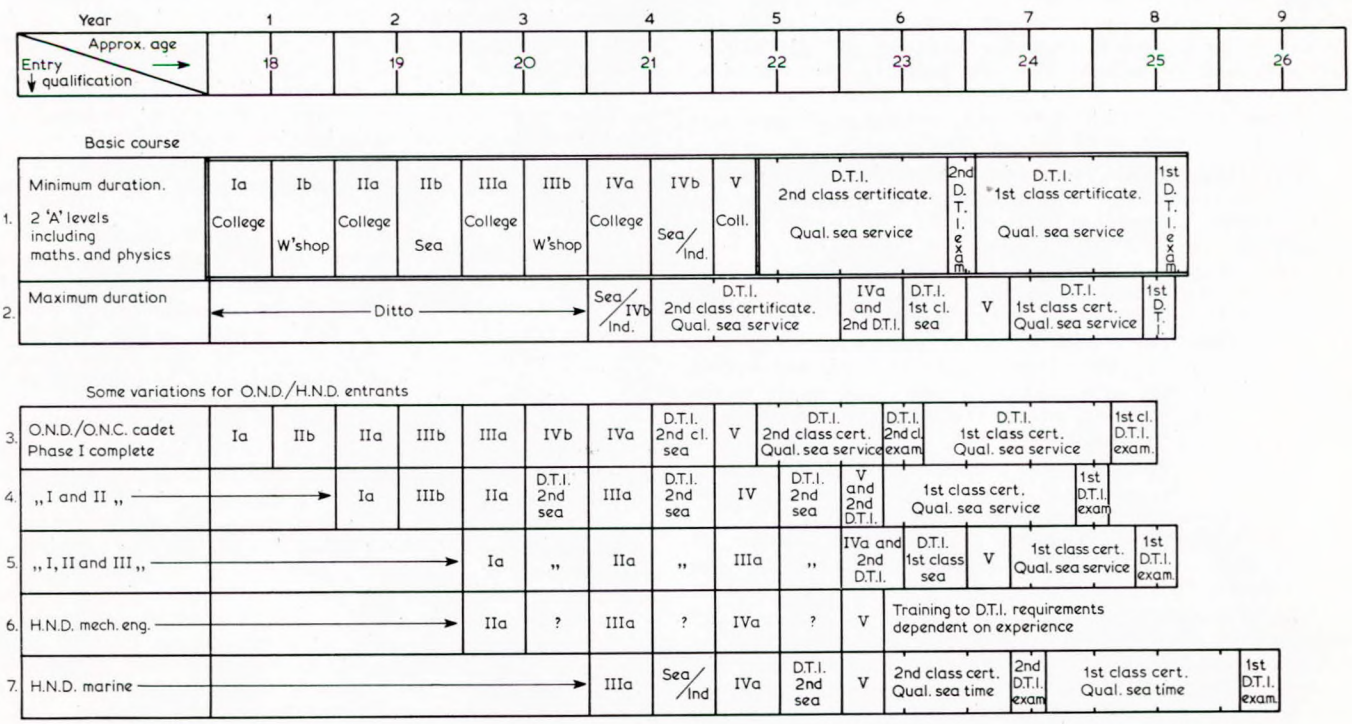


FIG. 2—*Alternative course and career programmes for the proposed C.N.A.A. degree in marine engineering*

The traditional way of recruiting these employees was to promote them from the craft training streams and the numbers currently employed, together with the limited range of skills actually required, suggested that this was the most logical approach. The relatively small numbers employed and the diversity of work undertaken indicated that it would not be possible to take elements from the existing courses for technician engineers or craftsmen. In any other cases short courses outside the company should be appropriate.

It was interesting to note that evening classes were now regarded as a last resort and difficult to understand why block release was the only means of providing an appropriate balance between education and training. This applied particularly to some of the categories not requiring a very high academic attainment. The loss of day release as an option was perhaps more a result of pressure from technical colleges rather than a genuine belief that this was not the most satisfactory way of educating technician engineers and craft apprentices.

MR. R. S. HUNTER, M.I.Mar.E., wrote that in his introduction Mr. Sivewright had indicated that prior to 1964 the government had stated "If training was left wholly to individual firms, the quality and quantity of the training generated was inadequate to meet the needs of the economy".

Industrial training by its very nature was a long term project, in which anticipated benefits might not be seen to be effective for a good number of years. It was not surprising therefore that individual firms faced with immediate and short term problems of high priority and magnitude were unable to supply the expertise and resources necessary for thorough industrial training on a national scale. The service the S.I.T.B. had given to industry in this field had been most effective. Their work since 1964 in laying down minimum standards for craft training had not been without its critics; but there could be little doubt that the industry was now making a much more concientious and sustained effort to anticipate and equip itself for the future with the type and skills of labour force required. Whether or not this progress would have been made without the guidance and financial encouragement of the S.I.T.B. was a question which could lead to a great deal of discussion.

The future vitality and commercial success of the industry depended as much on having an adequate number of trained professional engineers and technicians, as it did on having an adequate number of trained craftsmen. A decline of 24 per cent per annum of graduate scientists and engineers employed in the British industry was obviously unacceptable and naturally caused concern. This decline might have been caused primarily by retirement, in which case the solution might be extra recruitment. It was possible, however, that the decline was a result of able people leaving shipbuilding for another industry or profession and, if this was the case, then recruitment would only afford a temporary solution. If the industry wished to maintain a larger force of engineers, then the reasons for this decline must surely be sought. There was certainly no point in the Board and industry spending time and money training engineers only to find that they did not wish to remain as part of the industry, or, of even more importance, if challenging opportunities with responsibility suited to their experience and training were not available within the industry. The decline in numbers would not be halted simply by further training. Indeed training "for the sake of training" could undoubtedly exacerbate the situation.

Author's Reply

Mr. Sivewright, in reply, said that he was very appreciative of the generous comments contributors had made about the work of the Board.

A Training Board had to try to strike a balance between idealism and realism. It would not achieve its purpose if it was too realistic to the extent, for example, of setting low training standards; equally it would never keep faith with the industry if its standards were too exacting. Boards had to keep a reasonable balance between these two so that they could discharge their obligations while at the same time taking the industry with them and making employers feel that the Board could serve their interests.

A number of contributors had referred to the question of graduate recruitment and training. The reference in the paper to graduate marine engineers was illustrative of the situation and, as had been pointed out, numerous graduate mechanical engineers were recruited into the industry. But there was no reason to doubt the veracity of the statistics, which were based on annual statutory returns to the Board every year until 1971 and a further return in 1972. The reservation raised by Mr. Hardie could be explained by the fact that there were some 330 graduates at all levels in the industry in May 1972, of whom about 35 per cent were in his company's shipbuilding group.

It was clear that there was a declining trend in graduate employment for a variety of reasons and the situation was now being discussed between the Board and the S.R.N.A. Dr. Milne's view that there was an insufficient number of qualified staff in production management and management services was undoubtedly true.

The arrangements for sea training had to be made between individual shipbuilders and shipowners and neither the Board nor the British Shipping Federation could undertake to obtain billets, but a number of shipowners had indicated their readiness to participate in the scheme. Mr. McNee had suggested the periods of sea training were not long enough, but he did not think that the industry would accept longer periods.

In reply to Professor Chambers, comments about grants, in the past the Board had provided grants for the industrial training periods of sandwich courses and for long vacations, but it was too early to say whether these grants would continue to be available in 1974. The Board had not so far grant-aided post-graduate training as this had not been thought necessary.

Mr. Paxton had referred to the distinction between training and apprenticeship. The reality of the matter, he suggested, was that while apprenticeship had lost much of its significance in training terms, both employers and trade unions had made it clear that it served other useful purposes and they wished to retain it.

A number of contributors had referred to the fact that the increased productivity inherent in the new arrangements for craft training was not yet being fully realized due to trade union and other restraints on the deployment of the labour force. This was true, but the situation was improving and it was much to be hoped that the broadly based training and higher standards now being achieved would be put to good use in the yards subsequently.

He could not agree with Dr. Milne that the existing arrangements for the training of technician engineers and technicians were adequate. The Board's proposed policy involved providing tailored training schemes for jobs as diverse as draughtsman, estimator, maintenance technician and work study engineer, and not relying largely on the training of draughtsmen or craftsmen, which was uneconomic. The scheme—as outlined in the paper—of basic training, general training and objective training should meet the problems of small numbers and diversity of work and the training needs involved could not adequately be met from existing schemes. The proposals conformed to those of the engineering industry and should improve both the intake into and the performance of the technician group.