THE TRAINING AND EMPLOYMENT OF THE NAVAL ENGINEER OFFICER

BY

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In his articles in Vol. 14, No. 2, and Vol. 15, No. 3, Rear-Admiral Ridley gave a progress report on the state of the training, organization, equipment and facilities at the Royal Naval Engineering College, Manadon. A further article to show continuing development would appear timely but a simple catalogue of changes would not necessarily give the right overall emphasis.

Instead therefore the transcript of a lecture given by the Author to part of the Imperial Defence College which visited Manadon on 20th March, 1969, is reproduced below. The Author was at the time the Commanding Officer of the Royal Naval Engineering College, Manadon.

Introduction

Origins are often important. I would trace the origin of the present day engineering specialization back to the recommendations of the Cooper Key committee which reported in 1877. This may sound ludicrous. At that time engineering was confined almost entirely to the propulsion of the ship. The Admiralty were still concentrating on the development of muzzle loading guns. Electricity was some new fangled idea best kept ashore. But nevertheless almost every basic organizational feature of the engineering structure of the Navy was recommended by this committee. I would like to use one recommendation as my starting point, which reads: 'that engineer students would derive great benefits from the establishment of a residence where they would become accustomed to the discipline which, in many cases, they find irksome on first appointment to a Man-of-War'.

It is perhaps a tribute to the speed of decision in Whitehall and the Works Department of those days that the Royal Naval Engineering College was opened three years later in June, 1880. It is a very Victorian building perched some eighty feet above the Dockyard and facing on to the Keyham gas works. The training in those days was very practical, the majority being carried out in the dockyard workshops supported by a small measure of classroom lectures. The regulations of 1863, still in force at that period, required six years in the Dockyard and in school followed by a year at Greenwich.

Selborne Fisher Scheme of Training

The training of Engineer Officers slowly evolved on these traditional lines until the early 1900's when the Selborne Fisher scheme of training was introduced. Under this scheme the officers required for the executive, engineering and marine branches of the Navy—in short those officers essential for the fighting efficiency of a ship—were to be given a common entry and common training until such time as they would specialize in their respective branches.

It was also intended that the education would be mainly scientific and that one third of the training as Cadets, Midshipmen and Sub-Lieutenants which took ten years from entry at age thirteen was to be spent on engineering subjects or in the engine rooms of the Fleet. Specialization in gunnery, torpedoes, navigation, etc., or in engineering would start at approximately two years' seniority as Lieutenant and all specialist officers would revert to General

Service on being promoted to the rank of Commander. There was one exception, a few officers, not exceeding ten per cent of the total number of engineer officers, would be required to volunteer to devote themselves for the remainder of their service career to engineering. The first term of this entry were promoted Sub-Lieutenants in 1911 and the first specialist course for engineer officers commenced in 1913. The course consisted of two terms at the Royal Naval College, Greenwich, followed by one year at the Royal Naval Engineering College. Hardly had this scheme got under way than it was sharply modified by the urgent requirement to get officers to sea quickly to cope with the expansion and subsequent losses during the First World War.

Pre-War Training

In 1920 the principles of the Selborne Fisher scheme were put into reverse and segregation of engineer officers from executive officers was again introduced. Officers started specializing in engineering from the rank of midshipman. A four-year course of engineering was introduced at the Royal Naval Engineering College. The course became predominantly academic, applied training forming something under a quarter of the syllabus. But much more importantly the scheme of training, its syllabus and the examinations were accepted by the Institution of Mechanical Engineers as exempting those passing satisfactorily from the Institution's own examinations to give eligibility for corporate membership. From that time onwards, that is for nearly fifty years, the Navy has trained its General List engineer officers to the nationally accepted level of professional status.

Manadon

In the 1930's the increasing complexity and scope of marine engineering and the growth of aeronautical and gunnery engineering demanded an expansion of the College building and facilities. This was physically impossible at Keyham and the Admiralty acquired about one hundred acres of the Manadon estate. The original building plans with a facade incorporating the worst features of Dartmouth, Sandhurst and Cranwell were fortunately shelved at the outbreak of the 1939–45 war. The majority of the buildings are therefore post-war and purpose built; the first phase of the accommodation block being completed in 1958 when Keyham was finally evacuated.

The Electrical Branch was created immediately after the war and until 1960 all electrical officers read for an engineering degree, the majority at Cambridge. With the introduction of the Murray scheme of training, they also came to Manadon. This not unnaturally increased the student officer population so that it was necessary to extend the accommodation block, the final wings of which were completed in 1966. Certain features, such as the Great Hall and the Cinema were built for the originally expected population of 350 and are really therefore too small at our present figure of nearer five hundred officers under training.

Aim

Although methods, syllabuses, etc., have changed frequently and extensively the task of the Royal Naval Engineering College remains the same as it has throughout its eighty-nine years, that is, the training of naval engineer officers. This is a three-part task:

(*a*) Firstly, to continue the military or naval training started at Dartmouth and continued during the midshipman's year in the Fleet; we must develop the young officer's power of leadership, of initiative, of resourcefulness and of responsibility.

(*b*) Secondly, we must present to the young officer that fundamental engineering knowledge which it is considered necessary for him to absorb in order to reach professional status; which today means educating at least to Ordinary Degree level.

(*c*) Thirdly, we must apply this fundamental engineering knowledge towards the particular machinery and equipment which the young officer will meet on first going to sea or to an air station.

This three-part task immediately shows up the sharp difference between Manadon and a university, for the latter is concerned almost solely with our second task of academic learning. There is also a fundamental difference in aim. As a university is a centre of learning and of research into further knowledge, it is only natural that the prime concern of the professors and staff is in increasing this sum of knowledge and thought. The passing on of this knowledge to the young is of secondary importance. The undergraduate's learning and the success which he attains will be mainly of his own making. As an over-simplification it can be said that, cynically, a university exists for the benefit of the dons; and, pompously, that the Royal Naval Engineering College exists for the benefit of the Navy. For, our aim is to try to train the personnel presented to us to the standard laid down by the Admiralty Board.

Academic Task

I would like to deal briefly with the academic task first. We are training to the accepted national level required for professional engineer, for it is this and not the Degree for its own sake which is the primary requirement. The award of a Degree may mean more in recruiting terms as it is more readily recognized by parents and schoolmasters, but the Navy's requirement is for engineer officers trained to the accepted professional standard. The level of this standard has risen steeply over the last ten years. The course itself is a normal three-year Degree course in either mechanical or electrical engineering. We run two levels: an Ordinary level which is that required for professional status; and an Honours level designed to stretch the brighter student. The Degrees are our own accepted by the Council for National Academic Awards. The normal subjects are taken except that perhaps we cover a broader syllabus in the Electrical Degree than most universities including, for example, both heavy and light current.

Approximately one third of the time is devoted to lectures, all compulsory, one third to laboratory work and the remaining third to tutorials and private study. Throughout the course officers spend one day a fortnight in the workshops. We are of course not trying to produce a craftsman but only wish to give the young officer an understanding of the possibilities and limitations of the many crafts which he will meet later on. Two periods a week are given to Liberal or Complementary Studies which may include, as a series of lectures, almost any subject from Comparative Religions to Local Government or Renaissance Art. For these we use mostly lecturers from Exeter University. In round figures, we have an entry of just over a hundred a year to the Degree Course. About three quarters of them belong to the R.N. and the remainder to either commonwealth or foreign navies or the Royal Naval Engineering Service. This puts us in the big league of mechanical/electrical faculties lying perhaps fourth or fifth with Cambridge and ICST in first and second place.

Additionally we have about six or seven officers a year at Cambridge running in parallel with the Manadon course. They are nominated to go to Cambridge while at Dartmouth. We see them for a short time before they go up to Cambridge and during the two subsequent vacations when they come to Manadon for their workshop training. A Divisional officer visits them two or three times

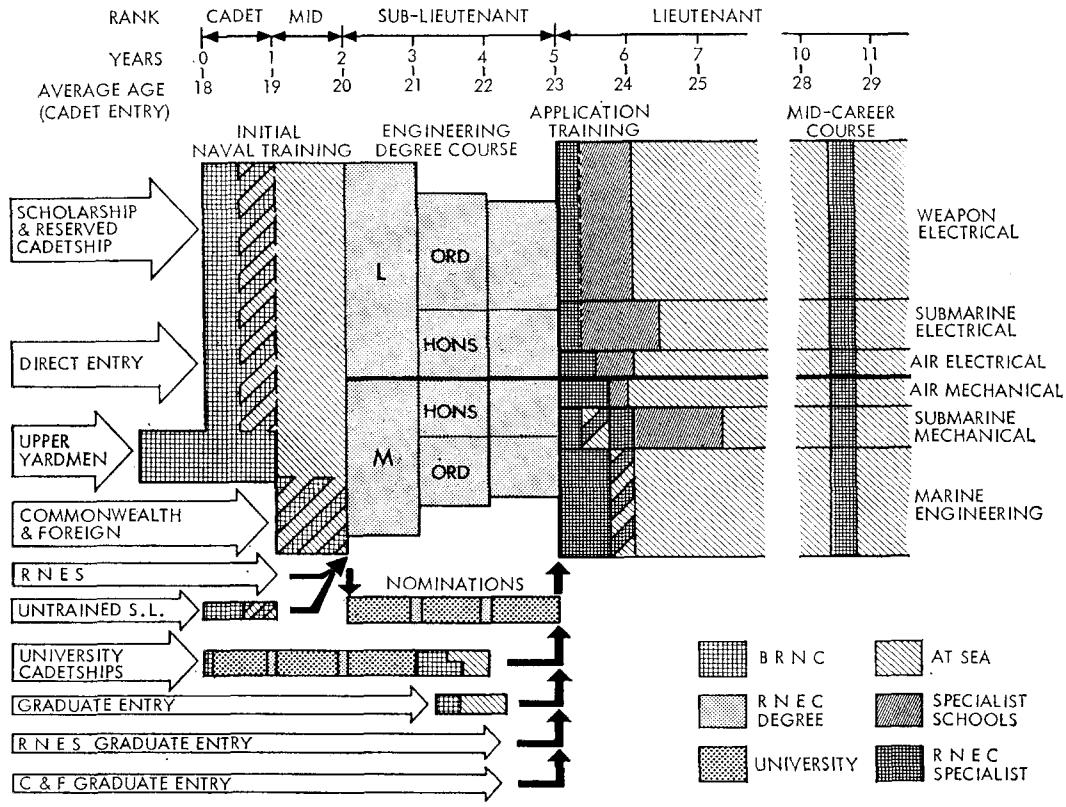

FIG. 2—SCHEME OF TRAINING

a term in order to keep in touch with them navally and they rejoin their contemporaries at Manadon for the Application Course. The first of the university cadet entries have just gone to sea and will not join us until next September for the Application Course. It will be interesting, particularly in view of the R.A.F.'s recent decision to enter only university graduates by one means or another, to see how these match up with their more navally trained counterparts. Academically there are already problems; gaps in certain fundamental subjects which are essential for a proper understanding of the wide range of applications in the Navy.

Failures

The corollary to insistence that engineer officers reach professional level is that those who fail to achieve this standard are withdrawn from training. One or two with good character and leadership qualities may be transferred to other branches of the Navy, if there are vacancies; but for the remainder it means withdrawal from the Navy. Our failure rate runs between fifteen and twenty per cent which compares very favourably with the average figures for the engineering faculties of the country. The entry standards and spread of academic ability of the officers is very much the same as it is for undergraduates at the red brick universities. The failures however occur at random throughout the span of academic ability from top to bottom; it is neither a matter of too low entry standards or of too high a standard on course or in the examinations; failure is almost invariably a matter of motivation. Young officers may become disenchanted with engineering or disenchanted with the Navy itself. A good two thirds of those who are withdrawn for academic failure have at best only marginal character and leadership potential.

There is little doubt that any officer entered with the minimum 'A' levels, but acquired normally, can get through if he really wants to.

Application Course

In industry, and elsewhere, graduates can in general learn 'on the job' while giving some return. Ships however are always short of accommodation and we can afford very few training billets at sea. Those appointed to sea must be fully effective at the earliest possible moment. We therefore do all we can ashore in a further year's application training. At this stage officers volunteer for, or are allocated to, one of the six sub-specializations shown in FIG. 2. The content of each course is directly related to the jobs which each officer will have to undertake in his early appointments. The scope and length varies for each sub-specialization, but in broad terms each covers:

(*a*) An extension of fundamental knowledge which cannot be introduced into the Degree course because of lack of time or because it is too specialized for the majority, e.g., the AE officers must learn the fundamental of aerodynamics.

(*b*) A large practical content so as to gain the essential knowledge of the machinery, systems and equipment with which each sub-specialization must deal upon going to sea or to join an air station.

The latter requires the provision of extensive, and very expensive, equipments. The highly complex weapon systems are already provided in the ratings training establishments, so that the WE officers do their equipment training at H.M.S. *Collingwood*, after completion of a term at Manadon on techniques applicable to these systems. Similarly the Air Electrical officers go to H.M.S. *Daedalus*. These officers will be essentially maintainers and diagnosticians in their first appointments. The ME officers, while also maintainers and diagnosticians but in a less complex field, have a machinery operational role.

The propulsion and associated systems in a ship are neither self-regulating nor, as yet, able to be subjected completely to any form of automatic control. Even fail safe devices may be dangerous if they mean that the ship is suddenly left without power and is therefore unmanœuvrable. Such systems still need a guiding human hand and a considerable degree of judgment in their control. It is necessary therefore for the ME officers to gain an intimate knowledge of these systems and confidence in operating them. This used to be done at sea in the big ships of the Fleet. With the demise of the aircraft carriers, we have had to use a ship especially earmarked for this training, as it is impossible to simulate such large dynamic systems ashore.

Much of the foregoing is also applicable to the submariners, but with the additional nuclear training commitment. The whole pattern of their training is currently under review.

Naval Training

To be fully effective at the end of training the naval engineer officer must be able to organize and look after the men of his department as well as to be competent technically. It will be at least four years since he was last at sea and in contact with naval ratings. Somehow we must strive to bridge this gap and make it possible for him to take charge quickly and easily. Perhaps four per cent of the time at Manadon is devoted directly to naval training but a great deal more can and is assimilated in the normal daily running of the College. We are a uniformed six-day a week establishment. We have Divisions and prayers four mornings a week and Ceremonial Divisions four times a term. All duties, except during the leave period, are carried out by officers under training. There is a most extensive programme of games and sports playing both for College teams and Inter-Divisionally. Officers are required to organize and undertake an extensive expedition during their first year and they spend a fortnight at the end of the second year in a new entry training establishment to remind them of what a sailor looks like and what are his problems.

It is never easy to foster the development of responsibility and leadership in a training establishment such as this, nor is it easy to achieve a rational balance between the conflicting needs of academic freedom and a disciplined service. The balance that has been and is achieved is possibly unique to the Royal Naval Engineering College and is one which has impressed many external observers. We believe that it is in part due to the relatively long existence of the College; it is helped immeasurably by the fact that all the lecturing staff are uniformed, we have no civilian professors; it is helped further by the fact that our aim is single, that is to train naval officers; we are not distracted by trying to run a research establishment on the side; it is helped too by the fact that we are located in a naval environment comfortably remote from the more sophisticated centres of entertainment, and some may add from the Front Office.

H.M.S. 'Urania'

We also have one Engineering Expedition. At the end of their second year officers are sent in groups to a ship, on the disposal list, and live there for a week. The ship is at buoys in the stream and everything is shut down. They arrive on board armed only with bedding, food and torches. They must start from scratch—get a Diesel generator going to provide lights; start up and test the fire-fighting systems; get the galley working and prepare their food; and so on, slowly setting all available systems, up to and including the main engines, to work. It is a sobering and salutary experience, which brings their feet right down to earth. It also teaches them, at first hand, of the housemaiding problems, the amount of effort required to keep the ship clean and to make themselves comfortable. There is, of course, some supervision for safety's sake, but the responsibility is theirs.

Mid-Career Course

This takes us to the end of the initial training. We should, if we have done our business correctly, have taken the engineer officer to the stage of his professional, administrative and naval training so that he can take a fully effective appointment in the Fleet. However his mid-career and later appointments will all contain a major managerial component. We used to include a certain amount of economics and management in the Application Course but we found that it was an unreal academic subject at that stage of an officer's career when he has very little idea of what he is trying to manage. We have therefore recently set up a Mid-Career Course, which has been given this innocuous name so as to avoid pre-empting the content of the course, in order to prepare engineer officers for these appointments. This course is aimed at providing a thorough understanding of the principles of management and a knowledge of the best modern techniques and practices. We will run three courses a year each lasting fifteen weeks. All officers will attend this course after two appointments at sea, and we intend to incorporate syndicate work and the maximum use of class participation to capitalize on these officers' recent experience at sea.

Post-Graduate Courses

Additionally we can and do send officers on selected post-graduate courses, either in university or at Greenwich, in order to prepare them for certain specialized technical appointments.

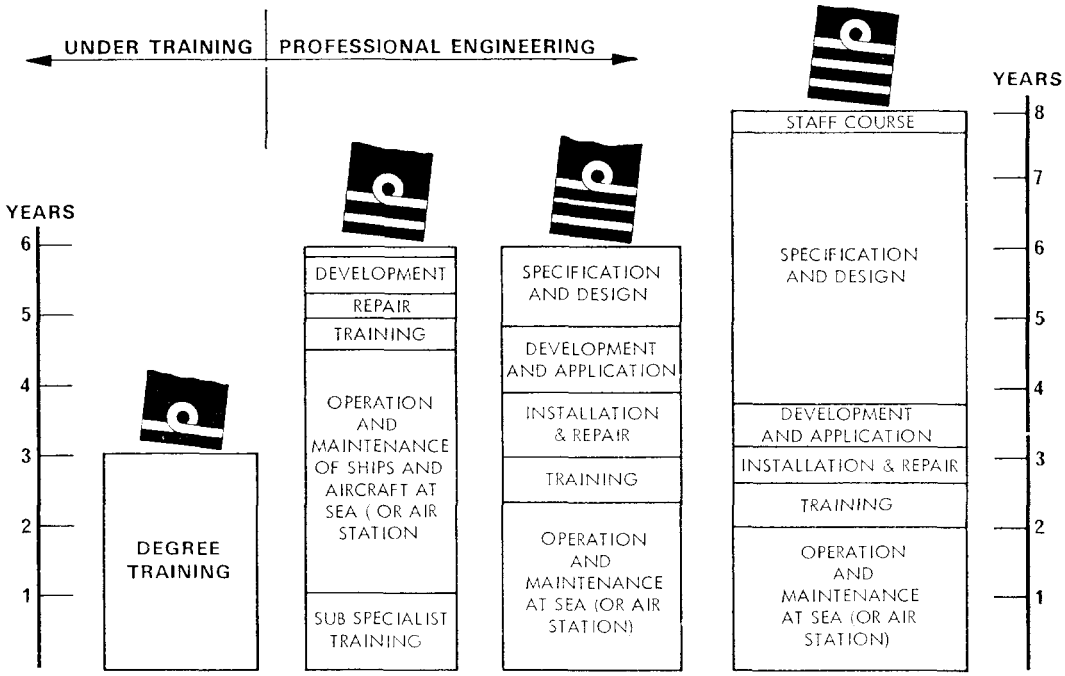

FIG. 3—PATTERN OF EMPLOYMENT

Employment

I should perhaps have organised this lecture differently and started with the employment of the naval engineer officer and from this derived the necessary training pattern. Historically however these two have gone hand in hand and it is well possible to postulate that if the training over the last few decades had been different the present pattern of employment would also have been different.

For example, the United States Navy, which in fact has developed a scheme very similar to the Selborne Fisher, deploys its officers for engineering duties at sea in a very different way from the R.N. Rating skills and structure, maintenance and support organization are also quite different, each having grown up to accord with the others.

The present pattern of employment is shown very broadly in FIG. 3. The blocks are the proportion of effort, i.e., the number of officers multiplied by the time in each appointment, in relation to the total available effort in each rank. As Sub-Lieutenants the officers are undergoing training all the time and as we have seen the Application Course extends into the Lieutenant's time. The great majority of the remaining effort here is in the straightforward job at sea or similar type of job at an air station. Towards the end of their time as Lieutenants some may be employed in the training establishments, particularly artificer apprentice training, one or two in dockyards and again a few in equipment development work in the naval research establishments or possibly even in industry. As a Lieutenant-Commander the proportion of effort at sea drops to below fifty per cent. Other types of appointments are growing and specification and design forms a significant proportion. As Commanders there is a further drop in sea time and a major increase in specification and design, up to fifty per cent. Here the officers are responsible for producing specifications for new equipment, machinery and complete ships' installations. Some actual design work, outside normal industrial experience, is necessary particularly on the major systems and installation work. The officers must also be capable of criticising industry's own specialized designs, ensuring that they meet the requirements of the sea and of ships which are rarely understood

fully in industry. They will be dealing direct with the top technical levels in industry—there is no Ministry of Technology between the Navy and industry except in the air world—and most of the work is in the forefront of technological development. For whatever criticisms may be levelled at the numbers and capabilities of naval ships there is no doubt that over the last twenty years the Navy has been in the lead in many fields of development. The value of the naval engineer officer for these appointments *vis à vis* his civilian counterpart, is that allied to a full professional training, he has also first hand and intimate experience of operating and maintaining machinery and equipment at sea. This unique combination of training and experience cannot be found in industry, the Ministry of Technology or anywhere else. It is I believe vital to preserve this combination if the Navy is to continue to put to sea at the earliest possible time the fruits of technological advance.

Standards

It is sometimes asked if we could not accept a less rigid insistence in professional standards, in the belief that not all officers will be employed at this level of work. The Engineering Specialization in the Navy is already diluted almost 50 per cent by Special Duties List officers. These officers are promoted from the lower deck, mostly from artificers, aged between 25 and 30 on promotion. They are eminently practical men with great experience but do not have the necessary background to cope with certain technical appointments. They are incidentally trained at Manadon on promotion, but this is intended only to widen their background and in no way attempts to bring them up to professional level. A sub-professional level officer would form yet another restricted category somewhere in between the professional and S.D. List with the virtues of neither. Some years ago we did allow some 'near misses' to pass to the Fleet. They have already become appointing problems.

In emphasizing the level of activity in specification and design I would not wish to belittle what I have called earlier the straightforward job at sea. The maintenance of design performance and availability in modern weapon and data equipments requires system engineers of full professional calibre. In the past the academic demands on the marine engineer have been less exacting but the introduction of more complex plants and their control systems is making this task more difficult.

The Future

Noting the trends of continually increasing sophistication of equipment it is perhaps worth while to speculate on the likely changes in training and employment in the next two or three decades. There is already a substantial mechanical content in the weapon electrical officers' task. The use of advanced control techniques in marine plants will grow and is likely to necessitate an increasing emphasis on electrical control and computation theory in the mechanical degree course in order that the marine engineer should become more of a systems engineer and diagnostician. In the long term this blurring of the boundaries between electrical and mechanical engineers may well lead to the need for a general engineering degree as a common basis for the education for all engineer officers.

Such a degree is probably more difficult than the specialized mechanical and electrical degrees which the officers take now. The length of the course may have to be increased; entry standards may have to be raised with unpredictable effects on recruiting. This need for higher standards, nationally, is already reflected in murmurings that nothing less than an Honours degree will be acceptable for Corporate membership of the Institutions. At the same time we cannot foresee accurately the changes which may take place in national

education standards. If the advances over the last twenty years are any guide, it might be that the level of secondary education will so rise that the numbers able to achieve present day Honours standard will be double or even three times the number today. There are many other imponderables. Some things however are quite clear. We must keep the education and training as broad as possible; we must use the pruning knife regularly—Parkinson has not pronounced a law on the subject but training always tends to increase in length; we must allow it to evolve—revolution seldom produces a better answer. We have experience of many widely differing schemes which have been tried, and have found that steady change produces a far better solution.

It seems probable too that there will be some redistribution of the task at sea between the Seaman and the Engineer, particularly in the weapon field. At present these are sharply divided into users and maintainers. A substantial blurring of this division is I believe inevitable, but it will necessitate a move towards tertiary education in the applied sciences for seamen officers.

Finally, the higher posts. Navally, just after the war, more and more Research and Development was the panacea to cure all our ills. Since then we have moved through, among others, planned maintenance, work study, operational research and cost effectiveness. Now management, and its training, and its jargon is all the rage to bring in the millennium. Each one of these is, of course, important as a single factor in an amazing complex of competing factors, but any one taken in isolation and given overriding importance leads to gross distortion and inefficiency. There is I am told a current school of thought which advocates that management training grafted on to Staff and War courses is sufficient to prepare officers for the higher posts. This seems an extension of the old belief that a near miss first in Greats was the minimum, but sole, requirement for a man to be able to administrate or manage.

I accept entirely the undoubted value of Staff courses at all levels and the need for training in Management, but I believe most firmly that the fundamental requirement for the higher posts, is an officer's earlier professional competence and experience allied with an education which has taught him to think analytically and flexibly, and which was relevant to his profession.

ENGINEER OFFICERS' REUNION DINNER, 1970

The Royal Naval Engineer Officers' Reunion Dinner will be held in the Painted Hall, Royal Naval College, Greenwich, on Friday, 24th April, 1970, at 1915 for 1945.

Applications should be forwarded before 15th March to:

Commander J. A. Stephenson, Royal Navy,
Royal Naval College,
Greenwich,
London, S.E.10.

Limited accommodation can be provided.