

# THE YARROW-ADMIRALTY RESEARCH DEPARTMENT

BY

COMMANDER H. HOUNSELL, R.N., A.M.I.MECH.E., M.I.MAR.E.

When invited by the Editor to write another article for the *Journal of Naval Engineering*, I could think of no better subject than the Yarrow-Admiralty Research Department. This organization is visited almost daily by naval and civilian officers, V.I.P.s, students from training establishments and others and, as the resident engineer overseer attendant upon many of these visitors, I have long been conscious of the need for greater publicity about the work of the Yarrow-Admiralty Research Department. An informal article of this kind might therefore give the Fleet in general, and potential visitors in particular, some insight into the nature and function of Y-A.R.D.

## **Historical Note**

It is an unpalatable but indisputable fact that Britain lost her lead in naval engineering in the inter-war years—1933 being regarded by some as the turning

point. Probably the chief reason for this was the financial stringency imposed upon the Admiralty in those years. As a consequence little development and progress was made in naval engineering until H.M.S. *Acheron*, using 500 lb/sq in/750 degrees F. steam, was completed towards the end of 1931. Most unfortunately this venture proved ill-famed because the ship was brought into operational service before the teething troubles, inevitable in an advanced design, had been ironed out; thus, when war broke out in 1939 the machinery of the Fleet was of somewhat conservative design. By comparison, American naval machinery embodied such advanced features as controlled superheat, economizers, higher steam conditions, greater turbine efficiency at lower powers, double reduction gearing and good thermodynamic cycles. But in fairness to the pre-war generation, it should be remembered that in those days, when a navy was a good reflection of its parent nation, Britain was struggling to recover from a great war and the economic difficulties of the 1930s. Whatever the reasons, something had to be done about the Royal Navy's adverse position. In 1943, a committee was set up to investigate steam turbine machinery for H.M. ships; it included representatives from the Engineer-in-Chief's Department, the marine industry and certain 'land' firms manufacturing power plant. Arising from the deliberations of this committee, and being possessed of information generously offered by America, it was decided to break from the traditional Parsons's machinery and to install new designs in the *Daring* Class ships then projected; these included turbine designs by the English Electric Co., British Thomson Houston and Pametrada. This latter organization (Parsons Marine Engineering Turbine Research and Development Association) had been instituted about 1944, and is referred to later in this article.

In 1945, Messrs. Yarrow and Company agreed to install English Electric Company turbines in their two *Daring* ships (*Decoy* and *Diana*) and this contract brought the firm into close relationship with the English Electric Company. Furthermore, even before the war, Yarrow's had built foreign naval vessels using higher steam conditions than those obtaining in the Royal Navy. In these and other circumstances, it is not surprising that, in 1945, the Engineer-in-Chief should invite Yarrow's to undertake, in conjunction with the English Electric Company, an investigation into the future development of warship machinery. Yarrow's accepted the invitation and a development contract was placed in December, 1946. Upon receipt of this contract an investigating team was set up. Quite small, the team consisted of engineers drawn from the staffs of Messrs. Yarrow and Company and the English Electric Company, working in close collaboration with naval and civilian officers in the Engineer-in-Chief's Department. It originally worked under the general guidance of a Yarrow-E.E. Co.-Admiralty Committee under the chairmanship of the Assistant Engineer-in-Chief (Research and Development) and was accommodated in the Rugby locality for about a year before moving to its present accommodation in the works of Messrs. Yarrow and Company. This pioneer party of engineers, sometimes loosely referred to as the Y.E.47A Team, was the forerunner of the Y-A.R.D. as now constituted.

### **The Function and Character of Y-A.R.D.**

The Yarrow-Admiralty Research Department is a Ship Engineering Design Investigation organization. Originally conceived by the Admiralty, it is now an integral part of Messrs. Yarrow and Company, who are responsible for its work and the results achieved. It works in the closest collaboration with the Engineer-in-Chief's Department but there are, of course, no active service officers employed in the Y-A.R.D. team, and it is not in any sense an 'outport' section of the Engineer-in-Chief's Department.

The principal aspects of the work of Y-A.R.D. include :—

- (i) Advising on the best machinery concept and balanced layout for any given ship requirement.
- (ii) Advising on gaps in knowledge and the means of filling them.
- (iii) Advising on lines of future development.
- (iv) Preparation of detailed machinery specifications to meet Admiralty requirements.

The team, therefore, fulfills the role of consultants to the Engineer-in-Chief's Department, the fulfilment of which is dependent on the team's complete commercial integrity and detachment. Aiming to give the Fleet that which is best, it owes allegiance to no one firm or organization. This integrity of purpose is the very foundation upon which it pursues its activities ranging over the whole field of marine and allied engineering. Without such integrity, it could not possibly garner the fruits of national and international engineering enterprise.

In the early days the emphasis had been on steam turbine units but it soon became apparent that installations needed to be considered as a balanced whole ; thus boilers and associated auxiliary machinery came to be treated equally with main turbines. In 1950, the English Electric Company, having made its contribution to the Y.E.47A investigation, withdrew its loan staff from the team which then became an entirely Yarrow team. Early in 1952, the title Yarrow-Admiralty Research Department, was adopted.

### **The Staff**

In the past ten years the team has grown considerably and at the present time consists of about sixty design engineers supported by a clerical and secretarial staff. The team is under the general management of Messrs. Yarrow and Company, whose board includes a director for research and development, the day-to-day working being managed by a senior engineering executive.

The individual members bring to the team a fairly wide range of experience and talent and the general academic level is that of Degree and H.N.C. standard. About half the members additionally possess first class seagoing qualifications—so necessary to keep the theorist's dreams within the bounds of practicality and realism. The team membership also includes some naval experience, but this is primarily provided by officers serving at headquarters since there is full Y-A.R.D./Headquarters co-operation at all stages of research and development.

### **Y-A.R.D. and Pametrada**

The activities of Y-A.R.D. and Pametrada are sometimes confused. It should be made clear, therefore, that these organizations are quite separate entities. Pametrada, whilst supported in some measure by the Admiralty, is chiefly engaged in turbine research, development and design for mercantile marine interests ; its Research Station at Wallsend-on-Tyne caters for actual physical research, and for full scale shore testing of machinery up to 60,000 s.h.p. As an organization, it stands in the same relationship to Y-A.R.D. as do other turbine designers. In other words, Y-A.R.D. might, for example, invite Pametrada to submit turbine designs in the same way that it would invite designs from firms designing and manufacturing turbine machinery.

The Y-A.R.D. organization does not include any facilities for physical research and testing and none is carried out except for a limited amount of

trials investigation at sea. Y-A.R.D. does, however, avail itself of the Pametrada full-scale test facilities on behalf of the Admiralty and there is, in fact, a resident Admiralty Engineer Overseer at Pametrada whose chief interest lies in the trials and testing of machinery sponsored by Y-A.R.D.

### Early Work

The first contract placed with the research team involved a survey (symbol Y.E.47A) of existing practice in the naval and mercantile fleets of America, Britain and Germany, and in the power stations of those countries. The survey covered boilers, turbines, condensers, gearing and all related auxiliaries, and considered such aspects as design, efficiency, economy and endurance ; production, operation, maintenance and reliability ; and weight and space factors. It is not proposed to enlarge on the technical conclusions and recommendations arising from this fascinating survey, which took two years to complete, but a brief bibliography is appended for those particularly interested in the development of warship machinery.

One of the many interesting facts revealed in those early days was that the U.S. Navy was able to call upon the resources of the entire engineering industry since America has no predominantly marine industry as known in Britain. And further, because a number of American engineering organizations had British associates with whom information was exchanged, American ships frequently embodied features of British origin, which features were absent in H.M. ships because they were outside the field of the marine engineering industry.

The survey formed the technical starting point for subsequent research and development and, in 1949, contracts were placed for the design, manufacture and test of Y.100 prototype machinery for what are now known as the *Whitby* Class frigates. This machinery was of 30,000 s.h.p. on two shafts, steam conditions being 550 lb/sq in and 850 degrees F. and it incorporated details designed to give high efficiency at economical speeds. Guidance drawings and specifications were produced by Y-A.R.D. and the prototype machinery, manufactured by selected contractors, was tested at Pametrada in 1951-52. By comparison with the *Dido* Class machinery of similar shaft horse-power significant reductions—of the order of 20-25 per cent—in weight and space were achieved. Also arising from the survey and running concurrently with the Y.100 contract was a design investigation into another prototype installation known as Y.E.A.D.I. This machinery installation of 30,000 s.h.p. on a single shaft, was manufactured by selected contractors and shore trials have been proceeding at Pametrada for some time.

### Later Work

Following the development of the Y.100 machinery was the Y.101 installation of 15,000 s.h.p. for the *Blackwood* Class frigates. The main turbines were identical with the Y.100 turbines but there were obvious differences in layout and size of other units since *Blackwood* frigates are single screw ships. Ships of the *Whitby* and *Blackwood* Class have been in service for some time and have given a good account of themselves. Experience has provided a number of valuable lessons from which successive designs will benefit. Worthy of particular note is the Canadian frigate *St. Laurent*, built in Canada and engined by Y.100 machinery. She was the first of her kind successfully to complete sea trials.

Investigations are being made into the feasibility of various forms and combinations of propulsion machinery including the use of gas turbines in

combination with steam turbines. Other specialized studies include the problems of filtration and ballasting and the possible use of free-piston gas generators in H.M. ships ; in this connection it is of interest to note that the Admiralty experimented with machinery of this type during the inter-war years. Nuclear propulsion studies are forming an increasing part of the activities of Y-A.R.D. For security reasons it is not possible to mention all the interesting and varied work at present being undertaken by Y-A.R.D. but it can be said that those visitors who are permitted an insight into the work of the team are invariably impressed by the scope of the work and the enterprise and forethought displayed. Some of the work of the Y-A.R.D. team was described in more technical detail by Commander A. E. Hollamby in his article entitled ' Steam Installations ' (*Journal*, Vol. 7, No. 1).

It should be understood that the Y-A.R.D. team does not of itself undertake detailed machinery designs but it does make comparative studies of designs offered by specialist firms or other organizations. It selects those designs which best meet the overall requirements of, for example, a complete installation. Neither does the Y-A.R.D. team produce manufacturing and production drawings, since this work is more appropriate to the ' designer ' than to the ' research and developer '.

In all this work there is the closest co-operation with headquarters. Indeed, in the earlier days of Y-A.R.D. there was a ' dagger ' engineer officer resident in Yarrows for liaison duties but ultimately this post merged with that of the engineer overseer.

### **Personalities**

One normally refrains from referring to personalities in articles of this kind, but I feel there are some names which are so synonymous with the Yarrow-Admiralty Research Department that no account of its activities would be complete without mentioning them.

The very existence of Y-A.R.D. has been made possible by the wisdom and foresight of Sir Harold Yarrow and the late Mr. A. L. Mellor, Engineering Director, in their co-operation with the Engineer-in-Chief. Mr. E. Norton, the Director of research and development, has had, perhaps more than any other person, continuity of interest and influence in the conception and development of the team. Admiral (then Commander) I. G. Maclean and Captain (then Lieutenant-Commander) R. G. Raper also played important roles in the formative years, Captain Raper making valuable contributions to the World Survey Reports. And finally, the now established position of the team owes much to the work and leadership of the inexhaustible Lieutenant-Commander E. D. Hobson, the Manager of Y-A.R.D., who has devoted most of his life to serving the Fleet from early Osborne days to the present time. One could mention the names of several others, both naval and civilian, who have made important contributions, but I think those referred to have a special place in the history of the Y-A.R.D.

### **Acknowledgment**

I am grateful to Messrs. Yarrow and Company for the help given in preparing this article and for permission to submit it for publication in the *Journal*. The views expressed are, of course, entirely my own.

### **Bibliography**

The following brief bibliography lists, with one exception, some of the articles on machinery development which have appeared in the *Journal of*

*Naval Engineering*. There is a vast literature on this subject, but I have referred only to *Journal* articles since these are more readily available to readers in the Fleet.

- ‘ Main Machinery ’—Lt.-Cdr. R. G. Raper, R.N.  
(*Papers on Engineering Subjects*, No. 21, September, 1946).
  - ‘ Marine Engineering from the Naval Aspect ’—Engineer Vice-Admiral Sir John Kingcome.  
(*Papers on Engineering Subjects*, No. 22, December, 1946).
  - ‘ Naval Turbine Development ’—Cdr. H. A. K. Lay, R.N.  
(*Journal of Naval Engineering*, April, 1949).
  - ‘ Marine Engineering - Review of Progress ’—Engineer Vice-Admiral Sir John Kingcome.  
(*Journal of Naval Engineering*, July, 1949)
  - ‘ Daring Class Prototype Machinery Trials ’—Lt.-Cdr. E. H. W. Platt, R.N.  
(*Journal of Naval Engineering*, April, 1951).
  - ‘ Development and Maintenance of Post War Naval Machinery ’—Commander A. F. Smith, R.N.  
(*Journal of Naval Engineering*, July, 1953).
  - ‘ British Naval Gas Turbines ’—Cdr. F. A. Trewby, R.N.  
(*Journal of Naval Engineering*, April and July, 1954).
  - ‘ Choice of Steam Temperature for Small Ship Machinery ’—Commander J. H. Joughin, R.N.  
(*Journal of Naval Engineering*, July, 1954).
  - ‘ Y.100 ’—Commander R. G. Raper, R.N.  
(*Journal of Naval Engineering*, January, 1955).
  - ‘ Naval Engineering ’—Vice-Admiral Sir Frank Mason.  
(*Journal of Naval Engineering*, April, 1956).
  - ‘ Y.E.A.D.I. Prototype Trials ’—Lt.-Cdr. N. K. Bowers, R.N.  
(*Journal of Naval Engineering*, April, 1956).
  - ‘ Canadian Y.100 ’—Commander E. B. Good, R.N.  
(*Journal of Naval Engineering*, April, 1956).
  - ‘ Design of Machinery for a Frigate ’—Cdr. P. F. Hoddinott, R.N.  
(*Journal of Naval Engineering*, July, 1956).
  - ‘ Lecture on Development of Naval Machinery ’—Vice-Admiral The Hon. Sir Denis Maxwell.  
(E.-in-C./BWS/1 of September, 1953).
  - ‘ Naval Propulsion Engineering—A Review of Progress in the Last Ten Years ’—Vice-Admiral Sir Frank Mason.  
(*Journal of Naval Engineering*, April, 1957).
-