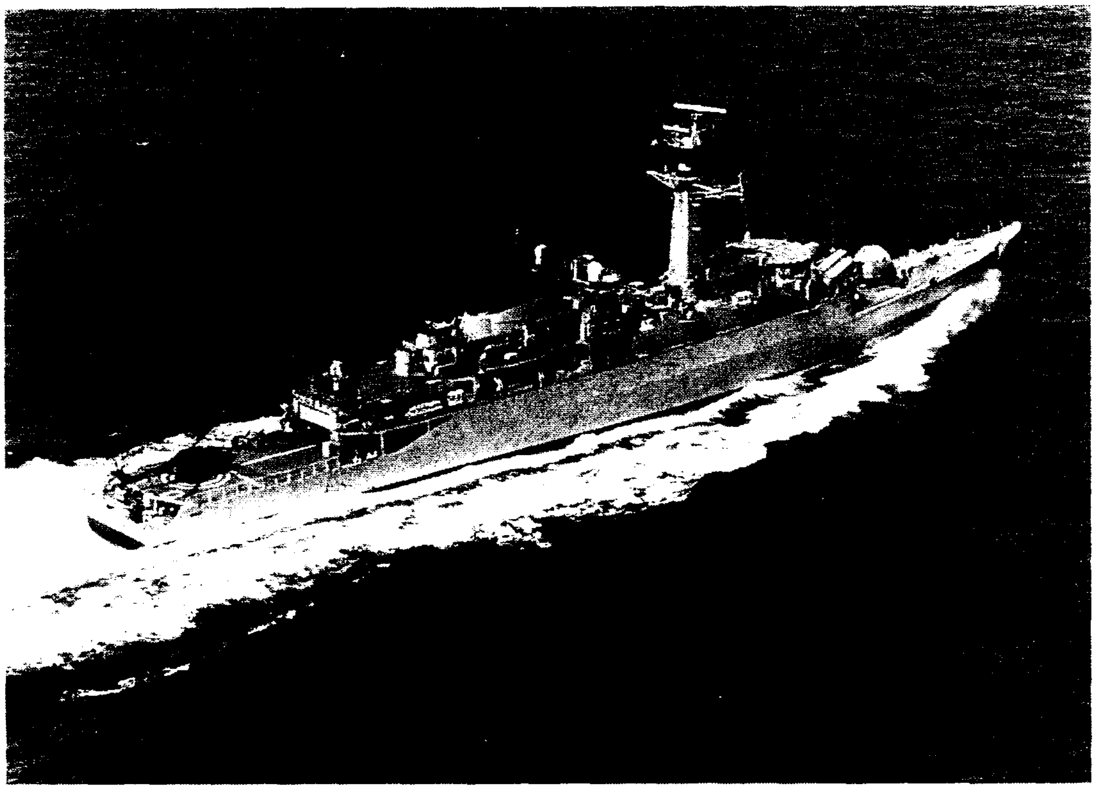

FIG. 1—H.M.S. 'ARDENT'

LIFE BENEATH THE MAST

BY

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An unexpected five months' deployment on Operation Armilla coinciding with an extended appointment to H.M.S. *Ardent* provided the author with an unusual opportunity for some measured reflection on the design and operation of the Type 21 frigate. With the ship on patrol in an agreeable corner of the world, and not subject to the frenzy of operation in and around the U.K.ports, the time seemed ripe for recording one or two impressions gained during two and a half years in the M.E.O's. chair and thus to provide a bit of feedback from sea.

This short collection of notes is not intended to be a comprehensive design appraisal and the author is well aware that certain aspects of the Type 21 design may be seen by some in a totally different light. What follows is simply offered as grist to the mill for whoever likes to read more about a class of ships which have a habit of arousing strong loyalties amongst those who serve in them.

Gas or Gas

Without doubt, the flexibility of *Ardent's* COGOG plant has more than proved its worth during a lot of varied service in the first four and a half years since commissioning. The following aspects come to mind:

—although there have been a number of engine component or gas turbine change unit failures at sea, maximum authorized power has been available for over 98 per cent. of the ship's operational time. Furthermore, such failures have yet to prevent the ship from carrying out her assigned tasks.

—throughout the long periods underway on Armilla patrol, the ship has been fully able to carry out her commitments without interruption, despite the need to carry out regular planned maintenance on the gas turbines and associated propulsion systems.

—the unserviceability of *Ardent's* port Tyne engine for the whole of January 1981 whilst on patrol proved an engineering inconvenience but it was not operationally embarrassing. The only significant effects were an estimated 10 per cent. increase in overall fuel consumption for the period and an overheated MEA(M)1 who spent a lot of time coping with a series of minor defects on the one serviceable Tyne.

—even with this engine out of action, the ship's fuel consumption on patrol was over 35 per cent. lower than for a LEANDER carrying out the same task. Much of the credit for this goes to the ease with which the shafts can be trailed and the propulsion system can be started and stopped at will.

Areas that have not shown up so well include the awkward step change from excellent to very average fuel consumption once an Olympus is needed for going faster than about eighteen knots (this occurs quite often on higher speed passages), the fairly frequent failure of the Tyne fuel control and engine surveillance system components (encouraged, no doubt, by the harsh vibration characteristics of some later Tyne RM1As), and the relative unreliability of the Tyne itself. This last item may well result partly from the understandable practice of driving one or both Tynes at lever 56 for long periods.

Nevertheless, when seen against the operational advantages above, these drawbacks are secondary, and do little to detract from the fine engineering achievement of getting aero-derived gas turbines effectively to sea in increasing numbers of operational ships.

The CPP System

In *Ardent's* first four years in commission, the CPP system has given accurate ahead and astern propulsion without any excessive demands on ship's staff maintenance effort. Close attention to OM33 hygiene, care for the actuator mechanisms, and a constant check on the setting up of the gear- and motor-driven CPP pump control loops appear to have been the main ingredients of success.

Unfortunately, the ship has suffered two emergency dockings in the past two and a half years, both for propeller faults. In the first of these, rapid corrosion of the blade bolts had started after the failure of the blade capscrews, whilst the second docking was brought about by a defective blade seal. So far, the ship has not been troubled by slackness in the propeller shaft screwed couplings, nor has slackness through wear in the pitch setting and feedback mechanisms led to control difficulties. But the possibilities are there.

From the operational angle, the system is seen to have the following disadvantages:

(*a*) The propeller is, by comparison with its fixed-pitch counterpart, relatively noisy, less efficient, and prone to higher cavitation at the blade roots.

(*b*) Blade seal leakage is an increasingly important environmental concern.

(*c*) Propeller defects can only be rectified by docking the ship. Emergency dockings cause upheaval for the ship, the dockyard, and, possibly, the Fleet programme.

Should the whole question of how to produce astern power in the future be under review once more, it seems that full weight needs to be given to the fundamental principles of keeping the ship's underwater engineering as simple as possible, of keeping oil well inside the ship, and of arranging important machinery so that it can be examined when it goes wrong without having to stop the ship any more than is absolutely necessary. One answer may lie in the route already taken for *Invincible* and now under consideration for *Taranaki* [1]; superconducting electric drive offers another.

Diesel Electric Generation

Probably, as in many other ships, diesel generators have produced their own learning curve in *Ardent*. Not surprisingly, and even with the benefit of previous diesel experience, it has taken ship's staff some time to learn the true idiosyncracies of the Ventura engine—that is the twelve-cylinder version. Also, there have been component failures, including three near seizures of pistons caused possibly by manufacturing errors, possibly by environmental factors, or perhaps a combination of both.

Nevertheless the engines have generally been very reliable. Mean time between operationally significant failures (i.e. OPDEFs) in the past two and a half years has been 1363 hours per engine, and this includes stoppages for thermocouple or Teddington panel module failures. The ship has never been embarrassed operationally through diesel generator failure and there is adequate flexibility in the system to allow normal ship's staff maintenance under the right circumstances at sea without any operational effect on other departments.

Apart from the normal requirement for good fuel, lubricating oil, and air hygiene, the following have been found of importance in achieving good engine reliability:

(*a*) Continuity of skilled maintenance effort. Experience with the Ventura is just as important as with, say, the Olympus.

(*b*) Close control by ship's staff of injector quality. The hartridge 720 Testmaster now held onboard enables the right standards to be set.

(*c*) Continuous attention to the balancing of the cylinder banks. Tuning of the fuel racks to achieve even temperatures between cylinder groups fed by individual pumps allows smooth running over a long period. A maximum exhaust temperature scatter of 35°C is entirely possible.

One other factor worth mentioning is the periodicity of the major overhaul. Whilst *Ardent* has yet to experience one, it is undoubtedly—even with the inbuilt removal routes—a disruptive process. It is clearly worth investigating any procedure which could lead to increased intervals between major overhauls, and a selective examination and gauging at the 6000-hour top overhaul is suggested as a worthwhile starting point.

Ventilation Systems

Operation of *Ardent*, even under prolonged closed-down conditions, has remained very satisfactory and there have been few defects of note in the air-conditioning and machinery-space ventilation systems. There are, however, some oddities in the layout of individual systems from which lessons could perhaps be learnt. Particular items which spring to mind are:

(*a*) The grouping and positioning of machinery-space ventilation terminals. Closing down machinery-space terminals in emergency can be time consuming, and almost every inlet takes in a lot of salt spray in rough weather. Pairs of supply and exhaust fan trunks for each machinery space could be combined into well-shielded single terminals high up amidships.

(*b*) The incompleteness of the air-conditioning system. In the after end of the ship particularly, there are many compartments which could be fed with conditioned air whilst also acting as the foul air exhaust routes. Some compartments, for safety or hygiene reasons, do need exhaust fans, but only the machinery spaces and the hangar actually require unconditioned air.

(*c*) The centralization and complexity of the air-conditioning system. Damage control considerations point to the need for decentralization of the important organs of the system, such as the air-conditioning plants and the fresh air make-up. Two air-filtration/make-up/conditioning plant/treatment complexes are needed, one forward of the machinery box and one aft of it.

Gas Turbine Changes

Ardent has had three Olympus and six Tyne changes since commissioning. Those known to the author have been completed quickly and most professionally by the specialist change teams and, apart from the extraordinary shortage of Tyne torque-tube coupling bolts, few significant problems have occurred. It seems that the support 'package' is excellent in helping newcomers to the gas-turbine change scene to acclimatize quickly to the disciplines involved.

With the exception of one Olympus change occurring at the end of the 1979 DED, all planned and unplanned changes have been deferred until programmed harbour time. This again highlights the first-class operational flexibility of the COGOG plant.

The one peculiarity is the need to dismantle a large proportion of the intake system (and the engine room in the case of the Tyne) to change a gas turbine, and the subsequent game known commonly as 'Meccano'. Naturally where structural integrity is important there can be no easy alternatives, but there must be simpler ways of doing the job. Is it not possible to have one central removal route for each gas turbine room—one that is not used for any other purpose?

The Human Factor

The Type 21s have some frustrating design features. Cluttered upper-deck areas and that extraordinary part of the after engine room happily called the 'snake pit', for instance, make the upkeep task much more of a problem than first imagined. But despite the drawbacks, the ships seem to remain very popular with the majority of those who serve in them and, as many will appreciate, the enthusiastic sailor has a habit of getting the best out of his ship.

The following is not intended as a definitive list of the design's good points nor are they in any order of priority, but they are amongst those frequently quoted by the devotees of the Type 21:

(*a*) The ship looks the part. Good-looking ships do not necessarily win wars, but the world would be a dull place without them.

(*b*) The later ships with their full weapon fit are understood to be well armed for their size by contemporary R.N. standards.

(*c*) They are versatile. Consequently they are available for deployment to many different theatres of operation and seem well suited to 'peace-keeping' duties.

(*d*) The size of the ship's company is limited to that necessary to fight the ship. This may make for stretch when it comes to upkeep but virtually everyone knows that his efforts are appreciated.

(*e*) They are agreeable to fight, to work, and to live in. No one has to negotiate an obstacle course to get to his place of work; most machinery is accessible; living accommodation is thoughtfully laid out and relatively spacious; heads, bathrooms, and messes are close together; the store-room/galley/dining-hall complex is excellently laid out; the main communication passages are continuous on three decks; and spaces such as the ship control centre are purpose-built and do not double as cross passages.

In short, the Type 21s are purposeful and they were designed with human beings very much in mind.

The Next Generation

The Royal Navy has a long and successful history of well-balanced and versatile ships that are capable of commanding much respect on the oceans of the world at moderate cost. With their effective offensive armament, their versatility, their elegance, their good cruising economy, and a respectable turn of speed, the fully-equipped Type 21s are of this line.

Sooner or later, a successor to the Type 21 general-purpose frigate will be required. If the design is as well balanced and technically challenging, the marine engineering personnel of tomorrow should derive much satisfaction from taking the ships to sea.

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