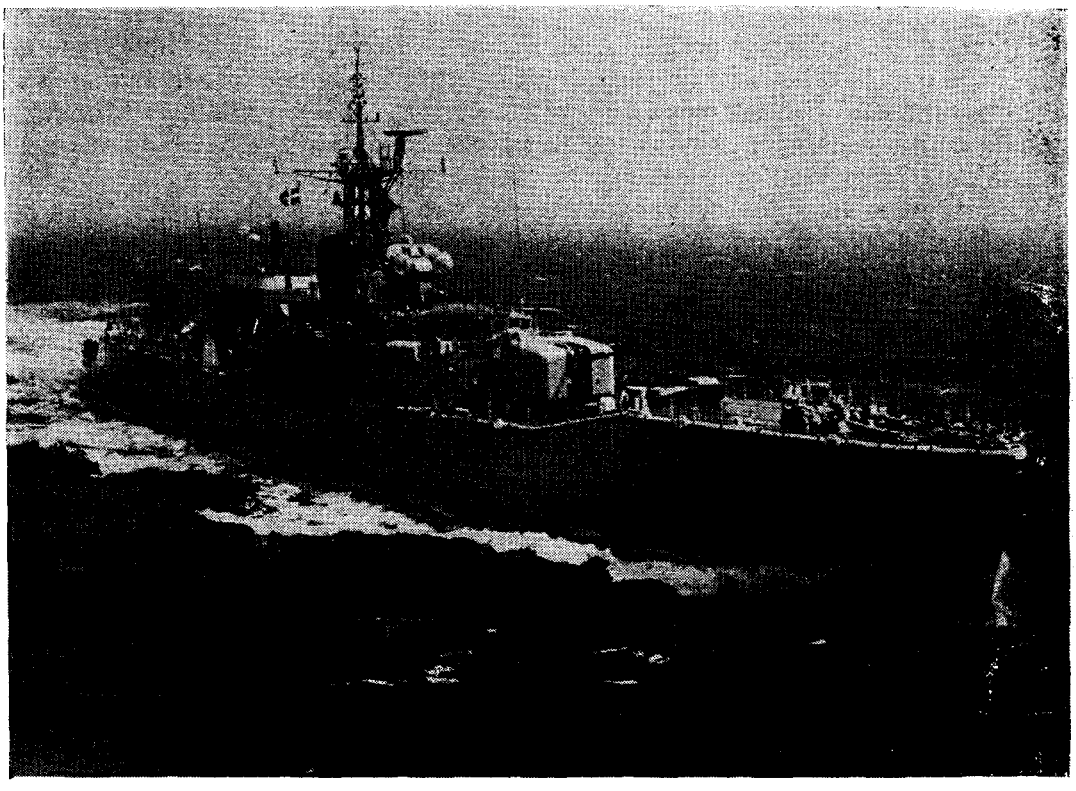

FIG. 1—H.M.S. 'RHYL'

TEN YEARS OF BUILDING FRIGATES IN PORTSMOUTH DOCKYARD

BY

G. E. BESANT

(Chief Draughtsman, H.M. Dockyard, Devonport)

The summit of dockyard aspirations at present should not be to close down on building of new ships but rather to aim for the star of being Lead Yard for a new class of ship.

The following are extracts from a book on Dockyard shipbuilding in the seventeenth Century.

'The building of a warship of the Third-Rate and upwards, whether in one of the royal yards or by contract, was a major industrial and financial undertaking. The Thirty Ships building programme of 1677 highlights all the contract problems with which the Navy Board had to deal. For the ships to be laid down in the dockyards the Board would have to purchase and provide all the timber, plank and other materials. They would also have to obtain the masts, rigging, equipment and stores for the whole programme, these items being supplied as a 'free issue' to the contract shipbuilders. This was a formidable assignment. Only exceptionally were warships built by contract. The view was strongly held that the King's ships should always be built in the King's yards, and that only in wartime or in some emergency, when the dockyards could not handle the full programme of building and refits, should

the resources of the private shipyards be utilized. As Sir William Penn put it in his *Discource of the Navy of England*, "all men know that works done by contract cannot be, nor never were, so punctually performed, as the like works done by day wages, because the contractor will be sure to be a gainer by the bargain . . . His private respect to his profit will not only tempt him to neglect what he covenants to perform, but also (at best) to do it in that manner that profit should redound to his purse thereby". It appears from the context that Penn was referring to the respective merits of time work and job contract work in the dockyards, but his sentiments exactly express the opinions held at the time about placing shipbuilding out to contract.

'The ultimate test to be applied to the organization responsible for building the Navy's ships and for supplying their equipment and stores is whether it met these requirements in good time and on as favourable terms as were possible in all the circumstances. Judged by this standard, The Navy Board served the country well'.

The pattern of shipbuilding in dockyards has changed only in detail and the following article is largely an expression of the author's opinions with an engineering drawing office background.

H.M.S. *Leopard* was building at the beginning of the ten years under discussion and for a number of reasons the ship took 6–7 years to complete. Procurement of material and equipment for the dockyard-built *Leopard* Class ships was in the main by Admiralty Supply Items. The next two ships to be built at Portsmouth were H.M.S. *Rhyl* and *Nubian* and at Devonport *Plymouth* and *Tartar*. For the building of these four ships and future dockyard new construction, the Admiralty introduced new procedures for procurement, drawing supply, contractural work, etc. The salient points of these new procedures were as follows:

(*a*) Portsmouth to act as Lead Yard for the *Rothesay* and *Ashanti* Class frigates building at Portsmouth and Devonport.

(*b*) A special procedure was introduced for all dockyard initiated orders to be passed through a named contact in Director of Contracts, Admiralty, thus dispensing with the need to circulate them through the Technical Department for approval. This reduced the time required to place contracts from 2–3 months to 7–10 days.

(*c*) A special ordering system was devised in conjunction with the Lead Shipbuilder so that ancillary manufacturers were informed in advance of dockyard requirements.

(*d*) A separate contract was placed with the Lead Shipbuilder to supply the working drawings (pipe sheets, cock sheets, etc.) in addition to the normal approved arrangement drawings supplied to other shipbuilders of the Class.

Regarding (*a*) the Lead Yard arrangements worked extremely well between the Engineering Departments of Portsmouth and Devonport. Due to confusion over the initial instructions the Constructive and Electrical Departments opted out of these arrangements, but this did not affect any major issues as the greater proportion of equipments for these departments were Admiralty Supply Items. The Lead Yard procedure meant that all procurement for engineering materials and equipment for the two *Rothesay* and two *Ashanti* Class frigates was initiated at Portsmouth. In addition to this the drawings for the Devonport ships were annotated at Portsmouth.

With regard to (*b*), the named contact scheme worked very well, the average time for placing contracts up to commencement of H.M.S. *Sirius* was 10–14 days. Unfortunately this period coincided with a very marked falling off of

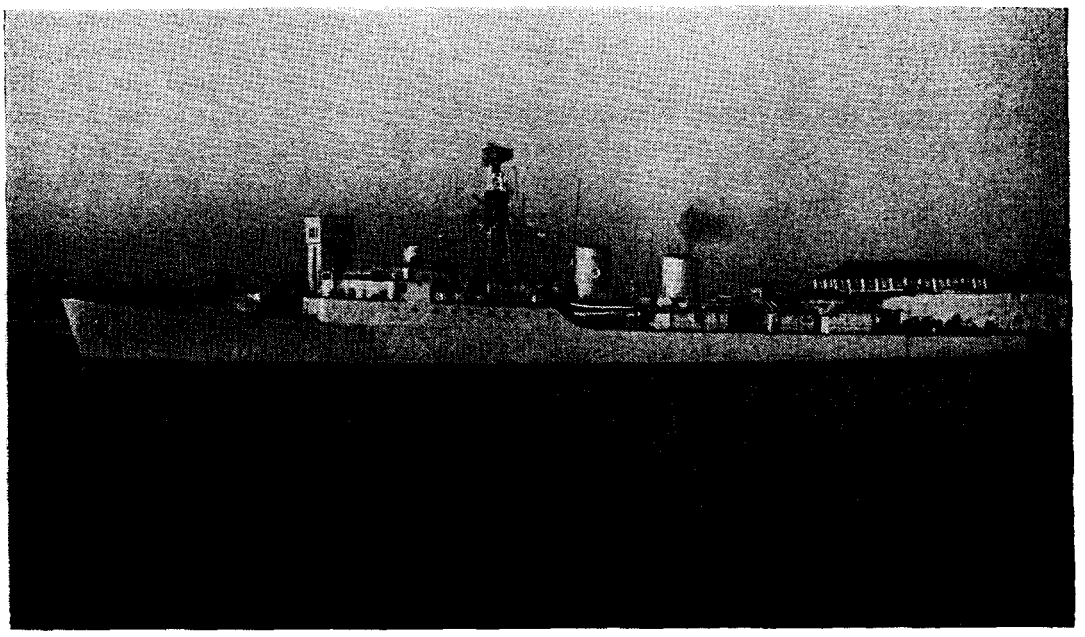

FIG. 2—H.M.S. 'NUBIAN'

delivery prospects for dockyard initiated orders. Indeed at this time most of the ancillary manufacturers would agree that delivery dates could be met up to the time for supplying despatch instructions, when deliveries would be delayed by considerable amounts. With the introduction of fixed price requirements the time required for placing orders for F.S.A. 33 is now four months, but this delay has been offset by a marked improvement in delivery prospects plus very invigorated progress chasing by dockyard officers. The Lead and other shipbuilders are able to place their orders with the minimum of delay as soon as information is received, and are thus enabled to take advantage of bulk manufacture with the resulting improvements in delivery and price. The enforced delays of the Admiralty contract procedure places the dockyards at a disadvantage in that contracts are frequently forced into the 'one off' category with resulting delivery delays and increase in price. All the so-called major items for F.S.A. 33 have now been received and it will be interesting to see what improvements are achieved in the delivery of the numerous valves and fittings which often prove greater delaying factors than the major items.

Programming

Portsmouth Dockyard achieved the distinction of completing H.M.S. *Rhyl* in 39 months, and followed this up by completing H.M.S. *Nubian* fourth in the class after starting as sixth. H.M.S. *Rhyl* was completed in the shortest time taken to build a *Whitby*, *Rothesay* or *Leander* Class frigate. This short programme for H.M.S. *Rhyl* was maintained by a rigid insistence on equal parity with the other top priority jobs in the Yard during the building period. H.M.S. *Nubian* almost received equal treatment but lost out when equal priorities were not maintained.

The basic building programme for frigates is as follows:

Order	*Lay Down*	*Launch*	*C.S.T.*	*Completion D.448*
6	12	15	6	

Months

Dockyards have been accused of giving false delivery requirements but it is necessary to meet the following basic deliveries in order that the ship will complete in the time allowed.

(*a*) Launch minus four months for all machinery which can be installed before launch.

(*b*) Launch plus one month for installation of main engines and boilers for which at Portsmouth docks have to be re-opened under the 240 ton crane, slip cranage not being suitable for installation of boilers.

Installation of all machinery items while the ship is on the slip has always been a pipe dream at Portsmouth and was impossible until the building of F.S.A. 33 for want of a suitable crane. The discovery of a 105-ton mobile crane recently imported into the United Kingdom, capable of lifting both boilers at the slip has opened up new programme possibilities. The gains resulting from the late discovery of these possibilities for F.S.A. 33 have not yet been fully explored, but at the time of writing have appeared briefly to be as follows:

(*i*) A minimum gain in the overall programme of 3–4 months. (It has already been proposed to advance the date of C.S.T.s from that planned).

(*ii*) Machinery compartment decks have been finally closed before launch.

(*iii*) Reeving of main run electrical cables was started prior to launch.

(*iv*) Final preparation of seats for all machinery items was commenced immediately on closing decks at the slip.

Engineering Experience

To commence with drawings, there have been many rather irrational statements on the merits or demerits of the various shipbuilders as Lead Shipbuilder. Experience in dealing with four firms as Lead over a period of eight years has shown that in the engineering field there is little to choose between them.

The lead for the *Ashanti* Class was the best possible, but it must be remembered that this was aided immeasurably by the production of $\frac{1}{12}$th-scale and full-scale models of the machinery spaces. For the *Ashanti* Class the Lead firm built the full-scale mock-up from the working drawings after correction by the smaller model, and then subjected each system in the mock-up to a weekly investigation into possible improvements and modifications. This went on until Admiralty and the Firm became heartily sick of the exercise, and to put an end to the frustration this was causing, all other shipbuilders and sub-contractors were invited to inspect the mock-up and recommend final improvements and modifications. Literally hundreds of suggestions were made and large numbers embodied. Portsmouth and Devonport Dockyards went as the final visitors on the end of this queue and joined up as one team. This team suggested upwards of 50 modifications of which 18 were implemented as essential and a similar percentage had applied for all the visitors. The moral of this appears to be that it does not matter how good the firm was, someone could always come along and recommend an improvement, and to meet programme dates moratoriums have to be declared on models as well as the actual ship. This exercise suggested that, subject to the use of model aids, one firm is no better than the others as Lead and on this basis it would be quite safe to consider giving a dockyard the lead job for a class of ship.

For the Y.136 frigates port and starboard $\frac{1}{12}$th-scale models were made of the complete machinery spaces and the machinery space bilges. Unfortunately, all those models were sited in Scottish shipyards and distance precluded any real use for dockyards. However, for the Y.160 frigates the Y.136 models have been modified within the Portsmouth Engineering Drawing Office to suit the Y.160

FIG. 3—SCALE MODEL OF PORT SIDE OF Y.160 MACHINERY COMPARTMENTS

specification. This has proved a most illuminating task and during modification very active discussion on controversial installation points has taken place between the Dockyard and Headquarters. The models have also been used prior to the launch of F.S.A. 33 to clear up a number of questions, and now they will be sited adjacent to F.S.A. 33 for on-the-spot use.

Work on these models has demonstrated the lack of appreciation of the difficulties of working to different departmental tolerances, and unfortunately this was only demonstrated to those working on the models. The author has often used soap box tactics to broadcast these difficulties but constructive comment is invariably misconstrued as an attack on other departments, when all that is required is a recognition of the difficulties involved. Failure to recognize these difficulties often leads to neglecting to feed back information. Invariably 'tight' spots are got over *in situ* without ever ascertaining the true cause, and the necessity to feed back the information is apparently lost. There are many instances which could be quoted but a classic example occurred during building of H.M.S. *Rhyl*. A fortnight before the boilers were due to be installed the boilermakers pointed out that the clearance between the boiler casing and the ship frame was quoted as $\frac{7}{8}$ in. whereas the ship was in fact $2\frac{1}{2}$ in. narrow from centre line to hull. At first sight this would involve a large amount of nugatory work to put right and affect completion programmes but a consultation offered the solution of angling the side casings to give the necessary clearance, this was done and the boilers were installed satisfactorily. Shortly after this installation, five new *Whitby* frigates appeared at Portsmouth and opportunity was taken to examine this situation and without exception all the casings were angled, but nobody had bothered to tell Bath or the other shipbuilders.

This question of tolerances is worth remarking on again. Engineers refer in jest that fitters work to thousandths, electricians to the nearest fuse box and shipwrights to the nearest ship. All joking apart, however, it must be realized that it is not possible to build ships to engineering tolerances; bulkheads, hull, and seatings buckle when welded but techniques are improving and tolerances are reducing. There is no evidence of specified figures but during building of H.M.S. *Sirius* verbal figures were given of 7 inches in 150 ft (a possible error of $3\frac{1}{2}$ inches at each bulkhead). Check dimensioning of F.S.A. 33 has shown that the maximum error in the vicinity of the machinery spaces is 1 inch but this barely acceptable for the known frigate hard spots, e.g., in way of E.R. turbo generator seats, and even in the 33rd frigate building there is still a slight foul between the back boiler casing and a foot supporting web. (This has been reported to the Lead Yard and M.O.D.(N.)).

The method of accepting seatings during building is a controversial subject. For H.M.S. *Rhyl* there was absolute insistence on each seat being checked and accepted just prior to installing the machinery item. No other heavy weights were installed and water tests of tanks involving filling the tank was stopped between acceptance of seating and installation of its associated equipment. This system appeared to give better results than that followed in H.M.S. *Sirius* where a number of seats were accepted and the machinery installed rather haphazardly on delivery. There was a lot of nugatory work in H.M.S. *Sirius* due to seats having to be realigned to remove distortions caused as each major item was installed. There is another contributing difficulty that of temperature effect. It was found that on the slip and in dock during building the stem of H.M.S. *Nubian* lifted nearly 2 inches between 0800 and noon on a reasonable summer's day.

Fitting of propeller shafts raised some problems. The method of lining out shafts came under intensive discussion during building of the *Ashanti* Class and the Lead Firm was directed to investigate. A beautifully abstruse calculation involving hogs and sags was the result but there is no evidence of any shipbuilder or dockyard departing from the standard 'line of sight' method. Fitting of

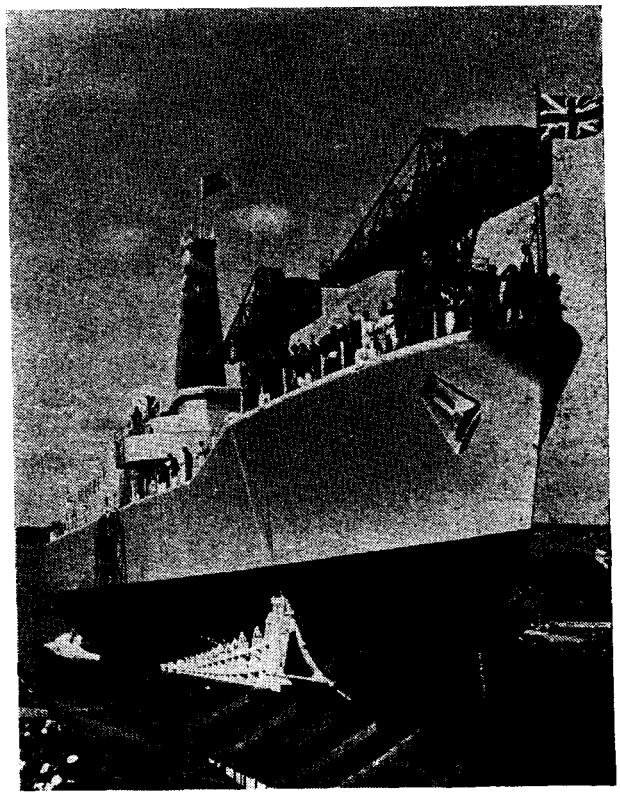

FIG. 4—H.M.S. 'SIRIUS'

agouti tubes for H.M.S. *Sirius* shafts proved difficult, involving substantial delays but the techniques have now been mastered and the same delays were not experienced with shafts for F.S.A. 33.

Building of the boilers to Messrs. Babcock and Wilcox drawings under licences, has proved a most interesting job for the last four dockyard-built frigates. The importance of air casing tests has been learnt by the hard way of experience. Air casing tests were performed correctly for the first time at Portsmouth during the building of H.M.S. *Rhyl*. In order to appreciate the requirements for this ship the tests were simulated in a tank of approximately equivalent capacity to the boiler casings. The hole for leakage was covered by a sliding door and it was found that at the lowest pressure test the size of the hole for the allowable leakage was 3 ft + 2 ft. Subsequently it has been found essential to obtain the best possible figures for the low pressure shop tests (an improvement of at least 50 per cent over the specified figures is recommended) otherwise the specified on board figures become almost impossible to obtain. This has been borne out by the recent tests carried out in H.M.S. *Devonshire*, following extensive repair of casings.

One of the biggest frustrations in dockyard shipbuilding is the lack of appreciation that non-delivery of so-called minor items of machinery can cause near major programme delays. For instance, for H.M.S. *Sirius* an important feed pump discharge valve was not delivered until well after the signing of the D.448, a delivery delay of $1\frac{1}{2}$–2 years after the firm had given a promise of two months. Again due to long-term delivery of feed heaters for F.S.A. 33 substitute spare Class heaters were released from SPDC. It was only discovered by accident that the Class spares were not modified to the standard required for F.S.A. 33. Sub-contractors for minor items such as valves, etc., will invariably quote that they can meet the required delivery right up to the request for dispatch instructions when they calmly state there is a delay of ten months.

Conclusions

The foregoing contains only a very broad look at the engineering aspects of dockyard shipbuilding but building of new ships is a very interesting job. There is, however, a school of thought which questions whether dockyards should be in this field despite the fact that dockyards have built new ships ever since the first Yard was started. The primary function of dockyards is to repair naval ships and the know-how acquired in building new ships is invaluable in assisting this function. To go back to the first paragraph of this article, this know-how could be enormously increased by using the Dockyards as lead shipbuilders in the full meaning of the term.