SOME MAINTENANCE ASPECTS OF THE WESTERN APPROACHES COMMAND IN THE SECOND WORLD WAR

by

ENGINEER REAR-ADMIRAL SIR H. W. WILDISH, K.B.E., C.B.

Decision to form Western Approaches Command

September, 1939, saw the orthodox opening of the U-boat campaign. Taking advantage of the inevitable delay in establishing the convoy system, U-boats sank 35 vessels totalling 160,000 tons in the first month of the war in the Atlantic. The intensity of the attack was steadily reduced owing to shortage of U-boats until in March, 1940, all U-boats were withdrawn for operation in Norway.

The results of the U-boat campaign for the first six months were painted extremely rosily in the House of Commons and the Press so that not only the nation but the Navy as well were lulled into a sense of false security for which we were to pay dearly later. This, with the resulting apathy, continued until July, 1940, when France fell and her Channel ports became bases for enemy U-boats.

On 1st September, 1940, a homeward bound convoy lost 11 ships in the night and on the 18th and 19th October 31 ships were lost from two homeward bound convoys. All this damage was caused by probably less than eight U-boats. If eight could cause such damage, what were the prospects when 100 were at sea?

This sudden flare-up of activity caused the Admiralty to review the conduct of the campaign and it was decided to move Western Approaches as a separate Command from Plymouth to Liverpool. The Commander-in-Chief, Plymouth, had been widely separated from his escort vessels which were operating from the Clyde and Mersey. Derby House, Liverpool, was to be fitted out as Area Combined Headquarters for the Navy and Royal Air Force and Admiral Sir Percy Noble was to take over command in February, 1941, when it was expected the headquarters would be ready.

Personally I was informed by the Engineer-in-Chief that I was to be sent to the Western Approaches in November, 1940.

Visit to Bases—December, 1940

I met Admiral Sir Percy Noble* soon after his arrival home from China and it was arranged that I should be relieved at once at Chatham so that I could visit the main bases of the future Command as early as possible.

I visited the three main bases from which escort vessels were to operate—Londonderry, Greenock and Liverpool. Looking back over the years, I shall always attribute to this tour a large amount of the success from an engineering point of view that was achieved later.

The idea was prevalent that maintenance bases were not of much importance so long as refitting facilities at private shipbuilding firms were available—this argument being used by one quite senior officer.

Londonderry was to be our principal base as it was obviously impossible to base too many ships on commercial ports such as Liverpool or the Clyde. When I arrived there, there was not much sign of a base. The Naval Officer-in-Charge, with his engineering staff, had offices in two small houses in a side street. Repair facilities did not exist. There was one very small engineering firm which carried out minor repairs to trawlers and coasting vessels. A few modern machines were being installed in a small shed on the waterfront and a new workshop was in the first stage of erection. A fierce argument was going on when I arrived as to whether the work on this shed was to be stopped, as an Admiralty delegation, which had been inspecting the shed, said it would cost £10,000 too much. (Needless to say it was not stopped.) The wharfage was quite inadequate for a large number of ships and the small river anything but ideal for mooring vessels. There was a small dry dock which had not been used for years and was in the last state of decay. Although disheartening, there was one bright spot in that the officer in command, Captain P. Rucke-Keene, was a very able, enthusiastic and energetic officer who was striving against great odds to get something done.

At Greenock, the facilities were again almost negligible. In fine weather vessels could berth alongside the tourist piers, otherwise they had to lie in the stream. On paper, there was said to be a workshop in the town for our use, but I remember when, with Admiral Noble, I inspected it, there were no machines and no roof. Such work as was being done was carried out by small local firms ; beyond their capacity ships had to be sent to Glasgow.

At Liverpool was perhaps the only sign of any base organization due to the energy of the Engineer Officer-in-Charge, Engineer Commander Belfield, who was playing a lone hand as most of the engineering talent in the port seemed to be concentrating on the trawler base at Birkenhead.

The base was in the vicinity of Gladstone Dock and had fair facilities for berthing (say) 50 ships based on the port.

The maintenance work, which was carried out by several small repair firms, was satisfactory. Much expansion was necessary but there was a nucleus on which to build.

Though depressed by my visit, I knew what I wanted—

(i) Utmost priority for the necessary work.

(ii) Sufficient wharfage to be built to berth alongside a quarter of the ships attached to each base. This is essential for small ships after a long period at sea.

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(iii) Base workshops and machine tools to enable maintenance staffs to undertake all but major repairs ; until these could be obtained a repair ship to be attached to each port. The repair ships were to be regarded as a makeshift as they can never replace shore workshops, particularly if they cannot be berthed alongside.

(iv) Distilled water, electric lighting and power available for ships alongside.

(v) Ample facilities for stowage of stores and spare gear.

(vi) Base organizations, so that crews of escort vessels returning from the Atlantic could have rest and leave while the base staffs could take over the ships for repair and, by routine examinations, anticipate defects so as to keep ships running to a definite schedule. The base staffs to include a percentage of Naval ratings so that last minute defects occurring out of working hours can be dealt with and not prevent ships from sailing.

(vii) And last, but perhaps most important of all, competent Engineer Officers at the bases, who can be relied upon to have the experience, training, example, sympathy and foresight necessary for efficiency.

On my return, Admiral Noble, who had himself been touring his new Command, called for a meeting at the Admiralty which was attended by all the Heads of Departments and most of the Chiefs of Admiralty Staff. At this meeting my requirements, strongly supported by Admiral Noble, were approved and given priority. So, six months after the fall of France, the technical preparation for the Battle of the Atlantic was begun. Had it been delayed much longer, I am of the opinion that we could have lost the war against the U-boats through technical inefficiency.

Setting up Western Approaches Command

February, 1941, saw the opening of the Western Approaches Command, extending from Loch Ewe on the north-west coast of Scotland to the Bristol Channel and including Northern Ireland.

In this article I am proposing to deal only with the main escort bases at Londonderry, Liverpool, Greenock and Belfast, and the ships, destroyers, corvettes and frigates which operated from these bases to form the Atlantic Escort Force. There were many other bases in the Command—Milford Haven, Swansea, Cardiff, Holyhead, Barrow, Glasgow, Tobermory, Oban, Kyles of Loch Alsh, Loch Ewe, Larne, etc.

The Command started with 53 ships at Liverpool, 42 at Londonderry and 51 at Greenock, 146 ships in all, though for many weeks the effective force was reduced to less than 80 as about 50% were out of action from one cause or another.

Our ships were composed of H, W, and V Class destroyers, the V and W classes being 23 years old, and the American destroyers given us in 1940, which were even older and had been laid up for 20 years, and also new corvettes. The V and W Class destroyers, when they had been repaired, gave wonderful service for three years. The American destroyers were supposed to have been thoroughly refitted on arrival from America, but somehow some mistake seems to have occurred as most of them were merely put into a state of running repair. They appear to have been built, like Ford cars, for a life of a year or two only, and suffered from two major defects : (1) chronic condenseritis for which there was no cure as the tube plates were weak and not being parallel, impossible to stay, and (2) bearing troubles due to disintegration of the cast iron housings of the bearings through old age and waterlogging when in reserve. Contamination of the oil by iron rust caused continuous wear of the bearings.

ADMIRAL SIR PERCY NOBLE WITH SENIOR STAFF OF WESTERN APPROACHES COMMAND

The first type of corvette received in the Command was thoroughly unsatisfactory as the hulls were not designed for Atlantic work and the forecastles had to be lengthened and the weak hulls strengthened. The machinery of most of them was badly installed so that a maintenance refit of 4-6 weeks had to be given before these ships could be put into service. This usually entailed lifting the crankshaft and re-aligning the whole engine. Such was the fleet we started with—140 ships with an average of 80 effective. It was intended that each escort group should consist of six ships but the condition of the ships often reduced this to three.

By the end of June 1941, the number of ships had increased to 180 and the percentage out of action reduced to 35%.

Operations and Maintenance Organization

As had been expected, it was slow work getting our bases ready.

Officers were being appointed for the base organizations. An Engineer Rear-Admiral was appointed as my assistant so as to give me freedom of movement in the Command, and Engineer Rear-Admirals had joined the staff at Londonderry and Greenock. The Liverpool staff had been increased by one Commander (E) and one Lieutenant (E), both active service.

Each escort group normally consisted of six ships and spent about six weeks at sea. On return from sea, the maintenance work was taken in hand by the base repair staff, who soon learned the peculiarities of each ship. During this period half the ship's company were given a week's leave, the other half helping with the work on board but were not overworked. This meant that

each member of the ship's company could expect a week's leave every 13 weeks and kept officers and men fit and keen. In future wars the use of boiler compound may enable the periods between boiler cleaning to be greatly extended but I am certain that some such routine as this will still be necessary for, in the words of Hopwood : " There is a limit to the man ".

The general plan of the maintenance organizations at the base ports was as follows, though it varied slightly to meet local conditions.

The senior Base Engineer Officer was on the staff of the Flag Officer in Charge, in general charge of all repairs and responsible that ships were ready on time. He worked in constant liaison with the Engineer Officer on the staff of Captain (D). He might be described as the general manager of all repairs including shipwright, electrical and gunnery, though the ratings of these departments worked under their own officers. Admiral Noble and Admiral Sir Max Horton, who succeeded him, agreed that unless there was one general manager for repairs there was liable to be chaos. With every department working as a separate unit, time would be wasted and ships delayed ; working as a team each department can help the other.

Extension of U-boat Operations to the Western Approaches

About June to July 1941 the operational aspect in the Atlantic had changed. April and May saw the losses in convoy reduced to about 100,000 tons a month but in June the U-boats were extending their operations further west.

So far we had been escorting the convoys to about mid-Atlantic as we had no vessels with a fuel endurance sufficient to make a complete journey from the United Kingdom to St. Johns, Newfoundland and to carry out the convoy routine. The Germans were quick to realize this and our losses increased. This new threat was countered by making use of Iceland as a fuelling base and working our convoys from the United Kingdom to Iceland to St. Johns so that the escort vessels could break off from the convoy and fuel. Aircraft were also based on Iceland.

Opening the Base at St. Johns

In the autumn of 1941 the United States declared Iceland a protected zone, landed troops there and ran convoys to and from Iceland and the U.S.A. in which ships of all nations could join.

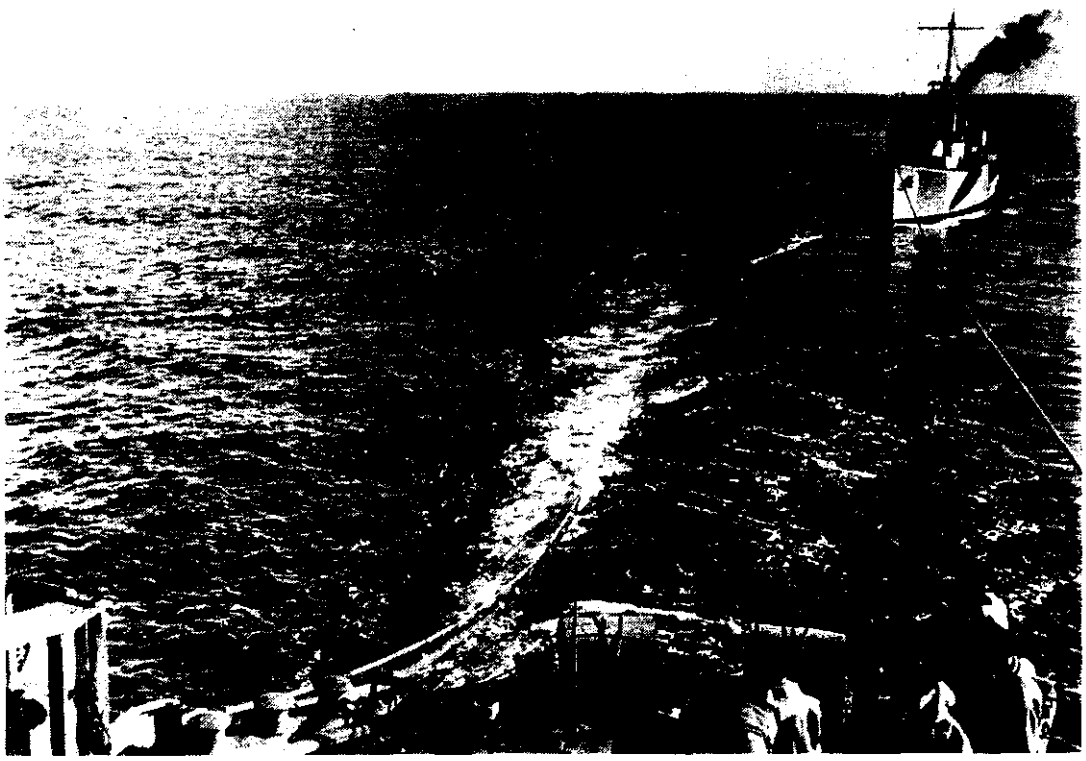
While this was a great help, it did not obviate the necessity of basing escort vessels on St. Johns to escort convoys from that base to Iceland. The basing of ships on St. Johns was an anxiety. Was the Canadian organization capable of maintaining them ? I so strongly stressed the maintenance side that Commander (E) Simms and Lieutenant-Commander (E) Shorto were sent from Liverpool to St. Johns and rendered excellent service there. The arrangement was that the ships based at St. Johns should return to the United Kingdom every six months to refit but I did not want them back floating ruins, requiring several months refit.

Declaration of War by the United States

The number of U-boats at sea continued to rise until at the end of 1941 it was estimated that about 40 were at sea.

On the 7th December the United States declared war and the enemy, neglecting us for a period, concentrated his attacks on ships in American coastal waters where the losses soared from 300,000 tons in January 1942 to 600,000 in May. The Americans were unprepared.

This period was critical as the enemy made a concentrated attack on tankers so that our oil supplies and stocks were sadly depleted.



THE FIRST TRIALS OF FUELLING AT SEA WITH A FLOATING HOSE

Development of New Methods of Fuelling at Sea

I mentioned before that from June 1941 we had to make the cross-Atlantic journey in two stages owing to the lack of endurance of our escort vessels. The problem of fuelling at sea became a major issue. Many suggestions were put up. I remember one distinguished naval officer suggesting using a nozzle mounted like a gun in the oiler and squirting the oil to the vessel being oiled and catching it in a large canvas funnel. Another suggested floating paper bags filled with oil.

Keeping in touch with Captain (E) Charley in the Department of Naval Intelligence for the latest known German developments, I was anxious to try floating hose and representations were made to the Admiralty in June 1941 for this method to be tried.

Instructions to manufacture a floating hose were given by the Admiralty to Messrs. Goodyear of Wolverhampton. The design of this hose was ill-conceived ; it was a 5 in-bore pipe surrounded by soft rubber to make it float, but rigid as a bar. It was difficult to understand how such a hose could be used at sea as no conceivable couplings could stand the strain.

Shortly after this, however, a German supply oiler was captured and orders were issued for trials with a light rubber hose completely flexible to be carried out. Admiral Noble put me in charge of these trials. After Messrs. Goodyear had manufactured sufficient hose of synthetic rubber I went to sea in an oiler for a fortnight off the North Coast of Ireland in February 1942 for trials.

Synthetic rubber is essential for this work as it is impervious to oil fuel. The trials were very successful and all types of escort vessels were oiled. It was, however, many months—in fact nearly a year—before oiling at sea became a regular practice, as oilers had to be fitted out for the job without delaying them. The fuel position was still critical.

Maintenance and Repair—Spring 1942

In the spring of 1942 our maintenance repair bases were becoming really efficient.

At Londonderry the workshop was built and equipped. This shop was staffed and manned by Messrs. Harland & Wolff of Belfast and employed about 800 civilians. The dry dock had been enlarged and repaired so that most of the escort vessels could be docked. This dock, under the charge of a Shipwright Lieutenant, rendered invaluable service, particularly in obviating the necessity of sending ships to the Clyde for small hull and asdic dome repairs.

The workshops on the dockside for the use of naval ratings was completed, employing about 150 ratings of all departments.

The berthing accommodation had been extended, piers and dolphins erected on both sides of the river so that all vessels on return to harbour could lie alongside and be supplied with power and light. Distilled water was available together with all the amenities such as one would find in a Home Port. The repair ship was released.

The Americans were also building, or rather completing, a base at Londonderry which they started some months before they entered the war. It was interesting to watch the preparations. The base was intended only to service their escort vessels and flotillas coming to the United Kingdom but their ideas were on a much grander scale than ours. They built barracks, wharfage, and a miniature dockyard on the west bank of the river. There was no doubt that they considered maintenance bases a vital necessity. In the early days of 1941 I had two American officers in my office at Liverpool for some weeks asking questions, taking notes and visiting our bases to watch our preparations.

The number of ships based at Londonderry increased to 100 in May 1942.

At Greenock the two workshops ashore for naval personnel were completed and in full use. It was decided that, as it was difficult to find a site for further expansion ashore, the repair ship should be kept, so that H.M.S. *Sandhurst* became a permanency. This was not ideal as she had to lie in the river.

However, a big scheme for dredging Greenock harbour was nearing completion and, on the north side of the harbour, piers were bu.lt similar to the pens we had at one time at Port Edgar. When these were completed H.M.S. *Sandhurst* was brought inside and was then adjacent to the escort vessels berthed at the piers. The *Sandhurst* was considered purely as a workshop and barracks, all other considerations being subordinated to this end.

Engineer Rear-Admiral Scott-Hill, on the staff of the Flag Officer in Charge, Greenock, had a staff of seven to eight Engineer Officers, the larger staff being necessary to administer the maintenance of about 100 power boats which served the convoys and troopships assembled in the Clyde. Incidentally, Admiral Scott-Hill was the oldest serving Engineer Officer during the war.

With the *Sandhurst*, about 200 naval ratings of all branches, mostly skilled, were employed ashore and afloat.

At Liverpool the workshop for the use of naval personnel had been enlarged

and a new shop developed in one of the large sheds at Gladstone Dock. Power and light was available to ships alongside. The naval maintenance parties had been enlarged and balanced and the Unity Pools building taken over as a barracks for naval personnel. About 100 ratings, mostly skilled, were employed. The arrangement was slightly different in that Liverpool was a large naval port as well as an escort base so that the Engineer Officer in Charge combined the functions of maintenance base repairs officer with that of S.E.O. (D).

" Operation Torch "

The landing in North Africa, known as " Operation Torch ", was carried out in October 1942. I had no warning of this operation but our forces were then in such good condition that by temporarily postponing refits for a few weeks it was possible to lend 76 vessels, destroyers, sloops and corvettes from the Western Approaches Command for this operation.

Out of a total of 180 ships, excluding those based on St. Johns, only 16% were out of action from all causes : refitting, damage, etc. Efficient base maintenance was beginning to pay dividends.

Dockyard Refitting

As stated earlier, ships were sent to dockyards or private firms to refit every six to eight months. At first this meant an absence of two months or more but, as the maintenance at bases increased, refit periods were reduced to four weeks.

The placing of all ships for refit at Royal Dockyards and private firms was controlled by the Emergency Repair Department at the Admiralty. With the congestion at all repair yards owing to the shipbuilding programme and naval and merchant ship repairs, the placing of our ships for refit needed very close liaison between the operational side, my office, and the Emergency Repair Department. Our programme was worked out two months ahead and the Admiralty was kept informed well in advance of the date each ship would return to U.K. so as to avoid depleting the potential force by having ships waiting about for refits. The liaison worked well and smoothly.

Occasionally ships had to be sent to the South or East Coast even though Admiral Troup, the Flag Officer in Charge, Glasgow, would always squeeze one of our ships into Glasgow if possible. This meant an extra week on the double journey.

Building Dockyards

To obviate this loss of time, and to increase our refit resources, it was decided to build two small dockyards on the West Coast of Scotland. I toured the area with Admiral Troup and we decided on Dunstaffnage, just north of Oban, and Corpach, opposite Fort William. There were many points to consider in selecting the site. It had to be a sheltered anchorage with sufficient depth of water for a floating dock. As it was necessary to build a small village for the dockyard men and their families, it had to have the usual services and be near a town. There was considerable argument that the dockyards should have been built at or near Greenock where there was anti-aircraft defence, but Dunstaffnage and Corpach were decided on.

It was a long and costly job and was completed in 1943. About 200 dockyard workmen, with their families, were moved up to each dockyard from Plymouth and very glad they were of the peace and quiet. The two dockyards under the command of F.O.I.C., Glasgow, gave excellent service.

Nineteen forty-two saw our commitments grow enormously. As stated earlier, the extension of the U-boat campaign further west necessitated the

double trip from U.K.—Iceland—St. Johns and, in addition to the troopship convoys south, convoys had to be escorted to Gibraltar, Freetown and the Russian port of Murmansk.

1943—U-boat Spring Offensive

At the end of 1942 Admiral Sir Max Horton* relieved Admiral Noble. If I may be allowed to say so, from an engineering point of view, Admiral Noble had forged the weapon which Admiral Horton was to use and sharpen. Our escort forces were in excellent condition and seldom were more than 20% out of action from all causes.

Concurrently with Admiral Horton assuming command, Gross-Admiral Doenitz was put in supreme command of the German Navy. He concentrated his U-boats in the North Atlantic for an all-out spring offensive.

In Western Approaches, we held our breath and waited the outcome with sober confidence. Our forces were in good condition and well trained but we still suffered from insufficient forces to fulfil our convoy obligations and had none to spare for striking or offensive tactics. The enemy had probably anything up to 100 U-boats at sea.

Of a convoy of nine tankers escorted by a destroyer and three corvettes only two survived. Forty-one ships were sunk in the first ten days of March and 44 in the second ten days ; against this probably four U-boats were sunk.

Confronted by this crisis, the Admiralty acted. On 25th March the War Cabinet sanctioned the transfer of 15 Home Fleet destroyers to Western Approaches and postponed temporarily the Russian conveys.

For the first time we had sufficiently powerful escorts on threatened convoys to enable one group to leave the convoy and act offensively without the fear of other U-boats attacking through a gap left in the screen.

From 400,000 tons in March our losses fell to 150,000 tons in April, seldom again to rise to 100,000 tons in any one month during the remainder of the war. Historians may single out April-May 1943 as the critical months during which the strength of the U-boat offensive started to sag.

The summer of 1943 saw a great addition to our forces. Improved corvettes and sloops had been joining during 1942 and now the Loch, Bay, and Castle Class frigates were coming to us every week from the contractors. These new classes of ships were an improvement on the older ships, particularly in endurance.

With oiling at sea working smoothly we were now able to give up Iceland as a fuelling base and to run our convoys direct to St. Johns. This economy of escort vessels increased our potential forces so that we were able to provide more offensive hunting groups at sea.

Untried Innovations

I must say a word on the new classes of ships if only to show the danger of making untried innovations in wartime.

In one class the spacing of frames was increased from the normal spacing of about 18 in for small ships to 2 ft 6 in. The first trip one of these ships did in a really rough Atlantic sea ended with her arrival in port with the bottom plating badly buckled between frames. Much stiffening work was necessary and ships out of action for a considerable time before they were seaworthy.

In another class, Michell thrust blocks were fitted in the after-compartment

* Admiral Sir Max K. Horton, K.C.B., D.S.O., R.N.

instead of the old-fashioned collar and shoe thrust blocks. Unfortunately, no provision for water leaking from the stern tube was considered. The thrust block was mounted on an athwartship girder with no limber holes. Water found its way into the thrust block. Luckily the two ships in which this occurred were near port when the disaster happened and were towed into harbour.

In yet another class, constant trouble was experienced during commissioning trials with the oil fuel burning ; fires in the boiler room were constantly occurring. One ship which was sent to Liverpool for examination had a new design of boiler front. It was obvious that the design was wrong, the air supply being badly balanced, and that the ships would not be satisfactory until this was altered. The Admiralty were informed and experts from the Admiralty Fuel Experimental Station at Haslar summoned to help. The defect was cured by fitting a restriction ring to the centre air supply.

American-built Captain Class Frigates

About this time the Americans were arranging to send us some of their turbo-electric and diesel-electric frigates later known as Captain Class frigates.

With this in view, it was decided to get rid of the American destroyers and the worst of the V and Ws as, though they had done us well, they were worn out, unreliable and were buying up billets in repair yards.

The proposal to lend us the Captain Class frigates caused us some hard thinking at first. With their new type of machinery, they could not be distributed around our present bases as their maintenance would entail two distinct maintenance staffs at each base. A new base was required with berthing accommodation and Belfast was selected. Belfast had been an escort and trawler base ; the trawlers, complete with maintenance staff, were moved to Birkenhead.

The change necessitated many alterations and extensions to accommodate the 36 new frigates to be based there. Thirty-seven dolphins were built in the Herdman Channel to provide 20 berths with the Pollock Dock.

H.M.S. *Pegasus* was moved to Belfast to supplement the present base ship, H.M.S. *Caroline*, for accommodation. Storage tanks for diesel and oil fuel had to be built and pipelines led to the oiling berths, distilling plant built and arrangements made for the supply of the two types of lubricating oils required. Accommodation for offices, stores and classrooms were built.

The first ships arrived from the U.S.A. in June, some of them having just managed to stagger across after many breakdowns.

The machinery of these frigates was as follows :—

Turbo-electric frigates ..	1,550 tons. Foster Wheeler boilers. Propulsion machinery, 2,700 volts A.C., 3-phase, 93⅓ cycles. Two generators each machine. General power distribution, 450 volts A.C., 3-phase, 60 cycles. Lighting, 115 volts A.C., single-phase, 60 cycles.
Diesel-electric frigates ..	Diesel engines by General Motors, four generators of 16 cylinders, 1,200 kW each. General power and lighting as for turbo-electric frigates.

The original arrangements made for training Engineer Officers and ratings provided for six weeks preliminary course in H.M.S. *Marlborough*, six weeks

course of instruction, ashore and afloat, in America, and then they were put into the ships and sent across the Atlantic. Some of the officers and most of the men had practically no knowledge of electrical machinery. The instruction in *Marlborough*, though excellent, was necessarily very elementary so that crews were unable to understand the instruction in America at classes which they attended with American crews. Under this system the officers and men never worked together as a team.

After visits to *Marlborough* and Belfast to meet the first ship that arrived, I suggested to Admiral Horton that I could see only chaos ahead and that, after consultation with officers at Belfast, we were of the opinion that the only solution was to train the crews at Belfast before sending them to America, using one ship of each type for training and sending the crew over as complete units when they were competent. This method was adopted though the preliminary instruction in *Marlborough* was maintained. At Belfast six weeks instruction ashore and afloat was given, during the afloat time of which extensive breakdowns were staged which the crews under instruction learnt to rectify.

The Engineer Officers of the ships were mostly Commissioned and Warrant Officers. I have the greatest admiration for the way in which they adapted themselves to entirely strange machinery at an age when it is not easy to learn new ideas.

We had no further trouble in bringing over the ships. In all 78 were brought over of which we retained 37 at Belfast.

The base maintenance work was carried out by civilians from 11 different firms ; at the peak period 1,500 men were employed and did excellent work. I remember on one occasion there was a six-weeks strike of ship fitters at Harland & Wolff. None of the Londonderry men came out but the Belfast men of our maintenance party sent a deputation to the officer in charge to say that they must show their ' solidarity ' but were there any ships it was necessary to get to sea ? This was Friday, and on being told yes, some ships must leave that night, they turned-to and got the ships away. The exercise in ' solidarity ' was carried out on Saturday but all hands were back to work on Sunday.

In addition to the civilian force we had about 80 naval ratings, mostly skilled.

The civilian labour force was entirely new to this type of work and had to be instructed in both diesel and electric work.

As at the other bases, the ships were put into six groups of six ships each, one group at least being always in harbour.

In the case of the diesel ships the lay-up period was 12 days, top overhaul one lay-up and complete overhaul the next ; the turbo ships had 10 days for boiler cleaning.

These Captain Class frigates had endurances of 6,300 miles for the Diesel and 4,000 miles for the turbo ships at 10 knots, a striking change from our own ships. They had a few teething troubles to start with ; the bilge keels which had a habit of falling off and winding round the shafts had to be redesigned and enlarged ; messing arrangements had to be altered to suit our standards ; additional top weight had to be added as the ships were too stiff. The distilling plants gave some trouble until we had got used to them. Most of this work was carried out by the maintenance staff.

The supply of power and light when these ships were laid up proved difficult at first as we had no supply of the same voltage and frequency but we managed to borrow two generators from the Americans at Londonderry.

The 2,400-ton floating dock at Belfast which was taken over proved a god-send. It sometimes handled three ships in one day and averaged a ship every

two-and-a-half days from December 1943 to V.E. Day. I think that the Warrant Shipwrights' docking allowance worked out at 4½d. a docking.

The provision of spare gear fell much behind the arrival of the ships themselves. An ample supply was arranged for from U.S.A. but did not arrive until several months after the ships which, like most U.S. vessels, live on spare gear. As much of it was impossible to obtain in U.K., we often had to cannibalise and borrow from ships lying-up to get others to sea.

The Captain Class eventually gave wonderful service. One diesel-electric ship steamed 136,000 miles without a refit and many did over 100,000 ; 90 achieved over 80,000. The welded hulls stood up to damage better than our riveted hulls and we had several cases in which, after the stern had been blown off by an acoustic torpedo, the compartment next to the damage was still watertight.

Our escort forces were, with the Captain Class, at the maximum in the summer of 1943. The number of ships based on Londonderry had risen to 120. The difficult task of maintaining this large number was tackled with great success as a result of fine team-work. At this time we were operating about 240 ships, apart from ocean-going trawlers and other smaller vessels, from all four bases with an average of 15% out of action, including refits. Oiling at sea was working smoothly with an oiler in each convoy. The loss of merchant ships was decreasing so that, between 16th May and 24th September, not one merchant ship was lost in convoy in Western Approaches.

New Weapons and Counter Weapons

On 22nd September 1943 the enemy started to use a new weapon, the acoustic homing torpedo ; the attack with this was mainly directed at our escorts. Altogether we lost 15 escort vessels from the use of this weapon. The counter to the acoustic torpedo—the Foxer—was quickly produced but we never completely defeated this weapon as the Foxer warned the enemy and reduced efficiency of our detecting devices.

Nineteen forty-three also saw the addition to our forces of escort carriers, mostly lent by the U.S.A., and converted merchantmen operating aircraft. These ships were operated by Western Approaches but maintained by Flag Officer Carrier Training at Largs. The escort carriers with their escorts worked in their own separate units ; their value was immense. While the Coastal Command of the Royal Air Force maintained a most effective air cover deep into the Atlantic and at the same time patrolled the Bay of Biscay, aircraft of the Fleet Air Arm from escort carriers and converted merchantmen operated outside the range of the shore-based aircraft. By day and night the U-boat on the surface was harried ; no longer could U-boats packs close the convoys. Trips to and from bases became most perilous. Extra A.A. guns were fitted to the U-boats and, for the first time in the war, they were ordered to fight it out on the surface with the aircraft, with disastrous results.

1944 and D-Day

And so we pass to 1944 and D-Day. I was informed some months ahead of the approximate date of D-Day as a large number of our escort vessels were to be required for this operation. By postponing refits, which could safely be done owing to the good condition of all ships—on the actual day we had only six out of action—about 90 ships from Western Approaches were lent. Patient work of the maintenance base officers and men had made this possible. It was interesting to note that, of the Captain Class lent, all had to be sent back to Belfast for their maintenance as no base in the South of England was capable of taking them on.

From D-Day to the end of the war we were definitely on top of the submarine in spite of the Schnorkel which was produced late in 1944. With this device fitted, the enemy U-boat entered coastal waters to attack the large numbers of small convoys previously escorted only by one trawler or two trawlers in the Irish Sea. Technique against inshore U-boats was soon perfected and the attack failed. Radar from the air and from our escorts was the biggest factor (when allied to intensive training) that crippled the U-boat offensive since heavy casualties forced them to take to the Schnorkel. This device, although it defeated Radar completely, yet rendered the U-boat useless at night and reduced their efficiency by day enormously both tactically and through the undermining of the morale and health of their crews through continuous submersion over weeks on end.

" Wrens " (Mechanical)

Before concluding I must say a word on the excellent work carried out by the " Wrens " (Mechanical). I think I am right in saying that the idea of using Wrens for maintenance work originated in Western Approaches.

Many were employed on skilled work and one Petty Officer Wren was one of our best machinists at Greenock. Others were employed on servicing and testing depth charge pistols, stripping and cleaning A.A. guns and many other duties which released numbers of skilled and semi-skilled men.

Conclusions

So much for the past, what of the future ? In any future war in which we are engaged, one thing is certain ; the submarine menace will recur. Will the lessons of 1939-1945 be forgotten ? Shall we again take a year-and-a-half before considering the question of bases ? Will our escorts again have insufficient fuel endurance for the task ? Oiling at sea was a makeshift, necessary but at the best a poor substitute as it means carrying back across the Atlantic part of the cargo brought over at great expense. Moreover, if the oiler should be sunk all the escort vessels in that convoy may be imperilled. Have these lessons been learnt ?

In considering the endurance of a warship I would utter a word of warning. It is certainly not the distance that can be steamed at economical speed that matters but the distance that a ship can steam when acting the part in wartime for which she was designed. This would mean for an escort vessel acting as such and prepared at all times to defend the convoy. I stress this point strongly because, though in our official list of endurances one may find a Flower Class corvette given an endurance of 4,400 miles, we found in practice the figure was nearer 2,750 miles, and less in bad weather. I believe one corvette did struggle into harbour at her last gasp after a journey of slightly over 3,000 miles.

Finally, while in Western Approaches I had the opportunity of meeting many American officers and it was interesting, from engineering point of view, to make comparisons with our own officers. One in particular I will mention, Captain Solberg, who since the war, I notice, was Rear-Admiral in command of the Atom Bomb experiments at Bikini. He visited me about once a month and first introduced me to boiler compound which was his patent. He obtained a small supply for me at Londonderry, the first used, I believe, in this country.

We often discussed the training of officers. I am of the opinion that before the war the training of Engineer Officers left much to be desired. Of necessity the Engineer must deal largely with matters of detail but this, if carried to excess, brings narrowness of vision. Engineer Officers were brought all too little into touch with operations and operational requirements. Thus, while as pure technicians our officers were probably superior in the higher ranks the American officer with his much broader outlook had a distinct advantage.

APPENDICES

TYPES OF SHIPS

Class	Tonnage	Type of Machinery	Maximum Speed	Economical Speed
BLACK SWAN	1,300	2 Sets Geared Turbine	18¼	10
MODIFIED BLACK SWAN	1,430	2 Sets Geared Turbine	18½	10
" CASTLE " CLASS ...	1,060	Single-Triple Expansion	16	9
" LOCH " CLASS ...	1,435	Twin-Triple Expansion	19½	8
ORIGINAL CORVETTES MODIFIED (" FLOWERS ").	1,060	Single-Triple Expansion (Cyl. Boilers).	16	9
LATER CORVETTES (MODIFIED " FLOWERS ").	980	Single-Triple Expansion (W.T. Boilers).	16	9
" CAPTAINS " D.E. ...	Deep 1,600 Light 1,200	Twin Shaft Diesel Electric	Deep 20 Light 22	11
" CAPTAINS " T.E. ...	1,300	Twin Shaft Turbo Electric	23½	13
" RIVER " CLASS ...	1,390	Twin-Triple Expansion	19	9

SENIOR ENGINEER OFFICERS AT PRINCIPAL BASES IN WESTERN APPROACHES

Headquarters	Engineer Rear-Admiral Sir H. W. Wildish, K.B.E., C.B.	1941–45
Staff of, C.-in-C. ...	(Deputy) Engineer Rear-Admiral Percy Stocker, O.B.E.	1941–45
	(Secretary) Lieutenant-Commander (E) L. Farrar	1941–45
Liverpool	Engineer Rear-Admiral R. G. Morton	1940
Staff of, F.O. i/c, Liverpool	Captain (E) R. E. Lambert	1941
	Captain (E) E. L. P. Mark-Wardlaw	1942
	Captain (E) O. W. Phillips	1943
	Engineer Captain L. Thackara	1944
Emergency Repairs Organization	Engineer Captain F. H. Buckmaster, C.B.E.	1940–45
Captain (D)'s Staff	Engineer Commander J. T. Belfield, O.B.E.	
Londonderry	Engineer Rear-Admiral Milner, C.B.E.	1941
	Engineer Rear-Admiral G. B. Allen	1943–45
Commodore's Staff	Lieutenant-Commander (E) R. R. Shorto, D.S.C.	1942–45
Belfast	Captain (E) O. W. Phillips	1943–45
Staff of F.O. i/c		
Captain (D)'s Staff	Lieutenant Commander (E) (later Commander (E)) J. A. Fenn	1943–45
Glasgow	Engineer Captain B. J. Johns, O.B.E.	1941–45
Staff of F.O. i/c		
Emergency Repairs Organization	Engineer Rear-Admiral R. C. Hugill, C.B.E., M.V.O.	1941–45
Greenock	Engineer Rear-Admiral W. Scott-Hill, C.B.E.	
Staff of F.O. i/c		
Captain (D)'s Staff	Commander (E) L. J. F. Howard-Mercer	1943–44
	Commander (E) P. E. F. Walker	1944–45

ESTIMATE OF TOTAL NUMBERS OF PERSONEL EMPLOYED

Greenock:	Skilled Ratings	...	150	*Liverpool:*	Skilled Ratings	...	80
	Semi-skilled ...	...	150		Semi-skilled ...	...	20
	Unskilled ...	...	350		Unskilled ...	...	160
	Wrens	...	25		Civilians, skilled and unskilled— max.		250
					min.		75
					Wrens ...	...	25
Belfast:	Skilled Ratings	...	30	*Londonderry:*	Skilled Ratings	...	100
	Semi-skilled ...	...	15		Semi-skilled ...	...	40
	Unskilled ...	...	40		Unskilled ...	...	150
	Wrens	...	30		Civilians, skilled and unskilled ...	...	850
	Civilians, skilled and unskilled ...	...	1,200				

Typical Composition of a Maintenance Base—All Naval

Greenock. Maintenance staff, including "Sandhurst"—Engineer Rear-Admiral (ret). in charge. 1 Engineer Commander. 3 Lieutenant Commanders (E). 3 Lieutenants (E). 2 Commissioned or Warrant Officers. 1 Electrical Lieutenant Commander. 1 Shipwright Lieutenant Commander.

40 Chief and E.R.A.s. 180* Engine Room Mechanics. 12* Motor Mechanics. 16 Electrical Artificers. 15 Electrical Mechanics. 20 Shipwrights. 3 Joiners. 2 Plumbers. 2 Blacksmiths. 12 Chief and S.P.Os. 350 Stokers. 15 Wrens.

Armament and special devices, Asdic, Radar, etc., dealt with by specialist ratings on Captain (D)'s staff.

* About 80 Engine Room Mechanics and 12 Motor Mechanics for maintenance of boat pool for servicing convoys assembling at Greenock.

TYPICAL DAILY STATEMENT OF FORCES

WESTERN APPROACHES COMMAND—Disposition of Forces at 1200, 3rd June, 1944.

GROUP B.2 (LIVERPOOL)

Destroyer
Hesperus

Frigates
Gardiner
Cotton
Mourne

Corvettes
Rushen C.
Oxford C.
Flint C.
Tunsberg C.

GROUP B.3 (GREENOCK)

Frigates
Towy
Anguilla
Antigua

Corvettes
Leeds C.
Knaresborough C.
Tintagel C.
Hurst C.

GROUP B.4 (LONDONDERRY)

Frigates
Helmsdale
Beyntun
Foley

Destroyer
Highlander

Corvettes
Kenilworth C.
Porchester C.

GROUP B.5 (GREENOCK)

Frigates
Exe
Ascension

Corvettes
Hadleigh C.
Berkeley C.
Carisbrooke C.
Dumbarton C.

GROUP 1 (BELFAST)

Frigates
Affleck
Garlies
Gore
Balfour
Bentley
Capel

GROUP 2 (LIVERPOOL)

Sloops
Starling
Wild Goose
Wren

GROUP 2 (LIVERPOOL)

Frigates
Dominica (temp.)
L. Fada (temp.)
Lochy (temp.)
L. Killin (temp.)

GROUP 3 (BELFAST)

Frigates
Duckworth
Domett
Essington
Blackwood
Cooke
Braithwaite (temp.)

GROUP 4 (BELFAST)

Frigates
Bentinck
Byard
Calder
Drury
Bazely
Burges

GROUP 5 (BELFAST)

Frigates
Bickerton
Aylmer
Bligh
Keats
Goodson

GROUP C.1 (LONDONDERRY)

Frigate
New Glasgow

Corvettes
Fredericton
Giffard
Halifax
Frontenac
Chambly
Orangeville
Chebogue
Edmundston

Group C.2 (LONDONDERRY)

Frigates
St. Catherines
Monnow

Corvettes
Chilliwack
Morden
Owen Sound
Fennel
Kamloops

GROUP C.3 (LONDONDERRY)

Frigate
Prince Rupert

Corvettes
Eyebright
Bittersweet
Napanee
La Malbaie
Forest Hill
Ettrick
Trillium

GROUP 6 (R.C.N.) (LONDONDERRY)

Frigates
Waskesiu
Outremont
Cape Breton
Grousea
Tememont
Port Golorne

GROUP 9 (R.C.N.) (LONDONDERRY)

Frigates
Matane
St. John
Swansea
Stormont
Port Colborne
Meon

GROUP 11 (R.C.N.) (LONDONDERRY)

Destroyers
Ottawa
Kootenay
Chaudiere
Gatineau
St. Laurent

GROUP C.4 (LONDONDERRY)

Frigates
Wentworth
Montreal

Corvettes
Collingwood
North Bay
Atholl
Brandon
Ville de Quebec
Amherst

GROUP C.5 (LONDONDERRY)

Frigate
Dunver

Corvettes
Rosthern
Dauphin
New Westminster
Hespeler
Wetaskiwin
Nene
Algoma
Long Branch

UNALLOCATED (BELFAST)

Frigates
Manners
Pasley
Hoste
Inman

GROUP 12 (R.C.N.) (LONDONDERRY)

Destroyers
Qu'Appelle
Saskatchewan
Skeena
Restigouche

GROUP 14 (LIVERPOOL)

Destroyers
Fame
Havelock
Hotspur
Icarus
Inconstant

GROUP 15 (Temp.) (LONDONDERRY AND BELFAST)

Frigates
Louis
Inglis
Lawson
Cam (temp.)
Moorsom
Mounsey

W.A. GROUP TRAINING SHIPS (LARNE)

Philante
P.C.74

UNALLOCATED (LIVERPOOL)

Sloops
Mermaid
Peacock

Frigates
Bullen
Goodall

UNALLOCATED (GREENOCK)

Destroyers
Escapade
Bulldog

Frigates
Catcos
L. Dunvegan
Cygnet

Corvette
Lobelia

UNALLOCATED (LONDONDERRY)

Destroyer
Duncan

Frigate
Grindall

Corvette
Lotus

ALLOCATED TO OTHER COMMANDS

Eastern Fleet

Frigates

Halladale
Awe

Ships at Sea

Ocean Convoys

Helmsdale Foley
Baynton Nairana
Porchester C.

Towy Anguilla Antigua
Leeds Castle
Tintagel C.
Knaresboro' C.
Vizalma Activity

Exe Ascension
Hadleigh C. Berkeley C.
Carisbrooke C.
Dumbarton
Coldstreamer

Hesperus Gardiner
Cotton Mourne
Rushen C. Flint C.
Tunsberg C. C. Argona
Campania

Dunver Rosthern
Dauphin Hespeler
N. Wesminster

Wentworth Montreal
Collingwood N. Bay
Atholl Brandon

Aquamarine

Support Groups

(*a*) Ottawa Kootenay
Chaudiere Gatineau
St. Laurent

(*b*) Qu'Appelle Skeena
Restigouche
Saskatchewan

ESCORT CARRIERS (GREENOCK)

Biter
Fencer
Tracker
Activity
Chaser
Sriker
Vindex
Nairana
Campania
Nabob
Slinger
Emperor
Pursuer

TRAWLERS (LIVERPOOL)

Ayrshire
Cape Argona
Cape Mariato
Cotillion
L. Madeleine
St. Elstan
St. Kenan
Vizalma
L. Nuffield
Coldstreamer
Scottish
C. Comorin
Blackfly
C. Palliser
K. Amber
Kingst'n Agate
Mazurka
Stafnes
Paynter

LOCAL ESCORTS

Aquamarine
Brimnes
Kirkella
K. Turquoise
Loch Tulla
Brontes
K. Onyx
Davy
Istria

OFFICIAL COMMENT

The following comments have been made by Admiralty staffs and Departments who have read this article.

The Director of Plans (Q) stresses that the lessons learnt during the late war have not been forgotten and that Oiling at Sea, now called Replenishment at Sea, is regularly practiced by the Fleet. Attention is being given in current plans to the establishment of escort bases against a future emergency.

The Director of Naval Construction states that the criticism of corvettes on page 45 is misleading. The hulls complied with British Corporation and Lloyds rules for seagoing vessels. They are not weak nor did they need strengthening. The *Flower* Class corvettes were designed pre-war for coastal patrol with fighting equipment available at the time and for small complements. When the vessels available for service were transferred to Atlantic patrols at short notice because of urgency it was soon realized that improvements in fighting equipment and larger complements were needed for ocean service. As. and As. including lengthening of forecastle were accordingly carried out at refits and incorporated in all vessels building.

The reference in " Untried Innovations " is not true if it refers to *River* and later classes of new construction in which the frame spacing was 2 ft 6 in. The speed requirement of 20 knots made weight economy of great importance and the principal hull scantlings and frame spacing were therefore based on construction of *Black Swan* sloops already found satisfactory. They have since been found satisfactory in *Rivers*, *Lochs* and *Bays*. Because of this experience, similar hull scantlings were adopted for the *Castle* Class frigates and the later edition of the *Flower* Class with satisfactory results.

There were cases of bottom plating forward being buckled in frigates, caused by driving the ships too hard in a seaway. Similar troubles were experienced in destroyers.

The Engineer-in-Chief points out that the Mitchell type of thrust block was fitted and proved well before the war and that, had the leakage of water been discovered and dealt with, no trouble would have occurred.