The information for these presentations comes from a series of informational booklets published by His Majesty's Stationary Office in the 1940's. This is one of a number of books that were bought by my father during WW2. They were sold [usually for 6d or 1s] to keep people informed of various theatres of war and as a boost to morale.

These books have now been donated to the Imperial War Museum archives and other organisations, grateful thanks are due to Arthur for his sterling work in scanning them to digital format, which I appreciate, was no easy task.

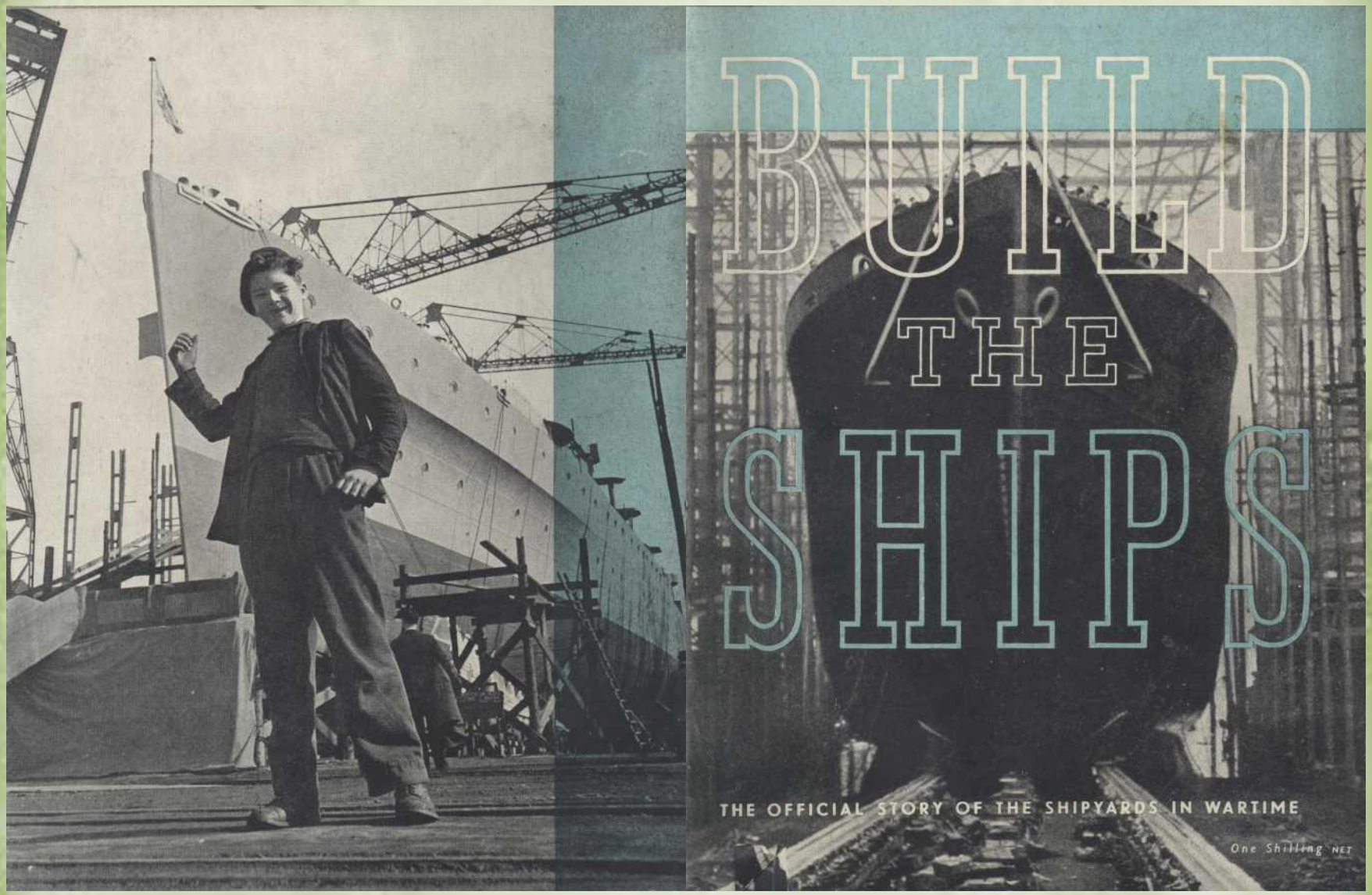
PJS

BUILD THE SHIPS

The Official Story of the Shipyards In Wartime

HIS MAJESTY'S STATIONERY OFFICE

CONTENTS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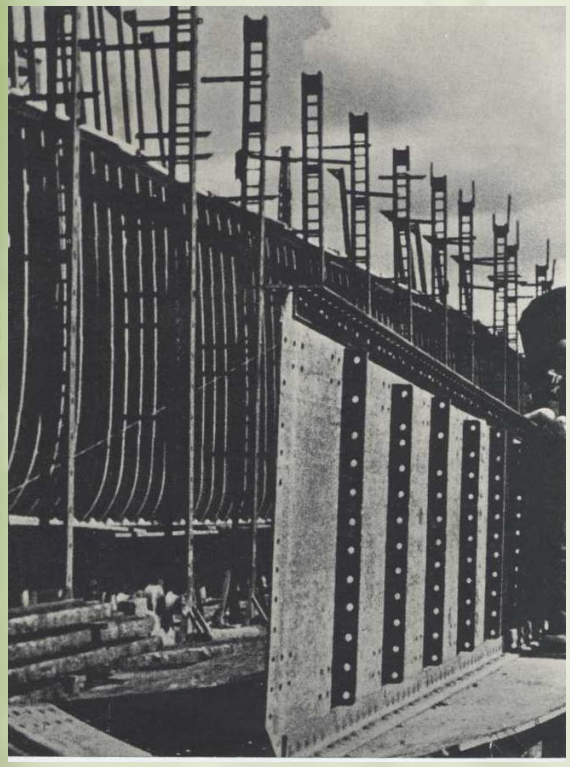
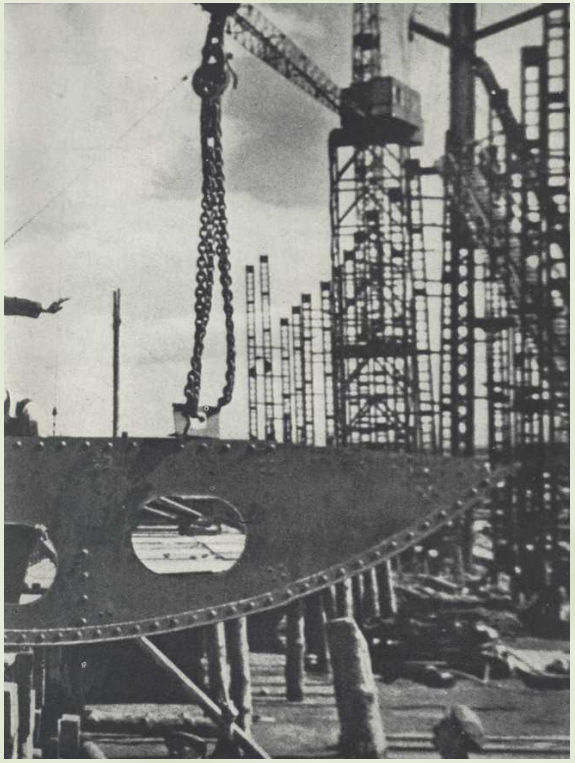
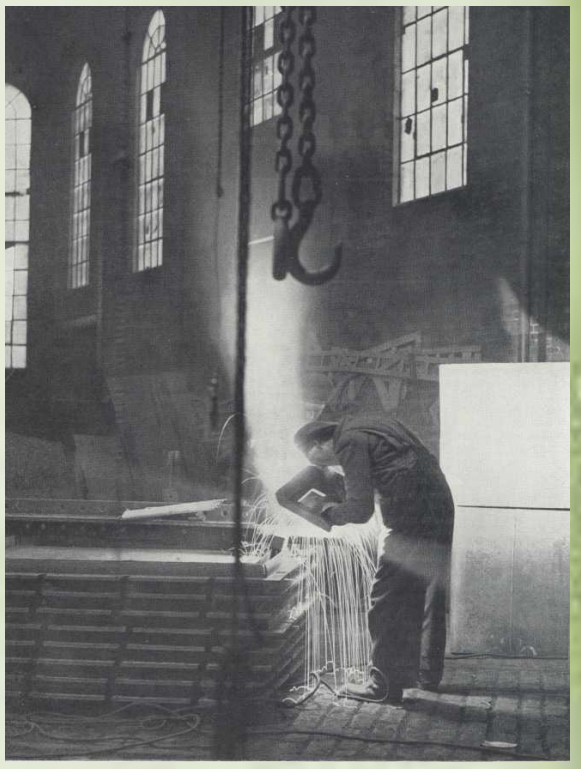






"Fill the Armies, rule the air, pour out the munitions, strangle the U-boats, sweep the mines, plough the land, build the ships." WINSTON CHURCHILL, 1940.

A MAN'S JOB

"Then the sixteenth day came," the sailor was saying. "The sixteenth day came and two more men died and still no sight of land...."

The hull of a half-finished aircraft carrier stood like a wall under the cranes behind him; but for that, one might have been back in the eighteenth century listening to a story of piracy and marooning, thirst, hunger, scurvy and madness, like Alexander Selkirk's tale, and not to a modern seaman in a Harris-tweed overcoat, with spotted tie, brilliantine on his hair, and a microphone taking in his words. He talked well. His talk was like a page out of *Robinson Crusoe*. There was the dour, factual voice inflected by only the simplest, common emotions. You could imagine, after listening to this man, what it was like to be torpedoed; how you wake up with the wardrobe on top of you and the cabin door jammed and the sound of water, as if a gutter had broken suddenly, very near on one side of the ship. You knew what it was like to be in an open boat for a month, to watch fifty people die, to be picked up at last by a German armed cruiser, to be put in irons with a machine-gun in front of you when the cruiser was attacked, and to hear the order come from the German captain, when his ship in turn was hit and sinking, "Let them go. Let them take their chance with the rest."

The sailor was standing on a cart in the shipyard telling his story. It was the dinner hour, when there are forty minutes of grey Sunday silence. A crowd of a few hundred workers was listening to him. He stood up in the sun with his back to a shed on which someone had chalked "Give us Beveridge," while the workers in their caps and overalls listened with faces turned away because of the dust flying in the bitter wind. They were pale, glum, tallowy faces. A speaker would be disappointed or perturbed by them in the mass. What was going on in their heads? The seaman looked so clean, sun-burned and athletic as he stood above this crowd of short, big-shouldered men with caps over their eyes and a day's growth on their chins. You looked at the sailor's face but you looked at the workers' hands; for their hands, hardened and in all shapes, were more expressive than their faces. The seaman was faced by one of the difficulties of the modern world – to remind a man what his job is for, to prove to him that it has a necessity, as well as a wage, attached to it: more important, to show him that you know it, too.

A woman of forty at a training centre was grumbling as she fiddled about with a file and six inches of steel: "I get pig sick of this," she said,. "I want to get into the shipyards where I can see what I'm doing." The shipyard worker is lucky. He can see his job. He can see the ships around him. Even while the sailor was talking, the crowd could see the dazzled grey and white of a liner docking across the river. She had made dozens of voyages on her own; she was too fast for the U-boats and did not need to sail in convoy. The crowd had the profit and loss of the sea in their bones. Farther down lay the little *Aconit*, looking like a piece of stage scenery in her camouflage. "Ce bâteau est formidable," the young French captain said regularly to visitors. He had sunk a submarine, which had taken a small, rat-like bite out of his ship's bows as she rammed it. There were a good many rat bites like that to be seen on the Clyde. That Italian liner below the *Aconit* had been captured. She was burned clean out like the *Normandie,* and they had to sink her to put the fire out. Now she was rising again, a new ship, and people keeping their mouths shut about her. The *Thetis* was often here. And there was the phenomenal destroyer, *Javelin*, which had her bows and stern blown off simultaneously so that she kept her balance and came in, square at the ends, looking very much more like the floating section of a house than a ship.

The men who stood listening to the sailor in the shipyard knew all these things and many more. They did not know as much as they used to know before the war, when some men followed the ships they had built as you might follow the form of racehorses. That is one of the handicaps of trade during a war. The most naturally public industry, one which certainly belonged to the general imagination, had to turn itself into a very secret one. It is extraordinary, but the people of

"THE SIXTEENTH DAY CAME." The sailor tells his story of torpedoing, open boats, tragedy and courage. The workers will not let him down.

Glasgow, who at one time knew what every ship on the Clyde was doing, simply did not know on February 26, 1940, that the newly built *Queen Elizabeth* had slipped out of John Brown's to "the tail of the bank." Her destroyer escort was waiting in the fog for her and did not know what ship he was getting until she appeared. Half Tyneside could point out the lovely Norwegian gunboat they called "The phantom ship," that flashed fast and white down the river and used, as they say, to "deliver *The Times*" at German G.H.Q. in Norway to annoy the Nazis, who could never catch her. The story of the *Illustrious* – some instalments of it anyway – are known in Barrow and in Birkenhead where she was completed.

The seaman had come to the end of his story. One of the Works Committee thanked him. "It's up to us," he said, "to see we don't let these brave men down." We depend on them and they depend on us." It was a plain truth which need no gesticulations and no cheers. The hands clapped. At the gates of the yard the last cigarettes were thrown away, and then the men streamed on to the empty slipway and into the deserted shops. The yards began to live. Like a machine-gun burst, the first pneumatic riveter sent off its roar, a noise enough to knock your head off, and the first limelight flash of the welder's flame came from the rust-coloured plates lying on the skids. Up the ramp at the end of the yard, scores of men were trooping on to three of the four destroyers lying in the water. And like an answer to this yard, the riveters from the yards across the river rapped out their fusillade.

It was like a battle. It was a battle. Who were the men? Pick them out at random, and it is astonishing how many of them were not lifelong shipbuilders. The slump left its mark on their lives. Here is a grimacing little man in his thirties, a droll with pop eyes and strong glasses, something of a comic turn. Nineteen years out of the industry. Packed up early in 1922, in a bad year; went on the dole for nine months; worked for six years as a gardener, which was changing one kind of open-air life for another. But gardening fell on bad times, so he went as a packer at a toffee works, then to a baker's; was a storekeeper and handy-man. There was a large, grave man sitting on the automatic punch. This convulsive machine looks like a mixture of grand piano and dentist's chair. The chair jumps up and down, and at each jump a rivet hole is struck through the thick steel plate

that will presently be part of the ship's hull. This man had been fourteen years out of the industry. Soft hands had been his trouble when he came back, as it is with all men who leave heavy industries and then return.

There was the head of the frame-bending squad, waiting to draw the frame from the furnace. A lean, wild-looking, tight-breathing man, he had indigo specks on his face – an obvious pitman. He had been a trimmer, a builder and a crane driver. With him was a sad man who left the shipyards for the milk trade. He had been apprenticed to the shipyards and it had been a waste of his time. He was thrown out. So he started a milk round, worked it up, until after years of pushing at it, he was selling his ten gallons of milk a day. He was called up. The end of that dream. He sold his business and came here. He thinks of one thing: getting the war over as quickly as possible and going back to the milk business. He was on his own. The slump in ship-building turned many energetic men into the builders of small businesses which hung together round the family.

THE SHIPBUILDERS stream back to work after their dinner hour. Soon the machine-gun bursts of the pneumatic riveters will rap out. Here too the battle against the U-boat was fought.

There was a grocer who was now a foreman. He was a slight, middle-aged man who wore a scarf and an overcoat, and was sheltering from the wind. The first thing he did was to apologise for his clothes; he'd just had 'flu. The northern shipyards are swept by bitter winds, but you don't go about in a coat and muffler. He had been in the shipyards before, but when they let him down he started, like so many others, one of those small mixed-grocery businesses. He ran this business with his son. His son was called up – that was the first blow. Then he called up himself. So now his sister is trying to run the place. "I made more money in the shop," he said, "and it was strange to me giving up everything and coming here. I want to get back. But, I will say this, shipbuilding is a man's job. You're one of thousands who are making something big."

It is impossible to appreciate fully the work the shipyard workers were doing in this war, anywhere in Britain, unless one gets into one's mind that these people were scarred by the slump. They saw famous yards close.

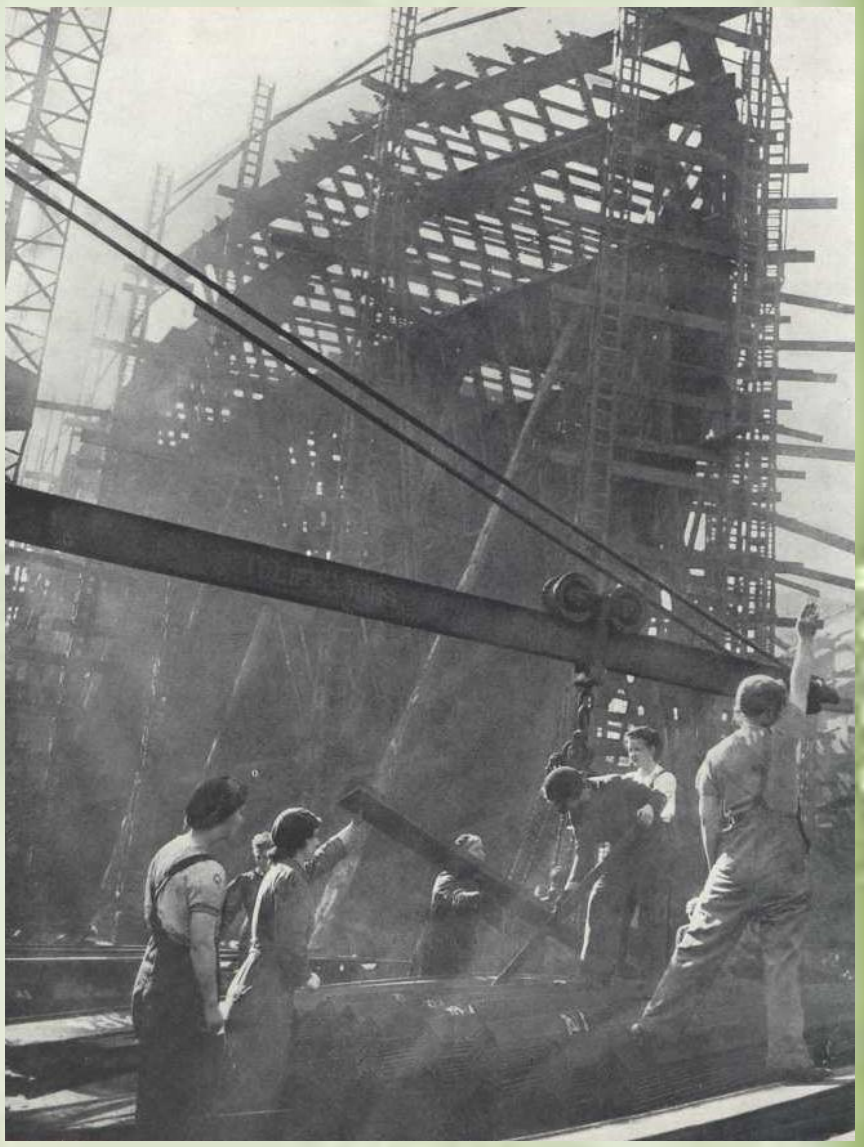
TWO OR THREE THOUSAND OF THEM came pelting out . . . men whose skins are yellowed and greasy with the fume of industry . . . they swarm in the streets, they own the city

They saw places where they had spent years of their life put up to auction. A man's sense of right and wrong, the resources of his character, are bound with his work and the place where he lives in and, like the rest of us, the shipyard worker feels he was torn up and that his roots are raw. He sees, with bewilderment, that he is caught in some world process, larger than his town or his trade; the war was part of it. He could see the necessity of building ships to win the war; he was glad of the good money that helped him to make up the arrears of the slump – the impoverished home and the spoilt chances; but he glowered at the thought of being thrown on the scrap heap again. He certainly saw the need of producing more ships. He thought – and no man is stricter about work than the worker when he feels a sense of responsibility – that long hours slacken the pace of work. Still, he would work, and did work, long hours.

The work in a shipyard has always been uneven in its flow. The frame bender and his squad stand idle while the frame heats in the furnace; the platers are waiting for the crane to come down with new plates. There were lulls, there were furious rushes during the war; and especially because of the submarine war, last-minute alterations - and drastic ones – had to be made to a ship. Disguises might suddenly be necessary, or new armament; work that had been painfully built up must be quickly burned down. Inexplicable delays, inexplicable rushes afflicted the shipbuilder; and it was all the more infuriating because it had always tended to be like that. New techniques come in and disorganise old ones and play the devil with conditions of labour.

You leave the workers in the din of their afternoon. And then at five o'clock – two nights a week the time was seven – the din ceased and was followed by a very different, human roar.

You are standing outside the gates of the yard. A line of empty trams is waiting there. Squads of buses are parked in the side turnings. Presently the gates slide back, and with the roar of a football crowd the workers rush out. Two or three thousand of them come pelting out, shouting, their metalled boots clattering on the cobbles. They blacken the roads. They pack the trams and busses, men whose skins are yellowed and greasy with the fume of industry, who have been deafened by pneumatic tools, who are soaked by the sweat of the forge, who have scorched their boot tips as they drew the steel frames from the furnace, or ruined their overalls on the welding frame. They swarm in the streets, they own the city.



RECRUITS AND VETERANS

You stand just inside the yard looking down on the roofs of the platers' shed and a destroyer in dry dock. The place presents the usual spectacle. Scores and scores of groups of men going about the place on this job or the other, like a scene in a big town. You say to the Irish policeman at the gate, "How many men work this yard?" "About a third. Tommy Handley," he laughs. He has been laughing at a large number of jokes, most of which you cannot hear because he is very tall, for the last quarter of an hour. You are hanging about waiting to go over the Labour Training Centre to look at the people who are going to be turned into shipyard workers. As you wait, a couple of welders pass.

"Good morning. What's your job?"
"Can't you see by our clothes?"

Their brown dungarees are ragged across the middle. "Welders," a public-school voice says. He is an ex-officer, wounded and discharged after Dunkirk.

"Why did you take on this job?" you say.
"It's interesting. It's the most interesting job I've ever stuck. And then, the money! I can make more here than I ever made as an army officer."
"*He* calls it interesting," the other welder grins. He is a Tynesider.
"So it is. There's nothing more fascinating than a shipyard," said the ex-officer. "You see all the secrets of the war. How the hell did you get in past the gates?"
"Influence," you answer.
"I was going to say! They practically search you."
The Tynesider grins. "He's new," he says.

The training centre was once a skating rink. There are 800 men and girls there training for factory life. Some of them will be going into the shipyards. It is the first fortnight that tests a man or woman. In that time the director can tell whether his pupil is going to fit in with factory life or not. They will get used to the noise, the hooter, the place, the order of their jobs, the monotony of them as well as the interest of them. The girls have come from shops and domestic service. They like the isolation of factory work, no customer to pester you, no mistress to drive.

A group of girls and men – the girls mostly in yellow, blue or khaki overalls, their hair tied up in coloured handkerchiefs – are standing round a machine listening to an instructor; upstairs a batch of the brighter ones are sitting at school desks, while the instructor explains a technical design on the blackboard. They are going to be supervisors. There is an N.F.S. group who have come in to learn about the upkeep of their vehicles, and here is a group of disabled soldiers – one of them from Tobruk – learning to be welders. In three months these people reach the three-year apprentice stage: such is the claim.

Now go back to the shipyards and ask about the workers. The management groans, the Admiralty groans. The problem of British shipbuilding during this war was the problem of every industry: labour was rationed. Skilled labour was finally rationed. One manager shrugs his shoulders with resignation at the thought of taking on more women; another is jubilant. "they're more conscientious than the men." The woman problem was a problem for shipbuilding because it is a heavy trade and has always been a man's trade.

Large offices, and those industries which have employed mixed staff for years, would smile at the moodiness of the shipyards on the subject of mixed labour. Of course, the shipyards are really proud of employing women.

The travelling gantry rumbles along overhead in the shed, and a man will touch your sleeve and point up to the little cage on the crane.

"Girl up there. Bloody marvel, isn't it?"

Foreman

Crane-Boy

Loftsman

Shipwright

Riveter

Welder

Sheet-Metal Worker

But what about the regular workers, the men who have served their time, who bear the scars of the slump and have been building ships all their lives? We have seen the trades. The shipwright who lays the blocks help to erect the bullheads and the frame. The shipwrights set the line of the ship. There are the platers, the frame turners, the riveters and welders, the carpenters who lay off the templates or patterns, the joiners who make the modern equipment which has not yet being swallowed up by the light-metal industry. Is there a hierarchy about them? Well, a foreman plater is somebody. In the old days, the foreman plater would turn up on Monday morning in a clean pair of moleskin trousers and a bowler hat and get his squad going like a sergeant-major. There is an inherited craftsmanship, and he was filled with the pride and pedantry of his craft. He still is.

Some of these jobs run in families. You see white-haired father and middle-aged son marking off the plates; and if that son falls sick, father simply sends down the yard for his other son. It is a kind of royal command. No one disputes the father's right to send for him. Some of these men have in their pockets lists of ships they have worked on. Some of them can say, "I must have passed the 200 mark." You feel in watching the skilled trades, indeed in watching most of the work, impressed by one fact – that these men are engaged in innumerable acts of judgment. Judging how far the crane hook must descend, where to stand for the plate or bolt the frame and so on. They have the absorption of makers who have had to learn to make together.

In so much of the work outside of the industry a man or woman works on his own. He serves the customer, he drives the lorry, he signals the train, he writes the figures in the ledger and drives the tractor and makes the contract, in a kind of solitude, and does not need the presence of others. Not so in industry. Here the unit is not the man, but the gang or squad, or the man and his mate. Even the man who dictates a letter to his secretary is not so dependent on her as the man in the factory is on his group, on its silent working rhythm, on its timing and understanding: the glance of an eye or the movement of the hand or finger has a meaning that is understood at once and also implies experience and reliance. You laugh incredulously when you see two men swinging on a plank over the ship's side, fifty feet above the concrete bottom of a dry dock, while one punches back rivets with a sledge-hammer and brings it down twenty times within a few inches of the hand of the man who is holding the set.

These partnerships are so silent. The inhuman noises drive out the possibility of human talk, and in that human silence judgment is refined and understanding has no hitch. The essentials of a man's character come out in many physical actions; much of the apathy, which observers think they detect on the faces of men working in this way, is really something else – a sinking and absence of the self, a merging in the rhythm of the job and, to judge by the shrewdness of comments you hear afterwards, a continual rumination on the character of the people you are working with, and of the other groups who are in contact with your own. The fast man, the careless man, the patient man – one in a kind of industrial *Pilgrim's Progress*.

Masters of their craft..

THE SHIPYARDS TURN TO WAR

It would take months to visit all the shipyards in Britain. It would mean not only going mile after mile along packed banks of the Clyde and the Tyne, down the crammed ravine of the Wear; one would also spend days in the fume of the Tees, in the fog of Birkenhead, the smoke of Barrow. One would have to take the plane to Belfast. This would be simply the beginning. For there are the yards of the Scottish coast and the English Channel, the dozens of places on the estuaries and rivers where small pleasure craft were built before the war. There are those inland factories where small ships and barges are made in sections. Everywhere ships and boats could be built they were built. The war programme stretched from the motor torpedo boat to the aircraft carrier, from the tank landing barge and the wooden minesweepers to the tanker and fast cargo liner.

Let us begin with the Tyne. In the train going north you study a number of shiny industrial documents, and at Darlington you pick up the first hint in the grey evening light. Your eye catches a sight of a small engine chuffing out of a steel works, and drawing a little truck. On the truck is a gleaming vermilion block which looks like red nougat; it is a block of red-hot steel. You have seen the Durham mines, you have seen the hoppers of ore and the long wagons of steel. You are in the coal and steel country of heavy goods trains with powerful engines that clank slowly as they draw their interminable loads along the branch lines between Middlesbrough and Northumberland. Men are building ships on the steep banks of the narrow rivers of this coast because the iron ore and the coal are near. They are the most awkward and difficult sites for shipbuilding in the world; but iron and coal have decided their position. The slipways, you notice,, have to be laid at an angle to the stream, for there is seldom room enough for a right-angle launch. From these places is launched a large proportion of the world's tonnage, a very great variety of specialised ships.

The coldest wind in England blows into the north-east coast and sweeps the shipyards.. Listen to it bouncing off the windows of the buses and trams on their journeys from town to town. For the Tyne is a string of towns, thrown over the steep hills and linked by wasteland, red brick slums [blitzed first by the slump of 1931-33, and then by the Germans], and by pink housing estates with miles of shrubbery. On these buses, you sit among experts. They are workers, all of them; not a man of wealth or leisure among them. Every one knows the yards. Your neighbour might be a gas man, the baker, a soldier on leave, or a shop worker or a miner; but ask him when this ship or that was launched, tell him you think welding is the coming thing, or try him on Russian Icebreakers and the speeds of destroyers, and he can flood you with facts and sink you with judgments. All the people on the bus can tell you about the shipbuilding firms, who is the brains of this business, who is the misfortune of the other, where this yard went right and where it went wrong. The family history, the births, marriages, deaths and investments of the shipbuilders come under the same scrutiny as their work. Not a success, not a scandal escapes. This industry belongs on Tyneside intimately. Not a good man and not a bad man but is known inside out.

It is not long on the north-east coast before you get into an argument about the merits of the English and American methods of building. If the rapid production of ships is what is wanted during war, why not copy the Americans, the masters of mass production? There is no British shipbuilder who does not admire the American effort, even though the notion of throwing a ship together as you would a car makes the heart of oak groan. The American system is the conveyor-belt system. You chose the site, you build your ideal shipyard. You chose your single type of ship, you stamp out the parts and weld beside the slipway – some of the sections weigh up to 50 tons – you put the machinery in before she is launched [which is the American habit, and desirable where the welded ship is concerned].

But look at the enormous difference between the British and American conditions. Remember, incidentally that the first Liberty ship, the prototype Britain gave to the Americans, was built on the Wear.

Remember, too, in hearing the now notorious arguments and wrangles between welders and riveters, that Britain has a big lead over the Americans in hand-welding. And now look at the two industries. British shipbuilding yards found themselves in the front line of a country at war when, even if it had been possible, it certainly was not desirable to waste time reorganising the industry from top to bottom. There was neither the time nor labour for that. The Americans had the fullest choice of land and labour. There was nearly twelve million unemployed to chose from. There was no scramble for waterfront as there is bound to be on English rivers. Above all, in America, rival war industries were not taking away the manpower.

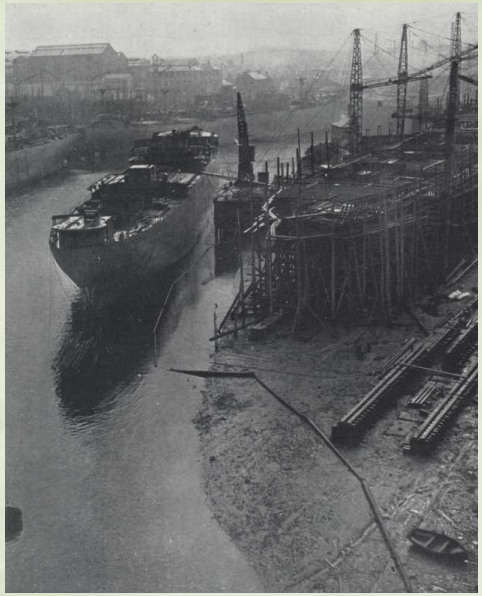
What the British builder had to consider, when he was tempted by out-and-out welding and prefabrication, was the fact that welding saved steel but used more labour. Which did he want to save? Labour, of course, under our conditions. He had riveters ready; but he knew that, since his labour was more and more diluted, it would be easier for him to weld, since you can train welders in a few months – youths and young women make excellent welders – whereas it is far harder to train good riveters and they have, as a rule, to be men.

What the British shipbuilder did was to compromise. The fancy lines went. In the drawing office you were shown how the number of straight plates – quicker to make than the curved ones – had been increased in ship after ship. You saw them mixing welding and riveting; you saw them marrying the traditional method of construction with various degrees of prefabrication. Prefabrication means that certain parts of the hull of the ship, parts which may weigh a few pounds or a few tons, are welded or riveted together on the ground beside the ship, or in some factory elsewhere, and they are then assembled in the shipyard by the waterside. Whereas, by the traditional technique of shipbuilding, where riveting is mainly employed, the parts are fitted one by one to the ship.

Before the war shipping companies indicated to the builder the kind of ship they wanted. In the light of the information furnished by the owner, the builder's drawing offices worked out the design. They experimented with models to determine the relation between engines and hull design. When the industry became organised for total war, design was stripped of its individual fancies and the Admiralty, in consultation with the Ministry of War Transport, determined what designs were best suited to fulfil wartime requirements. In fact, like people, ships were requisitioned, their equipment was rationed, and their jobs in most cases were very different from the ones they did in peacetime. The shipyard designer had to consider cargo and speed in relation to the war at sea. The Ministry of War Transport told the Admiralty which losses most urgently needed to be replaced, and the Admiralty, in turn, determined which yards were most suited to build the various types of merchant ships needed.

A similar attention was paid to size and materials used in the building of the ship itself. Steel had to be saved. Hence the attraction of welding, which saves an inch or so overlap on every plate. A few hundred inches make a respectable difference to tonnage. Then the wooden deck went; light metals and plastics took the place of wood in the ship's fittings – in cupboards, tables, wardrobes, lockers, etc. Paint is a costly part of shipbuilding; the three or four coats of peace time paint were cut to one or two. Three coats were exceptional and the paint had not its pre-war constitution. The upper masts went and the high funnel – they gave away a ship's course to U-boats.

In outline the ship was simpler; but in detail it was often more complex. There was more gear at the main hatchways, for in wartime a ship may have to unload her cargo. Blackout had come in: it was far stricter on sea than on land, and also more tiresome. But holystoning had gone. A mixer, which looks as though it is mixing chocolate, makes the composition that went down on the deck. No longer did you catch the smell of oakum or hear the tap of the wooden mallet as the shipwright caulked the wood deck. But, against these losses, you saw things like asphalted armour of the bridge and gun emplacements – the asphalt is poured in between two sheets of steel and is an excellent protection against bullets and splinters. And there was a whole new mythology of secret instruments.



ON THE NARROW RIVERS of the north-east coast, the slipways are laid at an acute angle to the stream: there is no room for right-angle launches. Yet from these crowded shipyards goes out a considerable proportion of the world's tonnage.

Those were the chief changes one saw in a ship. There were some changes in the engine room, too. The boilers, and main engines and auxiliaries, had in many cases been standardised, and they were built not only by marine engineering firms whose names are famous, but by firms who had never touched marine work before. Simplicity, if it could be achieved without sacrifice of efficiency and safety [for a vessel with a limping or stopped engine was like a lame animal, at the mercy of the marauder], was the object of the marine engineer and the builder.

PREFABRICATED TUG being put together, section by section, like a child's constructional toy.

MASS-PRODUCED MERCHANTMAN. Practically the whole of it was made at inland factories.

FROM DRAWING BOARD TO PLATERS SHED

A ship begins its life in the drawing office. After the dust, the cold wind and racket of the shipyard, the drawing office is quiet and warm. In the high, light room, the air is almost aromatic with the smells of polished wood, pencil sharpenings, tracing paper and Indian ink. The gold-rimmed spectacles of the draughtsmen catch the light as their heads turn. The silence is studious. It is broken only by the discreet step of shoes on the linoleum or the soft swish of the tracing paper as clean hands roll it back and weight it down with the heavy round rulers. The draughtsmen rarely look up when the stranger comes into a room, and you do not catch them nodding at each other as the men in the yards do, when you go out. Most of these men in the drawing offices come from the secondary schools; some of them get their first-hand experience in the yard; the ones who will have executive jobs later on have probably gone to the university in the winter, to get their B.Sc. in naval architecture, and work in the drawing office in the summer.

There are not just one or two plans of a ship. There are hundreds. There may be thirteen or fourteen thousand plates and bars, a million rivets Here is the plan of the frames, here the plan of the bulkheads. This one shows a weird cross-section. This one refers to the holds of the stern. And then you may see some rudimentary ship's model made to scale, which has been constructed to test the lift winches or the effect of certain weights. Here. too, you may see a model of the launching trigger.

From the drawing office the plans go to the mould left. You go out of the drawing office and up the stairs in some building of the yard and again you come into quietness. An enormous floor lies before you. It is like a skating rink with joiners' benches round the sides instead of seats. The wooden floor may be half be half the size of a ship, and a group of men in brown dustcoats, kneeling in the middle of that floor and tacking laths of wood together, look small and lost. As you walk across the floor, you notice that a fine pattern of curving chalk lines, made in thin hard chalk, is drawn on the floor. If you stand in the right position, you will see that these lines follow the curve of the hull, so that whatever plate or frame is needed on the ship, you will be able to walk across the floor to the precise spot and see its shape and work out its measurement. from the diagrams on the floor the carpenters are making full-scale patterns or templates of all the peculiar plates and frames of the ship's hull.

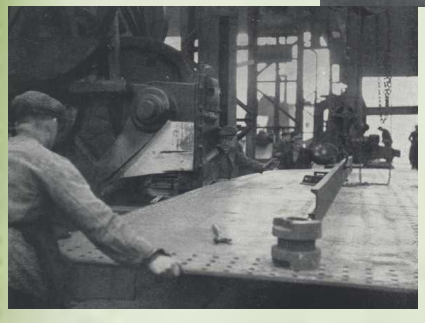
From this point shipbuilding leaves the quietness and spaciousness of theory for the muscular contention of practice. It passes from the clean hands to the dirty hands. First there is the forge. It is a building apart, and here the tools of the shipyard are made – things like the teeth of the punches which are driven through the plates, and all manner of shafts, There is this forge, and the lighter forge of the plumbers where they bend the lead and copper pipes like snakes.

In the main forge there are thirty or forty blacksmiths. The shed is dark. Each man stands before his hooded fire, his face smoky and reddened by the flame and glistening with sweat. This is one of the muscular, skilful and genial trades. The sweat pours out, the beer has to pour in – even at the present price, which hits the blacksmiths hard. The masters of the craft often run too fat. The sound of each trade in a ship has its special quality – the riveter's and caulker's fusillade, the plater's solemn clang, and the elephantine thumping of the forge. These steel hammers, that come down like tree trunks on the anvil, shake the earth and the building and thicken the air with a cloud of reverberations. One is surprised that the foundations of the world can stand to such tonnage of blows in the belly. There are craftsmen here who have been forty years at the job, and their fathers before them; cunning men who will temper still till it reaches the right degree of blue as if they were magicians.

Watch one of the master smiths at work. He and three helpers and a boy are there, waiting for a

HOW IT BEGINS. In the drawing office, a high light, silent room, plans and models are prepared. Templates, full-scale wooden patterns of the ship's plates and frames, are then fashioned in the mould loft.

"LIKE SOME PROFANE CATHEDRAL, dim, solemn and portentous," is the platers' shed, where the platers' squad and the frame-benders shape out in metal the template designs for the ship's hull.



PLATERS WORKING The one-man punch, with its jolting, bucking chair, punches rivet holes in the plate which is then trimmed to exact size by a shearing machine that cuts metal like cardboard.

"IT IS LIKE KILLING A SNAKE." Darting in and out with their hammers, they set to shape the red-hot bar that is to become one of the ship's frames, or "ribs."

for a shaft to heat. They do not speak. They stand relaxed, gazing at the fire, each forming his opinion of the right moment to draw the shaft out. Even the boy who sits on a perch behind the hood of the fire, and whose job it is to pull the lever back and forth and release the enormous stamping foot of the hydraulic hammer, has an alert eye on the smith. This is the boy's first job. Two months ago he was thirteen and at school. The smith, wide and fat in his apron, wipes his hands on a rag and picks up his tongs. The three men crouch and lift the shaft – which is about twenty feet long and the size of a half grown tree trunk – by a grip arranged like a double wheel so that they can turn the load. A wall of solid heat moves forward and leans flat against you, and down comes the earth-shaking hammer, squeezing an inch off the thickness of the shaft like toffee.

As the smith directs the turns, his helpers crouch like wrestlers. They grapple and strain with the end of the shaft, their watchful eyes missing none of the smith's movements. It is majestic smooth. Now and then the smith sprinkles a little water, like a baptism on the shaft, and adds an element of devilry and magic. It is a very ancient trade and yet, as you go, you notice a strange and beautiful modern aspect of it. Working at a lighter job before another fire stand a young man and girl, the girl with her hand on the lever, the man with the tongs in his, like some new Adam and Eve with the fire reddening their faces, standing in the silence of their work. It is the silence of people in the noise of these yards which you think of afterwards.

The forge is common to many industries, but when you go to the platers' shed you are in a place which belongs to the shipyard alone. It is like going from a fiery twilight into the wide, dim grey of a long evening. You step across the cobbles and light-railway or crane-tracks, through an entrance that can take half a dozen lorries or more, and you enter a building cathedral size, dim, solemn and portentous. The impression that one has entered some profane cathedral grows as one walks down the wide aisles between the great black machines that dwarf the people working at them, as one looks at the bare brick walls and the high windows, which have been darkened since the war by blue paint. When the welders tip back their masks or helmets they look like nuns or knights, and reveal that medieval aspect of modern industry which is confirmed by the sight of collective work.

Not individual people, but groups or gangs of people are important here; the individual is least, the group alone seems to have personality. And then, the sounds. There is no continuous racket of little machines. This diabolical religion is expressed in sounds more measured and portentous. There are great and sudden clangs, an intoned mutter runs between the greater noises, and there are bell-like, gong-like crashes, which astound the ear and the mind. You feel you may be watching a rite devoted to the creation of the ship which belongs naturally – before anyone else – to these votaries who are building her. Human hands, have touched every inch of that dour shell and given to their work an unconscious meaning.

When the "green" plates are brought by the railway from the steel works to the shipyard, they have been cut approximately to the right sizes. But many will have to be cut down, trimmed; many of them will have to be given the curve of the ship's bows or the stern. So they go to the platers' squad. The platers form one of the main trades of the industry; a foreman plater is a great man, a king with his own entourage. The size of the platers' squad varies from yard to yard, but it is common to find a squad of twenty or more platers' helpers working together and keeping the flow of plates going from the shop to the hull.

The platers whistle up to the girl in the little box of the crane which travels overhead quietly from one end of the vast shed to the other. It rolls slowly across the roof towards them. Down comes the chain; by instinct the men whistle – the girl cannot hear it in the rumble of the shed – but she sees a hand go up as well. One finger for stop, two fingers for go. You see a man, with a pot of paint, laying the wooden template or pattern on the plate and marking the rivet holes. Once more the hook of the crane comes down and the plate is carried to the one one-man punch, which grips

the plate, rolls it along and punches the holes in, while one man sits in his epileptic chair above the machine, pulling and releasing the lever. Or perhaps the plate goes to one of those long machines which drill four or five plates at a time, while a man watches the steel shavings corkscrew out of the hole – all he has to do is to water the drill and keep it cool. There will also be a countersinking machine which bevels the holes; and then the steel plate is picked up in its sling of chain and carried to the shearing machine, which will cut its edge like cardboard.

But perhaps a curved plate is wanted, with a kind of leaf curl in it. If this is so, it goes over to the furnace and there it is made red hot in the ovens. There are large wide ovens for the plates, and long narrow ones for the frame. There is silence near the furnace, except for the faint tick of burning coke, as the gang of plate or frame benders wait for the steel to be at the proper heat. They stand there, a gang of half a dozen men, waiting with their sledge-hammers –once in a while you will see a hefty-looking woman. The floor is an area of iron grating, and the men have fixed the cradle over which the plate is to be bent. This is a job of muscle, dexterity, incredible speed and skill. For they must strike while the iron is hot; they are racing the dying heat, and every blow must be in the right place so that the plate does not rise too much here or stiffen there. You were standing at the far end of the platers' shed when, suddenly, above the mutter and banging of the punches, you heard a noise like athe crash of a gong, like the beating of a barbarian's bell. That was the sound of the plate being struck to its shape, steel on steel, when it was drawn from the furnace.

A less sonorous cry comes from the frame benders, the men who bend the ribs of the ship, but here the sight is more animated:

"Is there a frame coming out?"

The head of the squad opens the oven door.

A tongue of heat leaps out and you stand back, a good six or seven yards clear, as you hurt your eyes looking for a second down the corridor of fire where the frame is quivering.

"There'll be one out in about two minutes."

On the grating where you stand – it is a grating of holes, not bars, and a good twenty yards square – the gang have fixed the curved steel pattern to which they will bend the frame. Near it are brackets – "dogs," they call them – which will be picked up by pliers and dropped into the holes and over the frame in order to hold it tightly down. The two minutes are up. A nod from the leader of thee gang, and a man opens the door of the bar furnace again. Two men pick up the end of the frame in their tongs and slide it swiftly out. It slithers out almost soundlessly, a straight, flashing, almost transparent ruby bat twenty or thirty feet long. They skate it over to the set-iron or pattern. Two of them slip the brackets over. The others lift their hammers and strike. In the midst of them is a man who has wheeled an hydraulic punch against the frame and squeezes it softly to the bar, while all round him the squad dance like boxers, picking out the dog or bracket from this hole, slipping it into another, while the hammers fly at it, and the straight bar is now a grey curve with the ashy flake of steel scale breaking off it. It is like killing a snake. And now the frame is a simple curve, a flattened "S"; or, when they are making the frames of a submarine's hull, it is almost a circle.

One watches the feet of these men, the way they dance round the metal, almost touching it with their boot tips [sometimes they do touch it, which is good for their coupons]. One notices how each man knows which bracket to loosen and which one to tighten, and when to slip back for a new one, and when to come in with those final blows that keep the end of the frame from buckling and rising. In a minute or two their frenzy is over. Six men stand there panting, their chests and faces drenched in sweat, their wet hair hanging on their foreheads. A frame-bender may make

£10 or £11 a week, but he commonly paid by contract. A lump sum is agreed upon by the gang for making all the frames of a ship and the men can draw on this sum as they want it. "I remember," said a Scottish plater, thinking of the ships he had worked on and of the horrible follies of mankind, "the what was it? – I forget her name. Anyway, ships are numbers to us, not names. We'd a week's work to go, and when I went to the office I found we'd made a miscalculation and had drawn all the money already." His laugh was macabre.

These are the main jobs of the shed where the grey cathedral mist rises between the machines. When prefabrication is being employed, you see the hydraulic riveting machine at work in the shed; it is a cousin to the one-man punch. The hydraulic riveter is like a beast with a large pair of lobster claws protruding from it. The plate is wheeled on a trolley and passes between the claws. The riveters' fire travels with it. Four or five red-hot rivets are thrown on the plate and the claws come down and squeeze them into holes. And no platers' shed is without the welder's flame. Its lilac electric flash distorts the faces of the men and women, and sets nervous triangles of light twitching and jumping over the machines and the wall.

THE LOBSTER CLAWS of the hydraulic riveter, a machine used to fabricate work.

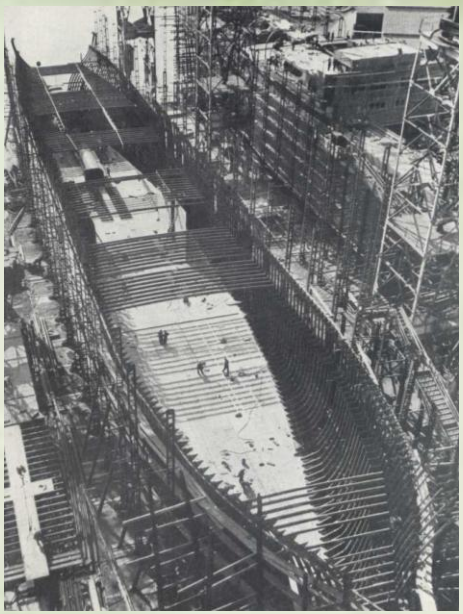
THE SHIP TAKES SHAPE

Outside in the yard the shipwrights are laying the wood blocks on which the keel of the ship is laid. These wooden strong-points are shoulder high when you stand by them. They are criss-crossed like a child's bricks, and a full line of them from bows to stern will take the whole weight of the ship as she rises. What is a ship's keel? It is not one of those deep fin-like blades which shape the bottom of a yacht and which are there to give her steadiness. A keel is the back rather than the backbone of a ship. When you duck your head and walk underneath a ship that is being built, you are stooping under a low, flat, black ceiling of riveted steel which is kept off the ground by the blocks and by phalanxes of pit props. You have the impression of walking down the galley of a coal mine. You may think of the keel as the ground floor of the ship, but in shipyards you must be careful of words. To the shipbuilder the floor means not the flat surface but those plates, each with a manhole in them, which are fixed in them, which are fixed vertically to the flat surface and help to make the box in the double bottom. The bottom of the ship is really several rows of narrow chambers, and they are, indeed, often used for carrying oil and water ballast.

After the bottom of the ship is laid, the frames [or what the layman calls the "ribs"] begin to rise: within them are built the great walls of the bulk-heads or watertight compartments. The plates or walls of the hull are "hung up" on the ribs. The crane picks up these plates from the platers' shed and carries them to the slipway. By now, you see that thick stockade of steel or wooden posts which rises round the hull. At the bottom of it, the supporting props are prodding into the side of the vessel, taking the enormous strain – short props close under, long ones further out – and over this maze of scaffolding rise the tall steel carriers of the cranes which preside like fantastic birds over the work. It is common to see a circle of these high stork-like structures, with their long-necked jibs slowly turning over the ship, while the chain dribbles down to pick up the plates from the gang of men below, who are struggling with a swinging sheet of steel which may be ten or forty feet long and many feet wide. "Hanging up," though it is an expression which suggests the lighter art of the wallpaper hanger, is a good phrase. The plate goes up into the sky and then is lowered to its place in the ship's side. A whistle blows, and it is temporarily held fast by nuts and bolts, waiting for the riveter. Or, if part of the hull is welded, then the plates are lifted in sections of many tons each to be tack-welded before the final welding is done.

That is the job as you see it on the slipway before the launch. Three thousand tons of steel, yellow as gravel, slopes to the water, held there by catches not much larger than a man's hand: [there were 40,000 tons of the *Queen Elizabeth* and six eight-inch triggers held her huge weight in place].

If the platers' shed suggested a medieval rite, the shipyard itself suggests a medieval city, self-contained and animated by a large number of independent trades. You are struck by the number of people walking about, apparently at random, but going on from one job to another. Everywhere you see little groups of men or girls, to all appearance detached from any contact with the rest, huddled round some special job. Those welders, older men than the general run, who are doing the upright welding and not the easy welding on the flat, are working on a collection of conning towers for submarines. Stuck down there, the conning towers look like enormous pepper pots. These two flour-whitened youths stirring that white powder and paste are mixing the insulating material that will go on the walls of destroyers; those others loading up the asphalt that goes into the anti-aircraft armour. This group following the crane are taking what is called the "coffin" plate to the new tanker. Those girls are going on to a launched ship with their paint pots.



THE GIANT'S RIBS. On these frames the plates are "hung up" to build the hull of the ship.

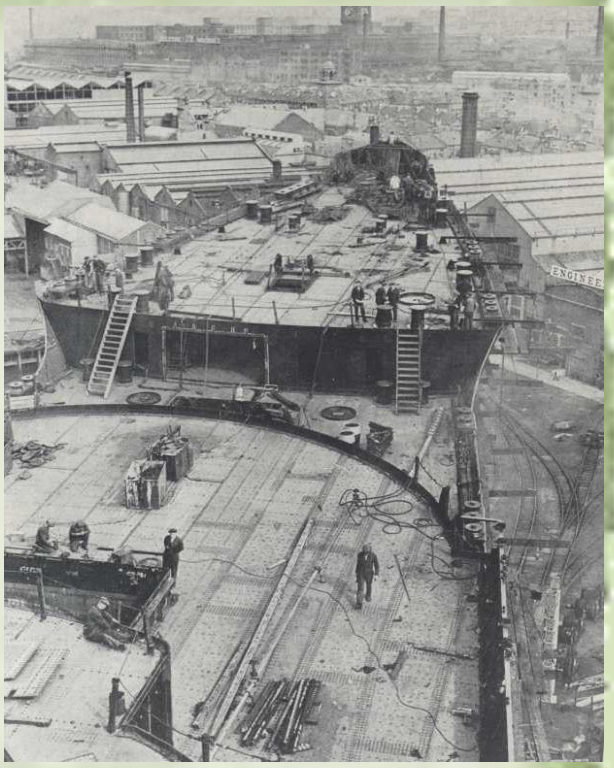
You hear a whistle from somewhere in the belly of the ship, and the plate with its lace of holes at the edges is stopped in its descent and men seize it to bole it into place. Those bolts have to come out when the riveter gets to work, and a woman has got a wrench on them. The riveter is a man who will work anywhere on a ship. He may be sitting with his legs dangling from a plank behind the mesh of scaffolding on the ship's side. he may be down in the darkness, that dead steel darkness of 'tween decks, which hangs in a ship when it is just a collection of rusted steel boxes stacked together, before the paint has lightened and civilised it. He may be working on the high, wide flight deck of an aircraft carrier, on the giddy projection of its gun emplacements, on its bridge that rises like a tin hotel on one side amidships. The wind can blow pretty well strong enough across the shelterless deck to blow a man down. The riveter, like the welder, may have to go down inside the oil tanks of a tanker, where he will work with his lamp and his fan in the fumes, and you wonder that there is room for the man and the noise together inside the cistern.

The riveter is a member of the "black squad" – a gang of four who turn up to the job with the misleading nonchalance of a family of jugglers. They are the riveter, the holder-up, the heater, and a boy. A speechless quartet, or almost speechless: "Where's that boy?" is about their only sentence. The "black squad" can set up shop anywhere and begin performing their hot-chestnut act. You see one swung over the ship's side. He stands on his plank waiting with the pneumatic instrument in his gloved hands. On the other side of the plate, inside the ship, is the heater with his smoking brazier – a blue coke haze is always rising over a ship: he plucks a rivet out of the fire with his tongs, a "boy" [nowadays it is often a girl in dungarees] catches the rivet in another pair of tongs and steps quickly with it to the holder-up, who puts it through the proper holes at the junction of the plates. As the pink nub of the rivet comes through, the pneumatic striker comes down on it, roaring out blows at the rate of about 700 hits a minute, and squeezes it flat.

One of the curiosities of the ship's side- it is also one of those accidental beauties of line which are sought by modern artists-is the white chalk mark which the rivet counter ticks across each rivet, showing how many the riveter has done in the shift. One see half a dozen plates cross-hatched in this way by the errant human touch, and a list of figures like a darts score is totted up beside them. Paid by the hundred, the riveter is keeping his accounts. He will average up to thirty-seven in an hour.

And now the ship has its walls and its holds: it is on the way to be decked, except for that great cavern into which the engines and boilers are to be lowered. The noise of the building reaches a note and volume which are unimaginable. From the distance it sounds like a thick gale of wind in a forest: in the yard itself, as the riveters' sparks dribble down from the ship's side, you seem to have got into a hot corner of a gunman's skirmish. In the yard you could hear if you shouted. Here your shouts are knocked clean out. You have to doge around a corner and hope one word in six will reach the ear that is leaned towards you. The roar comes from above, below and on either side of you – a pandemonium of clangings, rappings and sawn-off-gun work, with men making rival roars in an alley-way a yard wide, that at first causes terror as you grope through the darkness. Hundreds of men seem to be lying, kneeling, crouching, crawling about. Here is a group of men chipping the top of an airtight oil hatch. These stage-lighting flashes are the eternal welders, the boys. For the caulkers are at work, easing up the edges of the plates to the rivets heads, to make the ship watertight and sound. You step over their heads and legs. Once in a while a face which has gone beyond indignation and resignation into a world of its own looks up from the level of your knees. It is the face of some caulker coming up for air after twenty people in boots that are not light have stepped over him as he worked.

You look down into the body of the ship, through the smoke haze of the riveters' fires, and watch the men step about there like little demons in the galleries of Dante's hell. It is like looking down the side of a bombed-out house, each storey naked and revealed. And in all this shindy and rusty disorder you see one of the most extraordinary sights of the shipyard, the first sign of civilisation – a woman in overalls, sweeping up!



HER BOWS TOWER above the town, her deck "suggests a medieval city" with groups of people working independently or walking from one job to another. A pre-war photograph of the Queen Mary.

ON THE OTHER SIDE OF THE PLATE, inside the ship, are the heaters with their smoking braziers, plucking the rivets out of the fire.

A SHIP IS BORN

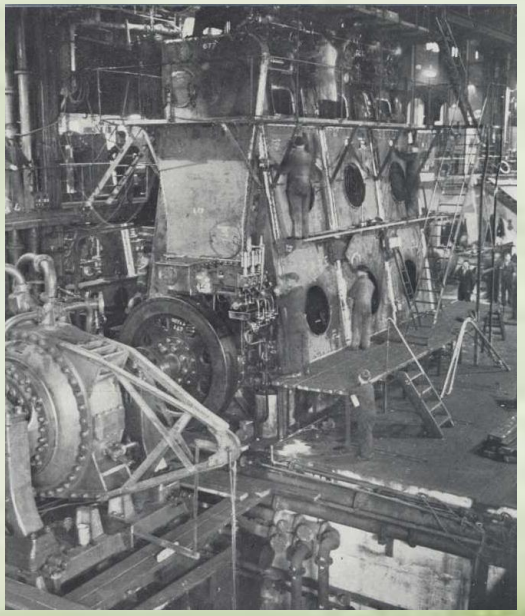
Now, underneath the ship, under that low black mine-like ceiling with its corridors of pit props, where the ground is littered with wood chips and where you are glad of a bowler hat to take the crack of the beam you did not see, the men are preparing for launching. Two more rows of blocks have been built on either side of the row that held the centre keel, and on these blocks are the launching ways. They are really a wide pair of wooden, scenic-railway tracks on which another pair of tracks called sliding ways, are resting. Thick yellow grease is melted and poured between them. At the fore-end and after-end of this track are the launching triggers.

Their mechanism is very much like that of the trigger of a gun, and when it is released – that is to say, when the men have knocked away the props – that small finger of wood comes down, and out slides the ship on its journey. At the side of the launching ways you will notice heavy coils of rusty chain, a pile of it looking like guts; they have not been dropped there by accident. They are used to break the ship when she goes off into the water. Remember, she has no engine in her. She is light and free. The naval architects have had to calculate the strength of the tide, the ships' weight and speed, the angle of the launch in regard to the width of the river; and when they have made this calculation they know how much chain she must drag, like the brake of a balloon, to check her at the right point in the river. Otherwise she might hit the opposite bank. She moves out slowly, momentously, to the plunge, and in the water glittering against her wide hull a mess of debris has gathered round about. This is not the rubbish of the river, but the blocks of the sliding ways which she has taken down with her, which are held together by wire and will presently be fished inshore again. A ship has been born and looking as plain, blind and unhopeful as any new-born thing. These blocks are a sort of afterbirth. The tugs, like midwifes, come along and take her down to the marine engineering works to get her boilers and her first feed of oil.

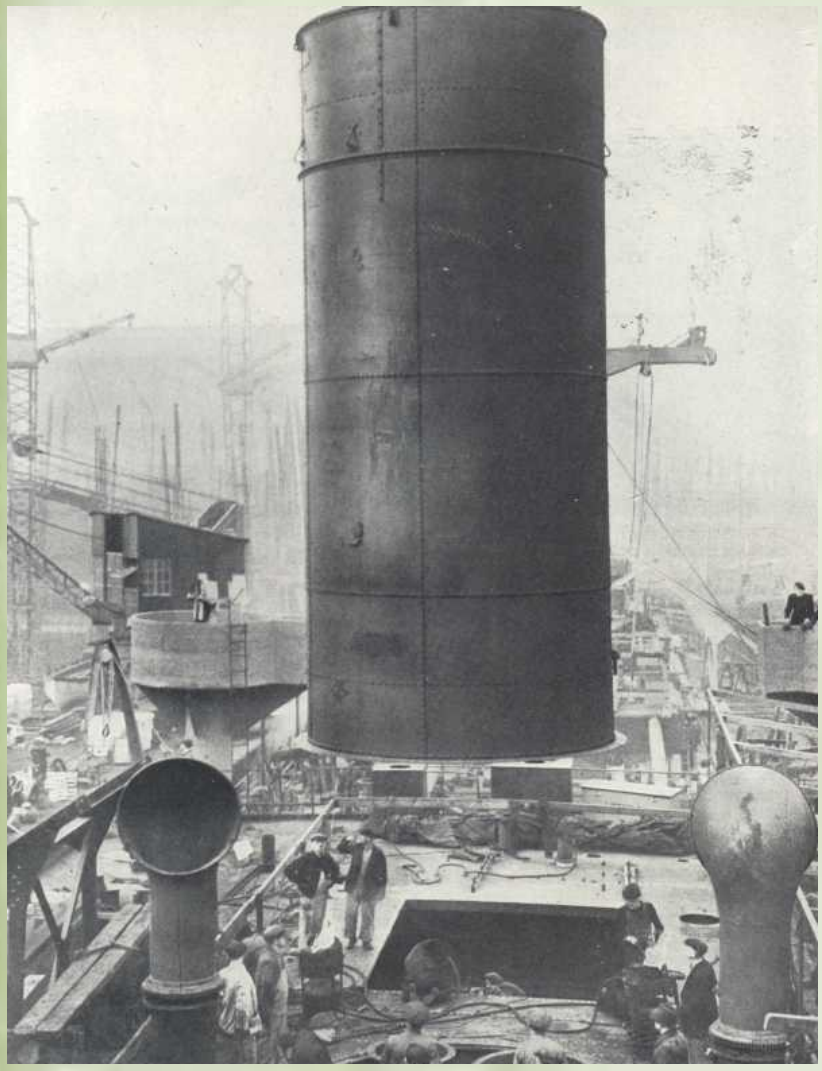
"She's gone down for her engines." Stand at the water's edge and gaze down the river, which looks like a busy street in the smoky sunlight. She is tied up, with two destroyers and a tanker, at the fitting out wharf. You can pick out the Works on the skyline, by the huge black cranes, like a heavy letter "L" printed upside down, which dominate all the shipbuilding rivers. These cranes are the house sign of a new industry – it is more than a hundred years old – which has become attached to the ancient trade of building ships. The Diesels and the turbines, and all the auxiliary machines which make a ship live and drive it, are made in the enormous halls of the Works. On the floor the new engines rise. They look like crude cathedral organs, with youths and men climbing over them to fit and to weld; and sometimes the machines which go to make the engines are larger than the engines themselves. To the stranger, walking down these crowded alleys, between one hissing giant and the next, and finding his way among the scores of preoccupied men who serve them, it is like a terrifying and powerful city enclosed unapproachably in its own din. Here are ten or twelve boilers. That young man with the shaggy black hair and sweat-silvered chest picks up his sledge-hammer and lays on with twenty alarming blows; then grins sardonically at your boot heels.

Further on, four men are turning a boiler top slowly round. One side of it is as red as a raspberry and almost as soft; the hydraulic press is coming against it and squeezing the red-hot metal. They are flanging the boiler. Then it is bored. Farther on again, you see a team of men bringing their hammers down on it and filling the hall with a sound like the peal of Big Ben. The riveter's boy, waiting for the next rivet in his fire, is playing about with the tongs and pulls an imaginary tail from the foreman when his back is turned. There is only one quiet place, a huge floor, cool and damp, where at first sight dozens of men and women appear to be gardening. They are really ramming the black wet sand round the cores of the moulds which lie in rows of boxes on the floor. At the end of the hall women joiners are constructing the wooden cores And out of the work of all these people come the castings which go into the most famous marine engines in the world.

SLOWLY, MOMENTOUSLY, SHE MOVES OUT INTO THE PLUNGE.



"SHE'S GONE DOWN FOR HER ENGINES." A huge Diesel engine, three stories high, dwarfs the men who put her under test.



SLOWLY THE GREAT FUNNEL swings into place; the huge stork-like crane handles it with care. Below the riveters wait.

IN A LAST_MINUTE HUSTLE, while the new ship lies at the fitting-out wharf, guns are hoisted aboard, welders flicker over the gun platforms. She is almost ready.

The business of the British marine engineer during the war was influenced by three main things: the need to produce a large number of engines which must be absolutely reliable; the need for simple designs which could be handled by sea-going engineers short of experience, for there had been heavy casualties among the skilled; and the need to produce faster cargo ships. When war started, we had to introduce high power to cargo liners by the adoption of geared turbines – an arrangement which effects a great saving in weight. These geared turbines, taking steam from water-tube boilers, had been used in general only in warships and high-class passenger liners; later, because of the saving in weight and the economy of materials, these engines went into a large number of the vessels in the Battle of the Atlantic.

In the evening you can go down to a small workmen's club. Most of the men there have been home an got out of their overalls, but there are a couple here with faces comically greasy and dirty, a Laurel and Hardy pair, sitting alone with vacant smiles on their faces and a glass of stout each before them. There are a number of small trades in a shipyard and the life of these two men is to on the ship when it is launched. They are shy, obscure men who watch the guiding wires, hand over to the tugs, and will go out anywhere up the coast with an un-ballasted hull that gets lively in a rough sea. On a job like a launch the men are all on the morbid look-out for something queer and unpropitious. Did you feel her roll this afternoon when she was half-way down?" says Laurel to Hardy. "Aye," says Hardy, "something queer out there – that roll in the launching. And in the way her 'arse'" shipyard technicality – "rose" when she floated."

The most exciting moment in a ship's life is a week or two, or a day or two, before she is finished. If she is a naval vessel the commander comes down every day to see her and launches with the firm. He is engaged in what the Navy calls "building the ship." "I remember," he says, "when I was building my last ship at So-and-so's." The shipyard managers, architects, engineers and so on, raise

an eyebrow. "Who built this ship?" they silently enquire. "You or the shipyard?" It is a manner of speaking. "Building the ship" means overseeing these last few weeks. Merchant seamen do not use the phrase. But you see the excitement of the job in its finished stage, the beginnings of the commander's passion for his ship, the daily growth of ardour for it. "That's a useful gadget. I remember I was coming down from Iceland last winter in a terrible hurry..." This is a good moment for the workers, for they sometimes get to know the oncoming crew and they suddenly get an impression of the thing they are doing. A few get caught by a fever for the sea; though most are like teetotal brewers – they will build the things but would see themselves dead before they went on anything so dangerous. Submarines, strangely enough, seem to have a strong power of attracting the younger worker. It is natural. Anyone who has worked on the wiring inside these electric herrings is bound to get the feeling that he must go out in one. A submarine flatters human intelligence in a superlative degree. It is a brilliant, sinister brainwave, a shaft of sheer intellectual satisfaction. It is like living inside a brain.

Then, these finished ships have got their paint Too long one has looked at that gravel-coloured steel, the sight of which sets the teeth on edge. Civilisation is being laid on by girls – who get a good deal of it on themselves; the decks are being stirred up like chocolate in the mixer and laid on in paste. There are no timber decks now – and good riddance, a destroyer captain will tell you. Pneumatic tubing infests the place like snakes. Scores of people are still at work. They are painting, wiring, welding, plumbing, caulking, all in one room. And one of the ship's officers has got on board and is letting his wife peep through the portholes at the bunks which have been fitted in one corner.

The engine is murmuring below. There is the hot smell of new oil and of new machinery working. The Admiralty surveyor is down there. Perhaps she is a "mystery ship." Once she was to be a plain merchant vessel of 10,000 tons with peculiar holds and abundant armament. She has been suddenly altered by Admiralty orders – one of those sudden changes which bewilder the workers. Where is she going? What is she going to do? The Captain walks about in mufti among the crowd of people, ignoring them, ignored by them. He comes, it is said, from the Orkneys and people from those islands are born with sealed lips. "Queer fellow," the yard manager says.

He seems not merely queer but momentous, his overcoat heavy with the mystery of the secret voyage. An officer's wife comes into the cabin and exclaims with delight. Girls being photographed on a plank on the ship's side giggle. And then a foreman is cursing a boy for wheeling a steel wheelbarrow over the pneumatic tubing. There is a notice chalked up:
"Watch your head, Ned.
Yes, rather Arthur."
The manager calls out: "You're working on her to-night"
"Yes"
"Have you arranged about the wind?"
Not the wind blowing cold through the sunlight on the river and brisking this scene, but the compressed air in the pneumatic tubes. Well, there she is: in two days she will be gone. They built her.

Will they forget? Is she just a job?
"Yes," says the plumber, "just a job."
"No," says the plater. "I sprained my ankle on her. I won't forget her."
"Yes," says the welder. "I might just as well have built an hotel or a block of offices." And an elderly man, known as Brother Gallagher, a wry-faced man, puts his hand in his pocket and taps a piece of a paper. "I've got the number of every ship I ever worked on for forty years in here. Every one. I don't know whether I speak for everyone else, but I think I do. . ."

"If you're wrong, brother, we'll tell you . . ."

"Well, to us who work in the shipyards," Brother Gallagher says, "a ship is like a beautiful woman. That is how we think of her, maybe a young girl, skipping along, or a mother, or a some heavy old woman – but beautiful."

Dead silence. Brother Gallagher is perhaps just a little well known for this speech. But the deaf caulker, pasty-faced, huge-handed, looks round, the others nod, and he says:

"What Brother Gallagher there has just said is correct."

"TO US WHO WORK in the shipyards, a ship is like a beautiful woman."

ESCORT CARRIER NUMBER ONE

.In the last war the submarine made the running in naval warfare. It became a dominant weapon of war, and although the British Navy defeated the U-boat, the performance of these underwater craft became one of the permanent problems of naval strategy. What has been the characteristic new naval weapon of the present war? Without question, the aircraft carrier. The aircraft carrier existed, of course, in the last war; but in this war scores of aircraft-carrying ships were launched from the shipyards of the United Nations. The demand was for more and more of them.

It would be not true to say that the aircraft carrier was born as an answer to the submarine, but the submarine has had a considerable influence on the production of carriers. In this war the submarine turned to hunting in packs; its ears have been sharpened by a great advance in wireless and hydrophone equipment, and now it has been given eyes as well as ears. The eyes of the submarine are aircraft. The aircraft of the Fleet carriers are the eyes of the Fleet, the convoys, and their escorts.

At the beginning of the war, Britain had nothing like enough of these great Fleet carriers to watch her trade routes, and the Fleet carriers take as long as a battleship to build. What was needed was more and more eyes to spot the U-boats, to report back to the convoys and escorts. Britain had not given them. She was also short of escorts. The umbrella of Coastal Command with its shore-based aircraft could give limited protection around the coast, and the merchant seamen were very relieved when their convoy got under that umbrella. But convoys still had to make long circuitous journeys to avoid the hunting grounds of the U-boat. Trips that had taken a matter of days now took several weeks; and the course of the Gibraltar convoy, for example, would strike a wide are far out into the Atlantic before the ships came within sight of the African coast; for the Germans could base their aircraft on the coast of France – bases more advanced than the British. They could take their toll, and the British learned that the crux of the Battle of the Atlantic, with its mounting losses, was the Atlantic Gap. How could it be provided with air cover? There were not enough Fleet carriers. Put aircraft on merchant vessels? They had no flight decks. The best that could be done was to carry a single aircraft on the open deck and catapult it into the air when the U-boats or hostile aircraft were sighted. You lost your aircraft because the pilot could not land on again; you picked up your unfortunate pilot from the sea perhaps an hour or two after he had baled out. The catapulted pilots of the Fleet Air Arm were among the bravest men of the war.

The solution of the problem was logical and revolutionary. There was a school of thought at the Admiralty which went all out for making small aircraft carriers. Merchant ships, had no flight decks: the answer was to take some of these ships and put flight-decks on them. That meant wholesale conversion of the ship; it also meant training the Naval Pilots to land on a deck several hundred shorter and many feet narrower than the deck of a Fleet carrier. It meant training them to land on a deck that would rise and fall the height of a house in a rough sea, and they would have to use fast aircraft to do it. For their job was to put out the eyes of the submarine, to shoot down the fast Focke-Wulfs that did the spotting.

It is a comment on the mounting losses in the Atlantic in those early days that, when the Admiralty came to chose a ship for the experiment, the best thing they could find was a German ship. Set a thief to catch a thief: the first British escort carrier, whose short but terrific career showed us how to cope with the Atlantic Gap, was a prize picked up by a cruiser six or seven months before the Florida Strait. She was called the *Hanover* and was carrying bananas on the Mexican run. Those bananas never reached Germany. Instead she was brought to England by Royal Mail engineers in June 1940, and after some repair yard had dealt with the damage the Germans had done when they tried to set fire to her, she was going to be armed and used as a trader interceptor for ocean boarding. She was going to be sent after her old friends. She was a good, well-found vessel, built in 1939 by Brenner Vulkan, at Vegesack.

But in January 1941 her history and her shape were changed. At a little town on the north-east coast there is a small shipyard, one of those yards which turn out small steamers, sloops and corvettes, nothing much larger than 300 feet. The big shipyards were packed with work; so here the *Hanover* was brought. And the people in the town used to look with astonishment and misgiving – for they feared visits from the German bombers – at the hull of a five or six thousand ton merchant ship rising like a huge wall over the roofs of the houses.

In the yard itself, where the workers knew they were working on an important official secret, there was natural sensitiveness when people suggested that the job was too large for the yard. And there were some, too, who wondered, since Britain was so short of ships, why the workers began stripping off the bridge and superstructure of a perfectly usable, up-to-date vessel. But they turned to. An enthusiasm for the job too hold of them and they drove 120,000 rivets a week. Their previous best had been 80,000.

But that is what happened. Down came the bridge, the funnel; and when she was flat they put a flight-deck on her, a mainly riveted deck. There was no island. She was as flat as a billiard table. She had no hanger under the deck and no lift for bringing up the aircraft, such as her successors had. There was no time for those refinements. When she went on her trials she was 453 feet by 60 feet, about half the length of a Fleet carrier, and they were landing Martletts at seventy miles an hour. They painted out the name *Hanover* and called her the *Empire Audacity,* but the Navy shuddered a little at the double name. It sounded like the name of a merchant ship. They got the name altered to *Audacity.* Her escort, when she was taken from the yard at the moment of birth, was the *Stork;* and it was the *Stork,* by an irony of fate, which was with her and picked up some of her crew when, many months later, the infuriated Germans put an end to her adventurous career.

DOWN CAME THE BRIDGE, the funnel. When she was flat, they laid a deck on her.

For the *Audacity* was a success. She proved something of vast importance. The men who put the rivets in the deck of the *Audacity* played their part in an extraordinary naval adventure. She made only two voyages on the Gibraltar run – and in those days the voyage took four weeks, not the five days of the old peace time Royal Mail liners – and on those voyages her six aircraft brought down Focke-Wulfs, sank submarines and played sheep-dog to the convoy. The aircraft were on the deck all the time, and whenever an aircraft was to fly off the remainder had to be perambulated out of the way on the narrow deck. It was called, with some bitterness and no restraint of epithet, "--- musical chairs."

The Germans were puzzled by her and fought shy. The British were puzzled, too. Was she a merchant ship? sailors asked when she came up to the boom. And then, inside her, all the German notices had been left. She had wonderful passenger cabins. Everyone who came back alive from her two outward and two incoming voyages liked her and was delighted because she was so manageable.

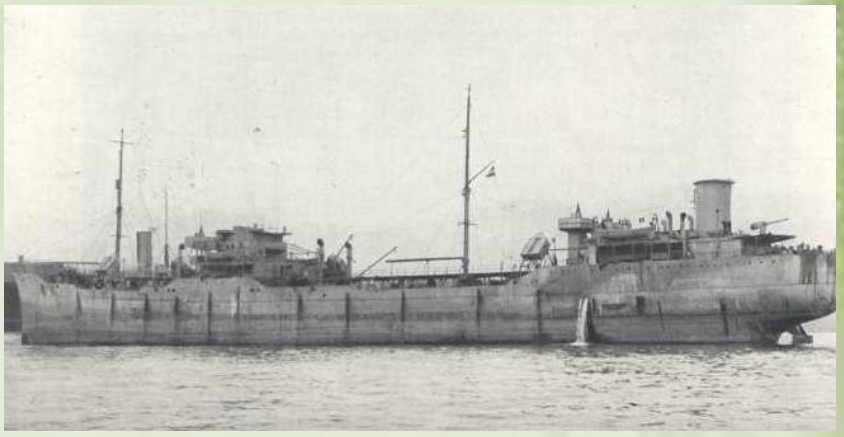
The Atlantic is not a peaceful place between August and December; the aircraft had a rough time. The crews worked on machines that were caked with salt and on a pitching and rolling open deck without a sheltered corner on it. But all the memories of her – unless sailors sentimentalise – seem to be happy. "Hurry up," the Loud Hailer of the *Audacity* called to a small ship that had got out of station in the convoy. There was no audible reply. There appeared to be no one on deck. Presently a blackboard appeared held up by two men. On the blackboard was written in chalk, "Don't leave us behind, we've got the beer."

Then the Germans went after her. On the first outward journey and her return, they had been baffled and scared off. The *Audacity's* aircraft were eyes; on her last voyage, her escorts claimed to have sunk a submarine a day. But when she was on the return journey of her second voyage the Germans waited to make a dead set at her. They wanted the *Audacity* more than the convoy; she had caused them too much trouble. It was sometimes the custom for a carrier to leave the convoy at night, for a ship of her kind was a target among the little ships and could give away the convoy in the night hours when it was most vulnerable.

Two days before Christmas in 1941, on the night of December 23, the *Audacity* left the convoy. The ring of submarines took a chance and closed in. The first torpedo was well aimed; it struck her in the engine room; she lay helpless, but she did not sink. The U-boats waited their chance for the kill. An hour or so later they put two more torpedoes into her, and that was the end. She did not catch fire: though she floated on 10,000 gallons of petrol, this had been stored in special cylindrical tanks, each one surrounded by sea water. She simply broke up and sank.

The men of the *Audacity* were brave men. They knew they were in one of the strangest ships in the Navy – she stood up high above the little ships of the convoy, and as everyone said, "What a target!" But they also knew they were proving something. The orders went out to the shipyards of Britain and America for more ships like the *Audacity*, with hangers this time and deck islands. And the men in that little shipyard of the north-east coast, who put such a spurt into their riveting, and worried about the bombers, who went home tired every night from the job, had played their part in history.

LOGICAL AND REVOLUTIONARY, the escort carrier was a success. Orders went out to the shipyards for more.



THE HANOVER LED THE WAY, this 12,000-ton tanker followed. She is entering dry dock.

SHIPS ON THE OPERATING TABLE

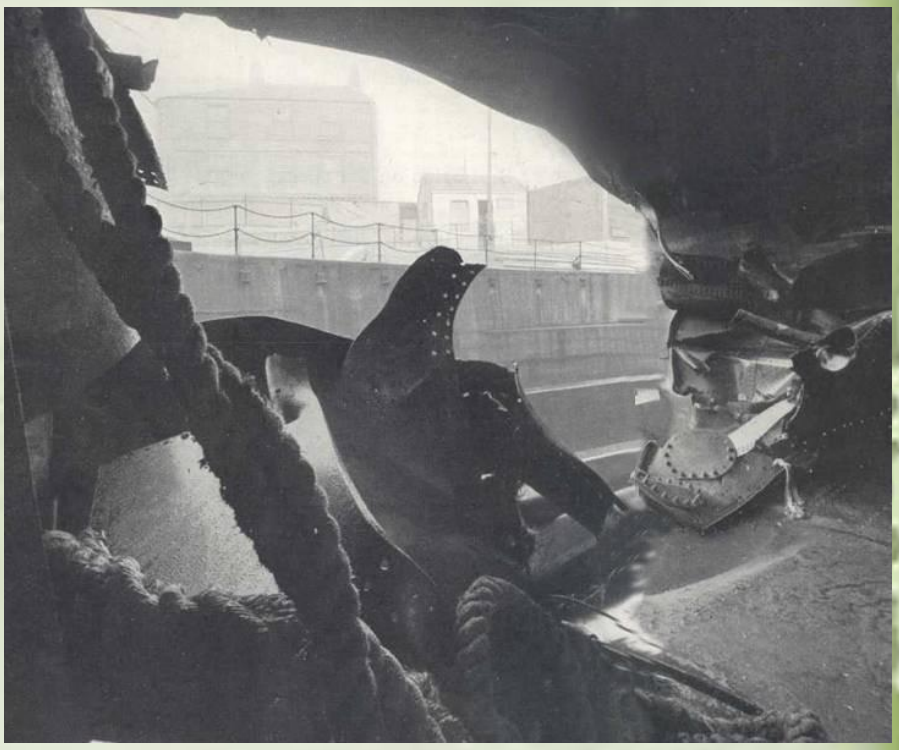
.In war, a ship may catch a torpedo, or strike a mine, or a bomb may blow a hole in her. This does not mean that she will sink. They close the doors of the bulkheads, and if one part of the ship is flooded the air in the other compartments will keep her afloat. A tanker is very hard to sink. She is a collection of self-contained boxes, a sort of floating chest of drawers. Of course if she is hit in the engine room or the boilers she is a very doubtful case. And if she is hit in the magazine there is no doubt at all. There is a destroyer still afloat which had a bomb in her magazine, but it did not explode. She could be seen in dry dock. The wireless was playing up in the bows and it seemed unearthly music.

Ships will survive appalling damage. The ship repairers have seen remarkable sights. A destroyer with the bows and stern gone. She came in looking like a cabin trunk. She was hit by two torpedoes; if she had been hit by one only, she would probably have gone to the bottom. The second torpedo gave her and even keel. Ships with broken backs. A ship with a hole in her side through which you could drive a London bus. Another with all her bridge and half her superstructure gone. She had been flattened by bombs. Her deck looked like a blitzed street. A ship that docked in two pieces. A boat they poured water into, to keep her afloat! Another brought in by a man and a boy. Yet another, a tanker, with most of her bottom gone, which was floated in on a mattress of compressed air.

To save a ship in wartime is everything. The repairing of ships became one of the most urgent jobs in the industry. It calls for the highest engineering ingenuity and for a capacity not to be defeated. A ship repairer is a surgeon or a doctor, who has to be ready to do anything to save a life. When you go to a ship-repairing yard, you perhaps expect to meet something like an old car dump. The truth is that at a repairer's dock you get a sense of the unity of building and the sea. People will never forget the *San Demetrio* coming up the Clyde.

Here is a huge 10,000-tonner on a floating pontoon. How does she stand upright out of the water? She is leaning, imperceptibly, on the dock wall. Not only do the repairers deal here with the major surgical operations on a ship, like amputating her stern or sawing her in half., but they deal with her nervous diseases. In this dock a ship has been boiled. Quite literally, they heated the water in the dry dock until the oil which had gone solid in her tanks – the tanks that lie along the keel – was melted. Another has had its polarity disorganised – by an electric storm, it is supposed – so that her compass movements were meaningless. The first thing the ship repairer wanted to know was, in which direction she was lying when she was built. [They like to have this information when they are fitting the degaussing apparatus.] This particular ship, it was found, was built on a north-to-south berth, so they got her back to that position and then chipped every bit of metal on her inside and out. They hammered a new polarity into her.

Since the war, we grew used to hearing fabulous stories about the navigating of damaged ships and of surgical operations performed on them; but the sawing-the-lady – in – half act is irresistible. The ship repairers will burn down half a ship and fit a new half to her. They will join up the remaining ends of ships that have been truncated. It is, as they say, "not difficult." It is a mathematical operation and had been done often before the war. The history of the tanker, *Imperial Transport*, will illustrate the process. She was out in the Atlantic when she was torpedoes 300 miles from land. There were nine oil tanks in her, numbered one to nine from the stern; five of the tanks were empty when she was struck and four were in ballast. The torpedo caught her amidships, striking her a glancing blow along the bottom and exploding in the way of No. 6 tank on the port side. It was a bad wound, the ship was sinking by her bows and the crew took to their boats; but as they watched her sink, they saw an extraordinary thing happen. The ship stopped sinking. She broke into two pieces and both portions were floating The watertight bulkheads at



EDGED WITH CONTORTED METAL, this cavern is where a torpedo struck the Atheltemplar. Her crew got her home, the ship repairers healed her wound and made her seaworthy again. To save a ship in war time is everything.

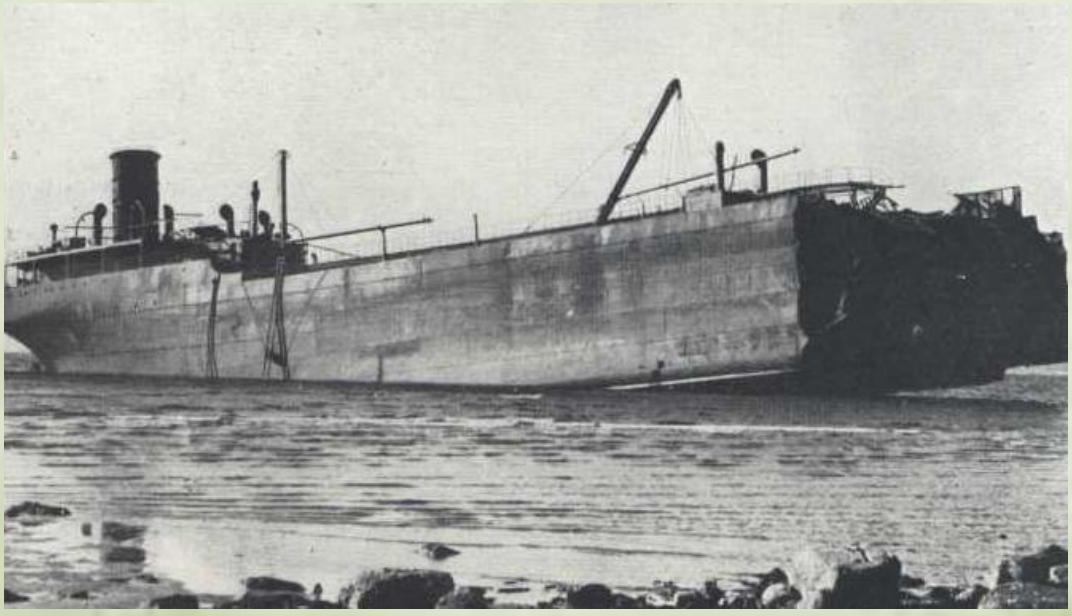
the end of the tanks had saved the hull, and the Captain told the crew he was going back to her – or rather to the stern half, because, of course, the steering and engine are there. He had decided to get her back to England.

He succeeded, though she did not travel under her own steam all the way, for she was towed and beached. With her blown-off end tipped in the air like the bows of one of those flat boats they used to send down the water-chute at the Crystal Palace, she reminded one of a chest of drawers with a funnel on top mysteriously bumping across the seas. They got her in. They docked her on centre and bilge blocks; that is to say, on a wooden track like the three lines of an electric railway. The men with their burning lamps came along and cut away the wreckage. Then, at the other end of the dock, they built a kind of cradle, to receive the new forward portion that was going to be joined to her. What are called "standing ways" were built. On these, sliding or launching ways over sixty yards long were laid, but they were laid level and not at a slope which is the usual method when a new ship is being launched. Men pasted a quarter of an inch of grease and soft soap on both these ways. Then, at dead slow water one day [because they did not want the old end of the hull to start floating], they shunted in the new fore-end.

They had to preserve the correct sheer and camber of the ship, they had to be sure she could not start a slewing movement when she was launching. They had to see, when two parts were joined, that the keels were in line and that if there was a sag it was righted, for a ship may, as they say, "sag" or "hog." Actually the shunting of the new fore-end was really a process of drawing her in along the greasy ways by purchase wires run off a capstan. She moved nine feet towards the junction in three hours and that was considered top speed; after that they slowed her down to get the alignment and overlaps dead right. She dovetailed in at last like a joint of wood and, counting from the beginning of the launching operation, it took seven working hours to finish the job. A new ship was ready to sail.

The ship repairers who worked on jobs like this are men of great experience and knowledge; but they also have a zest for difficulty and a flair which, in other professions, would be called inspiration. A similar gusto seems to be in the workmen of the repair yards. They are lucky. Every job is different. The *Teakwood*, for example, was another tanker which had to have a major surgical operation. She was one of the first vessels to be torpedoed in the war, as early as September 1939. She was caught at the entrance to the Bay of Biscay, and after she was hit she broke her back. Nevertheless, she got into Falmouth without help. In peace time they would have scrapped her, but in war she was valuable. They docked her with difficulty, gave her some temporary repairs and then let her out again to go under her own steam to the North of England, where they proposed to make a new ship of her.

She was a problem. Her fore-end, that is to say the bows, had dropped just over five feet, so that she looked like a broken stick – the wreckage was at the point of the break – and she was also twisted from stern to stern. They got her into the dock and raised the keel blocks beneath her to let her settle. They cut fifty feet out at the break and were left with two un-joined hunks of ship. When the fore-part had settle they took sights and found that the after-part was $11\frac{1}{4}$ inches out of true on the starboard side, so they ballasted this section and floated it out of the dock to the quay. The problem was how to float it in again so that her keel this time should be in strict alignment and also level.

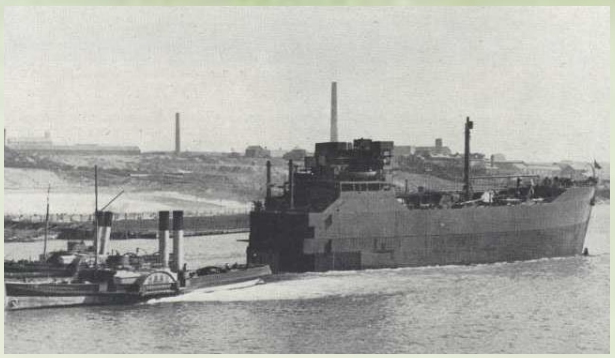


HALF CAME HOME. When the Imperial Transport was cut in two by a torpedo in mid-Atlantic, they sailed the stern half to Scotland, beached and later docked it.

In these shipbuilding towns one strikes the occasional artist whose brain is alight, who *feels* the job and is rightly exuberant about his inspirations. The men responsible for repairing the *Teakwood* were artists. The ship repairer did not know how he was going to get the ship into line. "They told me it couldn't be done," he said immodestly. "So then I knew we had to do it. I invented my patient." He bolted two cruciform supports with brackets in them to the bottom of the dock, and put two vertical stops or lugs on the keel. When the after-part came into the dock, she had to fit square to the brackets. They sent down a diver to have a look; a small group on the dockside were wondering if they had fixed her – she was an 8,000-ton ship – or whether the patent had failed. The diver down below went to the brackets. When he came out onto the dockside and got his head out of his helmet he said, "I canna get the blade of my knife between them. I tried" One imagines him trying.

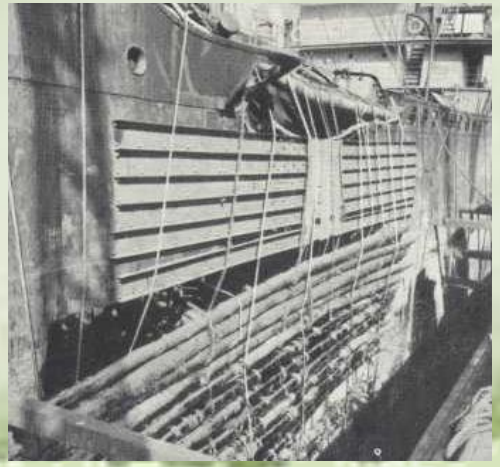
Ships came in, patched up by crews, with screens of logs hanging over the hole to break the seas. Under the logs one could see the steel plates torn like soft corrugated cardboard, crumpled up in folds like carpets or jammed together in the bows, concertina fashion. The essence of the problem for the Captain was to keep the ship upright and preserve her stability. There was an 8,000-ton cruiser which got a torpedo in the forward end of the forward boiler room. "First she floods , then she lists." The first thing they had to do was keep the aft engine room free of water. "Once that was done, the difficulty was to keep her upright and stable with so much free surface," a naval architect explains. By "free surface," he meant that loose mass of water in a ship which rolls about like a shifting cargo. Letting more water into another part of the ship will often, therefore, keep her steady and preserve her balance. This cruiser came up the Clyde one evening at six o'clock, with six dead men in the boiler room, which had not been opened; but she was safe and upright.

These temporary repairs at sea reached heights of ingenuity. There was a ship crossing the Atlantic with a refrigerator cargo, in the winter of 1942, when she was struck. The blow cam in the stern, but so robustly had the ship being built by a British shipyard that the propeller shafting stood up to the blow and was undamaged. She was able to limp to a small island harbour, and there, with what materials he could scrape together in the place and what labour he could train, the Captain decided he would patch her up and get home. By the time she got to harbour she stank. Many insulated hatches were broken and there were hundreds of tons of butter and mutton which immediately began to rot. Before starting the repair work, the crew had to clear out the cause of the awful stench. The area of damage was 45 feet by 32 feet; part of this huge hole – the size of a small house – was under water, and there was no dry dock to put the ship into. The first difficulty was to get people to work on a ship who had never done such work before. And then, once they had started, the gas for cutting and welding failed The "Z" and "T" bars of the ship had to be hand made. It was the same with the rivets and bolts. The ship's plates had to be cut cold with a chipping tool. Still, they pumped her dry and hit on the plan of sending men inland to cut down pine trees on the island, sawed them into planks, bolted these box-fashion over the hole and filled the box with concrete. There was no proper steel for holding the boxes, so they shored them up with lengths of railway lines. In a month this unhealthy and miserable wreck, with its suppurating wound, was ready for sea again. You can read the Captain's letter. It is a model of official understatement. One sentence stands out: "Many of our plans had to be scrapped or modified from time to time." It is the only personal comment he permits himself.

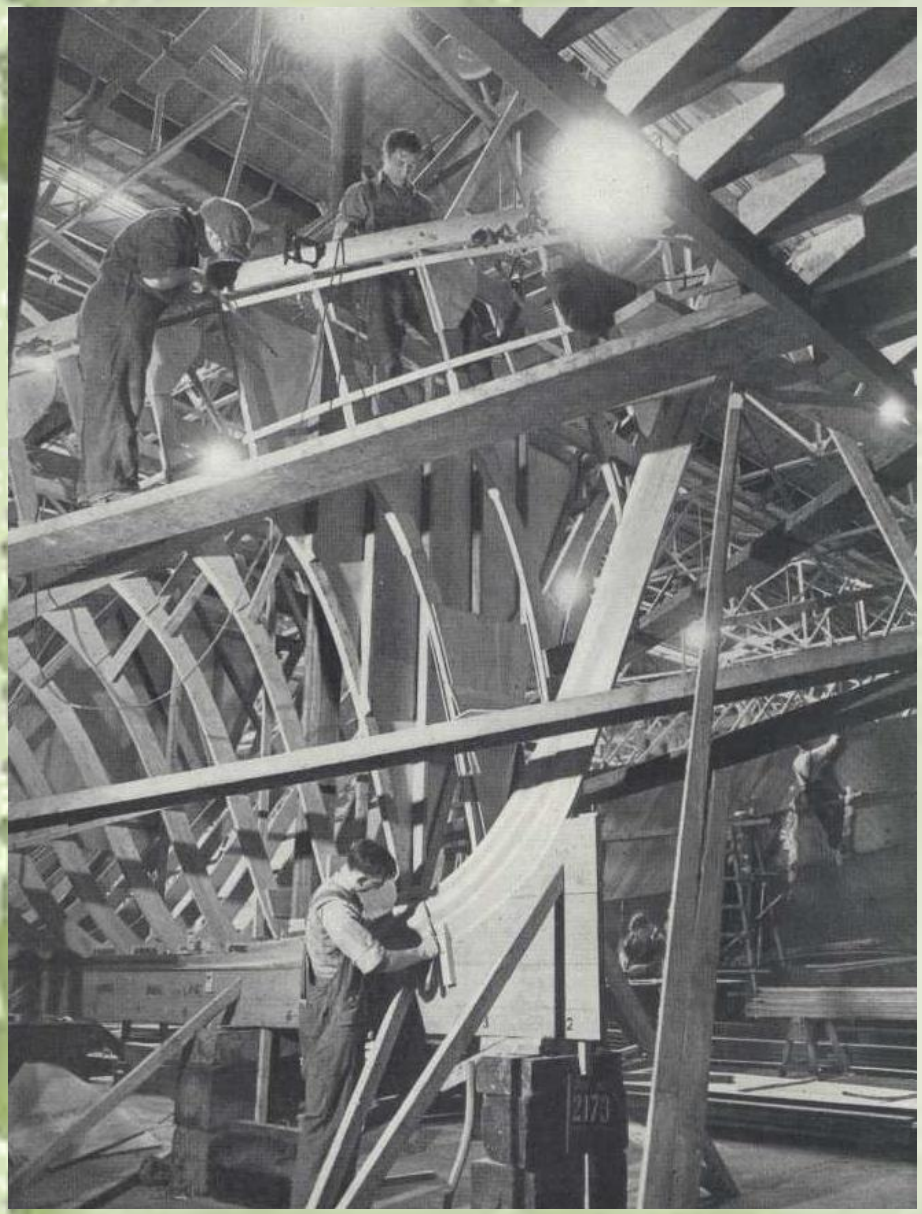


NEW BOWS WERE BUILT, towed down the Clyde. At dead slow water they shunted on the fore-end, nine feet in three hours. She dovetailed in like a joint of wood.

A SIMPLE JOB, as repairs jobs go. Another attack on the Atheltemplar, this time by aircraft.



A SHIP CAME IN, patched up by her crew with a screen of pine logs and lengths of railway line, lashed together with steel wires carried under the hull. It looked like a huge Venetian blind.



BUILDING THE LITTLE SHIPS

On the morning of August 19, 1942, a fleet of boats moved through the fog to the coast of France. It was an invasion fleet, and from the air the host of boats must have looked like hundreds of war canoes of the South Sea Islands. There were destroyers, motor gunboats and torpedo boats, escorts of all kinds, and those landing barges which look flat and black like water beetles creeping across the sea. It was the day of the Dieppe raid, a day of the little ships. Eighteen months later they were out again, crawling to the coast of Sicily, and even more peculiar craft were seen. The news cameras caught them, barge-like craft with what looked like battlements or painted forts. They were a group of American troop carriers which had been brought across the Atlantic; but, with this chief exception, all the craft which landed troops, guns and stores, the paraphernalia of a whole army, on to the shores of Sicily, had been built in the British Isles. Of the 2,400-odd landing ships and landing craft which, two years later, took the British invasion forces to Normandy, nearly 2,000 were British built.

These smaller craft had for the most part been made by the constructional steel firms all over the country and often far inland, by firms which, before the war, were making locomotives and railway rolling stock, steam rollers, bridges and the steel skeletons of office buildings and blocks of flats, firms which had fitted out the big department stores in peace time. Once they had been fitting staircases, counters, wardrobes and shop windows. Now they might be building a whole ship inland, which had to be transported by heavy lorry to the launch; or simply turning out sections like sectional huts to be assembled at the waterside. And then there were the small boatbuilders, experienced in this trade, dotted round our coasts and up the rivers too. There are names famous for those who, in peacetimes, were devotees of pleasure cruising and speeding on the sea. The old-timers in boatbuilding and the firms who went over to this work had a huge variety of craft to build. It was not simply a question of landing craft and torpedo boats and gunboats. There were minesweepers, the harbour-defence vessels, the rescue tugs, the corvettes, the old wooden drifters, built up on the Aberdeen coast by the people who had made the fishing boats and now built wooden ships to deal with the magnetic mines. There were all the small boats that wait on and provision the big ships. There was even the kind of boat which goes out to collect the dummy torpedoes after the aircraft carriers and the submarines have been practising.

Let us start with the landing craft. The Admiralty divides them into two classes – the major and minor; and the rough difference between them is that the minors can be carried away by a ship to the scene of the action, while the large ones, carrying the tanks, the troops and the guns, and dating from the old cross-Channel horse carriers of the last war, make the whole journey on their own engines. We paid more attention to the smaller craft before the war, and we had built a few more before Dunkirk. Then in 1941, the big demand for these assault boats started. First of all, the old-time boatbuilders made them; but it was not a job for the experienced craftsman. They were simple, flat-bottomed vessels with armour in them, forty feet long and with a ten-foot beam, and they were a job the joinery and building firms could easily do. That is one of the reasons why we had to do without new houses and fittings. The engines that moved them were conversions of motorcar engines, something like the Ford V-8. On the Dieppe raid we used old liners and cross-Channel ships to carry the troops and their assault craft, and to drop them on the fierce last lap of the journey.

The major landing craft – what we call the tank barges – are a different proposition. They are built of steel and not of timber. You saw them lying like huge rusty removal vans, near the river's edge, with the welder's torch fizzing and twitching round them; they are just about the plainest thing that ever went to sea. It would be easier, one imagines, to feel affectionate about a dredger. The big shipyards started building them in 1940 but this system held up the building of the big ships, so the task of providing an invasion fleet was given, as we have seen, to the

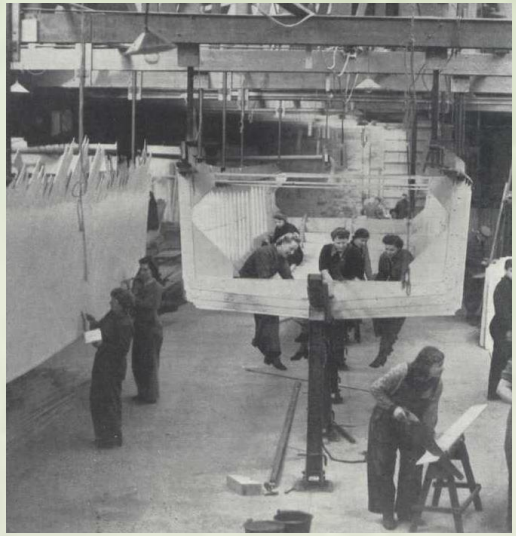
constructional engineers, first of all in the Clyde and the Tees, and then all Britain and Northern Ireland. This sounds like a simple matter of transfer, but in fact it was like starting a new industry. A little improvisation was possible. Some of the old Thames barges were converted to carry vehicles; the Thames barge builders took lighters and what are very expressively called "dumb barges," cut a ramp in the stern, and fitted them with a couple of Chrysler engines. But elsewhere shipyards had to launch the craft.

The tank landing craft is said to have been the beginning of prefabrication; certainly the sections came riveted from the engineers. When the sections were assembled, you had a boat 200 feet long, with a forty-foot beam, which would carry 300 tons of tanks.

But let us look again at the wooden ships. Once more the wooden walls of England were holding the Channel. For it was over and over again the motor gunboat and the motor torpedo boat that we sent out against the E-boats in these narrow seas. On the estuaries and inland rivers, close to those places where yachtsmen gathered before the war, you could see the building of these boats. They lay beside the towpaths and in their dazzle pain they look unreal, like stage boats from a musical comedy, painted to the colours of Edinburgh rock. And, indeed, the building of these small boats, deadly and immensely speedy as they are [they have converted aero engines inside them], is a softer, quieter, cleaner job than the steel work of the north. You step out of the boat shed into smokeless air, with the smell of cut wood and sweet varnish in your nose; and in the main building, where the hulls are lying, there is hardly a sound louder than the rat-a-tat of the girls' hammers on the copper rivets. Yet some of these boatyards have grown and swamped the life of small southern villages, as though a film company had suddenly invaded them.

The builder of M.G.B.s and M.T.B.s has a handier job than the big-ship builders. He can use unconventional methods. Here is a yard for example, where they are building hulls upside down. The pieces come in in section. They will start with the bulkheads, which is rather like beginning to build a house with the inside walls. Then the frames and stringers come in from the shops and are put in place, and the keel or chine goes on last. Here it is that the girls, in their gay overalls, are tapping screws, and the sound of the pneumatic driver has not the machine-gun uproar of the shipyards. Youths and girls are everywhere. They stand up above on the keel. They look, with their lamps, out of the hull. They are not only planking the hulls; they are making the ship's furniture, the oil and water coolers, the tanks that look like enormous mattresses in their self-sealing covers. Girl electricians are making the instrument boards and the switch panels. They work too, on the sheet metal, and the highly skilled ones are working on the adaptation of aero engines to marine use. From fifteen to thirty are the ages preferred. One notices the number of educated women; but skill, the blunt and experienced foreman will tell you, has nothing to do with education. He tells you Miss So-and-so is "a good soldering women," and that is that.

There are so many kinds and degrees of fabrication that it would be tedious to go into it all. But the small-boat industry has made one revolutionary step in its production which must be mentioned. Beside the world famous boatbuilding yards, there is a large number of small yards scattered round the coast of Great Britain. They were craftsman yards. Time and output had no special object to them. But when the war came the Admiralty saw that these firms, too, could play a part in the kind of production the war demanded, provided they could be given standard designs and could be moved as one unit. An ingenious scheme was put forward. Roughly speaking, it was this: a central brain was established to supply all these yards and to set the pace, a brain which would order so many boats, and supply everything for them from a keel to a screw and deliver it to them, like a conveyor belt, by road or rail, at the precise moment each yard needed it. Central stores were set up, and daily the lorries or the railways collected the next portions of the boat required by the builders – screws for Cornwall, planks for Glasgow, engines for the East Coast, wheels for the south, and so on. The builder did not have to build from scratch: he assembled; and he could always rely upon next week's work arriving ready cooked, as it were, like the next meal. This distribution from central warehouses to all points of the compass added greatly to the British small-boat fleet.



SIXTY MILES FROM THE NEAREST SEAPORT, women workers in a West Riding shipyard are building landing assault craft. The frame begins to take shape in the assembly shop.

THE BACK STREET BOYS. LCA 1144, one of many assault landing craft built in the same West Riding factory, is hoisted on to a trailer for her first trip.

WATCHED ONLY BY A FEW of the workers who built them, LCA 1144, a tank-landing craft, and a prefabricated tug take the water.

You go to a large shed off a London by-pass, and inside you will find all the metal that will make scores of boats. Here are dozens of compasses, wheels, bells, engines. Here stand a score of brass rudders. Here are bins of pipes, five tons of screws, nuts and bolts go into every boat: here they are. These are 1,500 different sizes of fastenings, from the long copper nails to the smallest screws. There are thirty-five different types of nails. You see the day's delivery to the boatyards being made up.

Near this store you will see a motor-coach builder's shed. Here they are making the wooden bulkheads. These large areas of timber lie on benches in the room; they look like pieces of a giant's jigsaw puzzles, big blobs of pink mahogany already cut to shape. Some of them stand against the wall. They are twice as high as a man, and you will see a girl in dungarees put a ladder against them and go tapping the thousands of rivets into them. Behind the bulkhead is another girl holding the rivet. How does she know which rivet is going to be hit next? These pairs of girls, patiently knocking in rivets for the whole of a working day and doing nothing else, work by ear. That tap of the hammer on the wood, like the sound of the caulker's mallet on the wooden decks before the war, is the natural hypnotising music of the industry.

At the timber stores the scene is not so passive. Timber from Africa comes up the river and lies in the water looking dirty, swollen, gnarled and twisted, like huge old bones. When it comes out of the water, the saws run through it, cutting it into long sandwiches. The man with the adze gashes into it. Gradually that surly tree trunk is leaved and cut into the hundreds of pre-designed shaped that the boatbuilders require. Each foot of timber on a ship has been numbered. A dozen 153s are wanted? Here they are. This place, like the metal stores, is the mother of innumerable ships, each one alike. You can go in here and order every inch of wood for a ship, to the right size and shape. You can have a ship delivered to your door in its component parts, complete. Order is the god of modern life. They could build you a million houses, a thousand cathedrals, railway engines, anything you like.

From these intensively organised stores, where every piece was numbered as the hairs of one's head are said to be, where checking and re-checking was the hourly business of the day, where people were dealing all the time not with boats, but with units and numbers – the material went out to the boatbuilders of England, Scotland and Northern Ireland, the small, old-fashioned yards of the sea ports, and to those long established little businesses where the pride of craftsmanship is great, but which during the war might have died. It was a strange partnership of the very latest methods with the least modern yards – least modern in the sense of speed production. Boats from these small yards, boats from the famous yards, and boats from the furniture shops, the building contractors, the motor works, went to fight in every sea and send up their tempest of spray as they almost flew out of the water into action.

PATIENTLY knocking in rivets for the whole of a working day. She builds the wooden ships.

EPILOGUE

What did the British shipyards achieve? Let us look at the figures of production. Mr. Alexander, speaking in the House of Commons, during the debate "Shipping and Shipbuilding," on November 1, 1944, said:

"I want to give some details which have not been given before, which will give the House some idea of the immensity of the naval shipbuilding accomplished by the United Kingdom in this war. I am giving the figures from September 1939 up to the end of 1943. Of major war vessels we completed 634, with a total standard tonnage displacement of 1,183,501. Of mosquito craft, including motor-gun boats and torpedo boats, various types of motor launches and motor minesweepers, we produced 1,260 of a tonnage of 120,358. Of naval vessels, including landing craft of all descriptions, armed trawlers and miscellaneous types, we produced 2,729 of a tonnage 334,919. These figures compare very favourably with the output of the last war.

"Some indication of the magnitude of the effort put into merchant shipbuilding of all types in this war is given by the figures and tonnage of the ships constructed. In the four months from September to December 1939, we completed 56 vessels of a gross tonnage of only 243,000. In 1940, the number of ships completed was 182 of a total tonnage of 810,000. The number in 1941 was 236, of a tonnage of 1,158,000. In 1942, the number was 259 of a tonnage of 1,302,000. In 1943, when we were beginning to get back some other work, the number was 237 of a tonnage of 1,204,000. The tonnage of merchant vessels launched in the four war years 1915-1918 was a good deal less than the tonnage we launched in the four years 1940-1943, in spite of the fact that we had fewer yards and ships, and less labour available than in 1918; and in spite of the black-out, and air-raid damage to the worker's homes."

The work put in by the ship repairers had an enormous importance. It is a surprising fact that nearly half the shipbuilding labour in Britain was devoted to repairs, and the increase of this kind of work was due not only to the larger superficial and underwater damage caused by air attacks, but to the great amount of time our ships spent at sea.

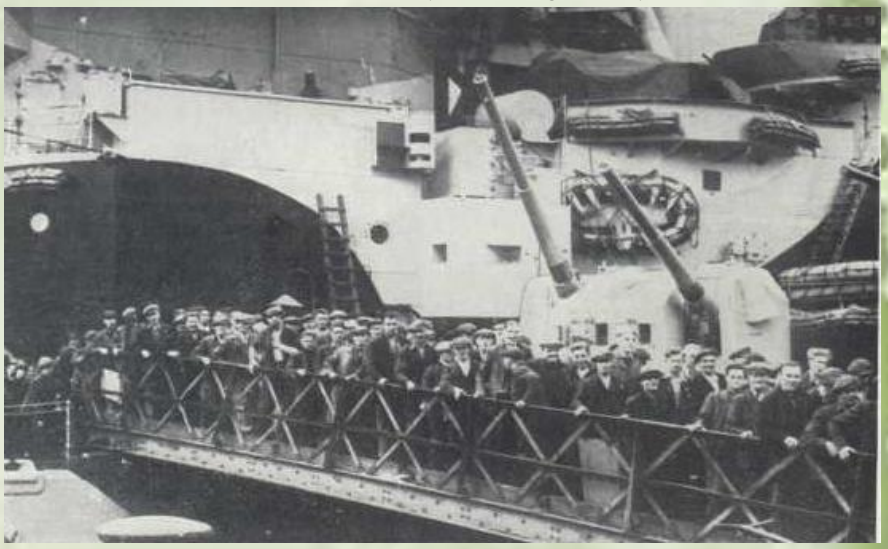
The dockyards put back over a hundred and forty million gross tons of merchant shipping into service in the first three years of the war. In the spring of 1941, the peak period, over two and a half million tons of merchant shipping were under repair. [The corresponding figure for 1914-1918 is one and a half millions.] And so in 1943, when the worst phase of the U-boat war was over, the shipyards of Britain, Canada, and the United States could pay one another compliments. Mr. Winston Churchill said:

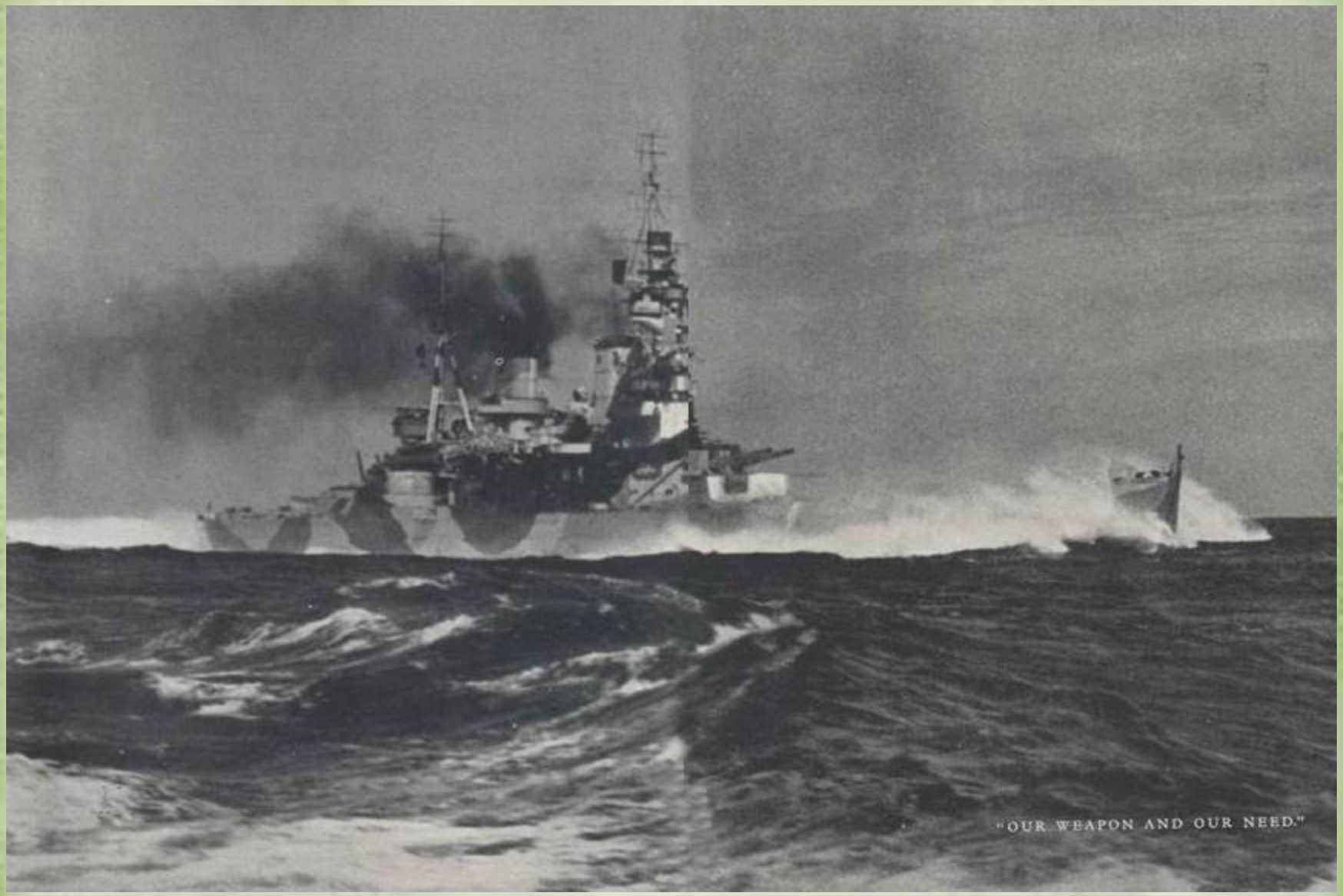
"The output of new building from the United States has fulfilled all that was ever hoped from it and more. We build our regular quota in this island, and the Canadian output, an entirely new development for Canada, is also remarkable. The credit balance of new building over losses of all kinds, including marine risks since the beginning of the year, the net gain that is to say, exceeds six million tons, and should the present favourable conditions hold we shall soon have replaced all losses suffered by the Untied Nations since the beginning of the war."

By November 1943 Colonel Knox, the United States Naval Secretary could announce that achievement: *"We had by Thanksgiving Day built more tonnage than has been sunk in the entire war. It is the most amazing achievement in the history of the war. Much credit is due to our friends, the British and the Canadians."*

This great shipbuilding and ship-repairing achievement was made possible by the technical recovery of the shipyards of Britain and Northern Ireland, and by the inherited skill, the experience and the versatility of their craftsmen. Versatility, perhaps, above all; for the whole story of shipbuilding in Great Britain during the war is summed up in the word adaptation. On the Clyde and Tyne, at Belfast, in all the real shipyards and the temporary ones, men and women, craftsmen and labourers, worked long hours a day, putting in their night shifts when the black-out let them. They worked when the menace of the U-boat was black, when every rivets they drove was a fight for Britain's next meal, her drop of oil, her next tank or plane; and they worked on the offensive, too, when the menace retired and there was the first sight of victory. No one who has heard the fusillade of the riveters under the dull northern sky, day after day, week after , or who has heard the endless hammer-taps of the boatyards, will fail to grasp the meaning of that harsh grey monotone which went on for six years of war. Hearing those sounds, you heard the collective anger, the collective will of the British ship-makers who have known throughout their history that the ship is pre-eminently our weapon and our need.

"WELL, THERE SHE IS: in two days she will be gone. They built her."




"OUR WEAPON AND OUR NEED."

WORLD WAR II

1939 - 1945

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