THE HISTORY OF BELFAST SHIPBUILDING.

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THE first record of shipbuilding in Belfast goes back to the year 1636, when a vessel of 150 tons register was built by the Presbyterian clergymen of Belfast. In 1682 the largest vessel owned in Belfast was the "Antelope," a Virginian trader of 200 tons; but in 1700 the "Loyal Charles" of 250 tons was launched, being owned by Belfast merchants. There was, however, no regular place for building ships at Belfast until after the year 1791; so that vessels belonging to the port were built and repaired in England or Scotland. William Ritchie, from Ayrshire, with his brother Hugh and ten men, began to build ships on the Antrim side of the Lagan in 1791. In twenty years they had launched thirty-two vessels; and in July, 1812, were employing "44 journeymen carpenters, 55 apprentices, 7 pair of sawyers, 12 blacksmiths, and several joiners, while the weekly pay-roll was about £120." The Ballast Corporation provided him with a dry-dock in 1824. He died in 1834. The portrait of "The Father of Belfast Shipbuilding" now hangs in the Municipal Art Gallery of Belfast.

In the early part of 1800 a large provision trade was done from Belfast, supplying pork to the British Navy. Brigs owned in Belfast also did a considerable trade with the West Indies and Demerara, the exports being pork, oats, hay, butter, potatoes, lime, soot, coal, horses, and mules, and the chief imports being cargoes of sugar for Belfast and other Irish ports. The cross-Channel trade of Belfast was then unimportant, and in the year 1811 it did not employ more than two or three regular traders in the London trade, and not more than twenty vessels in the whole trade between Belfast and Great Britain. These brigs were 200 to 300 tons burden; in fact larger vessels could not then get through the winding slop-lined channel of the River Lagan. Most of the local ships were then built in British North America; but a few were built in Belfast, such as the "Emulous" (194 tons) in 1826, and the "Lina" (206 tons) in 1847.

Things began to change after 1824, when the cross-Channel trade received a great stimulus from (1) the introduction of Steam Navigation,* and (2) the commencement of Free Trade between Ireland and Great Britain. In 1824 a shipyard was established at "Ritchie's Dock," afterwards filled up in 1849, and now forming Corporation Square. But the progress of the Belfast trade was long impeded by the want of a port authority with powers sufficient to carry out the engineering works absolutely required to enable vessels to navigate the Lagan up to the town. The tedious agitation on that subject (which laid the foundations on which the prosperity of Belfast as a port has since been erected), is told in Marmion's *History of the Ports of Ireland* (1856). The old Ballast Corporation, dating from an Act of 1785, was superseded in 1837 by a new body with larger powers; and this again was displaced in 1847 by the present Harbour Commissioners, vested with the full unified control of the port. However, during the thirty years, 1824–54, about fifty wooden vessels were built in Belfast—brigs and schooners of from 100 to 350 tons. These included two wooden steamers, viz.:—the "Aurora" for the Glasgow trade, and the "Victoria," for the Liverpool trade. The largest ship yet built in Ireland, the "Hindoo," a sailing ship of 440 tons, was launched at Belfast in 1833 to the order of a local firm engaged in the Calcutta trade. In 1844 the "Seagull," the first iron vessel to be built in Belfast, was launched by Messrs. Coates and Young. But the building of iron ships as a regular Belfast industry is really to be dated from 1853, when Messrs. Robert Hickson & Co. made it a new branch of their business.

It is always interesting, and usually difficult, to explain why a great industry has taken root and prospered in one locality rather than in another. But in the case of the Belfast shipbuilding industry the explanation is simple enough. There we have a remarkable instance of the power of a dominant personality to create a new industry.

What is called the Queen's Island is an artificial piece of land thrown up in 1841–6, when the Belfast Port authority of 1837 employed Mr. William Dargan, as contractor, to make through the slob lands the straight cut which is known as the Victoria Channel. The new Harbour Commissioners of 1847 built there a fine patent slip, and enclosed a shipyard of about four acres in extent. This place was first leased by

* In 1824 Messrs. G. & J. Burns placed their first steamer (the "Fingal," 116 feet long and with two 50 h-p. engines) on the direct service between Glasgow and Belfast. In 1824 Mr. C. W. Williams had also started the City of Dublin Steam Packet Company to trade between Dublin and Liverpool. Such were the first fruits of free trade conditions.

Robert Hickson & Co., owners of the Eliza Street Iron Works, Belfast, who in 1853 began to construct iron sailing ships. The "Mary Stenhouse," of 1,289 tons register, had been completed during 1854, and an order for two other large ships was in hand, when Mr. Hickson, who was not himself practically acquainted with shipbuilding, found it necessary summarily to dismiss his manager. Mr. Harland saw an advertisement in a paper of this vacant situation, secured the appointment, and so came to Belfast at Christmas, 1854, being then only 23 years of age, as the new manager of the Queen's Island shipyard.

Edward James Harland, a younger son of a doctor in Scarborough, had served an apprenticeship of five years, 1846–50, with Robert Stephenson & Co., engineers, at Newcastle-on-Tyne. He had worked as a journeyman on a wage of 20*s.* a week with the same firm till 1851, and then at Glasgow till the autumn of 1853, with J. and G. Thomson, an able firm of marine engine builders, who were just starting to build their own ships. Declining a more permanent position at increased salary, young Harland came back to the Tyneside to take up a manager's position, offered to him by Mr. Thomas Toward, a shipyard owner, whose health necessitated his spending the winter abroad. There Harland was superintending the building of ships and marine boilers, and he had full charge of the works. It seems to have been a good opening for an able young man. But the future prospects of the Tyne firm, in view of the master's infirm health, were somewhat uncertain, and Harland was so much struck with the advantageous location of the new Queen's Island yard, where he knew he would have a free hand, that he applied for the Belfast situation, and got it.

A rough time was before him when he reached Belfast. The dismissed manager was a great favourite with all the men employed at the Queen's Island, and not without some reason. Harland soon found that the wages being paid were above the usual rates, whilst the quantity as well as quality of the work done was below standard. When he proceeded to rectify these anomalies, he was met by a very determined strike. The " new manager " was put upon his mettle. He made repeated journeys to fetch over other workmen from the Clyde, but these fresh hands could not be induced to face the intimidation and stay at work. Just at this juncture, too, Messrs. Hickson closed down their ironworks in Eliza Street, which were found to be unremunerative, Indeed, within a few months the firm had to arrange with its creditors, and Harland had himself to guarantee the wages of the few leading men whom he had gathered round him. Nobody recognised in this troubled time the birth throes of a great industry. But it became apparent that young Harland

was determined to win through. When his closest friends advised him to "throw up the job!" his reply was that "having mounted a restive horse, I will ride him into the stable!" He held an order for two large ships, one of them being already partly in frame, and he knew that there was a profit to be made, provided only the men could be induced to settle down. He persuaded the Bank of Ireland, which had its own overdraft to recover, to stand behind him. Hearing of the death of Mr. Toward, Harland promptly brought over to Belfast the head foreman and a number of leading hands who had worked with him in the Tyne-yard. Thenceforward his task became easier. The work went on apace, until at last the two ships in hand were finished, to the perfect satisfaction of the owners. In this way was created the shipbuilding industry in Belfast.

After he had carried on Messrs. Hickson's business successfully for three years, Mr. Harland resolved to start somewhere as a shipbuilder on his own account. He was enquiring after suitable sites on the Mersey estuary when Mr. Hickson frankly met him with a satisfactory proposal for the transfer by purchase of his interest in the Queen's Island works. In 1859 the sale was completed, through the assistance of his friend, Mr. G. C. Schwabe, of Liverpool, and Mr. Harland began to look about for orders as his own master. Some six years back, while working as a journeyman at Glasgow, he had been the means of assisting Messrs. John Bibby, Sons & Co., of Liverpool, in the purchase of a steamer. That firm now entrusted him with what at the time was a large order—the building of three screw steamers, each 270 feet long, by 34 feet beam, and 22 feet 9 inches in the hold. When arranging for this job, Mr. Harland put his drawing office in the charge of Mr. G. W. Wolff, an able young draughtsman, who had served an apprenticeship with Joseph Whitworth & Co., of Manchester, and who was a nephew of his trusty friend, Mr. G. C. Schwabe. The works went on prosperously. The three steamers were all completed in the course of 1861, and their delivery was promptly followed by a second order from the Bibby firm for two larger vessels. Mr. Harland at this point took Mr. Wolff into partnership, and since January 1, 1862, the firm has been known as Harland and Wolff.

It will be seen from this story that the present year is the jubilee of this most eminent firm. It is this fact which has suggested to me the subject for this paper. For the foundation of Messrs. Harland and Wolff's business is a great epoch in their industrial history which all Irishmen should be glad to celebrate. But they should also be eager to learn the causes (not obvious without some study) which have

enabled this great new industry to attain such prosperity in Ireland of all places in the world.

The causes of economic progress are often obscure, because the same thing may be at once a cause and a consequence. The successful career of Messrs. Harland and Wolff must be attributed in part to the extraordinary development of British shipping during the last 50 years. The rise of a great industry at Belfast for the building of large ocean steamers has been possible mainly because of its convenient proximity to Liverpool; the Lagan has been the shipyard of the Mersey. But it is also a historic fact that the development of British shipping owes very much to the work of the Queen's Island firm. It is not by mere quantity that Harland and Wolff have earned their splendid reputation. They have been pioneer builders of vessels of great size, and of a new type, which were a great advance in marine construction, and have largely revolutionised the conditions of ocean transport. It is by the brains they put into their ships that they created this great new industry in Belfast.

Originally the Queen's Island yard had attracted Mr. Harland, because its clear frontage allowed of the largest vessels being freely launched. He was the first shipbuilder to perceive that an iron ship need not be kept to the lines that were most suitable for wooden vessels. He had early conceived his theory that if an iron ship were *increased in length without a corresponding increase of beam*, the carrying power both for cargo and passengers would be much greater, that the ships would show improved qualities in a sea-way, and that (notwithstanding the increased accommodation) the same speed with the same power would be obtained by only a slight increase in the first "capital cost." This idea was original with him, and is the reason why Belfast has become especially the place for building very large ships. Other people disagreed with him, especially all the "old salts," who confidently predicted that these long ships would break their backs. But Mr. Harland knew that with iron as your material things can be done which with wood were quite impossible; in short, he was confident that length could be fully compensated for *by making the upper deck entirely of iron.* "In this way," to quote Mr. Harland's own words, "the hull of the ship was converted into a box girder of immensely increased strength, and was, I believe, the first ocean steamer ever so constructed." He persuaded the Bibby firm to apply this theory to the two ships for their second order, which were made 310 feet long. These new vessels were nicknamed "Bibby's coffins," by the old sailors, but they inaugurated a new era in ship construction, "partly because of the greater cargoes which they carried, but

principally from the regularity with which they made their voyages with such surprisingly small consumption of coal."

The reputation which Harland and Wolff first made with the twenty or more ships built for the Bibbys has been continuously growing, because the firm has ever continued to apply new ideas in the design of their vessels. A few of their novelties may be mentioned as illustrations. The sharpness of their fish-like* hull conduced to steadiness in a pitching sea, as the ship *went through* the crest of the waves—"it was not only easier for the vessel, but the shortest road"—the bow bearing a turtle-back covering to throw off the shipped waters. The perpendicular stem formed by cutting the forefoot and figurehead away was an artistic sacrifice to efficiency, for when combined with a new powerful steering gear worked amidships, it allowed the extremely long ships to be easily handled and swung around in narrow channels of navigation. To give large carrying capacity, they gave to their ships "flatness of bottom and squareness of bilge," and the "Belfast bottom," as it is technically known, has since been generally imitated. Finding it impossible to combine satisfactorily wood with iron (the two materials being so differently affected by temperature and moisture), they filled in the spaces between frames, &c., with Portland cement instead of chocks of wood. While it is impossible to detail all the improvements in ship construction which have been introduced by Messrs. Harland and Wolff, I may add to those already mentioned the new developments effected in the construction of the double-bottom; of the keel; and notably the arrangement of the plating at the stern, by which the shaft brackets were made to form part of the internal instead of the external portion of the frame structure, at once increasing the strength and improving the appearance.

In the construction of marine engines Messrs. Harland and Wolff have also been pioneers in the introduction of original improvements. But it is not so easy to summarise such technicalities intelligibly in a few words. In 1880 their firm put up their own engine works and boiler shops, and commenced manufacturing all the machinery for their steamers. Long before that time, however, the cost economy (in fuel and in repairs) of their engines had become a prime factor in the success of the Belfast steamers. For example they were early advocates of the surface-condenser. If the steam from the engines be condensed, after it has done its work

* "Nature seems to have furnished us with the finest design for a vessel in the form of *the fish*: it presents such fine lines—is so clean, so true, and so rapid in its movements. The ship, however, must float; and to hit upon the happy medium of velocity and stability seems to me the art and mystery of shipbuilding."—Mr. Harland in *Men of Invention and Industry*, by Samuel Smiles, 1884.

by being passed through passages whose surfaces are kept cold by an outer circulation of cold salt water, it is preserved as pure water, and can be returned to the boiler free of salt. The idea was not new; but it had not been realised with practical success, because such leakages were found to take place in the tube-joints. An inventor named Stirling remedied the defect by a simple application of india-rubber collars in the joints. This remedy was first successfully applied in one of the Bibby steamers, thereby avoiding "salting-up," with all its expensive repairs, and saving about 20 per cent. in the fuel consumed. The combination of low-pressure turbine with high-pressure reciprocating engines, which the firm first applied to the "Laurentic" in 1908, has been shown to give a 14 per cent. saving in the coal consumption for a corresponding speed, or an increase of $\frac{3}{4}$ mile per hour in speed for an equal boiler-power. This triple-screw arrangement, in which the high-pressure steam first drives reciprocating (*i.e.*, piston-working) engines for the two wing propellers, and then passes into a low pressure turbine, driving the central propeller, in which the steam is further expanded down to about 1 lb. absolute pressure before exhausting into the condensers, was a veritable inspiration of brainy ingenuity. Messrs. Harland and Wolff have been identified with all the steps in the perfecting of the reciprocating engine—from the simple engine to the compound, the triple-expansion, and especially the quadruple expansion on the balanced principle, which not only increased the efficiency and economy of the machinery but also greatly added to the comfort of passengers by eliminating vibration. The economy of these modern reciprocating engines is hard to beat. It has recently been carefully estimated at 1·2 lb. for average coal consumption per H.P. hour. But many people thought the Parsons' steam turbine would supersede the reciprocating engine altogether; its adoption for the great Cunarders "Mauretania" and "Lusitania," as well as for the first Naval Dreadnoughts, seemed to be a verdict given by authority in its favour. The most recent estimates put the economy of the turbine at 1·3 lb. for average coal consumption per H.P. hour, with a steam consumption of 12½ lbs. But with a characteristic independence of judgment Messrs. Harland and Wolff have placed the turbine as an appendix to their reciprocating engines, utilising both to their best advantage. When the ship is required to go astern the exhaust steam from the reciprocating engines simply goes direct to the condensers, thereby saving the complication of an astern turbine (required when vessels are driven only by turbines), because for manœuvring in and out of port the reciprocating engines alone are quite sufficient.

It has been said that Harland and Wolff won their laurels

by the celebrated vessels that they have built for the White Star Line. Historically it is the other way round. The Oceanic Steam Navigation Company, Limited, was promoted in 1869 by Mr. T. H. Ismay and Mr. G. H. Fletcher because the speedy and economic working of the Belfast steamers was already so well known that those spirited shipowners determined to employ similar vessels, though of still larger size, for passenger and cargo transport between England and America. All the White Star steamers—and there have been more than fifty of them—were built at the Queen's Island. When the firm was given the commission to build the first six of these large transatlantic boats in 1869 they were long enough established to have trained most of their own leading hands. The then works manager was Mr. W. A. Wilson, and the head draughtsman was Mr. W. J. Pirrie (Lord Pirrie, the present Chairman of Harland and Wolff, Limited); both were Belfast lads who had, as pupils, worked up through all the departments, and had won their responsible positions by dint of merit only—by their character, perseverance, and ability. The "Oceanic" of 1870 was the first of the new vessels to be launched. Alike in her hull, in her machinery, and in her internal arrangements, she excelled any vessel yet built. She was one of the first passenger steamers to be fitted with water-tight compartments. She was also the first passenger ship to have the first-class accommodation placed amidships (instead of over the stern), with the third-class aft and forward. Her saloon was the first to extend the full width of the vessel, and be lighted from each side. "For the first time ocean-voyaging, even in the North Atlantic, was made not merely less tedious and dreadful to all, but was rendered enjoyable and even delightful to many." Her motion was remarkably easy, and her speed was "at least a knot faster" than had been so far accomplished on the Atlantic. But this "Oceanic" of 1870 was only a pigmy (with 400 feet keel, 41 feet beam, and 33 feet hold) when compared with the ships which the use of steel has since made possible. The new "Oceanic" of 1899 had a length over all of 704 feet. She was described at her birth as being "the finest vessel ever produced, and the crowning success of the century in naval architecture and marine engineering."—(*Engineering.*) What then shall be said of the latest of these Belfast steamers, the "Olympic," launched on October 20, 1910? "She beggars description," was the laconic phrase of more than one Pressman. Length over all, 882 feet 9 inches, or 850 feet between perpendiculars; breadth of beam, 92 feet; moulded depth 64 feet 3 inches; height from keel to the navigating bridge, 104 feet; gross tonnage, 45,000; load draught, 34 feet 6 inches; weight of displacement when at load draught, 52,000 tons. These figures are almost inconceivable. The "Olympic," how-

ever, is 90 feet longer than the " Mauretania " of the Cunard Company, has 4½ feet wider beam, and could take 6,000 tons more cargo in addition to many more passengers. With only 30,000 indicated horse-power for her reciprocating engines, and 16,000 shaft horse-power for her turbine, the " Olympic " will make a speed of 21 knots. The " Mauretania " can make 26 knots, but requires 75,000 shaft horse-power in order to do it.

For the building of these enormous steamers " Olympic " and " Titanic," very large additions to the equipment of the Queen's Island shipyard were made, as well as to the engine shops and the other works, which to-day are all fitted with the best and most powerful tools, and the most approved mechanical appliances for manipulating the heavy weights involved. There is a 200-ton floating crane, specially designed for Harland and Wolff's work, which is, I believe, the largest appliance of its kind in the world. At the south end of the yard, there is a new system of electric cantilever cranes over the building slips. At the north end of the yard, formerly equipped with powerful hydraulic travelling cranes or gantries for three slips, there now stands an immense double gantry for two large slips, which deserves detailed description, as there is nothing that can compare with it elsewhere. Including the great amount of piling and reinforced concrete to obtain a firm ground-bed, this great structure has cost above quarter of a million; it was designed to the requirements of Messrs. Harland and Wolff, and erected, by the engineering staff of Sir William Arrol & Co., Limited. The structure has a total length of 840 feet, and consists of three rows of towers placed 80 feet apart longitudinally, the two avenues, or " berths " between these three rows being 121 feet wide transversely. The towers support longitudinal girders tied together transversely at their tops. Over the central row of towers runs a high rail-track (176 feet above ground-level) on which a large cantilever crane may travel the whole length of the structure. This cantilever crane can lift 3 tons at a radius of 135 feet, or 5 tons at a radius of 65 feet; it has lifting, racking, slewing, and travelling motions; so that it commands a length of over 1,050 feet, a width of 270 feet, and can lift or deposit material anywhere over this large area. Then, spanning each " berth," there are three over-head travelling frames running on rails (148 feet above ground-level) placed on the longitudinal girders over the rows of towers, and each of these travelling frames contains two 10-ton travelling cranes. Another rail-track (118 feet above ground-level) is provided at the bottom of the same longitudinal girders, which carries 3-ton walking cranes. The six travelling frames, each provided with two 10-ton cranes, are for supporting riveting machines, and each of the 10-ton cranes may stretch

out longitudinally for 35 feet without necessitating the frames to be moved. The frames at the after end of the "berths" have special lifting eyes to deal with heavy stern-frames, &c., weighing up to 40 tons each. The ten side walking cranes are designed to lift 5 tons at a radius of 53 feet, and they have lifting, slewing, and travelling motions. Then the inside faces of all towers are fitted with a special arrangement to carry platforms (for riveting or building operations) at any level and at any angle to suit the line of plating. Fixed sloping gangways run up from the forward end of the "berths," so as to pass up through the towers, giving access to any level up to the underside of the top longitudinal girders. There are also other stairs and gangways throughout the structure to facilitate communication every way. All the cranes (which were supplied by Messrs. Stothart and Pitt, of Bath, as sub-contractors) are operated electrically (current being supplied from the main power station, erected in 1905, which develops the electricity for driving the whole works), and their collective power is 1,600 horse-power. Such is the cradle, or scaffolding, in which the "Olympic" and the "Titanic" have been constructed.

We have said that the shipbuilding industry was originated in Belfast by the power of one dominant personality. With few natural advantages and with but small local demand for shipping (Messrs. J. P. Corry & Co., of Belfast, have had a dozen large "East Indiamen" built at the Queen's Island, and other large sailing ships were built for Mr. Lawther, of Belfast, Mr. Martin, of Dublin, the Irish Shipowners' Company, and some others) the business founded by Sir Edward J. Harland, Bart., became the largest of its kind in the world. Even in the industrial history of the United Kingdom the achievement is remarkable. In Ireland is was unprecedented, almost unthinkable; and it has certainly inaugurated a wholly new tradition of the possibility of great industry in that country. But if Mr. Harland created, a whole group of very able men have contributed to the continued growth of the business. When Sir Edward Harland died in 1895 Mr. Pirrie succeeded him as the chairman of the firm. He had been made a partner in 1874, when 27 years of age. He was head draughtsman at the time when the White Star ships were first designed. The astonishing development of the firm's business in recent years is unmistakable evidence of the energetic spirit and far-seeing ability of Mr. Harland's successor and pupil. It was of Lord Pirrie the late Lord Dufferin spoke the memorable words: "That he was a man who, by his talents and indefatigable exertion had so stimulated the activity of his town, that he lifted it from its former comparatively inferior position

to that of being the third greatest commercial city in the whole Empire."

During four successive years, 1891–4, Messrs. Harland and Wolff launched the greatest tonnage of any one concern in the United Kingdom. In 1895, the Engineers' strike interrupted work at Belfast from October 25th to December 17th. But the firm's business increasing with great strides in 1896, 1897, and 1899 it again headed the list of private firms. The year 1901 witnessed another record output of 92,316 gross tonnage. Even this achievement was eclipsed two years later, and the 110,463 tons launched by Harland and Wolff in 1903, along with engines of 100,400 I.H.P., remains unparalleled by any single shipbuilding yard in the world for a single year's output. True, in 1906, the firm of Swan, Hunter, and Wigham Richardson, of Wallsend-on-Tyne, were credited with 126,921 tons, but this is an amalgamation of three shipyards, and the total included Floating Docks, Caissons, and (I understand) Deck Erections. In 1908 Harland and Wolff, for the eleventh time in nineteen years, again headed the list. Their output dropped to 29,708 tons and 46,250 I.H.P. in 1909, when the yard was being prepared, and progress was being made, with the great leviathans "Olympic" and "Titanic." But it is clear already that the year 1910 will again rank as a record year, for the firm's tonnage output will again be well above 100,000 gross tons.* Besides, the "Olympic" the firm will have launched in this their Jubilee Year the Shaw-Savill Liner "Pakeha" (7,911 gross tons); the Union-Castle Liner "Edinburgh Castle" (13,326 gross tons); the Bibby Liner "Gloucestershire" (8,214 gross tons); and the largest P. and O. Liner ever built, viz., the "Maloja," about 13,000 gross tons. The Aberdeen-Australian Liner "Themistocles," about 11,500 gross tons, is practically completed, and may therefore also be launched within the present month. Some very extensive repair work is also in hands which will increase the year's output appreciably. In 1907, Messrs. Harland and Wolff erected large works at Southampton, in order to deal promptly with urgent repair work on the spot. The shipyard at Belfast now covers some 80 acres; about 12,000 men are employed, and the weekly wages paid are about £20,000. At Southampton the firm employs 2,500 to 3,000 men, and pays over £4,000 in wages weekly.

The successful establishment of a new industry in Belfast has, of course, made other things possible as a consequence. One thing was the starting in 1878 of the Belfast Ropework Company, at Connswater, Belfast, which, under the chairman-

* Harland & Wolff's output in 1910 has since been declared at 115,861 Board of Trade gross tonnage, with engines of 100,130 I.H.P. This record total, besides the vessels named in the text, includes two Hamburg single-screw steamers, each 8,250 gross tonnage, viz., the "Bayern" and the "Sachsen."

ship of Mr. G. W. Wolff, has become the largest rope manufactory in the United Kingdom. Still more significant was the starting in 1879 of the "Belfast Shipyard," of Messrs. Workman, Clark, and Co., on the side of the River Lagan opposite to the Queen's Island.

As a lady is pleased when she is so favoured as to have "two strings to her bow," (otherwise "two beaux on her string"), so Belfast may be very proud of this second sucker which the shipbuilding industry, so well rooted by Messrs. Harland and Wolff, has thrown up, and which in the short space of 25 years has grown into a stately tree. On a plot of 4 acres, upon the North (Co. Antrim) bank of the river, Messrs. Workman, Clark & Co., began in 1879, employing about 500 men to build four vessels representing about 4,000 tons. This original north yard now extends to 14 acres. In addition, another much larger yard has been opened on the south (Co. Down) bank. and contiguous to this latter are their extensive engine works and boiler shop. The works now cover about 45 acres, and employ about 7,000 men. The cutting of the new "Musgrave Channel" by the Harbour Board—a duplication of the first "Victoria Channel," which from the north end of East Twin Island runs out about 1½ miles into deep water—has given new facilities to the firm for carrying on their increasing business. When first established they had no engine works, and the marine engines for their steamers were brought over from Glasgow. In 1891 they decided to construct their own engines; Mr. C. E. Allen became a member of the firm in that year, and took charge of the engine shops. In 1894, also, they took over the business of Messrs. M'Ilwaine and M'Coll, of Belfast, who had been engine builders.

Messrs. Workman, Clark, & Co., commenced business at a fortunate epoch. Messrs. Harland and Wolff had been making history with their new type of White Star Liners. It was a time when the substitution of steel for iron was beginning a new era of very large ships. Now, a young concern cannot start making its name with large vessels. Although always somewhat overshadowed by the great reputation of their neighbours, the new firm has steadily worked its way up from small things to great things; and by the growing volume of tonnage launched it has gradually risen to its present position among the four or five biggest shipbuilding concerns in the United Kingdom. There is nothing sensational in their steady progress; one fails to remember any record performance, any notable improvement in naval architecture, which stands to the firm's credit. But the fact is that the very large steamers which attract great attention and make records for their builders are not the normal type of the vessels that do the humdrum work of ocean transportation. One must bear in mind that, for good reasons, vessels of from 2,000 to 5,000 tons are more in request

for general trading work:—(1) they can carry from 5,000 to 7,000 dead weight tons, (2) they find a cargo without having to wait too long, (3) they are easily managed by a small staff and (4) they are economical in propulsion expenses.

If Messrs. Workman, Clark & Co. have made any notable record, it is their engine shops that have done it; they hold the license for building Parson's steam-turbine engines, and have made a speciality of it in their larger vessels. They launched in 1904 the Allan Liner "Victorian," as an 18-knot vessel of 11,000 registered tonnage with turbine engines of 12,000 S.H.P. She was the first turbine merchant steamer to be placed on the Atlantic service; and at her trials in March, 1905, which attracted the attention of the shipbuilders of the world, she maintained a speed of 19½ knots in a prolonged run. This performance largely influenced the Cunard Co. in their decision to make the "Lusitania" and "Mauretania" turbine ships. Only last year, the firm of Workman, Clark & Co., with their gross tonnage launched of 88,952 tons, took first place in the United Kingdom for 1909. This output included two Orient Liners, viz., "Orvieto" (12,130 gross tons and 14,400 S.H.P.) and "Otranto" (12,124 gross tons, and 14,400 S.H.P.), both turbine steamships, which are the largest ships yet built by the firm.

In order to explain clearly the high position taken by Belfast in the shipbuilding industry of the United Kingdom, I now give the following table showing the last nine years' output measured in gross tonnage launched, as well as the largest tonnage launched in any single year, for the nine largest shipbuilding firms in the United Kingdom. (Condensed from *Engineering*, December 31st, 1909):—

OUTPUT OF SHIPPING BUILT (GROSS TONNAGE).

	Nine Years, 1901-9. Tons.	Largest Output in One Year. Tons.	
1. Swan, Hunter and Wigham Richardson (Wallsend-on-Tyne)	748,053*	126,921*	(1906)
2. Harland and Wolff (Belfast) ..	692,895	110,463	(1903)
3. Russell and Co. (Port Glasgow)	544,190	73,689	(1904)
4. Workman, Clark and Co. (Belfast)	543,740	88,952	(1909)
5. William Doxford and Sons (Sunderland)	503,918	106,058	(1907)
6. William Gray and Co. (West Hartlepool)	480,392*	85,111*	(1906)
7. Irvine's Shipbuilding Co. (West Hartlepool)	452,004	78,574	(1906)
8. Sir W. G. Armstrong, Whitworth and Co. (Newcastle-on-Tyne)..	416,928	74,228	(1907)
9. John Brown and Co. (Clydebank)	387,841	55,152	(1903)

* Including Deck Erections, Floating Docks, Caissons, etc.

Also as a matter of record I give below in the form of Appendices to this paper, the following Tables, viz., (I) Table of ship-tonnage made in Ireland from 1842 to 1889. This is taken from Dr. Thomas W. Grimshaw's "Facts and Figures about Ireland," Part VI., published in 1893, wherein the Preface states that the figures were supplied by Sir Edward J. Harland, Bart. Note the rise in the figures after 1854; and how stationary the figures were from 1867 to 1878. (Average gross tonnage launched during seven years was 10,519 tons for period 1863–69, and only 9,602 tons for 1870–76.) II. Table showing the tonnage launched in Ireland from 1889 to 1909; with special columns for the output of each of the Belfast firms. The Dublin Dockyard Co., and the Larne Shipbuilding Co. are the only other shipbuilders now producing in Ireland; and the firm of M'Coll, Belfast, which makes engines for small steamers. (Figures drawn from annual statements published in *Engineering*). III. Table giving a complete list of the celebrated vessels built for the White Star Line by Messrs. Harland and Wolff, Ltd., showing the dimensions and dates. IV. Table giving list of firms, believed to be complete, who have had ships built by Messrs. Harland and Wolff. V. Table showing the ships built by the Firm in the year 1910.

APPENDICES.

TABLE I.—SHIPBUILDING IN IRELAND, 1842 to 1889.

YEAR.	Tonnage of Ships Built.	YEAR.	Tonnage of Ships Built.	YEAR.	Tonnage of Ships Built.
1842	1,042	1858	2,793	1874	16,238
1843	922	1859	3,935	1875	7,780
1844	415	1860	7,592	1876	9,602
1845	446	1861	7,549	1877	6,677
1846	436	1862	8,195	1878	14,755
1847	300	1863	9,979	1879	14,549
1848	138	1864	17,140	1880	13,842
1849	755	1865	9,190	1881	24,045
1850	1,092	1866	9,408	1882	28,122
1851	1,840	1867	13,183	1883	42,548
1852	386	1868	7,575	1884	30,686
1853	2,748	1869	7,155	1885	34,311
1854	4,558	1870	9,160	1886	26,471
1855	5,444	1871	16,073	1887	43,691
1856	4,315	1872	14,642	1888	40,326
1857	7,452	1873	1,878	1889	87,668

TABLE II.—SHIPBUILDING IN IRELAND, 1890 TO 1909.

	All Ireland.	Harland & Wolff.		Workman, Clark & Co.	
YEAR.	Ships Gross Tons.	Ships Gross Tons.	Engines I.H.P.	Ships Gross Tons.	Engines I.H.P.
1890	77,376	48,633	22,700	15,631	—
1891	103,466	64,962	34,650	24,922	—
1892	99,827	68,614	37,550	19,215	—
1893	87,256	65,660	41,640	16,635	—
1894	97,901	65,448	41,800	32,453	19,080
1895	102,067	58,093	36,500	43,723	26,900
1896	119,756	81,316	61,324	38,440	19,850
1897	109,277	84,240	45,850	24,743	16,100
1898	121,330	67,905	33,350	53,475	32,520
1899	131,723	82,634	66,150	45,018	29,950
1900	131,431	72,897	36,300	56,201	31,300
1901	152,402	92,316	76,000	58,459	33,000
1902	159,763	79,497	66,200	75,932*	46,900
1903	158,542	110,463	100,400	44,378	27,060
1904	78,000	31,842	22,700	44,272	34,000
1905	144,500	85,287	72,031	58,190*	44,250
1906	149,740	83,238	96,700	65,478*	49,500
1907	139,442	75,015	35,580	63,245	45,650
1908	158,626	106,528	65,840	50,303	38,400
1909	120,867	29,708	46,250	88,952	76,550

* Including deck erections, etc., which is not usually done, these figures would be 86,712 tons in 1902; 64,140 tons in 1905; and 75,045 tons in 1906.

TABLE III.

VESSELS BUILT FOR THE WHITE STAR LINE BY HARLAND & WOLFF, LTD.

Name.	Year.	Length.	Gross Tonnage.	I.H.P.
		FT. IN.		
"Oceanic" ..	1871	420 0	3,918	1,990
"Atlantic" ..	1871	420 0	3,707	1,990
"Baltic" ..	1871	420 0	3,707	1,990
"Republic" ..	1872	420 0	3,707	1,990
"Adriatic" ..	1872	437 6	3,887	3,500
"Celtic" ..	1872	437 6	3,867	3,500
"Gaelic" ..	1872	370 0	2,652	1,800
"Belgic" ..	1872	370 0	2,652	1,800
"Britannic" ..	1874	455 0	5,004	4,900
"Germanic" ..	1874	455 0	5,004	4,900
"Arabic" ..	1881	430 0	2,600	4,368
"Coptic" ..	1881	430 0	2,600	4,368
"Ionic" ..	1883	440 0	3,280	4,748

TABLE III.—*continued.*

Name.	Year	Length.	Gross Tonnage.	I.H.P.
		FT. IN.		
"Doric" ..	1883	440 0	3,280	4,748
"Belgic" ..	1885	420 0	4,211	2,800
"Gaelic" ..	1885	420 0	4,211	2,800
"Teutonic" ..	1889	565 0	9,984	17,500
"Majestic" ..	1889	565 0	9,984	17,500
"Cufic" ..	1888	430 0	4,640	3,050
"Runic" ..	1889	430 0	4,640	3,050
"Nomadic" ..	1891	460 0	5,749	3,573
"Tauric" ..	1891	460 0	5,749	3,573
"Bovic" ..	1892	470 0	6,594	3,700
"Gothic" ..	1893	490 0	7,755	4,400
"Magnetic" * ..	1893	170 0	618	1,126
"Cevic" ..	1893	500 0	8,301	3,700
"Pontic" * ..	1894	150 0	395	330
"Georgic" ..	1895	558 7	10,077	4,200
"Cufic" (*ex* "American")	1895	475 10	8,194	2,170
"Tropic" (*ex* "European")	1896	475 10	8,194	2,170
"Delphic" ..	1897	475 9	8,273	3,000
"Romanic" (*ex* "New England")	1898	550 3	11,394	8,436
"Cymric" ..	1898	585 6	13,096	6,800
"Oceanic" ..	1899	685 6	17,274	28,000
"Afric" ..	1899	550 2	11,948	4,800
"Medic" ..	1899	550 2	11,948	4,800
"Persic" ..	1899	550 2	11,948	4,800
"Canopic" (*ex* "Commonwealth")	1900	578 3	12,097	8,513
"Runic" ..	1899	550 2	11,948	4,800
"Suevic" ..	1899	550 2	11,948	4,800
"Celtic" ..	1901	680 9	20,904	12,600
"Cedric" ..	1901	680 9	20,904	12,600
"Arabic" ..	1903	600 7	15,801	9,800
"Athenic" ..	1901	500 3	12,234	4,400
"Corinthic" ..	1901	500 3	12,234	4,400
"Republic" (*ex* "Columbus")	1903	570 0	15,378	9,500
"Ionic" ..	1901	500 3	12,234	4,400
"Baltic" ..	1904	708 5	23,876	14,000
"Adriatic" ..	1907	709 3	24,541	16,000
"Laurentic" † ..	1909	550 0	14,892	12,000
"Megantic" ..	1909	550 0	14,878	9,700
"Olympic" † .. (Building)	1910	860 0	45,000	50,000
"Titanic" † .. (Building)	1911	860 0	45,000	50,000
"Nomadic" * .. (Building)	1911	220 0	1,260	550
"Traffic" * .. (Building)	1911	175 0	625	350
SAILING SHIPS.				
"Dawpool" ..	1880	256 0	1,778	—
"Garfield" ..	1882	292 0	2,347	—
"Callao" ..	1885	200 0	1,016	—
"Santiago" ..	1885	200 0	1,016	—
"California" ..	1890	318 0	3,099	—

* Tenders. † Triple-screw.

TABLE IV.—LIST OF FIRMS THAT HAVE HAD SHIPS BUILT BY MESSRS. HARLAND AND WOLFF, LTD.

Oceanic Steam Navigation Co.
Ismay, Imrie, & Co.
John Bibby, Sons, & Co.
J. P. Corry & Co.
Jas. Napier
T. & J. Brocklebank, Ltd.
J. Prawse & Co.
W. H. Tindall
Olano Larrinaga
Saltwater Creek Co.
G. Lomer
Fulcher
Cooper & Co.
British Shipowners' Co.
J. Moss & Co.
Dublin Corporation
Rock Ferry Co.
R. G. Sharp
New Steam Tug Co.
J. Dalglish
R. Evans & Co.
M. A. Corsanego
Admiralty
W. & T. Philips
S. Murland
C. T. Bowring & Co.
T. Levick & Co.
Wm. Gossange & Sons
T. & J. Harrison
Lord Erne
Belfast Harbour Commrs.
Workman Bros.
J. G. M'Cormick
W. J. Myers, Sons, & Co.
Larne & Stranraer S.P. Co.
Executors of J. Hargreaves
Cork Harbour Commissioners
S. Lawther
Lancaster Shipowners' Co.
R. C. Macnaughton
N. Mathieson
W. P. Sinclair & Co.
A. Guinness, Son, & Co.
R. Neill & Sons
Londonderry Harbour Commissioners
African Steam Ship Co.
Asiatic Steam Nav. Co.
Ulster Steam Ship Co.
J. Gault
T. Dixon & Sons
North Western Co.
P. & O. Steam Nav. Co.
West India and Pacific S.N Co.
R. Martin & Co.
Irish Shipowners Co.
River Plate Meat Co.
Belfast Steamship Co., Ltd.
G. H. Fletcher & Co.
J. Bullock
London and North Western Railway Co.
E. Bates & Sons
Rankin Gilmour & Co.
City of Liverpool S.N. Co.
Atlantic Transport Co.
G. Warren & Co.
F. Leyland & Co., Ltd.
Wm. Johnston & Co.
Bibby Bros. & Co.
Elder, Dempster & Co.
Mississippi and Dominion S.S. Co.
Pacific S.N. Co.
Union Steamship Co.
Bann Navigation Co.
Hamburg-Amerika Linie
Netherlands-American S.N. Co.
National Steamship Co.
Union-Castle Steamship Co.
Royal Mail S.P. Co.
Italia Societa di Navigazione a Vapore
British India S.N. Co.
Anglo-American Oil Co.
Geo. Thompson & Co., Ltd.
Red Star Line
Wilsons & Furness-Leyland Line.
M'Ilwraith M'Eacharn & Co. (Proprietary) Ltd.
Australasian United S.N. Co.
Shaw, Savill, and Albion Co., Ltd.
British and North Atlantic S.N. Co., Ltd.

TABLE V.

SHIPS LAUNCHED BY HARLAND AND WOLFF, Ltd., DURING THE YEAR 1910.

Name.	Description.	Port of Registry.	Board of Trade gross tonnage.	I.H.P.	Engines.
"Edinburgh Castle,"	Steel, twin screw,	London,	13,326	13,000	Quadruple expansion balanced.
"Pakena,"	Do.,	Southampton,	7,911	4,990	do.
"Gloucestershire,"	Do.,	Liverpool,	8,124	4,820	do.
"Themistocles,"	Do.,	Aberdeen,	11,500	5,850	do.
"Olympic,"	Steel, triple screw,	Liverpool,	45,500	51,500	4 cylinder triple expansion balanced, reciprocating and L. P. Turbine.
"Sachsen,"	Steel, single screw,	Hamburg,	8,250	3,700	Quadruple expansion balanced.
"Bayern,"	Do.,	do.,	8,250	3,700	do,
"Maloja,"	Steel, twin screw,	Belfast,	13,000	12,570	do.
			115,861	100,130	