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PAPER OF TRANSACTIONS NO. CLXXX.

Shipping on the Great Lakes of America.

BY MR. A. E. JORDAN (MEMBER).

READ ON

Monday, November 27, 1911.

CHAIRMAN: MR. F. M. TIMPSON (MEMBER OF COUNCIL).

CHAIRMAN: We are met to hear a paper on "Shipping on the Great Lakes" by Mr. A. E. Jordan, who has very kindly written this for our information, but, being resident on the other side of the Atlantic, the Hon. Secretary will kindly read the paper in his absence. Many of us, perhaps, do not realize in this country the size of the Great Lakes of America and the extent of the shipping upon them. When we consider that Lake Superior has an area equal to the whole of Ireland, it gives some idea of these enormous tracts of water.

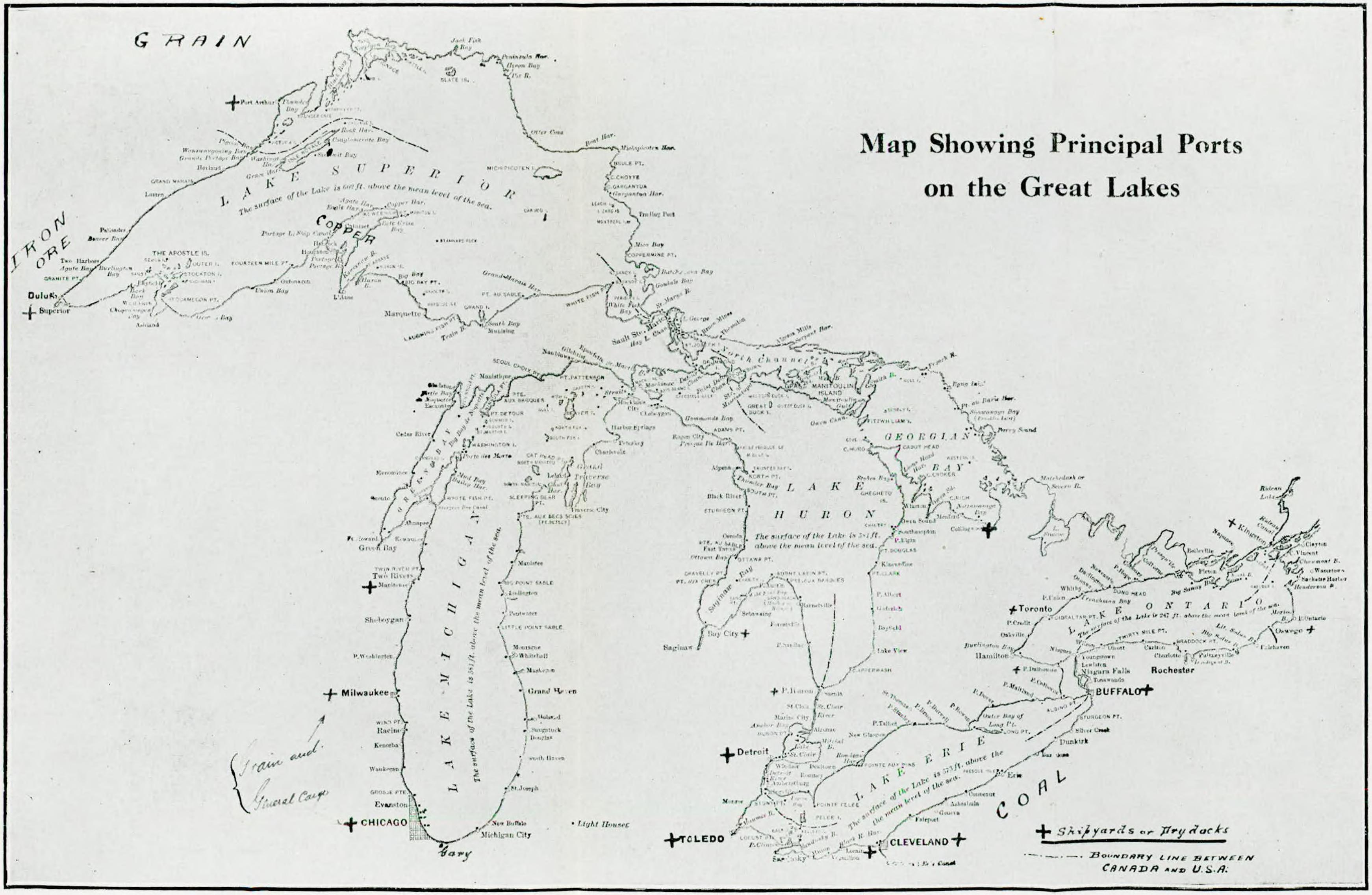
The Great Lakes of America should be seen to be really appreciated; it is perhaps difficult to realize the enormous amount of traffic which is confined to their waters unless one has seen them for himself. Lake vessels, however, carry more tonnage under the American flag than all the others in the United States put together, and the figures given hereafter will give an idea of the vast commerce on this inland sea of fresh water. The Net Registered Tonnage of the vessels which passed through the Suez Canal in 1910 was 16,311,955, whilst that of those through the Detroit River during the lake season of 1910 (eight months) was 58,821,282.

The approximate sizes of the different lakes, length and greatest width in statute miles are :—Superior, 350 × 150 ; Huron, 230 × 140 ; Michigan, 330 × 77 ; Erie, 240 × 55, and Ontario, 190 × 50. The larger vessels, however, are unable to get into Lake Ontario on account of the size of the locks in the Welland Canal, these not being able to take vessels over about 260 feet in length. The water surface of the Great Lakes is about 90,000 square miles and the distance from Buffalo at the eastern end of Lake Erie to Duluth at the head of Lake Superior about 1,000 miles.

The volume of commerce which passed through the Soo Locks to and from Lake Superior only, for the years 1909 and 1910 was as follows :—

	Season 1910.	Season 1909.
Steamers, number	17,674	16,463
Sailing Vessels, number	1,890	1,787
Unregistered, number	1,335	954
Total number	20,899	19,204
Lockages, number	14,569	13,571
Net Registered Tonnage	49,856,123	46,751,717
Freight, short tons (2,000 lb.)	62,363,218	57,895,149
Passengers, number	66,933	59,948
Hard Coal, short tons	1,658,844	1,412,387
Soft Coal, short tons	11,854,883	8,527,639
Flour, barrels	7,576,789	7,094,175
Wheat, bushels	86,259,974	113,253,561
Grain, bushels	39,245,485	46,519,451
Manufactured and pig iron, short tons	444,669	522,281
Salt, barrels	528,610	651,091
Iron Ore, short tons	41,603,634	40,014,978
Copper, short tons	148,070	127,212
Lumber, 1,000 ft. Board measure	603,101	552,380
Building Stone, short tons	9,635	1,784
General Merchandise, short tons	1,411,549	1,140,344

The season of 1911 has been a rather bad one for the Lake trade, the freight carried up to September 1 being 31,488,323 tons, against 40,046,800 for the same period in 1910. The season of navigation on the Lakes is about eight months, from



Map Showing Principal Ports on the Great Lakes
GRAIN
IRON ORE
COPPER
COAL
Grain and General Cargo
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
GEORGIAN BAY
LAKE ERIE
LAKE ONTARIO
MANITOULIN ISLAND
Port Arthur
Duluth
Superior
Marquette
Milwaukee
CHICAGO
Gary
TOLEDO
Detroit
CLEVELAND
BUFFALO
Toronto
Rochester
Hamilton
Sheboygan
Green Bay
Saginaw
Bay City
Erie
Kingston
Oswego
Michigan City
Grand Haven
Light Houses
Shipyards or Drydocks
BOUNDARY LINE BETWEEN CANADA AND U.S.A.

Fig. 1.

April to December. Early in December the ice commences to form in the rivers and straits, especially in the North, the Straits of Mackinac and the Soo River soon becoming frozen up solid, which stops all traffic to Lake Superior and it is usually the end of April before all the ice gets away. The level of the different Lakes varies considerably. Lake Superior is 602 feet above sea level and Lakes Huron and Michigan 581 feet; between Superior and Huron there are locks, two of these, the Poe and the Weitzel locks, belong to the United States, and one, called the Canadian lock, to Canada; the latter is the largest and last year handled 58 per cent. of the tonnage. There are no dues to pay for any of the locks nor are there any light, harbour, pilotage, port dues, etc., payable by vessels anywhere on the Lakes.

Lake Erie is about eight feet below Huron, the difference in the levels being taken up in the St. Clair and Detroit Rivers, where there is a current running down into Lake Erie, no locks being necessary. The level of Lake Ontario is 247 feet above the sea and 326 feet below Lake Erie; the famous Niagara Falls at the eastern end of Erie discharging the surplus water into the Niagara River, which runs into Lake Ontario. There are 25 locks in the Welland Canal in Canada, which goes from Port Colborne on Lake Erie to Port Dalhousie on Lake Ontario, through which vessels not longer than about 255 feet go, generally laden with grain from the ports on Lakes Superior and Michigan to Montreal; the majority of the lake vessels, however, are unable to go east beyond Buffalo on account of their size; they are built on the Lakes and when a bad season comes along they have to be laid up; in 1908 a number of vessels did not make a single trip all the season. The following table gives a comparison of the total Lake traffic which passed through the Detroit River from 1902 to 1910.

Year.	Number of passages.	Freight, Tons.	Estimated value.
1902	33,000	44,260,506	$440,834,640
1903	33,113	46,817,245	471,917,830
1904	29,472	42,792,326	453,598,656
1905	35,599	55,508,360	522,888,751
1906	35,128	63,808,571	662,971,053
1907	34,149	71,226,895	697,311,302
1908	27,883	54,086,750	614,425,480
1909	32,296	67,789,369	732,803,079
1910	33,638	73,526,692	771,294,055

The average freight rates for the ten years ending 1910 were as follows :—

		Cents.
Iron ore, from head of Lake Superior to Ohio ports.	(gross ton 2,240 lb.) .	74½
Iron ore, Marquette to Ohio ports	,, ,, .	67½
Iron ore, Escanaba to Ohio ports	,, ,, .	57½
Soft coal, Ohio ports to Milwaukee	(net ton 2,000 lb.) .	43½
Soft coal, Ohio ports to Duluth	,, ,, .	34
Hard coal, Buffalo to Chicago	,, ,, .	43
Hard coal, Buffalo to Duluth	,, ,, .	33½
Wheat, Chicago to Buffalo (bushel)	. . . . .	1·46
Wheat, Duluth to Buffalo ,,	. . . . . .	1·84

Iron ore is F.O.B. and 15 cents. per ton is paid by the ship for discharging. \$4·12½ per 1,000 bushels is paid by the ship for shovelling, trimming and tallying grain. Coal is handled in and out without charge to the ship.

The Lake freighter differs considerably from vessels built for ocean traffic. The draught and beam are fixed by existing conditions ; the draught is limited to 18 to 19 feet to and from Lake Superior and about 20 feet for other parts, owing to the shallow places in the waterways connecting the different lakes, and the beam by the width of the entrances of the Canadian and Weitzel locks, which will not admit vessels of over 60 feet ; the Poe lock has gates 100 feet wide, but should anything happen to it a vessel over 60 feet beam could not get into Lake Superior ; moreover the discharging berths are built to handle vessels not exceeding 60 feet, so that this is at present the limit, most of the larger vessels being 58 feet beam. The largest boats are 605 feet long over all, 58 feet beam, 32 to 33 feet deep and can carry 12,000 tons ; their lines are necessarily very full and they have practically flat bottoms ; they have 36 hatches which are about two-thirds of the vessel's beam and are 12 feet apart centre to centre fore and aft ; the hatch covers are made of steel-plate flanged at the ends and telescope over each other from the centre to port and starboard sides of the hatch, being handled by wires led to the mooring winches.

The deck is perfectly clear from forecastle to poop, there is no cargo-handling gear on board, the only machinery on deck being mooring winches. The pilot house (wheel house), captain's quarters and navigating bridge are right forward on a high forecastle deck, with accommodation for deck officers and part of the crew under this deck. Many of the vessels have fine accommodation for three or four passengers ; the quarters for officers and crew are all well fitted up and as a rule have shower and tub baths ; the captain's rooms in the modern vessels are far superior to those in any cargo boat on salt water.

The engines and boilers on all the bulk freighters are aft under a raised poop, on the deck of which are berths for the engineers, greasers, firemen, etc., also the galley and mess rooms ; nearly all the vessels are lighted by electricity and have telephones from the forecastle to poop, which are especially useful in bad weather.

The hold is quite clear, there being no hold beams or stanchions, but heavy, deep, arched girders are fitted under the deck between the hatches ; there are generally two divisional bulkheads, but these are not water-tight, there being no water-tight bulkheads between those of the forepeak and stokehold ; all the modern vessels have side tanks which run up to within 10 or 11 feet of the deck, as well as a double bottom which is about 5 feet deep, the side tank being in fact a continuation of the bottom tank.

The floors are made of 15-inch channel bars, the lower flange forming the frame bottom bar, they are spaced three feet apart and have a deep floor plate every 12 feet ; the vessels all have flat keel plates and a water-tight centre keelson ; there are usually four fore and aft plate girders on each side attached to the upper flange of the channel floor, with a continuous angle on one side and a lug on the other and intercostals between the floors connected to the bottom plating with the usual shell bars.

The tank tops have no wood ceiling and the holds no side bilges, the tank top plating (in vessels which have no side tanks) extending out straight to the side plating, heavy brackets above and below connecting the tank top plating to the side frames and to the bottom channel floors.

In the building of lake vessels no scrieve boards are used, all the plating, floors, frames, brackets, intercostals, girders, beams and other parts are shaped and marked off from carefully made templets, called moulds, and all holes punched before any parts are erected. A set of moulds can be used for a number of vessels of the same size. It is claimed that a considerable saving is effected by the mould method over the scrieve board (nevertheless the cost to the shipowner for a vessel built at any American yard is greater than for one of the same size built at home) and that the work is done much more quickly. The time for building say a 9,000-ton ship is sixty to ninety days from laying the keel until the trial trip is run, a number of vessels have been turned out in much less time than this ; one, the *J. Q. Riddle*, built by the American Shipbuilding Co. in 1906, 552 ft. × 56 ft. × 31 ft., was completed in forty-five days.

For over three-quarters of the length the bottom floors are all the same, straight lengths of 15-inch channel, the turn of the bilge being formed by an angle bent to shape and joined to the floor and to tank top plating with a large, shaped plate bracket ; the side frame is a 9 to 12-inch channel, according to the size of the ship, and is bracketed to the deck beam and to tank top ; the floors at both ends of the ship as she begins to narrow are carried up to the tank top, being bent and bevelled to suit the lines of the vessel. The shell plating used is all very large, the average size of plates being from 25 to 30 feet in length and 6 to 7 feet in width.

While there are a number of fine passenger and general cargo boats, the majority of the vessels are built expressly for the iron ore and coal trade, the lake term for them being bulk freighters, the general cargo boats being called package freighters. The loading and discharging of the bulk cargoes is done with surprising despatch ; the loading berths jut out into the water and are so arranged that a chute can be put into each hatch, all being spaced 12 feet centre to centre ; the discharging docks are fitted with overhead travellers from which grabs, called clam shells, are worked ; the latest pattern, named the Hulett, after the inventor, lifts 15 tons at each hoist.

All the discharging machinery is operated by electricity, and in August of this year a vessel loaded with 10,234 gross tons of iron ore was discharged at Ashtabula in four hours and six minutes with four 15-ton Hulett machines, the average tons per hour per machine was 637·6 and the average tons per hour from start to finish for the four machines was 2,550·5 tons. Unloading commenced at 6.30 a.m. and was completed at 10.36 a.m., this being a record for discharging ; the record for loading is 10,111 tons of ore put into a vessel in thirty-nine minutes. These of course are record times, but in any event the usual time to load is not more than two or three hours and to discharge from six to twelve hours. Lake vessels

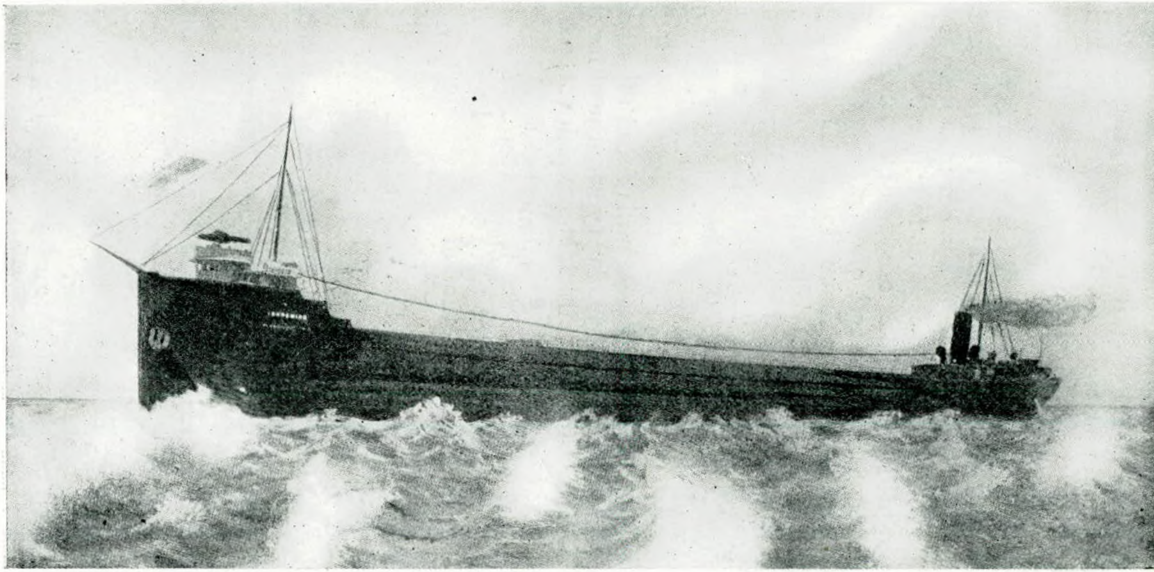


Fig. 2.
A Typical Lake Freighter, 530 ft. long, 56 ft. beam, 6,924 G.R.T.

have an advantage over their deep-sea brethren, as the captain has practically no ship's business to attend to ashore, so that as soon as the vessel is loaded or discharged she can get away. Vessels have made as many as thirty-eight trips during the season by going up light and only carrying ore from Lake Superior to Ohio or Lake Michigan ports ; an average number of trips for a vessel taking a cargo both ways is about twenty for the season of eight months, or about twelve days for each trip, two cargoes being handled in and out ; the longest passage, from Buffalo to Duluth, takes about four days.

The wages paid on the lakes are high compared with those on deep sea vessels, but the cost of everything in America is so much greater than at home that I do not think the men are much better off in the end. The captain gets from £400 to £500 a year, all other pay being monthly ; chief engineer about £35, assistant engineer £25, mate £27, second mate £19, wheelsmen (quarter-masters) £10, greasers and firemen £10 10*s.* to £11 10*s.*, and deck hands £6 6*s.* ; all provisions are found by the ship and all hands are well fed.

The machinery in all the freighters is fitted aft, the boilers are of the usual return multitubular type and call for no comment, the engines are nearly all triple-expansion, three cranks, and not having salt water to contend with they all have jet condensers ; no copper pipes are used ; the main and other steam pipes are steel and water pipes ordinary iron piping with screwed connexions. The method of fitting propellers is somewhat curious to us ; a large number of the tail shafts are parallel, the propeller is bored an easy fit and keyed on with a fitted, driven key ; then a heavy band shrunk on the end of the shaft. Comparatively few of the shafts have cone ends with fitted propellers secured with a nut ; there are no brass liners on the tail shafts and no corrosion takes place, and as the vessels are laid up for about four months every year there is no necessity to draw the shafts for periodical inspection. The stern bush is made very long and is generally cast iron or steel filled with lignum vitae, usually having white metal run between the strips. It is fitted so that it can be removed for re-wooding without drawing the tail shaft or removing the propeller. The after-coupling is disconnected and shaft and propeller jacked aft a sufficient distance to allow the bush to be drawn out ; the bush itself is made in halves and in three or four lengths connected together with dovetail or figure 8 keys, and has tapped holes in the after-ends of each section for draw bolts. The stern frame of Lake vessels lends itself to this operation as it has no rudder post, the weight of the rudder being carried on a bearing collar on deck and a bottom pintle, which goes into a bushed hole in the overhung sole piece of the stern frame, steadies the rudder and keeps it central. These rudders are huge balanced affairs often 8 feet wide.

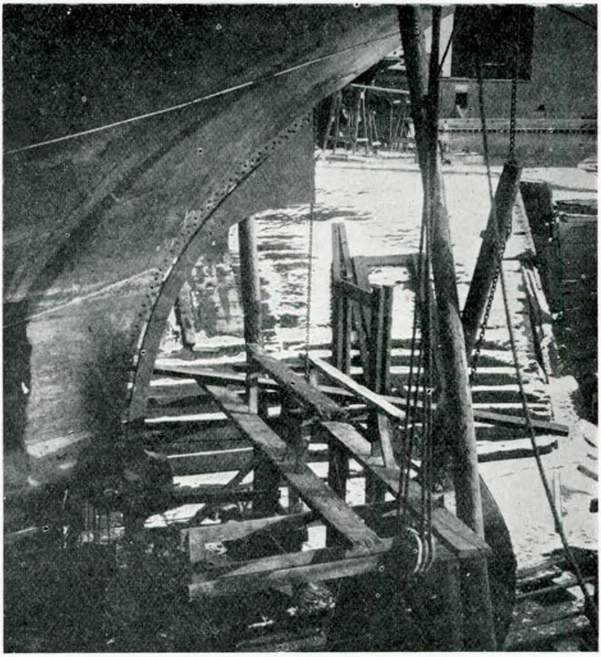
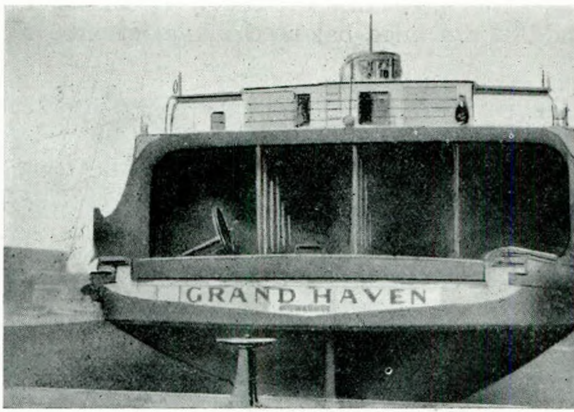


Fig. 3.
Stern Frame of Passenger Steamer, 233 ft. long, 40 ft. beam.

They can be disconnected on deck and turned at right angles to the ship, which gives plenty of room to get the propeller and shaft sufficiently far aft to allow the sections of the stern bush to be drawn out. After the latter has been replaced the stern tube is filled with heavy black oil and kept full with an oil pump. These bearings run for several seasons without requiring re-wooding, and give no trouble. Most of these vessels can easily be tipped sufficiently to get at the stern bush, so that re-wooding is often done afloat; built propellers are the rule, and when a new blade has to be fitted this is also done afloat.

The engines of any of the bulk freighters seldom develop



Figs. 4 and 5.
Lake Michigan Car Ferry.

more than 2,000 I.H.P. A typical case is a vessel 504 feet long and 54 feet beam, which carries 9,000 tons and has engines 23″, 38″ and 63″ with 42″ stroke, developing about 1,950

I.H.P. and running about 10 statute miles on a consumption of 1·7 lb. of coal per I.H.P. per hour. As soon as the season of navigation is over, early in December, the vessels are taken to winter quarters and laid up, the machinery is all opened out, cylinders, etc., drained, all working parts oiled and sea cocks filled with heavy black oil to keep out the frost.

The Southern end of Lake Michigan and the Detroit River are kept open all winter. One of the distinctive features of the Lakes, the railway car ferry, runs all the year round. These vessels are specially built for breaking ice, and carry complete trains (without the locomotive). The car deck is fitted with three or four sets of rails and the after-end of the deck left open so that she can be backed against the end of the railway tracks and coupled up in line with the rails, the car slip being raised or lowered to suit. The cars are then run on to the deck and secured with dogs. Some of these car ferries are fine twin-screw boats with an upper deck fitted with cabins for carrying passengers, several of them running across Lake Michigan, a distance of over 70 miles, their cargo consisting solely of freight trains. There are also ferries for taking passenger trains from Detroit to Windsor, about half an hour's run across the Detroit River, but they are now building a tunnel under the river there for the Canadian Pacific, one being already in operation from Sarnia to Port Huron on the Grand Trunk Railway, so that trains can run between Canada and the States without using the ferry.

The package freighters are in most cases owned by the Railway Companies, and pick up cargo from the different railway terminals. They have large side doors through which the cargo is wheeled on hand trucks from the railway cars, the boat's deck being nearly level with the dock ; they have their engines aft and a line of shafting runs the full length of the 'tween decks, with friction drums at each hatch to handle the cargo in and out of the lower holds.

A number of fine passenger boats are run during the summer. One distinctive vessel is the whaleback steamer *Christopher Columbus*, which was built in 1893 for the Chicago Exhibition, and is now running daily between Chicago and Milwaukee ; she is 364 ft. × 22 ft. × 24 ft., has engines 28″, 42″ and 70″, with 42″ stroke, single screw, and goes about 18 miles per hour.

The *City of Cleveland* is a paddle steamer 390 ft. × 54 ft. × 22 ft. 3 in., built in 1907, and runs between Cleveland and

Detroit. She has compound diagonal engines with 54″ H.P. and two 84″ L.P. cylinders and 96″ stroke. She is owned by the Detroit and Cleveland Navigation Company, who have a number of other passenger vessels, and have recently launched a still larger one 472 ft. × 55 ft. × 22 ft., with engines having a 62″ H.P. and two 92″ L.P's. with 102″ stroke. There are also excursion boats running from the lower lake ports to the islands at the head of Lake Huron and to Lake Superior, the number of passengers who went through the Soo Locks in 1910 being nearly 67,000.

During the late autumn the lake region is subject to very heavy storms which cause a big sea to rise ; a number of vessels have foundered, amongst them some of the 10,000 tonners, and have gone down in Lake Superior with all hands, without a vestige of them ever being recovered ; it is said that this lake is 200 fathoms deep in places. In 1910, nineteen vessels were total losses and forty-nine lives were lost ; ten of these vessels were burnt ; four foundered, including a car ferry of over 5,000 tons ; three were sunk by collision and two stranded and broke up, one of the latter being a 12,000 tonner. A very bad sea gets up which is similar to that in the North Sea. Passengers are invariably sea sick when there is much wind, and one has to be well used to these short heavy seas to go out on any of the lakes in a storm, without being affected.

A good deal of damage is sustained by the boats during the season, especially through groundings and collisions. Whenever possible the damage is patched up to enable the vessel to keep running until the season is over, so that the repairs keep the yards busy most of the winter months. All the shipbuilding yards have dry docks, of which there are about thirty over 250 ft. long, besides numerous smaller ones ; sixteen of the docks are over 400 feet long, and the largest is 764 feet with an 80 feet entrance ; all the graving docks are made of wood, with the bottoms heavily piled, and there are also steel pontoon docks at Detroit.

The American Shipbuilding Company has eight shipbuilding yards at various places, all of which have dry docks, and also two yards with dry docks only. The Great Lakes Engineering Company has three yards and docks, Toledo Shipbuilding Company has one, Manitowoc Shipbuilding and Dry Dock Company one and Collingwood Shipbuilding Company one. These yards build all classes of vessels, and make their own engines and boilers. During 1910 (exclusive of Canadian yards) the lake shipbuilders launched 51 vessels, 20 being bulk freighters, 3 package freighters, 2 passenger steamers and 3 car ferries, the remainder being tugs, tenders, dredgers, etc. The bulk freighters had a carrying capacity of 194,500 gross tons, five carrying 12,000 tons each, four 10,000 ; eight 9,000 and three 7,500. In practically all cases, lake vessels are launched sideways into a slip alongside the buildings ways, and in some cases they are launched into a "dry dock." Besides the abovementioned yards, there are others on Lake Ontario, and many smaller ones which build tugs, fishing boats, dredgers, motor boats, etc.

As before stated, the majority of the repairs are left until the winter, when the boats are laid up, and often have to be done under very severe conditions ; one vessel went into the dock at the Superior Shipyard on a Christmas eve, and there was so much ice in the dock, that when the water was first pumped down, we found she had over three feet of ice between her bottom and the keel blocks. She had to be floated again, steam led into her tanks, and the bottom swept with heavy booms, it taking three days to get her safely landed on the blocks ; then to make the survey we had to crawl under her bottom on top of huge blocks of ice, to ascertain the damage, so that the cranes could be put to work lifting the ice away from the damaged parts before the men could get to work cutting out. The temperature at Superior goes down to 40° below zero, but the air is fine and bracing, and when there is no wind, the men can work outside with the temperature 15° to 20°, but when it gets below 15°, all outside work has to be stopped ; the ice in the northern harbours and rivers gets so solid that scaffolding is erected on it, and a wagon with two horses and two or three tons of plates can be driven over it with perfect safety.

Lake vessels suffer very little from corrosion ; the holds, top sides, decks and deck erections are painted, but the shell plating below the light water line is left bare, and suffers no ill effects ; the insides of the tanks are not coated, nor is any cement used excepting in the fore and after peaks.

The channel floors lend themselves to efficient and economical repairs, as the damaged parts can be cut out at any point without shifting butts, new pieces fitted and joined to the existing part, with back bars of the same section, and a face plate fitted on the inside, giving the joint of a 15-in. channel, with $\frac{1}{2}$-in face plate, a sectional area of $6\frac{1}{2}$ in. more than the original.

Fig. 6.
Ice in Dry Dock at Superior.

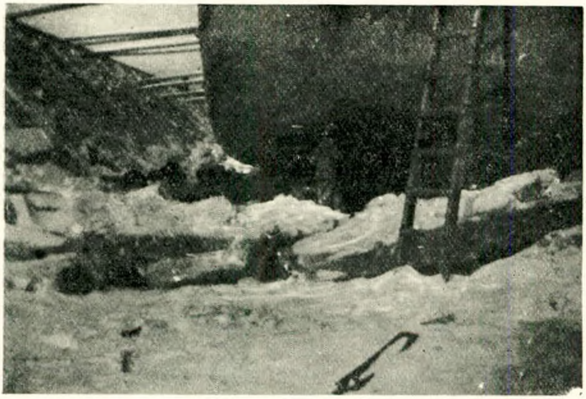


Fig. 7.
Ice in Dry Dock at Superior.

The use of pneumatic tools is universal on the Lakes ; all cutting out, drilling, caulking and most of the riveting is done by air, in fact, it would be almost impossible to get the work done without it, as while there are plenty of skilled men (most of whom have come from home yards) at the larger works, at some of the smaller ones a man may be a carpenter, working to-day at the planking of a wooden vessel (of which there is still a number), and to-morrow he may be riveting up plates on the bottom of a steel boat with a pneumatic riveter, and making a very good job of it, which it is very doubtful if he would be able to do by hand.

The names given to many of the parts are very different from those we use ; a propeller is called a "wheel," and when of the built type the blades are called "buckets," the cylinder cover is "cylinder head," the junk ring "follower," the tunnel "shaft alley," stern tube "stern pipe," funnel "smoke stack," the stern of the vessel the "fantail," the deck-house on the forecastle head "the texas," the stokehold "fire room," the shell plates of a boiler are "wrapper sheets," tube plates "tube sheets," front and back plates "front and back heads."

The sign # is used on all drawings, and has two meanings ; when placed before a figure it signifies number, #8 means No. 8, and when placed after a figure it means pounds ; a channel marked 15 in. × 33 # meaning that the channel weighs 33 lb. to the running foot ; all plating is marked in lb. per square foot instead of the thickness in 16ths or 20ths.

It is, of course, the enormous natural resources, iron ore, copper and grain in the North and West, and coal in the South and East, which have made the growth in commerce on the Lakes so rapid, and it is marvellous when we stop to consider that in eighty-odd years Chicago has grown from an Indian trading camp to a city which covers an area of 190 square miles, with a population of nearly two and a quarter million ; it is the terminus for about thirty railways, has hundreds of miles of streets and boulevards, and buildings and shops equal to the best in New York. The other principal cities on the Lakes are Cleveland, which is the centre of the shipping business, and has a population of over 560,000 ; Detroit, one of the most beautiful cities in America, has 465,800 inhabitants ; Buffalo with 423,700, and Milwaukee, a fine city with a population of 374,000, has about the largest engineering works, breweries and tanneries in America.

The Lakes are responsible for many useful innovations ; one in particular I may mention is the Schuette Recording Compass, which keeps an automatic record of the ship's course, time it was altered, and how long she ran on each particular course; it can be fitted to any vessel with a dynamo, and can, I believe, also be worked with batteries; the English agents are Messrs. H[illegible]h & Co., Crayford, London.

Kidd's anchor pocket is another interesting patent brought out on the Lakes. Instead of the hawse pipe extending through the bow plating, a casting is fitted which takes in the anchor flukes, leaving the crown practically flush with the bow plating; this casting has a plate steel cover on the inside, on which a short hawse pipe is fitted, the upper end of the pipe being connected to the deck in the usual way.

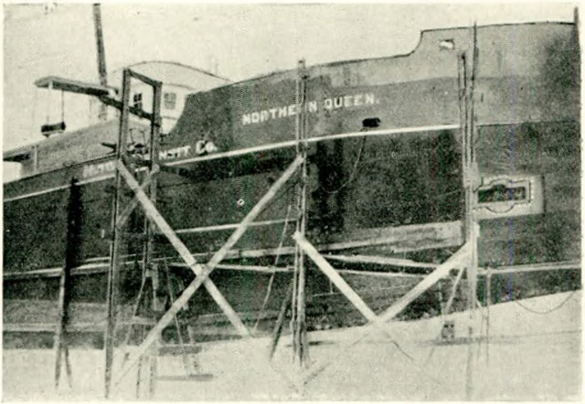


Fig. 8.
Kidd's Patent Anchor Pocket.

In conclusion, I would say, that although this is not strictly an engineering paper, I hope it has been found of some interest, and should any of you be in America with a few days to spare, a visit to the Great Lakes would, I am sure, well repay the time spent.

CHAIRMAN: I do not think this is a paper which will lend itself to very much discussion; but there are a number of items which are practically useful to engineers, for example, as regards the treatment of machinery in very cold weather, and if there are any other points members would like information upon, we could ask Mr. Jordan if he would be good enough to write a reply. The terms "hard coal" and "soft coal" which the writer mentions are not familiar to us here; but in British North America hard coal is largely used in the houses mixed with soft coal for the winter firing, and a great quantity of that comes from the American side. With regard to this rapid loading of cargo, some friends of mine who went out a few years ago called at one of the ports and were so alarmed at the rate of loading that they thought they were going to sink, and left the vessel. The normal rate, I believe, is about 1,000 tons an hour, but they can do it much quicker than that. Mr. Jordan makes a remark about the cost of living, but I think that remark applies to the American side and not to the Canadian. In Canada there are a good many articles favourable in prices compared with home prices. The item about corrosion reminds me of an incident which happened some years ago, when two vessels were built on the Lakes for the Canadian Government and were sent to Nova Scotia. The sea-cocks were of cast iron and of course under sea service corroded and had to be renewed with gun metal. Mr. Jordan speaks of a man putting down his tools on one class of work and taking up an entirely different job. Such a practice would cause trouble here, but in America it works all right, and as a consequence the American gets ahead more quickly than he would in this country. The Recording Compass the author describes will perhaps be needed to settle disputes at times, and I think it could be applied with advantage to deep-sea steamers. I have often heard of arguments from which it appeared the vessel had made a very serpentine track through the water, while the distance made good in direct line was low in comparison to mileage by propeller. We are all much indebted to Mr. Jordan for giving us a description of this important industry, and from reports which have come from Canada, it is evidently the intention to make these canals much larger so as to enable deep-sea vessels to go through into the Lakes. There is one part in which he speaks of the cost of freight. In the case of wheat, for instance, it must be borne in mind that wheat going from Duluth to Montreal means a great loss in trade to U.S. seaboard ports. I understand it is the case that you can land wheat in this country at three cents. a bushel less than by sending it by American rail to the sea-coast. This indicates that the Canadians intend to develop the east and west trade, and if they open up the Lakes with a larger canal it will mean a great deal more trade with this country. In the Clyde district during the last three or four years about sixteen or seventeen steamers have been built for Lake traffic, and several Canadian Pacific Railway boats are running in connexion with the railway on the various Lakes, in fact many travellers in Canada go west by rail and make the journey back by the Lakes, which is, I believe, a very enjoyable way of taking the trip. His remarks on the care of machinery in cold weather will be of interest. When you get in a country with winter temperatures below zero you find, as I know to my cost, quite a difference in making your arrangements.

Mr. J. CLARK : I am sure we have all listened with pleasure to this most interesting paper by Mr. Jordan, and a great number of the methods mentioned have been of especial interest to us. I notice from the paper that everything seems to be done electrically. I suppose the cold weather, and the consequent danger of the pipes freezing, prevents hydraulic plant being used. Here, generally speaking, hydraulic machinery is preferred. One of the points which occurred to me is in connexion with the handling of cargo. Mr. Jordan mentions that "Iron ore is F. O. B. and 15 cents. per ton is paid by the ship for discharging." I suppose I am right in assuming that 15 cents. is equal to $7\frac{1}{2}d.$ a ton, which seems to be rather a high price for discharging cargo at the rate they do it. One understands that capital costs and everything is included, but at the rate they seem to do the work it is somewhat surprising. Mr. Jordan says : "The record for loading is 10,111 tons of ore put into a vessel in thirty-nine minutes." I suppose it is not a misprint, if not, it is a remarkable record : it is equal to over 15,500 tons an hour, which seems tremendous. In connexion with the *Christopher Columbus*, it is stated that she is a boat of 364 ft. $\times$ 22 ft. $\times$ 24 ft. Either that 22 ft. is a misprint, or, being a whaleback, the dimensions are taken differently from what one would naturally think. The use of pneumatic tools is also interesting, especially when one considers the climate. Without a doubt steps must be taken to prevent the moisture freezing ; and Mr. Jordan might have given us some information on that point. The paper has been a most interesting one, and I am sure we are all very pleased that Mr. Jordan has taken so much trouble in putting it before us.

The Hon. Secretary : It would be interesting to have the cost of discharging grain by elevators and otherwise in this country. The author has been written to regarding the figures.

Chairman : With regard to prices, I think you can take a 5 cent.-piece in America to compare with a penny here. It is a very safe average to take and would be a fair comparison.

Mr. J. B. Kidston : Mr. Jordan's paper is a very interesting one, and condenses into small compass a great deal of information on a very important trade. As is only natural, the points on which the writer has enlarged or gone into details about are those connected with the engines, giving a great many interesting details as to the working of the machinery and the carrying out of repairs. He also lays before us a lot of information, as Mr. Clark has said, in regard to discharging ; as we know, these vessels carry no loading or discharging gear, but are entirely dependent on the various docks or ports where the ore is loaded or delivered ; and I have no doubt that has something to do with the rate charged. One point in the paper struck me from a shipbuilder's point of view. The author mentions in a general way, in a few paragraphs, some particulars as to the methods of construction, and my recollection goes back to a paper by Professor Sadler at the Institution of Naval Architects about two years ago, with a similar title. He divided about half to the ship and half to the machinery, and, although he did not mention many of these very interesting points about the tail shafts and repairs, he went more fully into the ship construction. The paper brought out an interesting discussion of which the principal point was that the weight of construction of a bulk freighter on the Lakes was very much lighter than the average sea-going vessel built in this country. The generally accepted reason for this is, I believe, the character of the rough weather which they meet. The waves being such that they do not require to allow for such large stresses as in an ocean-going ship built here, consequently the building is lighter, but every precaution is taken in the closer spacing of the fore-aft girders, and the construction appears to be of the best nature to meet the conditions, the amount of damage they suffer from weather is infinitesimal, and they do the work very well indeed. I believe the example set by these Lake builders in using the 3-ft. spacing, associated, as Mr. Jordan says, with wide-spaced solid floors and intermediate channel floors, has possibly modified the opinions of our naval architects and induced them to adopt a similar wide spacing for solid floors. At the present, 3-ft. frame spacing, with 6 ft. or more spacing of the solid floors is quite common. The idea is that, given sufficient strength, they get a better ship from the owner's point of view; there is easier access, and a large number of ships are being built on this principle. There are a great many other details which might be spoken of in this connexion, but I will not go further than express my thanks to Mr. Jordan for having put forward an extremely interesting paper on a subject not generally known in this country. I may say, however, that in this country during the last twelve to fifteen years there have been a very large number of the smaller Lake vessels built. As the writer says, the access to the Lakes is limited by the size of the locks. The principle of the Lake steamer construction is followed in these vessels, except that the side tanks are omitted, and quite a number have been built in this country, up to 250 ft. in length; but if, as Mr. Timpson says, the access to the Lakes is increased, that may revolutionize our share of the shipbuilding.

Mr. E. W. Ross: The subject of this paper is rather out of our usual line, but I am sure it is of value to us to know something of what is going on in America. We hear that it is a land where everything is done on a wholesale scale, and the data given prove the statement. The rapidity of loading and unloading appear to be marvellous, and no doubt some of our shipowners here will wish that a little of this speed could be shown in our docks. Mr. Clark referred to the prices for loading and unloading, but in America prices are higher than here. The author says: "There are no dues to pay for any of the locks nor are there any light, harbour, pilotage, port dues, etc., payable by vessels anywhere on the Lakes." How are these canals kept up; are they subsidised by the State? If there are no dues for coaling it would be interesting to know how they get the coal aboard; does the coal cost an exorbitant amount? The length of the ships on the Lakes is astonishing to me; 605 ft. comes up to the length of some of the Atlantic liners. Then again they have no bilges on some of the ships, otherwise, where grain is carried in bulk, some of the grain would be destroyed as the water would be sure to get in. With the others who have spoken, I am very much obliged to Mr. Jordan for the information he has given.

Mr. E. SHACKLETON : I am much of a novice in these matters as regards steamships, but I believe the *Toiler* took her first cargo, a very large one, on the Lakes not long ago. She is a Diesel-engined boat and took a three months' supply of fuel oil I understand from a reliable authority. I was rather struck, when I saw the *Toiler*, with her peculiar shape, canal barge cum-drifter-cum-cargo boat, but, from the illustrations given with this paper, it is apparently built on the lines of the typical Lake freighter. To me Mr. Jordan's paper has many attractions and I am sure that to the steam engineer it must be doubly attractive. I notice one thing, however, it is a very small point ; but when you see a 9,000-ton ship rushed off in forty-five days it makes one begin to wonder if they are built under Registries and surveyors. Even although it is a lighter vessel, to turn out a 9,000–ton vessel in sixty or ninety days even seems to me to be very quick time indeed. It would be interesting to know what is the average on this side with an ordinary light steamer. The paper is a very interesting one.

CHAIRMAN : In reference to Mr. Shackleton's remarks one of the records in this country was the building of the *Normania* in ninety-five working days. She was a first-class mail ship of the time. Undoubtedly on the Lakes there are surveys held on the vessels built, possibly directed from New York.

Mr. A. ROBERTSON : There are many things of interest in this paper ; most of them have been already touched upon, but one of the things that struck me was the fact that they are using to a very large extent steel-plate hatch covers on the Lake vessels. Several gentlemen in this country are trying to push patents of one kind or another at the present time, and it would be very interesting to know more of the exact details of how the hatches are worked. I take it the hatches are very small, otherwise they would not be able to be handled except, possibly, by wires. The principal thing of interest is really the method of construction of the steamers. They certainly seem to be more of the barge construction than what we would call the steamer construction. For three-quarters of the length they are practically the same section right through, so that it is easy to understand the reason for dispensing with a scrieve board in the framing of the vessels. It is not necessary, with the exception, of course, of the forward and after ends, where the frames, being so far apart as 3 ft., a complete set of templets could easily be made. I take it these steamers are, more or less, built to standard sizes so that quite a number of vessels could be turned out from the same set of templets. It would be quite an unheard-of thing in this country, to build a number of steamers all to the same size. Probably there might be five or six to the same dimensions, but it is very infrequent to build a large number from the same lines unless we take the case of barges, which are turned out in much the same way as these steamers on the Lakes. I should like to know more about the style of framing of the bottom tanks. I see the floors are made of 15-in. channel bars, then a deep floor plate every 12 ft. The tank top, I take it, comes to the top of that floor plate and then the fore and aft girders are the support for the tank top. The 15-in. channel bars, I understand, do not support the tank top, only the fore and aft girders.

Mr. Kidston: Professor Sadler made a very interesting statement, that, when running light with the ballast tank full, they very often supplement the water ballast by taking a manhole cover off and running water into the hold. It is quite a common practice he said, and does not seem to do them any harm.

Chairman: I have pleasure in asking you to pass a hearty vote of thanks to Mr. Jordan for sending this paper and to Mr. Adamson for reading it.

Mr. Ross: I have much pleasure in seconding this vote of thanks.

The Hon Secretary: I shall be pleased to convey to Mr. Jordan your appreciation of his paper. I was amazed when I read these figures; I had no idea the traffic on the Lakes was so great as it seems to be. In connexion with the use of pneumatic tools and electric drive a paper will shortly be read by Mr. W. R. Cummins, which, I expect, will deal with these applications of power for cargo work. Mr. Cummins, in a paper he gave us and which was read at the Exhibition at Shepherds Bush, referred to winches being worked by air or by electricity, and I think he will deal with that in the coming paper. I had no idea that a carpenter could take up a boiler-maker's work without labour troubles resulting; we know what would be experienced in London under like circumstances, amounting in some cases to the absolutely ridiculous. Indeed one is inclined to wonder whether the age of second childhood has been reached when some of the hair splitting lines are laid down—lines which do no good to anybody and do injury to the progress of work, and remind one of the "peevish child," as the distinctions made between what can and what cannot be done, or what dare not be done, by different tradesmen approaches childishness and is frequently a source of annoyance and a hindrance to progress of work."

The meeting closed with a vote of thanks to the Chairman, on the motion of Mr. Ross, seconded by Mr. W. Watson.

The following were elected at the meeting of Council held on Thursday, January 11, 1912 :—

As Members.

Charles S. Allen, Shanghai.

Thomas R. Blackett, London.

Robert H. Fleming, Southampton.

H. R. Forrest, London.

D. R. Dilworth Harrison, Longfield, Kent.

J. J. Kehoe, Southend-on-Sea.

John Oates, Newport, Mon.

Ralph Scott, Gateshead.

Robert J. Wilson, London.

As Companion.

H. A. H. Moore, London.

As Associate Member.

T. J. Coughlan, London.

As Graduates.

George Ayre, London.

C. J. Cruickshank, London.

Transferred from Associate Member to Member.

William Jessel, London.

INSTITUTE OF MARINE ENGINEERS

INCORPORATED

SESSION 1911-1912

President: The Most Hon. The MARQUIS OF GRAHAM, C.B., C.V.O.

VOL. XXIII.

REPLY TO DISCUSSION ON PAPER NO. CLXXX., "SHIPPING ON THE GREAT LAKES OF AMERICA."

By MR. A. E. JORDAN (MEMBER).

PAPER OF TRANSACTIONS NO. CLXXXI.

WIRELESS TELEGRAPHY.

By MR. JOHN McLAREN (VICE-PRESIDENT).

Read Monday, December 11, 1911.

CHAIRMAN: MR. E. W. ROSS (MEMBER OF COUNCIL).

ADJOURNED DISCUSSION,

Monday, January 29, 1912.

CHAIRMAN: MR. G. W. NEWALL (MEMBER).

ELECTION OF MEMBERS.

INSTITUTE OF MARINE ENGINEERS

INCORPORATED

SESSION 1911–1912

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F. M. Timpson.

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Jas. Adamson, A. E. Battle } Papers.
Jos. Blackett, Property.
W. E. Farenden, Press Cuttings.
J. G. Hawthorn, Library.
A. H. Mather, J. McLaren } Recreation.
E. W. Ross, Reading Room.
F. M. Timpson, Issue of Transactions.

J. G. Hawthorn and J. Lang, *Joint Conveners, Junior Section.*
J. Clark and W. Veysey Lang, *Joint Conveners, Experimental Dep.*
George Shearer, *Representative on Advisory Committee, Board of Trade.*

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