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JOHN HAWKSHAW, President,
in the Chair.

No. 1,094.—“On the Communication between London and Dublin.” By WILLIAM WATSON, M.A., T.C.D., Assoc. Inst. C.E.

HOLYHEAD, the nearest point of land in Great Britain to the metropolis of Ireland, was naturally thought of at an early date as a convenient port of departure and arrival for the mails; but though its proximity was undoubtedly the principal reason for its selection, yet it possessed also the advantage of being exactly opposite to Dublin, without any great difficulties in the navigation of the channel, and with easy access into the bay, at a time when shore lighthouses were scarcely known on that part of the coast.

This line of mail communication has been used for a century and a half. It is recognised in the Act of Parliament, passed in 1729, to confirm the patent previously granted to the Trench family, for erecting a lighthouse on the Skerries Rock,¹ near Holyhead, which authorised the payment of £50 a year by the Postmaster-General, in consideration of the benefit of the lighthouse to the packets sailing between Holyhead and Dublin. The communication between London and Dublin was then very irregular, and the time occupied on the journey was very protracted. Traveling through North Wales was attended with difficulty and fatigue, and the passage of the channel was altogether contingent

¹ The history of this lighthouse is remarkable. It is stated in the preamble of the Act 3 Geo. II., “that the lighthouse which had been established by Mr. Trench under authority of the Charter from Queen Anne, he was no longer able to support from the duties then collected, and, that it must inevitably fall into decay unless the said duties were extended, and some further powers and encouragements given.” Accordingly, increased powers and encouragements were afforded by the Act of Parliament to so great an extent as eventually to produce to Mr. Trench’s representatives a clear revenue of £16,000 a-year. The Trinity House having been authorised by Act of Parliament in 1845 to purchase up the light, paid for it no less a sum than £445,000. The means were entirely provided out of the dues collected from commercial shipping.

This, however, was not the only case of an “improvident” grant made by the Crown or Parliament, adding to the burdens of shipowners; there were other private lighthouses, the interests in which were likewise purchased by the Trinity House, at a further cost of upwards of eleven hundred thousand pounds; all of which money was supplied from the dues which had been levied on shipping.

on the state of the weather. Swift, in a letter to Pope, mentions the "quick change" which he "made in seven days from London to the deanery, through many nations and languages unknown to the civilized world." The poet Gay at another time speaks of "the plague which his friend suffered in the little smoky room at Holyhead," where he appears to have been kept weather-bound for ten days, and after "at last setting out he had been driven back by the storm, put to sea again, and was finally landed at Carlingford," sixty miles away from his destination. Fifty years afterwards, Edgeworth, passing through Dublin to cross the Channel, to visit his wife who was ill in England, says in his journal "just as I was going to embark in the packet, the wind became directly adverse, and I sat hour after hour with my eyes fixed on the weather-cock. Day after day the wind continued in the same point; no vessel could sail, and for more than a week I was thus kept in suspense." But even after fairly getting under weigh, the passage of the Channel, little more than 60 miles across, was often extremely tedious. In the journal and correspondence of Lord Auckland, recently published, Woodfall says, in a letter from Dublin to Mr. Eden, "Lord Mornington and his brother came over with me in the packet, and we had a great deal of political chit-chat one of the days (for we were near three on board)."

The public appear to have submitted with wonderful patience to the fatigues, delays, and inconveniences attending the journey between London and Dublin; and although, long before the close of the last century, measures of improvement were proposed, one of which was the construction of a bridge over the Menai Straits, no effectual means were adopted, until after the legislative union had taken place between Great Britain and Ireland, in the year 1801. Thenceforward, the necessary attendance of peers and of the representatives of the Irish constituencies in the Imperial Parliament could not fail to lead to the adoption of such improvements in travelling, and in the communication between the two capitals, as the advance of engineering skill of that day showed to be practicable. Public Commissions were constantly engaged in inquiries, and Committees of the House of Commons presented no less than twenty-four reports on the subject within ten years.¹ In these are described the various impediments which then existed in the way of public communication between the two countries and plans and proposals for improvements, principally in reference to the land part of the journey. Hills were to be reduced, more

¹ The first of these Reports, made in 1810, is exclusively on the improvement of Holyhead Harbour, and recommends the expenditure of £67,862 on the construction of a pier for the use of the small sailing packets then employed in the mail service.

direct and perfect lines of road to be made, and the inconvenient, and at times dangerous, ferries near Conway and Bangor, in North Wales, to be bridged over, with the object of providing a continuous and easy road for the entire distance of 267 miles between London and Holyhead. A measure of such great national importance could not fail ultimately to obtain the cordial approval of Parliament. The late Sir Henry Parnell, one of the members for the Queen's County, took the most prominent part in urging forward the adoption of those improvements, and his persevering energy was ultimately rewarded with complete success. Large grants of public money were voted, and all other necessary means provided, to complete the arrangements for making this the most perfect road in the kingdom; even the short length of road between Howth and Dublin, on the Irish side of the Channel, was not overlooked. Nearly a million of money appears to have been expended on these works. The genius of Telford, aided by the talent of Macadam, having mastered every difficulty, in 1826 the astonished and admiring traveller was enabled to pass with regularity, safety, and comparative comfort over the entire distance from London to Holyhead in thirty-four hours.

Improvements for the sea part of the journey had also engaged some degree of attention; but, while sailing vessels were in use, it was not thought that much could be gained in the passage of the Channel. In 1814, passages appear to have extended to three days in duration, and it is recorded, in the Parliamentary returns of that year, that for the space of nine days but one packet could sail, owing to adverse wind. In 1819, the average time occupied on the passage from Holyhead was about twenty hours, and about fifteen hours from Dublin. The vessels then employed were small cutters. Two years afterwards Sir Robert Seppings submitted designs for a superior class of vessel, 65 feet in length, 19½ feet beam, and of 102 tons burthen. The inferiority of the vessels previously employed in the service may thence be imagined.

The packet harbour at Howth was constructed, at a cost of £300,000, with the special object of facilitating the intercourse with England. Improvements, at considerable cost, were also provided from time to time, for the Mail Packet service at Holyhead, at the public expense. Indeed, nothing appears to have been overlooked, which could render more perfect the connexion of the several parts of the chain of communication.

The application of steam power for propelling vessels at sea, which was commenced in these islands by Henry Bell, in 1811, extended but slowly for some years; and no attempt was made to introduce the improvement for Channel navigation until 1819, when the 'Talbot,' of 156 tons, built by Wood, of Port Glasgow, with two engines of 30 H. P. each, by Napier, was placed on the

Holyhead station for the summer and autumn ; and in the following year the 'Ivanhoe,' built by Scott, of about the same size, with engines, also by Napier, of 70 H. P. Their unexpected success overcame the professional prejudices of the experienced commanders of the sailing mail packets, who had recently recorded their opinion "that no vessel could perform the winter service with safety, but sailing cutters." Soon afterwards the 'Royal Sovereign' and the 'Meteor' were built specially for the Post Office service. The sailing cutters then disappeared for ever. The 'Royal Sovereign' was of 205 tons burthen, with two engines of 60 H. P. each. The 'Meteor' was 15 tons less in size, and had 20 H. P. less than her consort. The vessels were built by Evans, and the engines were made by Messrs. Boulton and Watt, who had also the honour of making the first engine placed in any vessel—namely that for Fulton, in 1804, and used by him in his first boat on the Hudson River. The performance of the 'Royal Sovereign' and the 'Meteor' fully established the advantage of steam. The average length of their passages in the first year between Holyhead and Howth was seven hours and thirty-three minutes, the shortest passage was five hours and forty-eight minutes, and the longest is stated to have been upwards of twenty-three hours.

The mail communication between London and Dublin had been thus long maintained exclusively by way of Holyhead ; but the rapidly growing importance of Liverpool,—the sea-port of the manufacturing districts of Lancashire, Yorkshire, and Staffordshire,—justly claimed a direct postal service with Ireland, which was accordingly established in 1826, though the sea passage is more than double that from Holyhead. Packets of a larger size were built, and provided with more powerful engines. The Parliamentary returns, for a period of three years, give the shortest passage as having been made in eleven hours five minutes, while the longest exceeded thirty-five hours. Private enterprise, as early as 1819, had placed steam vessels on this station, for the conveyance of passengers during the summer months. In 1823, however, Mr. Charles Wye Williams, of Dublin, a venerable Associate of the Institution of Civil Engineers, originated a company for the maintenance of a regular steam communication throughout the entire year. His plan embraced not only the conveyance of passengers but of merchandize, an extension of the advantages of the regularity of steam transport till then unattempted. His plan was so eminently and immediately successful, that it was speedily adopted on other lines of the coast, and ultimately over the entire globe.

Though not, apparently, necessarily connected with the subject of the communication between England and Ireland, it is right to draw attention to the substitution of iron for timber in the con-

struction of steam vessels, as having afforded great facilities for building models of the finest form, combined with lightness and strength, and the name of the first builder of an iron steam vessel should not be forgotten. Mr. Aaron Manby, the father of the Honorary Secretary of the Institution, built the first sea-going vessel of that material so early as the year 1820; in which year the first sea voyage was performed, when a cargo was conveyed direct from London to Paris without transshipment, the late Admiral Sir Charles Napier acting as captain, and Mr. Charles Manby as engineer. Many good authorities then questioned the innovation: now, scarcely any but iron steam vessels of every class, are used for commercial purposes. This material has also of late been extensively adopted for vessels of war. In fact it may be doubted, whether vessels of the form of those which now perform the Holyhead Mail Service could have been built of adequate strength of timber.

But if private enterprise was successful by sea, it was soon to be almost eclipsed by still greater success on land. The same spirit in England originated, and soon saw accomplished, that wondrous improvement of modern times, the railway. The line from London to Liverpool was completed in 1838; thenceforward that line became, for some years, the most expeditious route to Dublin, and the mails and passengers nearly deserted the Holyhead route. Liverpool did not, however, long retain this superiority. The proposal to continue the line of railway from Chester to Holyhead met with general acceptance; English enterprise again triumphed over every difficulty. The genius of Stephenson rivalled that of Telford; the Conway River and the Menai Straits were spanned a second time, and in 1849, a continuous line of railway was completed between London and Holyhead, by private capital, three-and-twenty years after the continuous line of road had been constructed by direction of the State and principally by grants of public money. The conveyance of the Irish mails was then retransferred from Liverpool to Holyhead, and the large and powerful packets of the Government, and of the Company which had carried the night mails under contract for the previous ten years on the Liverpool line, were appropriated to other duties.

It is not easy, from the Parliamentary returns, to arrive at the exact cost of maintaining the service between Great Britain and Ireland prior to its concentration at Holyhead, on the completion of the railway to that place. In addition to the principal postal services with Dublin, two other lines of mail communication had for many years been carried on by Government vessels; one in the north, between Portpatrick and Donaghadee, and the other in the south, between Milford and Waterford. The expense of supporting all these communications is stated at £75,000 a year,

without taking into account the original cost of the vessels, built in the royal dockyards, the interest on the capital, the annual depreciation, or the insurance. The outfit of the steam vessels provided for the Irish service appears to have cost upwards of £600,000, between the years 1820 and 1848.

During the period while these recent changes had been in progress, the Asylum Harbour of Kingstown was completed, and having ample depth of water at all times of the tide, which the harbour of Howth had not, the packet service was transferred to it. Ultimately a line of railway, 6 miles in length, connected it with Dublin.

The new Refuge Harbour at Holyhead was next decided on, with the avowed intention of providing the most perfect arrangements for the Irish Mail Service.

The only link then remaining to complete the communication with Ireland was such a superior class of vessels as the mechanical skill of the day could construct. The Government declined the offers of the former mail contractors to supply the vessels, having decided on building four of about 700 tons burthen each, fitted with engines of 350 nominal H. P. Great attention was bestowed on these vessels, and no expense was spared, with the desire of securing a result far in advance of any which had been previously arrived at. The result was universally admitted to have been a success. The 'Banshee,' built of timber, with double planking, but without frames, was a beautiful model, and of light draught of water. Her oscillating engines indicated 1,555 H. P., and her rate of speed at the measured mile on the trial trip was rather over $18\frac{1}{2}$ statute miles per hour, nearly 4 miles more than had been previously attained by any other vessel. The speed of the 'Llewellyn' was very nearly as good (*vide* Appendix, p. 595), but the other two vessels, having heavier engines, were not equal to the same high rate of performance.

About the same time the Chester and Holyhead Railway Company, under what were considered the exceptional circumstances of the case, succeeded in passing a Bill through Parliament, authorising the novelty of owning and navigating steam-packets for a period of twelve years. Four vessels were accordingly provided by that Company for the conveyance of passengers. Two of these were fully equal in speed to the 'Banshee,' another was considerably less, but the fourth was admittedly a failure.

The Lords of the Admiralty, acting in accordance with the recommendation of a Committee of the House of Commons, decided, after a trial for a short time of the New Service at a heavy cost, to have it performed by contract, as had been the case for some years previously on the Liverpool line, and the tender of the former contractors was ultimately accepted. The service was to

be performed at the average speed of 12 knots, or nearly 14 statute miles per hour. Four hours and forty minutes were allowed on the average for the passage of the Channel, from outside the lighthouse at Kingstown Pier to the light at Holyhead. This service lasted from May, 1850, until October, 1860, and the passages were generally performed within the stipulated time.

Having thus traced the several changes in the means of communication between London and Dublin up to the commencement of the service now in operation, it may be interesting to state the time usually occupied in the journey at various periods, in order to show the gradual improvements in acceleration, which have resulted from the continued attention of Parliament to the subject.

Before the opening of the new turnpike-road by way of Shrewsbury to Holyhead, and of the establishment of steam mail packets, the communication with London was attended with so much uncertainty, that it would be difficult to give any accurate estimate of the time necessary for the journey. Travellers in those days thought themselves fortunate, if they accomplished the distance within four days. But after the opening of that road, and the establishment of steam vessels, the average time occupied in the transmission of the mails was reduced to about forty-three hours: letters posted in London on Monday being considered as due in Dublin on the following Wednesday evening. The adoption of Liverpool as the principal packet station, and subsequently, the opening of the railway from thence to London, shortened the time for the transit of letters to twenty hours, so that letters reached either capital in the evening of the day following that on which they were posted. Within a few months after the complete restoration of the mail service to Holyhead, the time allowed for the transit of the mails was reduced to sixteen hours from Dublin to London, and about fourteen hours in the opposite direction, the reason for the difference being, that the service from Ireland was timed with sufficient margin for the contingencies of the Channel passage, to insure the arrival of the mails so as to allow of their being forwarded by the trains appointed for the ordinary English services; while for the down mails, the packets waited the arrival of the train at Holyhead from London, and invariably proceeded to sea as soon as the mails and passengers were embarked, so that generally, there was an advantage in time in the journey to Dublin. Great however, as was the improvement thus finally effected, it was impossible to afford the public the advantage of the entire day for completing their correspondence in one capital, coupled with a morning delivery in the other, so long as the transit occupied from fourteen to sixteen hours, to which must be added the time required for sorting the letters, after their arrival at the

respective post-offices. The night service was therefore necessarily divided into two parts. First, an early despatch from the one end of the line, accompanied with an early morning delivery at the other; and the second, a late, or night despatch from the one capital, coupled with a late, or afternoon delivery in the other.

The Directors of the Company into whose hands the mail service between Holyhead and Kingstown had been intrusted, soon turned their attention to the subject, with the object of proposing further improvements, to be effected by the substitution of special express trains for the Irish service, in place of the ordinary trains, which were timed more in reference to the requirements of the English mails; and, secondly, by the employment of larger and more powerful steam-packets. Considerable doubts were at first expressed, as to the practicability of running trains with safety, the starting of which was to depend on the arrival of the packets at Holyhead. But the public loudly demanded more commodious vessels. Meetings were held in London, which were attended by the most influential persons interested in the question, who warmly approved of a plan then submitted for consideration, of a vessel of great size and power, which the projectors anticipated might attain the extraordinary speed of 25 statute miles an hour. Meetings of the commercial interest were also held in Dublin, to urge forward the adoption of any feasible measure of improvement, in the postal and passenger arrangements, for communication between Great Britain and Ireland. A plan was soon after submitted to Government, proposing a new service between London and Kingstown, the entire distance to be performed under ordinary circumstances in eleven hours. Express trains were to be appropriated exclusively for the Irish service, completing the land journey in six hours and forty-five minutes. For the Channel part of the service, steam vessels were proposed, 300 feet in length, with sufficient engine power to attain the speed on trial, of 20 statute miles an hour, so that the passage of the Channel could be made under favourable circumstances, in three hours and a half. The ship-builders and engineers who were consulted unhesitatingly stated that such a result was practicable.

A Committee of the House of Commons was appointed in the following year to inquire into the subject; and their report strongly recommended that the improved class of vessels should be provided, and that the speed on the railway should be accelerated, so that the mails, instead of requiring the average of fifteen hours between London and Kingstown, might be conveyed in eleven hours, as had been proposed. The Committee further recommended to the favourable consideration of the Government, the plan and estimates of the class of vessel contemplated, as able to attain a

speed of 25 statute miles an hour, but to be employed only in day-light; their advocates having expressed the opinion, that they could not be safely used at night. This objection, in addition to the great cost of the vessels, estimated at £180,000 each, no doubt caused that plan to be rejected.

The London and North-Western Railway Company, and the City of Dublin Steam Packet Company, having agreed to united action, passed a Bill through Parliament, in 1855, to sanction and facilitate their arrangements.

The Government then made a communication to the Companies, as to the requirements of the Post Office, for two services, one by day and the other by night, to be completed in half an hour less time than that which had been already proposed, and this to be guaranteed under heavy pecuniary penalties for every minute of excess, arising from causes even beyond control. The Companies agreed to undertake this service, but altogether declined to submit to penalties for loss of time arising from fogs, or other causes wholly beyond their control. The subject having been allowed to lie dormant for another year, the Members of Parliament for Ireland collectively urged on the Prime Minister so forcibly the expediency and necessity for providing for the improved means of communication at the public expense, as had been formerly done when the new Holyhead Road and Telford Bridges were constructed, that the matter was at last taken up seriously and the Government agreed to carry into effect the plan recommended in 1853, and which eventually received the cordial approval of the Lords of the Treasury.¹

¹ Extract from Treasury Minute, dated October 19, 1855.

"My Lords have before them a private Act, passed in the last Session of Parliament, intituled, 'An Act for improving the Postal and Passenger Communication between England and Ireland, and for authorising Arrangements between certain Companies in England and Ireland in relation thereto, and for other Purposes.'

"By this Act the London and North-Western Railway Company, the Chester and Holyhead Railway Company, and the City of Dublin Steam Packet Company, are empowered to provide and use such steam boats for the conveyance of mails and passengers between Holyhead and Kingstown or Howth as they shall think fit; and it is also provided by the 18th section of the said Act as follows:

"'It shall be lawful for the aforesaid Companies from time to time to make and enter into and carry into effect any agreements and arrangements with Her Majesty's Postmaster-General, or with the Lords of the Admiralty, in reference to the conveyance in their steam boats of Her Majesty's mails or post letter-bags between Holyhead and Kingstown or Howth: Provided always, that, until an agreement or arrangement for the purposes hereinbefore in this clause mentioned shall have been so made and entered into, none of the powers by this Act granted shall be exercised by the said Companies, and that, unless such an agreement or arrangement shall have been made and entered into on or before the first day of May, one thousand eight hundred and sixty, it shall not be lawful for the said Companies, in pursuance of this Act, to exercise any of the powers granted thereby, and such powers shall thereafter cease and have no effect.'

"My Lords fully recognise the main motive which the Legislature had in

The main provisions of the new postal contract were, first, that the entire distance between London and Kingstown was to be performed in eleven hours (eleven hours and a half being allowed to Dublin), assigning four hours for the sea passage, subject to fines

passing this Act, and in extending, in the respects therein contained, the powers and functions of the three existing Companies referred to. That motive was undoubtedly the hope that, by the combination so created, a more efficient steam boat service would be established between Holyhead and Dublin, thus connecting England and Ireland by the shortest possible passage, and in the shortest possible time, with a view to their postal and passenger communication. But so far did the Legislature recognise in any such arrangement the paramount importance of the postal service, that the clause already quoted was introduced into the Bill, by which the powers granted under it should only take effect in the event of the united Companies being able to make an arrangement with the Postmaster-General or the Admiralty for the conveyance of the mails.

"While, however, my Lords regard this as being the main object of the Act, and the one which the Government is officially called upon to take into its consideration, they by no means desire to leave out of view, in connexion therewith, the enormous social and political advantages which may be expected to be derived from such an improved communication between the two countries as the progress of art and science entitle the public to look for. Nor can my Lords leave out of view the great advantage and convenience which such an improved service would confer upon Irish Members of Parliament whose public duties necessarily lead to their frequent passage between the two countries, and who are entitled to expect every fair facility for that purpose.

"My Lords desire to know if it would be practicable—

"1. For a mail leaving London at a convenient hour in the morning to arrive in Dublin in time for the departure of the evening mails, and also for a delivery in Dublin the same night.

"2. For a mail leaving London in the evening at the usual time of departure to arrive in Dublin in time for the day mails from Dublin, and for a convenient morning delivery in Dublin.

"3. For a mail to leave Dublin in the morning at a convenient hour after the arrival of the night mails from the provinces in time to reach London for the departure of the evening mails, and for a late delivery that night.

"4. For a mail to leave Dublin in the evening, after business hours, and to arrive in London in time for an early delivery, and for the day mails out of London.

"If such arrangements shall prove to be practicable, then my Lords would be prepared to incur a considerable increased expenditure in order to secure them.

"In that case, in the majority of instances, the Irish postal service both ways would be advanced by periods varying from six to twelve hours, and in many cases, practically for business purposes, twenty-four hours, would be saved in replies, besides which the most perfect passenger accommodation would be secured. A mail would leave from each end at convenient hours, morning and evening, and, occupying only eleven hours, would arrive also at convenient times, and such as would enable passengers to pursue their journey forward without stoppage. For example, letters and passengers leaving London in the morning would arrive in time for the night trains out of Dublin, and by midnight of the same day, or shortly after, would reach all the chief cities in the provinces; and letters and passengers leaving London in the evening, would reach Dublin in time for the departure of the morning trains out of Dublin, and would arrive at all the chief cities in the provinces a little after noon on the following day; so also, letters and passengers leaving Dublin in the morning would arrive in London in time for the Continental and other mail trains the same night, and those leaving Dublin in the evening would arrive in London in time for the departures of the mail day trains. For some great and decisive advantages, such as these, to be enjoyed by the public, would my Lords feel that they were justified in incurring a material increase on the present expenditure of public money."

for loss of time, unless arising from weather, or other causes beyond control ; secondly, that four steam packets should be provided, each 300 feet in length, and 1700 tons burthen builder's measurement, with engines of 600 nominal H. P. ; thirdly, that express trains should be appropriated exclusively to the Irish traffic ; and fourthly, a morning and evening departure from each capital. The Improved Service was arranged to be commenced in January, 1861, two years being allowed by the contract for building the vessels.

To accomplish what had been proposed, and fully to realise the expectations of the public, was naturally a subject of no small anxiety to those on whom the responsibility devolved of providing vessels so much in advance of any which had yet been built. It was not a mere question of speed at the measured mile in Long Reach, or in Stokes Bay ; that had been shown to be practicable, by the great success of the Royal Yacht, which attained the unprecedented rate of speed, at the trial trip, of $19\frac{1}{3}$ statute miles per hour (*vide* Appendix, p. 595) ; the difficulty was, to maintain such a rate of speed in severe weather, and under the disadvantageous circumstances which must so often occur in the passage of the Channel four times every day in the year, as to insure comparative regularity in the due performance of a mail service, with but very small margin for contingencies at sea. With the object therefore of insuring this result, it was ultimately decided to increase the size of the vessels to 2,000 tons, and that of the engines in like proportion. Designs were received from the most eminent builders in England. Those submitted by Messrs. Laird, of Birkenhead, and Mr. Samuda (M. Inst. C.E.), of London, were adopted. Messrs. Ravenhill, Salkeld, and Co., supplied two pairs of engines, and Messrs. James Watt and Co. the other two pairs. The dimensions and general arrangements of the four vessels are so nearly alike, that the following description of one, the 'Con-naught,' will be sufficient for all. This was built by Messrs. Laird, as well as the 'Ulster' and the 'Munster ;' the fourth, the 'Leinster,' was built by Mr. Samuda.

The ships are built of iron. The length between the perpendiculars is 334 feet ; the beam is 35 feet, and depth 21 feet. The keel is formed of a centre keel plate, 3 feet deep and $\frac{5}{8}$ inch thick, with two bars, 9 inches deep by $\frac{5}{8}$ inch thick, on each side at the bottom ; these five plates, with the two garboard strakes, $\frac{7}{8}$ inch thick each, are secured together with iron bolts riveted and countersunk. On the top of the centre keel plate, two angle iron bars are riveted, 5 inches by 4 inches by $\frac{1}{2}$ inch, and to these angle irons, and to the angle irons on the top of the floorings throughout the entire length of the vessel, as far as the fine ends will allow, is riveted a strong plate, 4 feet wide amidships, and 2 feet 6 inches wide at the ends. There are

also two very strong box keelsons, secured on the floorings at each side of the keel, and another in each bilge. The general framing of the ship and the outside plating are done in the usual way, care being taken to have everything well put together. The engine beams, paddle and spring beams, and all other beams for the main and lower decks, are of iron. Timber has been used only for the decks and cabin fittings. There are nine principal iron water-tight bulkheads, which not only provide for the safety of the ship in case of accident, but add greatly to her strength in a sea-way. The bulwarks are of iron plates, in continuation of the sides of the vessel to the rail, and without any break for gangways, such not being required for landing, either at Holyhead, or at Kingstown. To give additional strength in the centre, where the weight of the engines, wheels, and boilers, has to be carried, the insides of the paddle-boxes are also formed of iron plates, continued from the sides and bulwarks of the vessel, with a strong bow girder, formed of an iron plate 15 inches broad and $\frac{3}{4}$ inch thick, so as to provide ample means of resistance to the severe shocks which these long vessels must encounter in rough seas, when driven at such a high rate of speed. The gunwale is formed of angle iron bars, 4 inches by 4 inches, riveted to the sheer strake and to a plate which is riveted on the top of the beams. At a distance of about 15 inches from this, an inner angle bar is riveted, against which the wooden waterway is fitted, so as to leave the outer part, between this and the gunwale, to form a drain to take the water off the deck, and to discharge it through the scuppers. This arrangement, which was introduced by Mr. Laird, has been found very convenient, in freeing the decks quickly from water. These iron gunwale plates are 5 feet wide by $\frac{3}{4}$ inch thick amidships, tapering gradually to about 2 feet 6 inches by $\frac{1}{2}$ inch at the ends, with a system of diagonal tie plating from side to side, securely bolted or riveted to the deck beams. Between the paddle-boxes, an upper deck, about 50 feet in length, has been placed. It is laid on iron beams well secured, and being provided also with diagonal tie plates, it further adds to the strength amidships; though the primary object was for the more rapid embarkation and landing of passengers and luggage at times of low water, both at Holyhead and at Kingstown. It also forms an agreeable promenade for the passengers in moderate weather. The wheel and the binnacle are placed on this upper deck, so as to allow of the commander and the officers being near to the men engaged in steering. All difficulty is thus avoided in passing the word, a distance of nearly 200 feet, as would have been necessary, in the ordinary way. The entire of the main deck, from the foremost funnel to the bows, is covered over by a hurricane deck formed with angle iron beams, 5 inches by $2\frac{1}{2}$ inches, extending from the

rail at each side, and boarded over with planks $1\frac{1}{2}$ inch thick, leaving when at sea but one small opening round the foremast. This construction has been found of great advantage in throwing off the seas, which previously to the vessels being thus protected, occasionally in heavy weather caused damage to the skylights and upper works. The weight of so large a piece of work, about 140 feet in length, is considerable, and increases the immersion of the vessel forward; but this has been amply compensated for, by the security afforded when pressing at a high rate of speed in tempestuous weather. There has not been the slightest damage to any of the vessels, during the last two years, since they were completely provided with this excellent protection. The plan was copied from a small vessel, the 'Menai,' fitted out in Liverpool for the River Plate in 1854.

The engines for all the vessels are on the oscillating principle. In the two pairs made by Messrs. Ravenhill, Salkeld, and Co., for the 'Leinster' and the 'Connaught,' the cylinders are 98 inches diameter, with a length of stroke of 6 feet 6 inches; the air-pumps are 54 inches diameter, with a stroke of 2 feet 6 inches. The eight boilers are multitubular, four being at each end of the engine-room space, arranged in pairs, with one funnel to each pair. There are five fire grates in each boiler, 3 feet 1 inch wide, with bars 5 feet 6 inches long. The boilers being placed lengthways in the vessel, the firing space, which is 11 feet wide, is in the centre. The entire extent of the grate surface in the eight boilers is 677 square feet; and the heating surface measures 19,700 square feet. The bunkers are small, being made to contain only one day's coal, as the vessels can be supplied either at Holyhead, or at Kingstown, during the interval between their arrival and departure. The space occupied in the length of the vessel by the engines and boilers is 108 feet, and this has been subdivided, by iron watertight bulkheads, into three compartments, an arrangement suggested by Mr. Laird, and which has been found most beneficial in giving strength in a part of the vessel which might otherwise have been weak, and unequal to the severe strain of the powerful machinery working in the heavy sea-way of the Irish Channel. The wheels, which are constructed on the feathering principle, with fourteen floats each, are 31 feet in diameter at the outside of the floats, or 27 feet to the centre of axis; and each float is 12 feet long by 4 feet 4 inches broad. On the trial trips, the engines worked at the rate of $25\frac{1}{2}$ revolutions per minute, under a steam pressure of 25 lbs. per square inch. The mean of the runs of the 'Leinster,' at the measured mile in Stokes Bay, was at the rate of $20\frac{1}{2}$ statute miles an hour, a greater speed, by upwards of one mile an hour, than had been previously attained by any other vessel. The 'Connaught,' when subsequently tried at the measured mile in

Stokes Bay, attained a higher result, the mean of her runs showing the speed of $20\frac{3}{4}$ statute miles per hour. (*Vide* Appendix, p. 595.)

The 'Ulster' and the 'Munster' were built by Messrs. Laird, on exactly the same lines as the 'Connaught.' The engines of these vessels were constructed by Messrs. James Watt and Co., of Soho, the same establishment from whence the engines proceeded for the first steam vessels built for the Post Office for the performance of the Holyhead Mail Service. Boulton and Watt would have been somewhat surprised, if it could have been foretold, that their successors would have been called on to construct engines tenfold the size of what they had made, to be placed in vessels tenfold the tonnage of the 'Royal Sovereign' or the 'Meteor,' and for the same line of postal communication. The general arrangement of the engines in the 'Ulster' and the 'Munster' is nearly the same as of those in the 'Leinster' and the 'Connaught.' The cylinders are, with a length of stroke of 96 inches in diameter, 7 feet. The wheels are 33 feet in diameter over all. The boilers have each six fire-places, 2 feet 6 inches wide, and the bars are 5 feet 6 inches long, giving in the aggregate as large an extent of grate surface as in the others. The area of the heating surface is 18,033 square feet. One funnel is used for the four boilers of each compartment, and as the coals are carried on the top of the boilers, the entire space occupied in the ship by these engines and boilers is but 102 feet. These engines were erected on board the vessels in the Liverpool Docks. There is not any measured mile at that port for testing speed; but from a return supplied by Messrs. Watt and Co., of observations made on several trips, the rate attained appears to have been $17\frac{1}{2}$ knots, or 20.3 statute miles per hour, and the average performances of the 'Ulster' and the 'Munster,' contrasted with the average performances of the other vessels, fully proves, that this in no degree overrates their speed, when going under the usual conditions of a trial trip.

The internal arrangements of the vessels were planned with the object of providing for the comfort and accommodation of the public, in the way best calculated to mitigate, and as far as possible to prevent, the sufferings so usually inseparable from the passage of the rough Irish Channel. For although the talented builders endeavoured to design a form which should be easy in a sea way, both they, and those for whom they were building, were well aware, that it was utopian to expect, as many appear to have expected, with ships of even their large dimensions, a uniform horizontal position in tempestuous weather. Enlarged size has no doubt, in many cases, lessened the motion at sea; but the chief advantage in this instance is that, it has afforded the means of providing reasonable accommodation for many passengers,—a want

which had been so much felt with the previous smaller class of packets. The saloons and cabins in the new vessels are large, lofty, and well ventilated. The principal one is upwards of 60 feet in length, by 17 feet in breadth, and 9 feet 6 inches in height. On each side of this saloon there are state-rooms, with several berths, or sofas. The ladies' saloons and cabins, which are entered from a large deck house by a separate staircase, are provided with upwards of forty sofas and berths, independent of the accommodation in the deck saloon and in the adjoining state-rooms also on the main deck. First-class passengers have excellent sleeping cabins in other parts of the ship, and there are also two commodious deck cabins, one of which is appropriated as a smoking-room. The cabins for the second-class passengers are placed forward. Throughout the whole of the communications which took place between the builders, the engineers, and the Directors of the Company, the most perfect concord prevailed; all parties appearing to be actuated by the desire to produce vessels and machinery in every way calculated to fulfil the high expectations which so much public discussion had raised.

A better opportunity could not have been desired for attaining a good result, than the Holyhead and Kingstown mail line. There was sufficient depth of water at all times of the tide, with no natural obstruction to the navigation of the Channel, and the short distance needing no great weight of coal, and no cargo being carried, the vessels would at all times have very nearly the same uniform immersion. Besides, the vast importance of the communication justified an expenditure for the mail service, which could not be undertaken as a commercial speculation, to be remunerated solely by the conveyance of the traffic. All these advantages united, afforded an unprecedented opportunity, which those engaged in the work fully appreciated, and they endeavoured to make the most of it. It is due to them to state, that after the contracts had been entered into, every suggestion made during the progress of the work, with the desire of providing further improvements as to strength, or accommodation, was at once adopted though attended with increased cost. The result proved that the unbounded confidence which was placed in the contractors, by the Directors of the Company, was well deserved.

The cost of the four ships to be provided, in accordance with the contract, was £75,000 each. The actual cost has, however, greatly exceeded the amount agreed to be expended by the Company, in consequence of the size of the vessels having been enlarged to upwards of 2,000 tons, and the engines in about the same proportion; a change which has obtained increased accommodation for the public, and probably a superior performance of the vessels at sea.

One of the principal peculiarities, which render these vessels of so unique a class, is the post-office fitted for sorting letters during the passage. The space occupied for this purpose extends across the entire breadth of the vessel, and for the length of 30 feet, between the first and second class cabins. It is divided into two rooms, one for letters, and the other for newspapers. In these rooms the sacks are opened, the contents taken out and arranged, by eight, or ten sorters, under the direction of a head superintendent. The letters are stamped with the post-office packet brand, the postage label cancelled, and all the operations completed, so that the letters are ready for delivery, or to be forwarded to their destination, on the arrival of the vessel at Kingstown. About two hours are thus saved in the transmission of the mails, in consequence of their being made up on board, instead of after their arrival at the General Post Office in Dublin. Besides the gain in time thus secured for postal purposes, the main object to be attained was regularity; while for passengers, accommodation was perhaps even more to be valued than extreme speed. To fulfil all these conditions, it was necessary to have very large vessels; such only obviously allowing the requisite extent of accommodation, and experience had shown that the larger the vessel, when provided with adequate power, the less was the difference in the length of the passage at sea caused by severe weather.

The contract with the Postmaster-General had appointed January, 1861, for the commencement of the Improved Service. But the vessels being in readiness some months sooner, it was commenced, by mutual agreement, in October, 1860, and has since been continued without interruption. When two of the vessels, the 'Leinster' and the 'Ulster,' were completed, and ready for duty, it was thought advisable to make a trial with them, by way of practice, in the performance of the old contract. Each performed the distance between the lighthouse on Kingstown Pier to the lighthouse at Holyhead, upwards of $65\frac{1}{2}$ statute miles, in nearly the same time on the average, namely, the 'Leinster' in three hours and thirty-one minutes, and the 'Ulster' in three hours and thirty-two minutes, being respectively thirteen and twelve minutes less than the shortest monthly average of the 'Banshee' in 1848-49, and twenty and nineteen minutes less than the 'Llewellyn,' when the distance between the lights was one mile less than in 1860—the Holyhead breakwater not having been then in existence.¹ The gain in speed realised by the new vessels was therefore at the rate of from 1.2 to 1.7 mile per hour.

Before however giving an account of the actual performance of

¹ The courses are laid down on the plan of Holyhead Harbour attached to this communication.

the contract for the Improved Service, which is one combining the land journey with the passage of the Channel, inclusive also of the time occupied in the transfer of the passengers, mails, and luggage, between the packets and trains at the Holyhead jetty, it will be right to state the means agreed to be provided by Government for the berthing and accommodation of the large vessels at Kingstown and at Holyhead. This subject had from the first engaged the anxious attention of the promoters of the Improved Service, for they were well aware, that any attempt to convey the mails with regularity between London and Dublin in eleven hours and a half as proposed, would be wholly unsuccessful, unless landing piers were provided at both sides of the Channel, easy of access in all weathers, and such as would allow of the berthing of the vessels, and the transfer of all on board, with the utmost economy of time. A stone jetty, perfectly adapted to meet all these requirements, had been commenced in Kingstown Harbour by the Board of Works, in accordance with the plans of the late Mr. Barry Gibbons, in 1852, provision having been made for the continuation of the line of rails, so as to connect it with the Dublin Station. The late Mr. Rendel having stated his objections to this pier, both as connected with the safety of the vessels and the convenience of the public, the work was ordered by Government to be suspended, and it was not again resumed, until after a full inquiry by a commission of naval officers appointed for the purpose by the Admiralty. Their report was so decisive in favour of the pier as originally designed, that the work was immediately resumed, and it was completed and ready for use in good time. After a daily experience of nearly three years, it is due to the memory of Mr. Gibbons to testify, that this packet pier has fulfilled to the utmost the most sanguine expectations of all who were qualified to give an opinion on the subject. The packets usually arrive at the west side, where the passengers land under shelter, and taking their places in the railway carriages, are conveyed to Dublin in fifteen minutes. The packets are afterwards backed round the semi-circular end of the jetty to the east side, where they remain in readiness for the outgoing mails. They lie in still water at all times.

The new harbour at Holyhead, which was sanctioned by Parliament with the twofold purpose of providing for the mail packet service and for refuge, had made considerable progress before any definite plan was arranged for the primary of these objects. Mr. Rendel, a short time before his last illness, had been in communication with the steam and railway companies, to ascertain their views as to the arrangements which would best suit the Irish service ; but requiring that the position should be in a depth of water sufficient for the accommodation of the Trans-

atlantic vessels, it being at that time anticipated that Holyhead would be fixed as their port of call. The death of Mr. Rendel soon afterwards left the decision in the hands of his successor, Mr. Hawkshaw, (President Inst. C.E.,) who renewed the inquiry with a similar limit as to choice of position. The result of his investigation was a plan for very extensive piers, with quays upwards of 3,000 feet in length, which met with the approval of all the parties whom he consulted, and he omitted none who were interested in the subject. These plans, the estimated cost of which was £425,000, were sanctioned by Government and by Parliament in 1858. Provision having thus been agreed to be made for the safe, easy, and expeditious berthing of the large vessels, near the entrance of the new harbour, and for convenient communication with the railway and trains, the united companies entered into the joint contract with the Postmaster-General for the performance of the entire journey between London and Kingstown pier in eleven hours, guaranteed under penalties for excess of time, unless arising from causes beyond control. These penalties were not, however, to be put into operation, as proposed on the part of Government, until the piers which had been agreed to be provided were completed. The vessels being ready, it was arranged by Government, that the service should be commenced and carried on, as well as the circumstances would admit, without penalties, so long as the vessels and trains were confined to the use of the timber-jetty, constructed at the end of the old packet quay for temporary use, pending the completion of the permanent works. It will thus be seen, that there is yet to be provided one link for the chain of the improved communication between London and Dublin; a most important link which had been very carefully considered, and specially stipulated for, as essential to the full accomplishment of the plan which had been proposed for adoption.

It remains now to give some information as to the manner in which the new service has been performed since it was commenced in 1860. From what has been already stated, with regard to the speed of each of the vessels on their trial trips, when, as is usually the case on such occasions, the utmost power of the engines is exerted during the short time required for the run of a few miles, it may be readily seen, that for actual daily duty, the difference between the four vessels is inappreciable, a matter of paramount importance to a mail service. The extreme difference in the rate of speed on trial appears to have been about half a mile an hour, which would add but six, or seven minutes to the passage between Holyhead and Kingstown, taking the present course at 57 knots, or a little over $65\frac{1}{2}$ statute miles; the extension of the great breakwater having added more than a knot to the distance

given in the Admiralty Returns, as having been performed by the 'Banshee,' the 'Llewellyn,' and other packets in 1849-50. A speed of $17\frac{1}{2}$ knots, or 20 statute miles per hour, on the trial trip, allows a safe margin for making the passage commonly in four hours, the time proposed by Government; but this large margin has not in practice been found too much. Again, it may be observed, that there is a considerable difference in running a few times by the measured mile, when all is tasked for a short time to the utmost; and making a single complete passage of the Channel, even under favourable circumstances. Thus, while the 'Connaught' attained a speed of $20\frac{3}{4}$ statute miles an hour on her trial trip, her shortest passage of the Channel occupied three hours and fourteen minutes, being at the rate of about 20 miles an hour. The shortest passage of the 'Leinster' was made in three hours and twenty minutes; that of the 'Ulster' in three hours and eighteen minutes, and of the 'Munster' in three hours and twenty-six minutes. But the average performance of the vessels for the two years and five months during which they have been on service is still closer. Inclusive of all passages made in fogs, gales, &c.,

			h.	m.
The 'Connaught' made	1,064	in the average time of	3	51.5
The 'Leinster' . . .	919	"	3	52.5
The 'Ulster' . . .	925	"	3	55
and the 'Munster' . .	920	"	3	58.1

So close a performance by the four vessels, not identical and not all from the same builders and engineers, could scarcely have been anticipated. The longest passage made in the severest gales has not exceeded five hours and forty minutes, and one vessel only has been that length of time on but two occasions. The previous packets were retarded by the weather to a far greater degree. The 'Banshee' has taken nearly eight hours to cross the Channel; the 'Llewellyn,' the 'Caradoc,' and the 'St. Columba' still more. Nearly four thousand passages have been already made without collision, except on one occasion, which happily was not attended with very serious consequences. Experienced naval officers anticipated frequent and serious disasters, but the rate of speed, 16 miles an hour, though high for night-work, does not appear to have been too high for safety. The sense of greater responsibility, and the larger number of men engaged in the navigation and management of the vessels, must naturally induce additional precaution, as well as afford the means of guarding against danger. The facility with which these large vessels are handled and brought alongside the jetties is remarkable. The practised skill of the officers, and the quickness with which the engines are managed, frequently succeed in getting the vessels along-

side, in making them fast, establishing the means of communication with the shore, and in landing the mails in three, or four minutes.

The consumption of coal in the first few months was considerably in excess of the quantity originally estimated. Steam of from 25lbs. to 28lbs. pressure was then used, which not only required much extra coal, but severely taxed the durability of the boilers. Arrangements were therefore made to reduce the consumption to the amount stated in the estimates submitted to Government, on which the contract was founded. The result has been satisfactory, while the additional time occupied on the passages is but a few minutes, and they are still made on the average within the time allocated to the sea service by the proposal of Government. The necessity of laying up the vessels more frequently for repairs has been also diminished, which is a matter of much importance, as they are of so unique a class, that in the event of more than two being laid up at the same time, it would be impossible to obtain an efficient substitute, and therefore, the postal service might be exposed to some danger of interruption, if such circumstances were to continue for any length of time. The engines in the 'Ulster' and the 'Munster' were provided with superheaters, but experience has not shown any advantage resulting from their use, either as reducing the consumption of coal, or tending to a superior performance. These vessels have made in the aggregate 1,845 passages, in the average time of 3 h. 56 m., and have consumed 30 tons 7 cwt. on the average of each, inclusive of the quantity required for raising steam, which is very considerable. The 'Leinster' and the 'Connaught,' without superheaters, have made 1,983 passages, in the average time of 3 h. 52 m., and have consumed (inclusive of raising steam) on the average, 30 tons 1 cwt. of coal.

No break-down has taken place with any of the engines. On two occasions some derangement occurred with the wheels. Very constant attention is given during each 'rest' after the usual term of duty, to the machinery and the boilers, so as to prevent the necessity of extensive repairs.

The principal trouble has arisen from the difficulty which appears to be experienced, in obtaining sufficiently sound forgings for the large intermediate air-pump crank shafts. As a precautionary measure, two duplicate shafts fitted with cranks had been included in the original order; one suitable for either pair of engines from each firm, so that no time might be lost in replacing one, if at any time it was found to be defective, or appeared to be doubtful. This was no needless precaution, as within the first year it was found necessary to condemn two shafts, and to use the duplicates, and the vessels were ready within the week for service instead of being laid up for months. Two new spare shafts were

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immediately again ordered, and these have since been required ; and another of steel, made by Mr. Krupp (of Essen), is also now in use. Thus, within the space of two years and a half, five of these costly pieces of work have been already condemned. It is justice to the makers of the engines to state, that they have met the case in the most satisfactory manner. No failure has hitherto occurred with any of the shafts supplied by the Mersey Steel and Iron Company, and they have done their full share of duty. Very great exertion was made by that establishment on one occasion to prepare a forging within the short space of three weeks, to replace one under peculiar circumstances, which rendered the utmost expedition important.

With regard to the ships, it is very satisfactory to be able to state, that no repairs have so far been needed. They are now in as perfect a condition, after the performance of their severe duty, as when they commenced in 1860. The frequency of docking, for the purpose of cleaning and coating, has afforded constant opportunity of examination, but painting only has been found necessary.

To maintain speed, it is obviously indispensable to keep the bottoms of the vessels clean ; but as no docking accommodation has as yet been provided at Holyhead, and it being objectionable to remove the vessels from the station to the graving-docks of other ports, if possible to avoid doing so, the experiment of employing divers, while the vessels lay alongside the jetty, was tried last summer, and with some success. The growth of marine vegetation, and the adhesion of marine animals, which take place rapidly in the summer months, were prevented to a considerable extent.

The Author, connected as he has been with the sea part of this service, has thus endeavoured to give the information which constant and anxious watching over it from the commencement has enabled him to do. He postponed submitting to the notice of the Institution any communication on the subject, until a sufficiently-prolonged experience might justify the expectation of a continuance of the same performance. It would be wrong, however, to close this Paper, without referring to the admirable performance by the London and North-Western Railway Company, of the land portion of the journey from London to Holyhead ; the punctuality of the arrival of the trains on the jetty there, the speed maintained, and the excellence of the carriages supplied, are the subject of universal approval. Further improvements at present unthought of may no doubt be yet brought into operation ; but whatever changes may take place, there would appear no reason for anticipating that the communication by way of Holyhead will ever cease to be the best for postal purposes, and to be preferred by the travelling public, so long as the entire distance between London and Dublin can be accomplished within eleven hours and a half.

[APPENDIX.

APPENDIX.

PARTICULARS OF TRIAL TRIPS.

	Banshee.	Llewellyn.	Victoria and Albert.	Leinster.	Connaught.
When tried	10th Jan., 1848.	15th May, 1848.	23rd July, 1855.	26th July, 1860.	27th Sept., 1860.
Where tried	Long Reach.	Nore and Mouse.	Stokes Bay.	Stokes Bay.	Stokes Bay.
Draft of Water {	8 ft. 8 in.	8 ft. 6 in.	13 ft. 10 in.	12 ft. 2½ in.	12 ft. 9 in.
	9 ft. 0 in.	9 ft. 2 in.	14 ft. 0 in.	13 ft. 2½ in.	13 ft. 2 in.
Area of Midship Section . . .	192 feet.	185 feet.	401 feet.	336 feet.	341 feet.
No. of Revolutions.	30·5	28·5	25·4	26·25 mean.	25·5
Pressure on Safety-valve . . .	19 lbs.	20 lbs.	23 lbs.	25 lbs. by gauge.	26½ lbs. by gauge.
Vacuum in Condensers	..	..	25 inches.	25 inches.	25½ inches.
Nominal Horse-power	350	350	600	720	720
Indicated Horse-power	1,555	1,890	2,980	4751	4735
Speed of Vessel—Knots	16·1	15·912	16·827	17·747 ¹	18·079 ¹
„ „ Statute Miles	18·553	18·317	19·377	20·429	20·811

¹ The mean of four runs.Mr. J. SCOTT RUSSELL,
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