EUROPEAN STEAMBOATS PRIOR TO THE "CLERMONT."

As in America, so in Europe, the quarter of a century preceding the successful inauguration of steamboat service on the Hudson River was a period of extraordinary interest among inventors in the possibilities of steamboat navigation, during which a great amount of thought and experimental work was devoted to the development of a successful steam-driven vessel. In the present chapter we shall touch lightly upon those inventors who merely drew up plans, took out patents, and made more or less successful models of steamboats; our attention will be devoted more specifically to the clearly-recorded and well-authenticated instances, in which steamboats of useful size were actually propelled by steam.

Following this plan, we may dismiss at once the oft-asserted claim that a vessel of some 200 tons, built by Blasco de Garray, a native of Biscay, was propelled by steam at Barcelona in Spain in the year 1543. Careful search by investigators has revealed two letters, signed by Garray and dated 1543, describing experiments with different vessels, both of them moved by paddle wheels *turned by men*. There is no mention of the use of steam, or anything to indicate that this motive power was contemplated.

The Marquis of Worcester published a book in 1663, in which mention is made of an engine, and of the ability of the inventor to make the vessel which carried it "go against the stream which the more rapid it is the faster it shall advance." His patent, however, contains no suggestion that he had any idea of using steam.

Although the name of no inventor in the early part of the eighteenth century is more closely associated with the design of the steamboat than that of Jonathan Hulls, there is no proof that he ever built and operated one. At the same time, Hulls was a man of unusual intelligence and of considerable mechanical skill. His patent, taken out in 1736, describes the invention as "a machine for carrying ships and vessels out of, or into, any harbor or river against wind and tide." The following year he published a pamphlet in London describing his invention; and it is curious that, like many early experimentalists, he considered that its greatest usefulness would be found in the towing of vessels. The illustration of his boat, given on page 220, was drawn from his very complete description of the mechanism of the boat, and Admiral Preble, of the United States navy, in his work "On the Origin and Development of Steam Navigation," says that "there can be no doubt of his having been the first inventor of an ingenious and practicable mechanism for propelling vessels by a condensing steam engine and by paddle wheels"; and this, be it remembered, was as far back as 1736. Writing over a quarter of a century ago, again the same author says: "The following doggerel is still the burden of a common street ditty among the boys of Campden of Gloucestershire, Hulls's native place:

'Jonathan Hulls,
With his patent skulls,
Invented a machine
To go against wind and stream;
But he, being an ass,
Couldn't bring it to pass,
And so he was ashamed to be seen.'"

Truly, a prophet is not without honor save in his own country.

It is a disputed point whether to Denis Papin, the great French engineer and professor of mathematics at the University of Marburg, is due the credit of being the first to make a steamboat run upon a public waterway. Preble, however, is of the opinion that his correspondence with Leibnitz, which was brought to light during the latter part of the nineteenth century, fully proves that Papin actually constructed a steamboat which he ran upon the river Fulda in 1707. It is certain that he met with the seemingly inevitable ridicule and abuse. Disgusted with the conduct of the Hessians, he determined to go to London in his steam vessel, and descended the Fulda as far as Munden, where the boatmen laid violent hands upon him, and destroyed his little craft.

Next to Papin comes the Marquis de Jouffroy, who in 1781 built a steam vessel 150 feet in length and 15 feet in beam, which, according to a document now in Paris, was propelled by steam for fifteen minutes against the stream.

WILLIAM SYMINGTON.

The credit for the invention and construction of the first steamboat to be successfully applied in Europe to useful navigation is due a Scotch engineer, William Symington, who attacked the problem on original lines, and produced a vessel, the "Charlotte Dundas," which in many respects was half a century in advance of the state of the art. Symington was born in Scotland in 1764. Educated for the church, his taste for mechanical philosophy, he tells us, led him to direct his studies to the exercise of the profession of a civil engineer. He obtained patents for several improvements in the steam engine, and designed a steam carriage, which in 1786 he submitted to several learned and scientific men in Edinburgh. Here he met Patrick Miller of Dalswinton, a wealthy banker, who informed Symington that he had "spent much time in making experiments as to the propelling of vessels upon water by using wheels in place of sails or oars. These wheels he had put in motion, applying the strength of men to the turning of a handle or winch." Symington told Miller that he believed a steam engine might be constructed for the purpose, and he proposed that favorite method with early steamboat inventors, of communicating a rotary motion to the paddle by the alternate action of ratchet wheels. The first experiment was made with a two-cylinder engine, the cylinders being of 4 inches diameter and 18-inch stroke. It was installed on a double-keel vessel, and tried on the Dalswinton estate in 1788, with satisfactory results. The next experiment was upon a larger boat, 60 feet in length, belonging to Miller, which was already equipped with man-operated paddle wheels. In this vessel Symington placed a two-cylinder engine, each cylinder being of 18 inches diameter and 3-foot stroke; and in October, 1789, with Miller and several prominent business men and engineers on board, the boat was driven at a rate of five miles an hour in still water. The engraving on page 220 is based on the original plans of this boat, as given by Symington. At this point, Miller retired from business to devote himself to his estate at Dalswinton; but in the year 1800, Lord Dundas, one of the principal owners of the Clyde Canal, requested Symington to take up his experiments with the steamboat, and spent about $35,000 in this work. With sufficient capital assured to give him a free hand, Symington designed an entirely new boat and engine, called the "Charlotte Dundas." An examination of the drawings of the vessel, as shown on pages 220 and 221 of this issue, proves that Symington was an engineer of decidedly original genius. Even at that early day, his mechanical sense objected to the cumbersome overhead working beam, and in a letter at that period he criticises the cylinder erected in a vertical position and the heavy working beam, and other heavy and complicated apparatus of the old steam engine, and explains how, by changing the position of the cylinder and "by coupling to the end of the piston rod a crank and arm," he "reproduced a rotary motion without the intervention of a lever or beam." In other words, Symington in the engine of the "Charlotte Dundas" originated the modern horizontal reciprocating engine, which was destined to become the predominant type for steamboat, locomotive, and stationary engines, and continued to be such throughout the middle period of the history of the steam engine. The cylinder was double acting, 22 inches in diameter and with a stroke of 4 feet. It was direct-connected to the crankshaft of a paddle wheel at the stern of the boat. The account of the experiment, as given in his own narrative, which has been confirmed by others, is as follows:

"Having previously made various experiments, in March, 1802, at Lock Twenty-two, Lord Dundas, the great patron and steamboat promoter, along with Archibald Spiers, Esq., of Elderslee, and several gentlemen of their acquaintance being on board, the steamboat took in drag two loaded vessels, the 'Active' and 'Euphemia,' of Grangemouth, Gow and Elspine, masters, each upwards of *seventy tons* burden, and with great ease carried them through the long reach of the Forth and Clyde Canal at Port Dundas, a distance of nineteen and a half miles, in six hours, although the whole time it blew a very strong breeze right ahead of us; so much that no other vessel could move to windward in the canal that day but those we had in tow."

Since the object of Lord Dundas in employing Symington was to have him devise some cheaper means of towing canalboats than the existing method by horses, it would look as though the future of the steamboat was assured; but, unfortunately, the other proprietors of the canal objected to the use of steamboats, urging that the waves set up would wash away the canal banks. Therefore, nothing further was done. Subsequently, Symington was introduced by Lord Dundas to the Duke of Bridgewater, who was responsible for the introduction of canals into England. Symington impressed him so favorably that he gave him an order to build eight boats similar to the "Charlotte Dundas" for service on his canals, but the death of the Duke shortly afterward led to the canceling of the order.

Among the many methods of applying the power of the engine to propel the boat that were tried by the early inventors, one of the most popular was to use an endless chain of paddle boards, traveling over wheels or pulleys at each end of the boat, the paddles being submerged as they passed toward the stern, and being carried clear of the water as they returned toward the bow. Of this type was Desblanc's steamboat, which was tried on the river Doubs in 1802. The arrangement of the engine and the chain of paddles is shown very clearly in the engraving on pages 220 and 221. The engine was horizontal, and the reciprocating motion of the piston was converted into rotary motion by means of a ratchet gear acting upon a spur wheel upon the main driving axle.

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(*Concluded from page 219.*)

Council, after a trip on the Delaware, were so greatly pleased as to present Fitch with a suit of colors for his boat.

The new venture was now ready for commercial exploitation. A schedule of sailing dates and fares was drawn up, and during the following three months there appeared in the local papers twenty-three advertisements announcing the times of sailing. The routes covered were to Trenton, thirty miles; to Burlington, twenty; to Chester, fifteen; and to Wilmington, thirty miles. During these three months "The Steamboat," as she was popularly called, ran in regular passenger service for a total distance of between 2,000 and 3,000 miles. Limitations of space prevent any further quotation of the certificates and eulogies given by prominent men of the day. We present engravings of two of the advertisements of 1790, photographed for the SCIENTIFIC AMERICAN from the files of the Pennsylvania Packet and the Federal Gazette, by the courtesy of Mr. Abbott, the curator of the Philadelphia Library.

In view of this crowning success to the labors of Fitch and his associates, the story of the rest of his life is truly tragical. His attempt to build another and larger vessel failed for want of financial support. Had some influential, wealthy, and far-sighted patron come to Fitch's assistance at this time, there can be little doubt that the advent of successful commercial steamboat navigation would have been hastened by twenty years. But it was not to be. Discouraged and embittered by failure to secure recognition and support, Fitch, after an abortive trip to France, wrote an account of his life and experimental work, which he delivered to the librarian of the Philadelphia Library, with instructions that it be not opened for thirty years; and then, retiring to Bardstown, Ky., he ended his unfortunate life by committing suicide.

JOHN STEVENS.

The claim of Col. John Stevens to a foremost position among those who contributed to the early development of the steamboat is based upon his recognition of the value of the screw propeller, of the multitubular boiler, and of high-pressure steam. Like Fitch, Stevens was possessed of great mechanical ability; and to this was added the advantage of wealth and education. His claim to have built the first steam screw propeller boat to navigate the waters of any country we consider to be indisputable.

After some preliminary experiments, as recorded earlier in the present chapter, Mr. Stevens designed an entirely new engine and boiler, differing from anything that had yet been attempted either here or in Europe, and erected it in a 28-foot boat, which made many successful trips at speeds of between seven to eight miles an hour on the Hudson River. The twin screws, engine, and the boiler are still in existence, and are now at the Smithsonian Institution, Washington. The accompanying illustrations are reproductions from photographs of this exhibit made especially for the SCIENTIFIC AMERICAN by the courtesy of the curator. The cylinder was of 4½ inches diameter and 9 inches stroke. Motion was transmitted from the overhead crosshead by two connecting rods to a pair of cranks, one on each propeller shaft. The cranks turned in opposite directions (to overcome the tendency of a single propeller to rotate the boat) and the cranks were maintained in their proper rotating position relatively to each other by means of two gear wheels on the propeller shafts. The reaction of the connecting rods against each other served the purpose of a parallel motion and maintained the piston rod in alignment. The valves consisted of two-way cocks, and they were driven by a crank on one of the propeller shafts, through the intermediary of a vertical rack and gear wheels on the spindles of the two-way cocks. The boiler is one form of the multitubular type invented by Col. Stevens. It has 28 copper tubes, 14 projecting from each side of a center rectangular chest.

Contemporary testimony to the successful operation of this boat is given in Stewart's "Anecdotes of the Steam Engine," published in 1829, and in an article by Dr. James Renwick contributed to Tredgold's "Treatise on the Steam Engine," published in London in 1838.

That John Stevens and his son, Robert L. Stevens, are to be credited with having built the first ocean-going steamship is proved by the well-authenticated voyage made by the "Phœnix" from New York to Philadelphia. The engines of the "Phœnix" were designed and built by Stevens. The accompanying illustration of this historic vessel is from a photograph of an old painting at the family home, Castle Point, Hoboken, N. J. Alluding to the above voyage, the late Mr. J. Scott Russell, the builder of the "Great Eastern," said that Mr. Robert L. Stevens was "undoubtedly the pioneer of steam navigation in the open sea."