CHAPTER I

THE BIRTH OF THE STEAM BOAT

AMONG the many branches of engineering which during the last century and a half have widely and profoundly influenced the progress of civilisation, that of marine engineering has an interest second to none. More than a century ago Tredgold, in the elaboration of his memorable definition of civil engineering as "the art of directing the great sources of power in Nature for the use and convenience of man", included "the art of navigation by artificial power for the purposes of commerce", but of this art he lived only long enough to see the first-fruits. When he died in 1829 steam vessels were still small in size and comparatively few in number, and the greater part of the world's overseas commerce was then, and for many years afterwards, carried in ships driven by the wind; within half a century, owing to the advance of marine engineering, the sailing ship was fighting hard for its very existence. In those fifty years the marine steam engine had brought about a revolution in methods of sea transport and in naval warfare, and marine engineering had become a great national industry.

Marine engineering, it is true, is but a branch of mechanical engineering which had its birth in the eighteenth century with the work of Newcomen and Watt, and most of the early marine engines differed little from land engines; but the application of steam power to ships presented so many new problems, gave rise to so many new inventions, engrossed the attention of so many great engineers and led to such splendid

achievements that its history claims special consideration. Then, too, it must not be forgotten that the work of the early marine engineers led to a revolution in the design and construction of the ships themselves, and naval architects and shipbuilders were obliged by force of circumstances to adopt some of the methods of the engineers. It was engineering which gave rise to the use of iron for the hulls of ships and to the use of iron armour for fighting vessels; the liners and battleships of to-day are, in the main, the results of the application of engineering to ships which began with the work of the pioneers of a century and a half ago.

Though it would be wrong to neglect what was done in the United States, the progress of marine engineering was mainly due to the work of British engineers. As soon as it had been demonstrated that boats could be successfully driven by steam, establishments for the construction of marine engines sprang up here and there. In the course of time from the Clyde, the Thames, the Mersey and the Tyne, from places like Southampton, Bristol and Hull, went steam ships for practically every nation, until at one time 80 per cent of the world's sea-going steam vessels came from British yards. With but few exceptions, all the greatest improvements in steamship construction and marine engineering were originated in this country, and though other nations founded their own ship yards and engine factories, it was often done with the assistance of British engineers. To-day the ships of America, France, Germany, Italy, Japan and other countries, in size, speed, equipment and performance, rival any we can produce, but it may be presumed that, even if our insular position did not constitute a constant stimulus to fresh activity, the genius of our race for nautical affairs will lead our con-

structors of the future to emulate the achievements of their predecessors. With the future, however, we are not here concerned—if engineering ever has a deity it should, like Janus, have two faces, one looking forward, one backward. It was no less a man than Pasteur who recalled to the students of Edinburgh the exhortation to "remember the past and look to the future", impressing upon them the advice to "associate the cult of great men and great things with every thought". No branch of engineering is associated more closely with great men and great ideas than that of marine engineering, and it is one of the objects of the following chapters to recall some of these to mind.

The practicability of the application of the steam engine to boats was demonstrated almost simultaneously in America, Scotland and France. In America the principal experiments were made by Rumsey, Fitch, Stevens and Fulton; in Scotland by Miller, Symington and Bell; and in France by Périer and the Marquis de Jouffroy d'Abbans. These trials were all carried out during the last two decades of the eighteenth century and the early years of the nineteenth century. There had been earlier pioneers who had planned and schemed but with no success. There are also stories of a fabulous nature such as that relating to Blasco de Garay, who is said to have moved a boat by steam at Barcelona in 1543. A certain Thomas Gonzales in 1825 was apparently the first to credit Blasco de Garay with using steam, but the documents relating to the incident were examined by John Macgregor who, in a paper read before the Royal Society of Arts on April 14, 1858, stated that "neither of them contained any mention whatever of the use of steam".

About a century after Blasco de Garay's experiments

with boats, David Ramsey obtained a patent in this country which referred to the use of fire and its application to boats, ships and barges. The names of the Marquis of Worcester, Denis Papin and others are sometimes coupled with the invention of the steam boat, but nothing came of their labours. Another projector was Jonathan Hulls, of Campden, Gloucestershire, who on December 21, 1736, secured a patent, and in 1737 published a *Description and Draught of a new-invented Machine for carrying Vessels or Ships... against Wind and Tide or in a Calm*, detailing his invention of the principle of steam navigation. There appears to be no evidence that Hulls actually constructed a steam boat and, as the only steam engine available at that time was the cumbrous slow-moving Newcomen atmospheric engine, it is exceedingly improbable that he could have driven a boat by steam.

The experiments made at the end of the eighteenth century are in a different category from those just referred to, and in most cases are supported by documentary evidence. The accounts of the experiments made in France by Périer and the Marquis de Jouffroy d'Abbans are the least satisfactory, and the experiments cannot be said to have had much influence on the introduction of steam navigation. Jacques Constantin Périer (1742–1818) was a very able engineer, while the Marquis de Jouffroy d'Abbans (1751–1832) was an infantry officer. Between 1770 and 1780 Périer is said to have tried a steam boat on the Seine, while in 1776 and in 1783 the Marquis de Jouffroy d'Abbans made experiments on the River Doubs and the River Saône respectively. By that time the steam engine was attracting much attention and there is no difficulty in believing that the Marquis de Jouffroy d'Abbans

obtained some measure of success. Unfortunately no account of his work was published till thirty years later, and then another twenty-five years elapsed before his claims were examined by the Paris Académie des Sciences. In the absence of contemporary documentary evidence it is therefore impossible to say with certainty what machinery he employed or what results he obtained.

But whatever was done in France was far surpassed in America by the work of James Rumsey (1743–92) on the Potomac, and of John Fitch (1743–98) on the Delaware. Biographers have kept the memories of both these inventors alive, and a few years ago Mr L. F. Loree, of the Delaware and Hudson Company, placed students of steam boat lore under an obligation by the reproduction of parts of documents, books and pamphlets relating to their projects, under the title *Developments of Steam Navigation*. The Catalogue of the Water Craft Collection of the National Museum, Washington, contains valuable notes on the work of Fitch and Rumsey, while among the latest reviews of the work of Fitch is that contained in a memoir by M. Paul Augustin-Normand, read on June 16, 1933, to the French Açadémie de Marine.

Rumsey hailed from Bohemia Manor, Cecil Co., Maryland. The first definite information of his experiments on propulsion is contained in a note in the diary of Washington who, on September 6, 1784, wrote "Remained at Bath all day and was shown the model of a boat constructed by the ingenious Mr Rumsey for ascending rapid currents by mechanism". Evidence goes to show that Rumsey's first plan was to work his boats up-stream by mechanically-worked poles, but this plan was later abandoned for the system proposed

long before, and since known as jet propulsion, in which water drawn into a pump in the boat is ejected at the stern. The first trial of any consequence appears to have been made on December 3, 1787, and another trial was made a few days later. In the main Rumsey's machinery consisted of a boiler, a cylinder and a pump, the cylinder and pump barrel being placed vertically, the one on top of the other. One of the boilers tried was a "pipe boiler".

Besides his ideas for steam boats Rumsey put forward projects for pumping, for mills, etc., all appearing to be generally useful, and in 1788 the Rumseian Society was formed to further his schemes, Benjamin Franklin being one of its supporters. In 1788 also, Rumsey published at Philadelphia *A Short Treatise on the Application of Steam whereby is Clearly Shown from Actual Experiments that Steam may be Applied to Propel Boats or Vessels of any Burthen against Rapid Currents with great Velocity*.... The formation of the Rumseian Society led the inventor to visit England. In London he took out two patents, No. 1669 of November 6, 1788, and No. 1734 of March 24, 1790. When applying for the second of these he described himself as of the parish of Saint Margaret, Westminster. In 1792 he tried a steam boat on the Thames, to which Fulton made a reference in his note-book. All further action, however, was brought to an end by Rumsey's unexpected death on December 23, 1792, at the age of forty-nine, in London. He was buried in St Margaret's churchyard. Many years afterwards, in 1839, the Kentucky Legislature presented a gold medal to his son "Commemorative of his father's services and high agency in giving the World the benefit of the steam boat".

Rumsey's great rival John Fitch came from Windsor, Connecticut. It is said he first conceived the idea of

applying steam to transport in April 1785. In September of that year he laid a drawing, a description and a model of a steam boat before the American Philosophical Society, Philadelphia. In October he had an interview with Washington and soon afterwards applied to the legislature of Virginia for assistance. In March 1786 he obtained exclusive privileges for his boats in New Jersey, and during the next eighteen months obtained similar privileges from the States of Delaware, New York, Virginia and Pennsylvania. During the three years 1785 to 1788 he built at least three steam boats, 34 ft., 45 ft. and 60 ft. long respectively. A model of the first of these is in the National Museum. In this boat Fitch used twelve vertical oars like snow shovels, operated by gears, and a sprocket wheel and chain driven by a steam engine. In 1788 a Steam Boat Company was formed and his 60 ft. boat made a trip from Philadelphia to Burlington, about 20 miles. After a trip in this boat on October 12, 1788, ten worthies of Philadelphia declared "we are clearly of opinion that the rivers of America may be navigated by the means of steam boats, and that the present boat would be very useful on the Western Waters". Two years later Fitch placed another vessel on the Delaware, which ran for three or four months. An advertisement of July 26, 1790, announced

THE STEAMBOAT

Sets out tomorrow morning at ten o'clock, from Arch Street Ferry, in order to take passengers for Burlington, Bristol, Bordentown, and Trenton, and return next day.

Fitch and his supporters next planned to exploit his invention in Europe and through Aaron Vail, United States Consul at L'Orient, France, on November 29, 1791, secured a French patent. It is of interest to note

that this patent was one of the very early ones granted under the Patent Law which had just been brought into force. The original of Fitch's Letters Patent, signed by Louis XVI and bearing the great seal of France, now in the United States National Museum, Washington, D.C., it is stated, was rescued from the wreckage of the National Library after the Commune and was taken to America. It is shown on Plate I and a translation of the essential part of the patent is given below.

DIRECTORY OF INVENTION No. 28

DEPARTMENT OF PARIS
16 2h.

29 November 1791

Letters patent for Fifteen Years, for a mechanism suitable for making boats, ships and other vessels move by means of a fire engine.

TO MR JOHN FITCH, citizen of Philadelphia, in the United States of America.

INVENTOR
AND IMPORTER.

LOUIS, by the Grace of God, and by the Constitutional Law of the State, King of the French, to all present and to come, Greeting.

MR JOHN FITCH, citizen of Philadelphia in the United States of America, having made known to us that he desires to possess the rights of property assured by the law of January 7, 1791, to promoters of discoveries and inventions in every kind of industry and consequently to obtain a patent of invention which shall last for the period of fifteen years, for the exercise and use in all the Kingdom of a MECHANISM SUITABLE TO MAKE BOATS, SHIPS AND OTHER VESSELS MOVE BY MEANS OF A FIRE ENGINE, of which mechanism the said Mr Fitch is declared to be the INVENTOR and IMPORTER; also that it follows from the report established at the time of the deposition made by Mr Aaron Vail, given powers of attorney by the said John Fitch, to the Secretariat of the Directory of the Department in Paris, where the said powers have been communicated under date of the twenty sixth November seventeen hundred and ninety one. Having seen the request of the said Mr Vail, in the name of Mr Fitch, together with the explanatory memorandum and the drawing, addressed by the petitioners to the DIRECTORY OF PATENTS FOR INVENTIONS of which memorandum and drawing follow the literal text and the copy.

MEMORANDUM

Mr John Fitch, citizen of Philadelphia, in the United States of America, is the inventor of a machine suitable to make boats, ships and other vessels move, where fire serves as the motive power, operating by means of boilers, cylinders, pistons, air pumps, wheels and iron chains, like the drawing here annexed and according to any other, either in the application of vapours, smoke or fire to navigation in all operations whatsoever, in following up which inventions and perfections the said Mr Fitch has made considerable sacrifice, expending very large sums, as well as in work lasting six consecutive years, for compensation of which Mr Fitch is recognised in the procuration of Mr Aaron Vail, citizen of New York, now in this city, with a view of soliciting the Government of France to grant to him a patent of invention for fifteen years comformable to the laws of 7 of January and of 25 May 1791.

Paris November 25, 1791.

(Signed) Aaron Vail

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WE MAKE KNOWN to and command all tribunals administrative bodies and municipalities that they make John Fitch and his assigns to enjoy and use fully and peacefully the rights conferred by these presents ceasing and causing to cease all troubles and contrary hindrances; we make known to them also that at the first requisition of the patentee of these presents they shall do [illegible] respective, and to execute during their duration as if it were the Law of the Kingdom. In witness of which we have signed and had the said presents counter-signed, to which we have had affixed the seal of the State, at Paris the twenty ninth day of the month of November, one thousand seven hundred and ninety one and the eighteenth year of our Reign.

(Signed) LOUIS

by the King

The Minister of the Interior

B. C. Cahier.

LEGEND

A, the large piston acting upon the wheel *B* which gears with the wheel *C*, and makes the wheel *D* turn continuously towards the supports where the large piston always moves from above downwards, and acting on the endless chain *aaa* makes the wheel *E*, fixed on the extremity of the axle, turn continuously towards the supports.

The arms *CCC*, placed on the quarters of the boat, support the ends of the axle, and the framing *CCC* supports the ends of the paddles by means of arms suspended by the hinges *ddd*. The paddles are so constructed that the end of the axis turns into the wheel, and in proportion as it turns it makes the paddles *ggg* move somewhat as a man puts them in motion in a boat.

N.B. This drawing represents the view of the works constructed on the stern of the boat, the perspective of the large piston, and one of the sides of the boat.

At the foot of the drawing is the following: "Brian architect and draughtsman of the Directory of Patents of Invention."

In 1793 Fitch himself crossed to France, but the French Revolution was then reaching its climax and he soon returned home a disappointed man, working his passage as a seaman. Back again in America he experimented with a screw-driven steam boat on the Collect Pond, New York, but in spite of all his ingenuity and perseverance he failed to make any headway, and overcome by his misfortunes he became ill and in the summer of 1798 died at Bardstown, Kentucky. His position as an original and independent inventor is unassailable and whatever admiration is accorded him is increased by a realisation of the backward state of engineering in the United States in the eighteenth century. He was a very far-sighted pioneer and once wrote that with steam "The Grand and Principle object must be on the Atlantick, which would soon overspread the wild forests of America with people, and