

# **GREAT INVENTORS AND THEIR INVENTIONS**



**GREAT INVENTORS  
AND THEIR  
INVENTIONS**

**BY**

**FRANK P. BACHMAN**

**YESTERDAY'S CLASSICS**

**CHAPEL HILL, NORTH CAROLINA**

Cover and arrangement © 2006 Yesterday's Classics.

This edition, first published in 2006 by Yesterday's Classics, is an unabridged republication of the work originally published by American Book Company in 1918. For a listing of books published by Yesterday's Classics, visit [www.yesterdaysclassics.com](http://www.yesterdaysclassics.com). Yesterday's Classics is the publishing arm of the Baldwin Project which presents the complete text of dozens of classic books for children at [www.mainlesson.com](http://www.mainlesson.com) under the editorship of Lisa M. Ripperton and T. A. Roth.

ISBN-10: 1-59915-066-2

ISBN-13: 978-1-59915-066-6

Yesterday's Classics  
PO Box 3418  
Chapel Hill, NC 27515

## **PREFACE**

THIS book contains twelve stories of great inventions, with a concluding chapter on famous inventors of to-day. Each of the inventions described has added to the comforts and joys of the world. Each of these inventions has brought about new industries in which many men and women have found employment. These stories, therefore, offer an easy approach to an understanding of the origin of certain parts of our civilization, and of the rise of important industries.

The story of each invention is interwoven with that of the life of its inventor. The lives of inventors furnish materials of the highest educative value. These materials are not only interesting, but they convey their own vivid lessons on how big things are brought about, and on the traits of mind and heart which make for success.

It is hoped that this book will set its readers to thinking how the conveniences of life have been obtained, and how progress has been made in the industrial world. While appealing to their interest in inventions and in men who accomplish great things, may it also bring them into contact with ideas which will grip their hearts, fire the imagination, and mold their ideals into worthier forms.



# CONTENTS

## PART I

### INVENTIONS OF STEAM AND ELECTRIC POWER

- |      |   |    |
|------|---|----|
| I.   | JAMES WATT AND THE INVENTION OF THE<br>STEAM ENGINE         | 1  |
| II.  | ROBERT FULTON AND THE INVENTION OF<br>THE STEAMBOAT         | 21 |
| III. | GEORGE STEPHENSON AND THE INVENTION<br>OF THE LOCOMOTIVE    | 47 |
| IV.  | INVENTION OF THE ELECTRIC ENGINE AND<br>ELECTRIC LOCOMOTIVE | 71 |

## PART II

### INVENTIONS OF STEAM AND ELECTRIC POWER

- |       |  |     |
|-------|--|-----|
| V.    | THE INVENTION OF SPINNING MACHINES:<br>THE JENNY, THE WATER FRAME, AND THE<br>MULE | 87  |
| VI.   | ELI WHITNEY AND THE INVENTION OF THE<br>COTTON GIN                                 | 106 |
| VII.  | ELIAS HOWE AND THE INVENTION OF THE<br>SEWING MACHINE                              | 124 |
| VIII. | CYRUS H. MCCORMICK AND THE INVENTION<br>OF THE REAPER                              | 148 |

IX.	HENRY BESSEMER AND THE MAKING OF STEEL	169
-----	---	-----

### PART III

#### INVENTIONS OF PRINTING AND COMMUNICATION

X.	JOHN GUTENBERG AND THE INVENTION OF PRINTING	196
XI.	SAMUEL F. B. MORSE AND THE INVENTION OF THE TELEGRAPH	219
XII.	ALEXANDER GRAHAM BELL AND THE INVENTION OF THE TELEPHONE	241
XIII.	OTHER FAMOUS INVENTORS OF TO-DAY	262
	THOMAS A. EDISON	262
	ORVILLE AND WILBUR WRIGHT	268
	GUGLIELMO MARCONI	278
	JOHN P. HOLLAND	282







## JAMES WATT AND THE INVENTION OF THE STEAM ENGINE

UNTIL a little more than one hundred years ago, the chief power used in the production of food, clothing, and shelter was hand power. Cattle and



JAMES WATT

horses were used to cultivate the fields. Windmills and water wheels were employed to grind corn and wheat. But most tools and machines were worked by hand.

Men had, for many years, dreamed of a new power which would be more useful than either work animals, sails, wind-

mills, or water wheels. This new power was steam. Yet no one had been able to apply the power of steam so that it would grind corn and wheat, spin and weave cotton and wool, or do any useful thing at

## *GREAT INVENTORS AND THEIR INVENTIONS*

all. The man who succeeded in giving to the world this new power was James Watt. Steam now propels ships over the Atlantic in less than a week. It speeds express trains across our continent in ninety hours, and it does a thousand other wonderful and useful things.

### **CHILDHOOD AND EARLY EDUCATION**

James Watt was born in 1736, at Greenock, Scotland, not far from Glasgow. His early education was received at home, his mother giving him lessons in reading, and teaching him to draw with pencil and chalk. His father drilled him in arithmetic and encouraged him in the use of tools. When at length James went to school, he did not at first get along well. This was due to illness which often kept him at home for weeks at a time. Still, he always did well in arithmetic and geometry, and after the age of fourteen he made rapid progress in all his studies.

Even as a small boy, James was fond of tinkering with things. This fondness was not always appreciated, as is shown by a remark of an aunt: "James Watt, I never saw such an idle boy; take a book or employ yourself usefully; for the last hour you have not spoken a word, but taken off the lid of that kettle and put it on again, holding now a cup and now a silver spoon over the steam, watching how it rises from the spout, and catching the drops of water it turns into. Are you not ashamed to spend your time in this way?"

## JAMES WATT AND THE STEAM ENGINE

Much of his time, as he grew older and stronger, was spent in his father's shop, where supplies for ships were kept, and where ship repairing was done. He had a small forge and also a workbench of his own. Here he fashioned cranes, pulleys, and pumps, and learned to work with different metals and woods. So skillful was he that the men remarked, "James has a fortune at his fingers' ends."



WATT AND THE TEAKETTLE

The time at last came for choosing a trade. The father had wished James to follow him in his own business. But Mr. Watt had recently lost considerable money, and it now seemed best for the youth to choose a trade in which he could use his

mechanical talents. So James set out for Glasgow to become an instrument maker.

## **LEARNING INSTRUMENT MAKING**

He entered the service of a mechanic who dignified himself with the name of “optician.” This mechanic, though the best in Glasgow, was a sort of Jack-of-all-trades, and earned a simple living by mending spectacles, repairing fiddles, and making fishing tackle. Watt was useful enough to his master, but there was little that a skillful boy could learn from such a workman. So he decided to seek a teacher in London.

There were plenty of instrument makers in London, but they were bound together in a guild. A boy wishing to learn the trade must serve from five to seven years. Watt had no desire to bind himself for so long a period. He wished to learn what he needed to know in the shortest possible time; he wanted a “short cut.” Master workman after master workman for this reason turned him away. Only after many weeks did he find a master who was willing to take him. For a year’s instruction, he paid one hundred dollars and gave the proceeds of his labor. The hours in the London shops were long. “We work,” wrote Watt, “to nine o’clock every night, except Saturdays.” To relieve his father of the burden of supporting him, he got up early and did extra work. Towards the end of the year he wrote,

## *JAMES WATT AND THE STEAM ENGINE*

with no little pride: "I shall be able to get my bread anywhere, as I am now able to work as well as most journeymen, though I am not so quick as many."

### **JACK-OF-ALL-TRADES**

In order to open a shop of his own, Watt returned to Glasgow. He was opposed in this by the hammermen's guild. The hammermen said that he had not served an apprenticeship and had no right to set up in business. They would have succeeded in keeping him from making a start, had not a friend, a teacher in the University of Glasgow, come to his aid, providing him with a shop in a small room of one of the college buildings.

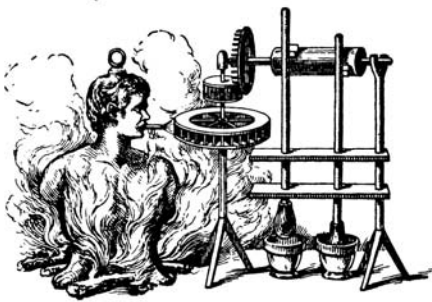
Watt soon became a Jack-of-all-trades. He cleaned and repaired instruments for the university. Falling into the ways of his first master, he made and sold spectacles and fishing tackle. Though he had no ear for music and scarcely knew one note from another, he turned his hand to making organs. So successful was he, that many "dumb flutes and gouty harps, dislocated violins, and fractured guitars" came to him to be cured of their ills.

All the while, Watt spent his leisure time in reading. The college library was close at hand, so there was no lack of books. Chemistry, mathematics, and mechanics were studied. By learning all he could and by doing everything well, Watt came to be

known as a man “who knew much and who could make anything.”

## **CAPTURED BY STEAM**

Coal and tin mining had for a long time been important industries of Great Britain. Shallow mines were easy to work. Men and women carried out the coal or tin ore in buckets, by winding stairs. Or a windlass was used, turned by hand or with the aid of a horse. Water was taken out in the same way. As the shallow mines became exhausted, deeper ones were



BRANCA'S STEAM ENGINE  
OF 1629

opened. The deeper the mine, the harder it was to lift out the coal or tin ore. Into these deeper mines also came quantities of water, flooding many of them. Unless a machine should be invented which could be run

at a small cost, to pump out the water and to hoist the coal or tin, these mines would have to be closed. The need of such a machine led to the invention of the first successful steam engine.

Watt first heard of the steam engine in 1759. The idea captivated him, and he began to read how others had tried to make successful engines. Finding that the best books on steam and “fire engines,” as

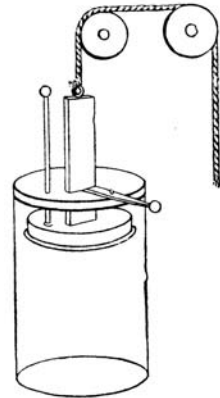


## JAMES WATT AND THE STEAM ENGINE

they were then called, were in Italian and German, he took up the study of these languages.

In an Italian book he read about Branca's steam engine, invented in 1629. Branca's engine was little more than a toy, no use being made of it, except to pulverize saltpeter and do other simple things of like sort.

In a German book he read about Papin's engine, which was invented in 1690. In Papin's engine steam was admitted into the cylinder. The steam was then allowed to condense, that is, turn back into water. This formed a vacuum, or space without any air in it, under the piston. The weight of the atmosphere, which is about fourteen pounds to the square inch, on the upper side of the piston, forced it down, and the descending piston raised a weight fastened to the rope. Papin never went further than the making of a model. But his idea of using steam to make a vacuum, and of using the pressure of the atmosphere to force down a piston was applied a few years later with some success by Thomas Newcomen.



PAPIN'S  
ENGINE

Newcomen made his first engine in 1705. Although big and awkward, a number were used in England to pump out the water at the mines. But they could not be used in deep mines, as they could lift only six or seven pounds for each square inch of

## *GREAT INVENTORS AND THEIR INVENTIONS*

the piston. They worked slowly, making only about fifteen strokes a minute, and they were expensive also, a single engine burning fifteen thousand dollars' worth of coal in a year.

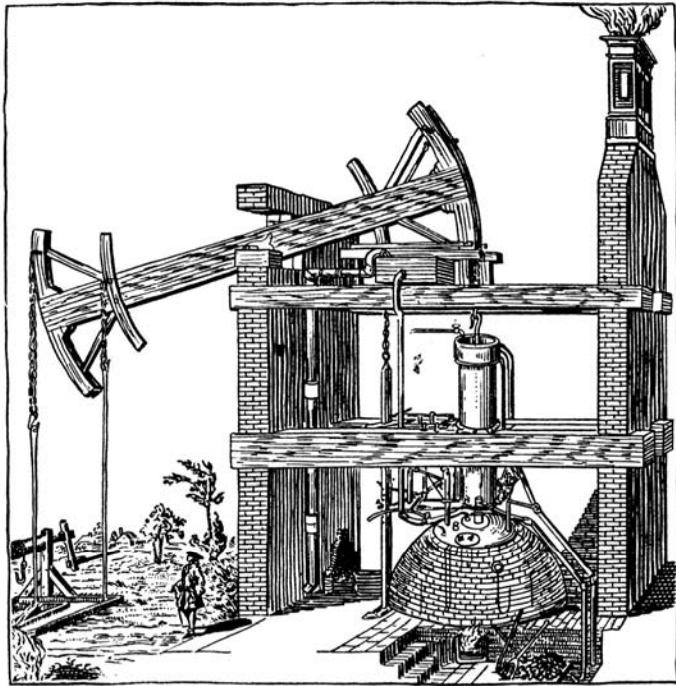
### **FINDING THE TROUBLE**

Watt had been thinking about steam for four or five years before he saw one of Newcomen's engines. Then it was only a model of one, brought to him from the university for repair. When he had repaired the model, he started it to going. It made a few strokes and stopped. There was no more steam. The boiler seemed big enough, so he blew up the fire. The engine now ran all right, but it required much fuel and used up quantities of steam, though the load on the side of the pump was light. Most men would have thought nothing of this, and would have sent the model back to the university. But that was not Watt's way. Everything he did not understand was for him a subject for study, and he never stopped until he understood. So he set to work to discover why the engine used so much steam.

Steam was used, you will remember, to make a vacuum in the cylinder. Watt found that to drive out the air and water, enough steam had to be let into the cylinder to fill it four times. Why was this? First, the cylinder was exposed to the air, which chilled it. The cold cylinder itself, before it was warm, changed considerable steam into water.

## *JAMES WATT AND THE STEAM ENGINE*

Second, cold water was poured into the cylinder to condense the steam, and this made the cylinder cold again. Watt estimated that three fourths of all the steam used was thus wasted in heating and reheating the cylinder. Here was the trouble with Newcomen's engine. Watt saw that, to remedy this defect, a way must be found to keep the cylinder always as hot as the steam which entered it, and the vacuum must be made in the cylinder, without cooling it.



NEWCOMEN'S ENGINE

## **MAKING THE INVENTION**

Watt spent much time and money in making experiments, but nothing he tried succeeded. "Nature has a weak side," he was fond of saying, "if we can only find it out." So he went on day after day, following now this and now that false hope.

"One Sunday afternoon early in 1765," writes Watt, "I had gone to take a walk in the Green of Glasgow. I was thinking upon the engine and about how to save the heat in the cylinder, when the idea came into my mind that steam was an elastic body and would run into a vacuum. If connection was made between the cylinder and a tank from which the air had been pumped, the steam would pass into the empty tank and might there be condensed without cooling the cylinder. I then saw that I must get rid of the condensed steam and of the water used in condensing it. It occurred to me this could be done by using pumps."

With a separate condenser in mind, to get rid of the steam after it had done its work, without cooling the cylinder, other important improvements were thought of. In Newcomen's engine, the upper end of the cylinder was open to let the air act upon the piston. Watt now planned to put an air-tight cover over the end of the cylinder, with a hole for the piston rod to slide through, and to let steam in above the piston to act upon it, instead of the air. This change made Newcomen's atmospheric engine

## *JAMES WATT AND THE STEAM ENGINE*

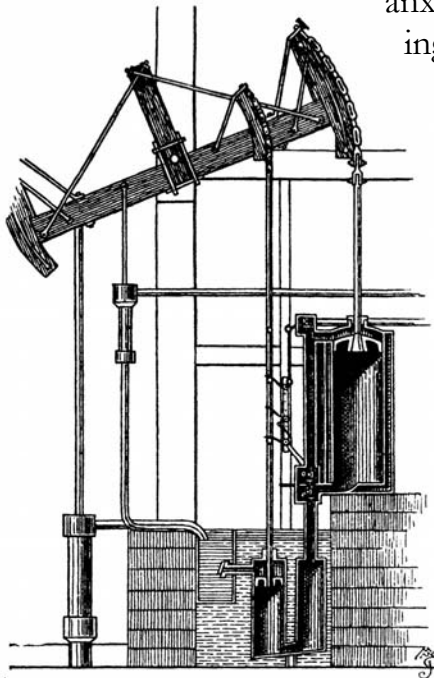
into a steam engine. In Newcomen's engine the power was the pressure of the atmosphere upon the piston, and this power acted in one direction only. In Watt's engine steam was the power, and the piston was shoved both up and down by it; hence Watt's engine was called a double-acting engine.

"All these improvements," says Watt, "followed in quick succession, so that in the course of one or two days the invention was . . . complete in my mind."

The next step was to make a model, to put the invention into working form. Making the drawings was easy, but to carry them out was hard. A lack of good workmen was the chief difficulty. There were no skilled mechanics in those days, nor self-acting, tool-making machines; everything had to be made by hand. Blacksmiths and tinnermen were the only men that could be hired, and they were bungling workers even at their own trades. After eight months of racking labor, the model was ready to start. It worked, but despite all Watt's care, it "sniffed at many joints." The condenser did not work well; the cylinder leaked, and the piston was far from being steam tight. To add to Watt's troubles, his "old White Iron man," a tinner and his best workman, died. The cross-beam broke. Nevertheless, Watt saw enough to know that he was on the right track.

## BEELZEBUB, THE TRIAL ENGINE

Watt's great need was money, for it was necessary to build a trial engine to show the value of steam power. He finally, in 1767, secured a partner who promised, for a two-thirds share in the invention, to pay a debt of five thousand dollars owed by Watt, and to bear the expense of further experiments. The partnership was formed, and Watt turned to the plans for the trial engine.



THE ENGINE  
BEELZEBUB, 1767

As the trial engine neared completion, Watt's "anxiety for his approaching doom kept him sleepless at night, for his fears were even greater than his hopes." Alas! the trial engine did not work well. The new condenser acted badly. The cylinder was almost useless. The piston, despite all that could be done, leaked quantities of steam. The whole machine was a "clumsy job." From the

## *JAMES WATT AND THE STEAM ENGINE*

way it wheezed, and snorted, and puffed fire and smoke, the engine was named Beelzebub. Months were spent in overhauling him, but he behaved only slightly better on second trial. Beelzebub was far from being a practical engine, and he was left for the time to rest and rust.

There is little wonder that Watt was downhearted and wrote to his friends: "Of all things in life, there is nothing more foolish than inventing." "I am resolved . . . if I can resist it, to invent no more." "To-day I enter the thirty-fifth year of my life, and I think I have hardly yet done thirty-four pence worth of good in the world."

### **COMPLETING THE ENGINE**

Watt had by this time spent ten years and several thousand dollars upon his invention, but it was still only a dream. Brighter days were, however, at hand. Matthew Boulton, owner of the largest hardware factory in the world, at Soho near Birmingham, and who had working for him the best mechanics in Europe, became interested in the fire engine. In 1774, he became Watt's partner.

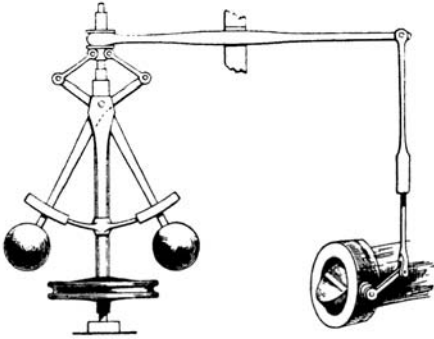
Meanwhile, old Beelzebub was shipped to Birmingham. The best mechanics of Soho set to work upon him. One by one the separate parts were repaired and improved. In a few months, he was ready for trial. Beelzebub puffed as much smoke and fire as ever, but with all his bluster and noise,—thanks to good workmanship, he went surprisingly

## GREAT INVENTORS AND THEIR INVENTIONS

well. Everyone who saw Beelzebub run felt sure that the invention would prove a success. Even modest Watt wrote to his father: "The fire engine I have invented is now going, and answers much better than any other that has yet been made, and I expect that the invention will be very beneficial to me."

Though success was promised, much remained to be done to make the engine practical. It was found, for example, that if the load Beelzebub was pulling, for some cause became lighter, he would run too fast; if the load suddenly became heavier, he would run too slow.

Some way had to be found to make him run faster when there was need of more power, and to run more slowly when less power was needed. Two



WATT'S ENGINE  
GOVERNOR

heavy balls were fixed to swing around an upright rod. When the engine ran fast, the upright rod turned fast, and the balls swung out and so acted as to admit less steam. When the engine ran slowly, the rod turned slowly, and the balls swung down and let in more

steam. By the use of this contrivance, or the governor, Beelzebub was made to run at about the same speed, and when started and set to work, became his own engineer.



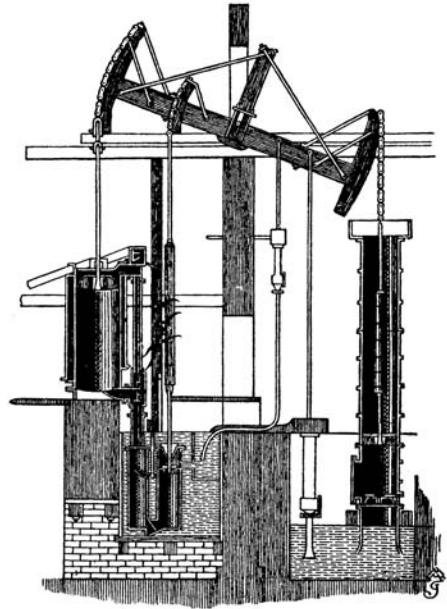
## JAMES WATT AND THE STEAM ENGINE

Other inventions were made, and the separate condenser, piston, and cylinder were improved. Thus, after years of thought and labor, the steam engine at length stood full grown and ready for all kinds of work.

### MAKING THE BUSINESS PAY

To make an invention is one thing. To get people to use it and so make it profitable is another. It is difficult to say which is the harder. In any case, Watt's troubles were not over.

All the time that Watt was working on his invention, mines were being flooded with water and had to be given up. Among the first orders for engines was one for a mine in Cornwall. Watt made the drawing with care, and the workmen did their best, for much depended on the first engine.



A MINE ENGINE

The engine was ready by the middle of 1777, and Watt went to set it up. The people were eager to get a look at the

## *GREAT INVENTORS AND THEIR INVENTIONS*

monster. Mine owners came from far and near to see it work. Many were doubtful, and some even wished that the engine might fail. But to the surprise of all it succeeded. It pumped water as they had never seen water pumped before. The size, the speed, and “the horrible noise of the engine,” wrote Watt, “give satisfaction . . . and the noise seems to give great ideas of its powers.” In a few days the mine was dry. It was the deepest mine in the district, and orders for engines began to come in. They came so fast that in the course of the next four or five years almost all the mines in England and Scotland were supplied.

Boulton, Watt’s partner, felt from the first that the greatest field for the steam engine was in mills and factories. When orders for pumping engines fell off, Watt went to work on a factory engine. The first factory engine was built in 1782, and was for a corn mill.

The use of the steam engine in mills was opposed by the millers. They saw that to put steam engines to grinding corn and wheat would do away in many places with windmills and water mills. The working people also were stirred up. They were led to believe that if the steam engine was put in mills, it would take work away from them.

“It seems,” wrote Watt, “the meddlers are determined to be masters of us. To put a stop to fire-engine mills, because they come in competition with water mills, would be as absurd as to put a stop to canals, because they interfere with wagoners. . . . The argument that men are deprived of a livelihood

## *JAMES WATT AND THE STEAM ENGINE*

would put a stop to the use of all machines whereby labor is saved. Carry out this argument, and we must do away with water mills themselves, and go back again to grinding corn by hand labor.”

So strong was the opposition that Watt and Boulton decided to build a flour mill, to show what could be done. They built one at a cost of sixty thousand dollars, and put into it their newest and best engine. The mill attracted much attention. But it was not allowed to run long. So bitter was the feeling against the steam engine that the mill was set on fire and burned to the ground.

Though the mill was a total loss, it served its purpose. Orders for factory engines came in apace,—orders from France, from Italy, and from America. The advantages of steam power were now apparent. Water mills were stopped in the summer by the lack of water, and in the winter by frost, while steam mills worked on, by day and by night, in all kinds of weather, and in all seasons.

To bring the world to appreciate the value of the steam engine was thus a hard struggle. Down to the year 1785 every penny made from the sale of engines, amounting to more than two hundred thousand dollars, was put back into the business. Besides, large sums were borrowed. So great was the need for money that even the patents were mortgaged. Time and again it seemed as if all would be lost. More than once Watt and Boulton felt that this would be a blessing. The mine owners, for instance, refused to pay for the engines which had

## *GREAT INVENTORS AND THEIR INVENTIONS*

saved them thousands of dollars. Dishonest persons stole and used their patents. They were continually annoyed by rumors that a better engine was on the point of being completed. Efforts were even made to get Parliament to take away their patents.

“We are in the state of the old Roman,” Watt wrote, “who was found guilty of raising better crops than his neighbors, and was ordered to bring before the assembly of the people his instruments of husbandry, and tell them of his arts. He complied, and when he had done, said, ‘These, O Romans, are the instruments of our art, but I cannot bring into the forum the labors, the sweats, the watchings, the anxieties, the cares which produce the crops.’ So everyone sees the reward which we may yet probably receive from our labors; but few consider the price we have paid for that reward, which is by no means certain.”

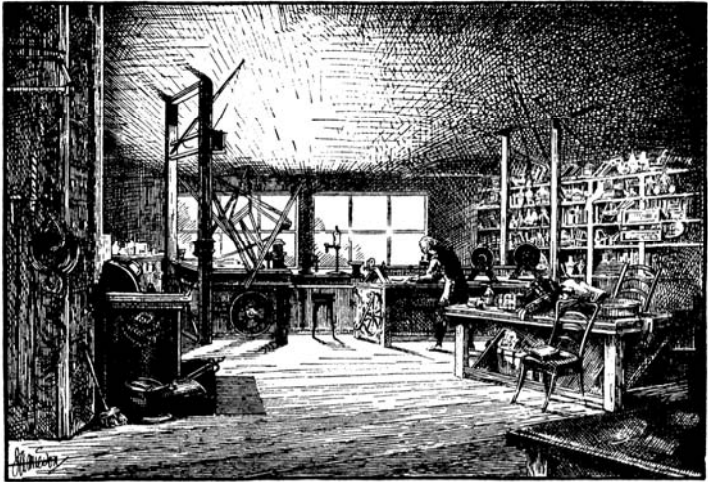
Difficulty after difficulty was, however, battled down. Parliament refused to take away the patents. Persons who used them without right were punished. The mine owners were forced to pay what they owed. The business, after long waiting and untold distress, began to pay.

### **OLD AGE AT HEARTHFIELD**

The partnership between Watt and Boulton came to an end in 1800. Watt was now well-to-do. Relieved of business cares and worry his health improved. He built a beautiful country home at

## *JAMES WATT AND THE STEAM ENGINE*

Hearthfield. From there he made trips to different parts of Scotland, Wales, and England. To Hearthfield came old friends and the greatest men of England to visit him. Inventing continued to give him the greatest pleasure. A room was fitted up in the attic of the house, and there he would work for days at a time. This room remains just as it was in 1819.



WATT'S WORKROOM AT HEARTHFIELD

On a monument erected to Watt's memory in Westminster Abbey are these inspiring words:

*GREAT INVENTORS AND THEIR INVENTIONS*

NOT TO PERPETUATE A NAME  
WHICH MUST ENDURE WHILE THE PEACEFUL ARTS  
FLOURISH  
BUT TO SHOW  
THAT MANKIND HAS LEARNT TO HONOR THOSE WHO  
BEST DESERVE THEIR  
GRATTITUDE,  
**THE KING**  
HIS MINISTERS, AND MANY OF THE NOBLES AND  
COMMONERS OF THE REALM  
RAISED THIS MONUMENT TO  
**JAMES WATT**  
WHO DIRECTING THE FORCE OF AN ORIGINAL GENIUS,  
EARLY EXERCISED IN PHILOSOPHIC RESEARCHES,  
TO THE IMPROVEMENT OF  
**THE STEAM ENGINE**  
ENLARGED THE RESOURCES OF HIS COUNTRY;  
INCREASED THE POWER OF MAN  
AND ROSE TO AN EMINENT PLACE  
AMONG THE MOST ILLUSTRIOUS FOLLOWERS OF SCIENCE  
AND REAL  
BENEFACTORS OF THE WORLD.

## II

# ROBERT FULTON AND THE INVENTION OF THE STEAMBOAT

ON August 17, 1807, a curious crowd of people in New York gathered at a boat landing. Tied to the dock was a strange-looking craft. A smokestack rose above the deck. From the sides of the boat, there stood out queer shaped paddle wheels. Of a sudden, the clouds of smoke from the smokestack grew larger, the paddle wheels turned, and the boat, to the astonishment of all, moved. It was "Fulton's Folly," the *Clermont*, on her first trip to Albany.

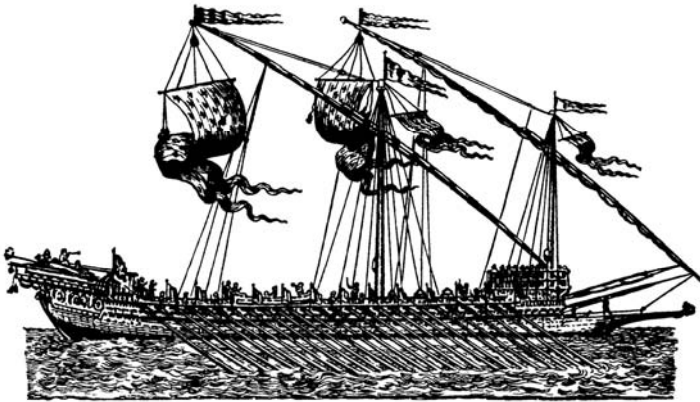
## THE FIRST BOATS

The first boat used by man was probably the trunk of a fallen tree, moved about by means of a broken branch or pole. Then some savage saw that a better boat could be made by tying a number of logs together to make a raft. But rafts are hard to move, so the heart of a log was hollowed out by means of a

## GREAT INVENTORS AND THEIR INVENTIONS

stone ax or fire, to make a still better boat, or strips of birch bark were skillfully fastened together to form a graceful canoe. Boats were constructed also of rough-hewn boards. With such primitive craft, voyages of hundreds of miles were made up and down great rivers like the Mississippi, or along the shores of inland seas like the Great Lakes.

The Phœnicians were the first great sailors. Their boats, called galleys, were sometimes two to three hundred feet long. These were of two kinds, merchantmen and war vessels. The merchantmen were propelled partly by sails and partly by oars, but



A MEDIEVAL GALLEY

on the war vessels, when in battle, oars only were used. On a single boat there were often several hundred oarsmen or galley slaves. These galley slaves were as a rule prisoners of war. They were chained to the oar benches, and to force them to row, they were often beaten within an inch of their lives. In enormous sail-and-oar vessels the Phœnicians cross-



## ROBERT FULTON AND THE STEAMBOAT

ed the Mediterranean in every direction, pushed out into the Atlantic Ocean, and went as far north as England.

The chief improvement in boat making, from the time of the Phœnicians until the first trip of the *Clermont*, was to do away with oars and to use sails only.

It was not until about fifty years before the time of Columbus that oars were generally discarded and large boats were propelled entirely by sails. Sail-boats were, to be sure, a great improvement over oar boats. Yet at best they were slow and unreliable, held back alike by calm and storm. The Pilgrims were ten weeks in crossing the Atlantic, and the regular trip, in the time of Washington, required six weeks.



COLUMBUS'S  
SANTA MARIA

Boats were thus from the very earliest times important in trade and travel. For this reason it is not surprising that Watt's engine was scarcely perfected, before men tried to make it propel a boat.

## THE FIRST STEAMBOATS

The first American to attempt the propelling of a boat by steam was William Henry, a gunsmith of Lancaster, Pennsylvania. In 1760, Mr. Henry was in

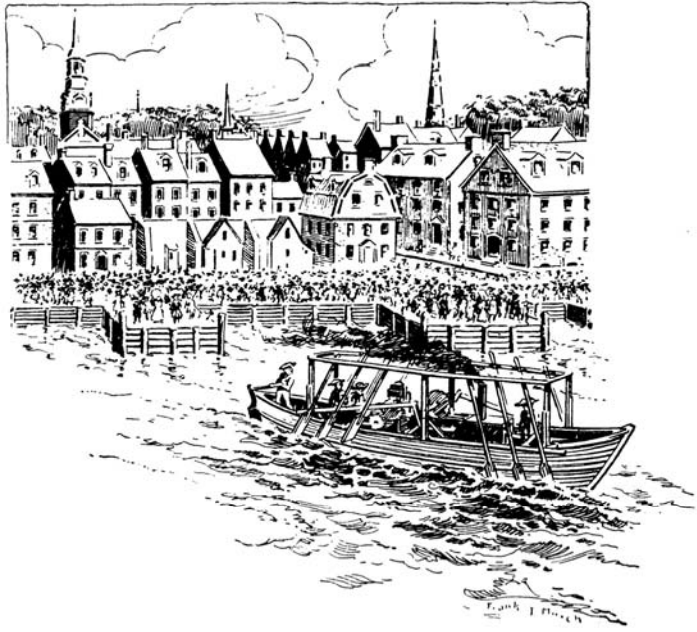
## *GREAT INVENTORS AND THEIR INVENTIONS*

England on business. He took great interest in the talk going on then about the use of steam to drive machinery, propel boats, and the like. On his return to America, he built an engine fashioned after one of Newcomen's engines, and so placed it in a boat that it worked a number of paddles. The boat did not go well, and a little later was accidentally sunk. Though unsuccessful, Henry never lost his interest in steamboats.

The first American to propel a boat by steam successfully was John Fitch. Fitch was a frequent visitor at the home of Henry, and probably got the idea of building a steamboat from him. However that may be, Fitch built a better boat than Henry, and he is regarded by some people as the real inventor of the steamboat.

Fitch built his first boat in 1787. The engine was made in America, but was copied from that of Watt. Along each side of the boat stood two sets of three paddles. To move the boat, these were given a motion like the stroke in paddling a canoe. Six paddles entered the water, while six came out. Fitch had great difficulty in obtaining the money to build the boat, and even after it was built the boiler had to be made larger. Finally, after much delay and anxiety, all was ready for a public trial. This took place at Philadelphia. Men like Washington, Jefferson, and Franklin came to see the new wonder. It was marvelous to see a boat propelled by steam, but the speed was only three or four miles an hour, so there was no great enthusiasm over the steam oar boat.

## ROBERT FULTON AND THE STEAMBOAT



TRIAL TRIP OF FITCH'S STEAMBOAT

The next year, Fitch built a second boat, with the paddles placed at the stern. But the boat could not be made to go faster than a man could walk, and it was no more of a success than the first. Fitch succeeded, however, in 1790, in making a boat sixty feet long and eight feet wide with paddles at the stern, which had a speed of seven miles an hour. After a trial at Philadelphia, it made regular trips, during the rest of the summer, between Philadelphia and Trenton running between two and three thousand miles with no serious accident. But it cost more

## *GREAT INVENTORS AND THEIR INVENTIONS*

to run the boat than the fares amounted to, and the venture failed.

Fitch found his way to New York, and might have been seen there in 1796, working on a screw steamboat. He had long since spent all his own money. Nobody would help him, and therefore the screw steamboat had to be given up. Completely discouraged, Fitch retired to a farm in Kentucky. He believed in the steamboat until the last, and was confident that the day would come when steamboats would be running on all our large rivers and across the ocean. "The day will come," said he, "when some more powerful man will get fame and riches from my invention; but now no one will believe that poor John Fitch can do anything worthy of attention."

Driving along the shore of the Delaware one day, John Stevens of New Jersey saw Fitch's little steamboat puffing slowly along between Philadelphia and Trenton. He followed it to the next landing and examined it with care. He had long been interested in steamboats and now decided to build one. He set to work with great energy, and by his enthusiasm he induced Robert R. Livingston of New York to share in the enterprise. After almost ten years of planning and experimenting, these men thought they were on the point of success. The boat of which they expected so much was launched in 1798. But alas! it could run only three miles an hour in still water, and was soon given up as a failure.

## ROBERT FULTON AND THE STEAMBOAT

Stevens, undaunted, continued his experiments year after year. Model after model was made. Some of these boats had paddle wheels extending from the sides; some were propelled by a single revolving screw at the stern, and others had two screws. Stevens experimented also with different kinds of boilers. So successful was he that he came very near winning the prize that was afterwards awarded to Robert Fulton. The very next month after Fulton's first boat made its trial trip, Stevens launched the *Phoenix*, which was quite as good a boat as the *Clermont*. His screw propeller, as well as his boilers, afterwards came to be used extensively on ocean steamships. Thus, after Fulton, Stevens did more than any other man to make the steamboat a practical success.

Inventors in England were likewise busy. The most successful of these was William Symington. The money to build the trial boat was supplied by Lord Dundas, who hoped that steam might take the place of horses in towing canal barges. The *Charlotte Dundas*, Symington's boat, was ready for trial in 1802. She was a stern-wheeler, that is, she was propelled by a paddle wheel at the stern. An engine built by Boulton and Watt supplied the power. The new boat took two barges of seventy tons burden each, and in the face of a strong wind towed them down the canal twenty miles in six hours.

Lord Dundas was delighted. He wanted this way of towing adopted. The other owners of the canal were not convinced, however, that there would be much saved by the change, and besides, they

## GREAT INVENTORS AND THEIR INVENTIONS

feared that the new boat would damage the banks of the canal. Lord Dundas finally succeeded in interesting the Duke of Bridgewater, who gave Symington an order for eight boats like the *Charlotte Dundas*. Had these been built, Symington would today probably be known as the inventor of the steamboat. Unfortunately the Duke died about this time, and the boats were never built. The *Charlotte Dundas* was anchored in a side creek to rot, and Symington gave up the project in despair.

Though men had been working and experimenting for many years, a practical steamboat, that is, one which could be used at a good profit to its owners, was yet to be built. There was great need of such a steamboat, and Watt's engine was strong enough to propel it. But no one seemed able to build a boat of the right shape, to make the right kind of a propeller, or to harness Watt's engine to it in the right way. So many attempts had been made, and there had been so many failures, that most men came to believe it was impossible to make a successful steamboat. The man who first succeeded in accomplishing the "impossible" was Robert Fulton.

### FULTON'S EARLY LIFE

Robert Fulton was born at Little Britain, Lancaster County, Pennsylvania, in 1765. His father, though not successful in money matters, was highly respected; he was a leader in the Presbyterian Church, and held a number of minor public offices

## ROBERT FULTON AND THE STEAMBOAT

of honor. His mother was an excellent woman who had more education than most women of the time, for she taught Robert reading, writing, and ciphering, until he was eight years of age.

Robert was then sent to school, where he acquired a good elementary education. He was not a superior scholar. Books interested him much less than painting or the shop of the gunsmith. Nobody knows who taught him to paint, unless it was Major André, who was later hanged as a spy. Major André lived for some months at Lancaster and gave painting lessons there. It is possible that Robert was one of his pupils. At all events, the boy learned, when quite young, to draw and to paint.



ROBERT FULTON

He had some talent, and perhaps was inspired to become an artist by the example of Benjamin West, one of America's greatest painters. Mr. West when a boy was often in Lancaster, and he painted a portrait of Robert's father and mother. Mr. Henry, of whom mention has already been made, had a number of Mr. West's pictures, and Robert used to go to his home to look at them. It may be true, also, that Mr. Henry talked to Robert, when on these visits, about his steamboat, and how fine it would be to invent one, and that these talks did much to lead

## GREAT INVENTORS AND THEIR INVENTIONS

him to give up art and become an engineer and inventor.

Besides being fond of drawing and painting, Robert was fond of tools. Not far from his home, there were shops where muskets were made for the soldiers of the Revolutionary War. Robert was a frequent visitor there, and he spent much time in making drawings of guns and tinkering with broken muskets.

His turn for making things showed itself early. One day, Robert was very late at school. "Robert, why are you so late?" asked the teacher.

"I was making a pencil out of a piece of lead," he replied.



FULTON AND THE  
LEAD PENCIL

The teacher looked at the pencil and found it a good one. Before many days, all the children had lead pencils.

At the age of seventeen, Fulton left Lancaster and went to Philadelphia. He gave his attention principally to painting portraits and miniatures, but he turned his hand to anything that



## *ROBERT FULTON AND THE STEAMBOAT*

came along. He drew plans for machinery and for carriages, and even houses. In this way he not only made his own living, but by the time he was twenty-one he had saved four hundred dollars.

While living in Philadelphia, Fulton became acquainted with Benjamin Franklin. Knowing that Fulton would never succeed as an artist unless he prepared himself better, Franklin advised him to go to London and study. Fulton decided to do this; but just then his father died, leaving his mother without a home. He therefore took a part of the four hundred dollars which he had planned to spend on his art education, and bought his mother a farm, where she lived in contentment and plenty for many years.

### **STUDYING ART IN LONDON**

With a letter from Franklin to Benjamin West, Fulton set out for London, where he landed early in 1787. He had about two hundred dollars in his pocket, not a large sum with which to get an education; but lack of money has never been a bar to young men of character and energy. Benjamin West received the young man with kindness, and in addition to giving him instruction, helped him in other ways.

The story of Fulton's life at that time is told in a letter to his mother. "I had an art to learn by which I was to earn my bread, but little to support me while I was doing it. Many, many a silent, solitary

## *GREAT INVENTORS AND THEIR INVENTIONS*

hour have I spent in most anxious study, pondering how to make funds to support me until the fruits of my labor should be sufficient. . . . Thus I went on for nearly four years—happily beloved by all who knew me, or I had long before now been crushed by poverty's cold wind and freezing rain. When last summer I was invited by Lord Courtney down to his country seat to paint a picture of him, . . . His Lordship was so much pleased that he introduced me to all his friends. And it is but just now that I am beginning to get a little money and pay some debts which I was obliged to contract. So I hope in about six months to be clear with the world, or in other words out of debt, and then start fair to make all I can."

### **ENGINEER AND INVENTOR**

After four years of study, Fulton felt that he was ready to take up his life work. Among the friends to whom Lord Courtney introduced him was the Duke of Bridgewater, who became one of Fulton's good friends. Whether it was the talks about steamboats and about canals with the Duke of Bridgewater; or whether Fulton was carried away by what was then being written in England and America in regard to boats and waterways; or whether it was his talent for mechanics and invention grown strong, we do not know,—but Fulton suddenly gave up the idea of being an artist and decided to become an engineer.

## *ROBERT FULTON AND THE STEAMBOAT*

Whether Fulton would have become a great artist or not, no one can tell. He surely had artistic ability. He had been taught by the best teachers of England, and had gained some recognition and honor as an artist. At all events, if the world lost a great artist, it gained a great inventor. Nor was his training as an artist entirely lost when he turned engineer. He was able to make his ideas clear by means of drawings, and was also able to draw his own plans and designs.

Immediately after making his decision, Fulton went to Birmingham, where he lived for two years. There he studied the great canals which were being built. He became acquainted with Watt and his engines, and saw the best mechanics in Europe at work. His active mind soon began to turn out invention after invention. He invented a double inclined plane for raising and lowering canal boats from one level to the other, a machine for spinning hemp, and one for twisting hemp rope.

A project to which he gave a great deal of time was his submarine or plunging boat. Fulton was able to go down into the water in this diving boat twenty feet or more, and move about. In this way he could get near a vessel without being seen, and then by means of a cigar-shaped torpedo which he invented could blow it up. In an experiment at Brest, in 1805, he succeeded in doing this. Fulton thought his diving boat and torpedoes would make war vessels useless, and would do away with war on the seas. He tried in turn to get the French and English governments to adopt this invention; he also offered

it to the United States. Nothing, however, came of his efforts. Submarine and torpedo boats have since come into general use, but they have not put an end to naval war, as Fulton hoped they would.

## **EXPERIMENTING WITH STEAMBOATS**

We do not know when Fulton first began to think of making a steamboat. But we have his own words for saying that in 1802 he began “experiments with a view to discover the principles on which boats or vessels should be propelled through the water by the power of steam engines.” Fulton did not undertake to make a successful steamboat without knowing of the failures of Fitch, Stevens, Symington, and others; and without understanding that after so many failures, men who still thought a practical steamboat could be built were looked upon as madmen. Yet it has ever been so. The men who win fame and fortune do what other people say cannot be done. Fulton learned all he could from the mistakes and failures of others. To make sure that he was right before he went ahead, he did what was still more important, he made experiment after experiment.

He built a model boat, four feet long and twelve inches wide, provided with two strong clock springs for power. Experiments were made with propellers which opened and shut like a duck’s foot, with side paddle wheels, stern paddle wheels, side oars, screws, and paddles fastened to an endless

## *ROBERT FULTON AND THE STEAMBOAT*

chain passing over two wheels. Fulton was convinced that side paddle wheels were the best. He learned also that the propelling surface of the different paddles combined should be twice the exposed surface of the bow. In addition, he worked out a table to show the power that was needed to move boats of different sizes at different speeds. With this information, Fulton was ready to experiment on a larger scale, and he began to dream of boats that should make the trip between New York and Albany in twelve hours.

Robert R. Livingston was at this time United States minister to France. Fulton, then living in France, succeeded in getting him to advance the money to make the larger experiment, and the two formed an agreement that if the experiment proved successful, they would construct and run steamboats between New York and Albany. To protect themselves in their invention, Livingston secured from the State of New York, in the name of himself and Fulton, the exclusive right for twenty years to navigate steamboats on all waters of the state. No one thought, even in 1803, that there was any danger that such an invention would be a success.

Fulton at length set to work on a boat seventy feet long, eight feet wide, and with three feet draft. The paddle wheels were twelve feet in diameter, and the engine was about eight horse power. When the boat was nearly ready for the trial trip, a violent storm arose one night, and so beat the boat about that it broke in two and sank to the bottom of the Seine. Fulton was awakened from an anxious sleep

## GREAT INVENTORS AND THEIR INVENTIONS

by the shouts of his servant, who exclaimed, "Oh sir! the boat has broken to pieces and has gone to the bottom."

Fulton hurried to the river, to find that this was all too true. He labored for twenty-four hours without stopping, to raise the boat. The machinery was little harmed, but the hull was such a wreck that it had to be entirely rebuilt. This occupied several months, and the boat was not again ready for trial until August, 1803.



FULTON SHOWING HIS BOAT TO LIVINGSTON, IN PARIS

The trial trip was thus described in one of the French newspapers: "At six o'clock in the evening, aided by only three persons, he (Fulton) put his boat in motion . . . and for an hour and a half he produced the curious spectacle of a boat moved by

## *ROBERT FULTON AND THE STEAMBOAT*

wheels, . . . these wheels being provided with paddles or flat plates, and moved by a fire engine. In following it along the wharf, the speed against the current of the Seine was about that of a rapid walker, that is about four miles an hour. . . . It was maneuvered with ease, turning to the right and left, came to anchor and started again." Not only was the new boat declared a success by the French newspapers, but the success was such as to lead Livingston and Fulton to begin the building of a boat for actual service on the Hudson.

### **BUILDING THE CLERMONT**

A twenty-four horse power engine was ordered, in August, 1803, from Boulton and Watt, to be shipped to New York. Boulton and Watt at first refused the order, because the British government would not let them ship the engine. The government probably feared that the engine was to be used in a torpedo boat by the French. After much delay, permission was secured, and the order was accepted. Fulton, who was then in England, went to Birmingham to see that the engine was built just as he wanted it; for he was right in feeling that the success of his boat depended upon how the engine worked. Fulton arrived at New York in December, 1806. He at once hired a famous shipbuilder, whose yards were on the East River, to build the hull of the boat. The boat was to be one hundred and fifty feet long,

## GREAT INVENTORS AND THEIR INVENTIONS

thirteen feet wide, and was to draw two feet of water.

When it became known that the new boat was to be a steamboat, idle crowds used to collect around, and in derision they called it "Fulton's Folly." Nor did these crowds take kindly to the idea of a steamboat; they even went so far as to try to destroy it. Neither did the owners of the sailboats on the East River like the idea, so when they were passing by in their sloops they would bump into the *Clermont*. To protect the boat, it became necessary for Fulton to hire men to watch her both by day and by night.

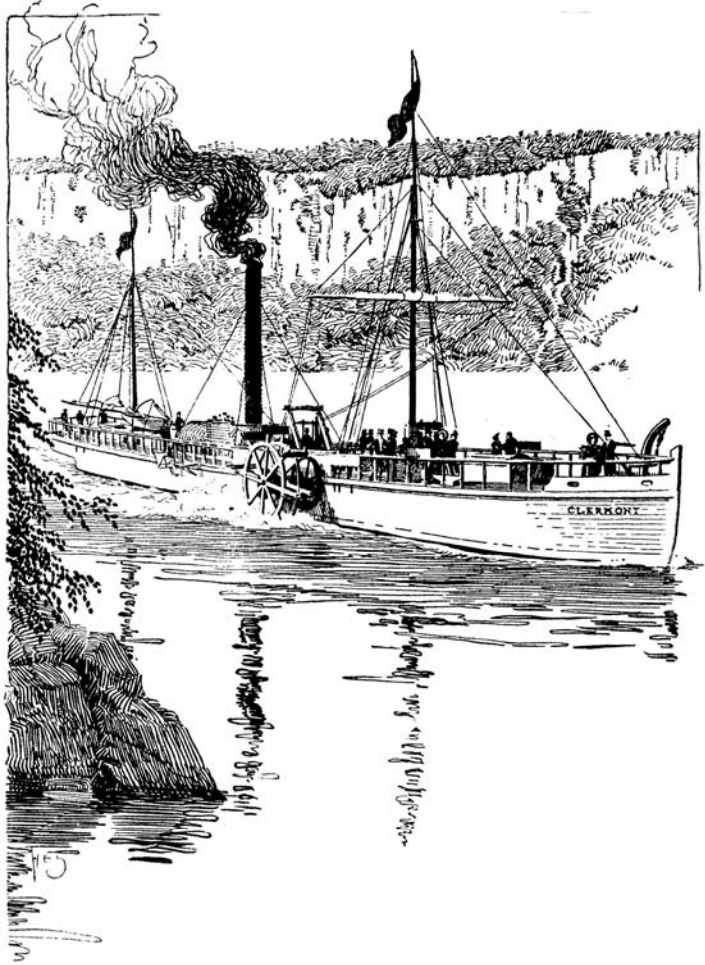
No one had any faith in the success of the venture. When, in 1806, Livingston and Fulton offered to take Stevens into partnership with them, he refused, and said, "Mr. Fulton's plan can never succeed."

At another time, when it became necessary to raise a thousand dollars to complete the *Clermont*, Fulton went to some of his friends for aid. Most of them told him they were too wise to sink good money in such a wild scheme. After much difficulty, however, Fulton succeeded in obtaining the needed money, but only by promising his friends to keep their names secret. They feared that they would be ridiculed for their folly.

The *Clermont*, when completed, was a queer-looking craft. There was a mast at each end, but these carried very small sails. A little to the front of the center stood the smokestack and the working



*ROBERT FULTON AND THE STEAMBOAT*



FIRST TRIP OF THE CLERMONT

beam and piston. Projecting from the center over each side was a great uncovered paddle wheel. "She looked," said one observer, "like a backwoods saw-mill mounted on a scow and set on fire."

## FIRST TRIP OF THE CLERMONT

The *Clermont* was ready for her first trip up the Hudson, August 17, 1807. Here is Fulton's own story of the trip:

"The moment arrived at which the word was to be given for the boat to move. My friends were in groups on the deck. There was anxiety mixed with fear among them. They were silent, sad, and weary. I read in their looks nothing but disaster, and almost repented of my efforts. The signal was given, and the boat moved on a short distance and then stopped. . . . To the silence of the preceding moment, now succeeded murmurs of discontent and agitation, and whispers, and shrugs. I could hear distinctly repeated, 'I told you it was so; it is a foolish scheme; I wish we were well out of it.' "

"I elevated myself on a platform; I stated I knew not what the matter was, but if they would be quiet and give me half an hour, I would either go on or abandon the voyage for that time. . . . I went below and found. . . . the cause. . . . In a short time it was fixed. The boat was again put in motion. She continued to move on. All were still incredulous. None seemed willing to trust the evidence of their

## ROBERT FULTON AND THE STEAMBOAT

own senses. We left the fair city of New York; we passed through the romantic and ever varying scenery of the Highlands; we descried the clustering houses of Albany; we reached its shores,—and then, even then, when all seemed achieved, I was the victim of disappointment. . . .

“It was then doubted if it could be done again, or if done, it was doubted if it could be made of any great value.”

In another letter Fulton wrote:

“My steamboat voyage to Albany and back has turned out rather more favorably than I had calculated. The distance from New York to Albany is one hundred and fifty miles. I ran it up in thirty-two hours and down in thirty. I had a light breeze against me the whole way, both going and coming, and the voyage has been performed wholly by the power of the steam engine. I overtook many sloops and schooners beating to the windward, and parted with them as if they had been at anchor.

“The power of propelling boats by steam is now fully proved. The morning I left New York there were not perhaps thirty people in the city, who believed that the boat would ever move one mile an hour, or be of the least utility, and while we were putting off from the wharf, I heard a number of sarcastic remarks. . . .

“Having employed much time, money, and zeal in accomplishing this work, it gives me, as it will you, great pleasure to see it fully answers my expectations. It will give a cheap and quick conveyance



WATCHING THE CLERMONT  
STEAM UP THE HUDSON RIVER

## ROBERT FULTON AND THE STEAMBOAT

to the merchandise on the Mississippi, Missouri, and other great rivers, which are now laying open their treasures to our countrymen; and although the prospect of personal gain has been some inducement to me, yet I feel . . . more pleasure in reflecting on the immense advantage that my country will derive from the invention.”

The passage of the *Clermont* caused great excitement among the people along the way. Here is a description written by one who stood on the bank and saw the boat go by:

“It was in the early autumn of the year 1807, that a knot of villagers was gathered on a high bluff just opposite Poughkeepsie, on the west bank of the Hudson, attracted by the appearance of a strange, dark-looking craft which was slowly making its way up the river. Some imagined it to be a sea monster, whilst others did not hesitate to express their belief that it was a sign of the approaching judgment. . . . The dense clouds of smoke, as they rose, wave upon wave, added still more to the wonderment of the rustics.

“On her return trip, the curiosity she excited was scarcely less intense,—the whole country talked of nothing but the sea monster, belching forth fire and smoke. The fishermen became terrified and rowed homeward, and they saw nothing but destruction devastating their fishing grounds; whilst the wreaths of black vapor and rushing noise of the paddle wheels, foaming with the stirred-up waters, produced great excitement amongst the boatmen.”

## GREAT INVENTORS AND THEIR INVENTIONS

On her return from Albany, the *Clermont* was put in dock. The paddle wheels were covered, decks were made over the boilers, the rudder was repaired, and three cabins of twelve berths each were fitted up to accommodate forty to fifty passengers. Thus equipped, the *Clermont* started in September, 1807, to make regular trips between Albany and New York, and continued to do so until the Hudson froze over late in November. As a passenger packet, she was a success from the first. To be sure, people were in great fear that the boiler would burst, or that the boat would catch on fire. There was also a vague feeling that something terrible must surely happen to the "monster which defied storm and tide and belched forth fire and smoke."

The fare was just the same as that on the sailboats, three dollars, but it took sailboats, on the average, forty-eight hours to make the trip, and the average time of the *Clermont* was only thirty-six hours. It was not long before she was crowded.

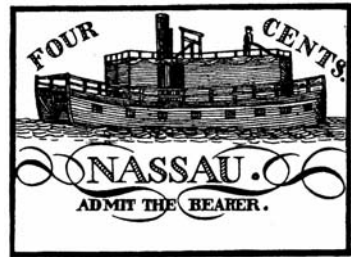
## STEAMBOATS ON RIVER AND OCEAN

Most great inventions are a long time in coming, but when once their utility is demonstrated they are quickly adopted. This was true of the steamboat. During the winter of 1807 the *Clermont* was made better and larger, and renamed the *North River*. So great was the demand, that within the next eight years Fulton constructed, or there were built according to his plans, no less than ten other boats for

## ROBERT FULTON AND THE STEAMBOAT

service on the Hudson River, Long Island Sound, and the Potomac. Fulton also designed and built great steam ferryboats to cross the East River and the Hudson River. Steven's *Phoenix* began in 1807 to make regular trips on the Delaware, and by 1810 steamboats could be seen trailing long lines of smoke up and down the Mississippi and the Ohio. They were also introduced into England and Russia, and even into far-away India.

Fulton's belief in the commercial usefulness of steamboats was so great that he not only expected them to be placed on all the rivers of the civilized world, but he hoped to see them on the great oceans also.



AN OLD FERRYBOAT  
TICKET

The first steam vessel to cross the Atlantic Ocean was the *Savannah*, in 1819. Fulton did not live to witness this great event, for he died in 1815. To a great idea,—steam navigation,—he had given freely of his time, his talents, and his money. Others like Fitch helped him to succeed. Others like Stevens improved on his invention. Together they gave to the world one of its chief means of travel, transportation, and communication. Yet to Robert Fulton belongs the honor of being the first inventor to make a genuinely successful steamboat.

GREAT INVENTORS AND THEIR INVENTIONS

Estimate for the expense of a steam ferry boat  
for one year

2 fire men at 30 dollars a month each they findings  
themselves, they will also act as engineers to keep the  
engine in order, they must be engaged for the year, as  
such men cannot be turned away in the winter &  
got on the spring = 60 dollars a month — 720 year  
Two Boatmen to take turns in steering  
at 25 dollars a month each, 50 dollars } — 600  
a month.....

1 1/2 cords of wood for 12 or 13 hours at  
4 1/2 dollars a cord or say 7 dollars a day } 2240  
to work 320 days -----

Wear and Repairs ----- 600

Total. 4,160

Robt Fulton  
Jan'y 22<sup>d</sup> 1815

Estimate for the  
expense of a steam  
ferry boat for one  
year

FULTON'S ESTIMATE FOR A STEAM FERRYBOAT