

# James Rumsey American Inventor



James Rumsey 1743-1792  
Oil portrait by Benjamin West

James Rumsey was the “most original and the greatest mechanical genius I have ever seen.”<sup>1</sup> —Thomas Jefferson

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<sup>1</sup> “Jefferson to Joseph Willard, March 29, 1789, *The Papers of Thomas Jefferson*, 14:699.”

Edwin T. Layton, Jr., "James Rumsey: Pioneer Technologist," *West Virginia History*, 1989. Vol. 48, p. 22.

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## **Introduction: Making Steam Power Work**

Though even the Ancients<sup>2</sup> knew that steam could be a propellant, it wasn't until 1662 when Robert Boyle first explained the behavior of gases that humans could begin to dream of using steam for motive power. Boyle's Law, as his treatise is known, was later expanded by other scientists such as Daniel Bernoulli. You are familiar with Bernoulli whether you know it or not because Bernoulli's Principle (1738) explains why a chimney flue drafts smoke and hot gases away from the hearth.

Another key to understanding steam power was the discovery of the heat of evaporation (latent heat). People knew that it took a great deal of energy to convert water at 212° F. into steam. Early measurements of that burst of energy were done by whiskey distillers in Scotland out of necessity to calculate their fuel requirements.<sup>3</sup>

About 1710, Thomas Newcomen of England invented a practical steam engine. As underground coal mining in England began to develop, the mines needed a mechanized pump to dewater the workings. Newcomen's engine, primitive though it was, served the purpose.

Newcomen's single-piston engine was very inefficient. Steam filled the cylinder pushing the piston down. Then cold water was turned into the cylinder to condense the steam. This resulted in a vacuum which gave the piston rod its power stroke. Because these engines were being used to pump water from coal mines, the high cost of fuel (coal) to generate steam was not prohibitive.

Newcomen's engine remained pretty much unchanged until 1765 when James Watt, an instrument maker at the University of Glasgow (Scotland), realized that the Newcomen's method of condensing the steam robbed the engine of its heat. He calculated<sup>4</sup> that up to 80% of fuel's energy was being used to simply re-heat the cylinder.

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<sup>2</sup> Hero of Alexandria (ca. 10-70 A.D.); Aeolipile.

<sup>3</sup> Joseph Black (1728-1799), a scientist at University of Glasgow, is credited with discovery of latent heat and solved the distiller's riddle. He was James Watts' mentor.

<sup>4</sup> "As to Boilers you must allow me to observe that Mr. Watt was the first & only discoverer of the precise quantity of Water & the exact quantity of Steam of a given elasticity as well as the knowledge of the Total quantity of heat producible by a given measure of such Coals as this Country produces [...]" From a letter to James Rumsey written by Watt's partner, Matthew Boulton, August 14, 1788. Ella May Turner, *James Rumsey: Pioneer in Steam Navigation*, Mennonite Press, 1930. p. 151

## James Rumsey, American Inventor

By David G. Allen

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Watt's invention, a separate steam condenser, meant that steam engines could be used at locations other than coal mines where fuel costs had previously been prohibitive. Watt's engine design also benefited from new technology such as the development of machines to bore the piston cylinder.<sup>5</sup> Newcomen's cylinder was a hand-finished casting, and the piston seals were made of leather.

Other improvements such as Watt's planet and sun gears and Pickard's off-set crankshaft greatly improved work efficiency of these engines. Watt also built a double-action steam engine.

Robert Fulton's steamboat (*Clermont*, 1807) was the result of centuries of learning the science of thermodynamics and developing the technology to harness steam power.

James Rumsey deserves his own chapter in the story of harnessing steam for motive power. His inventions were an important part of the development of the steam-powered boat. That James Rumsey, a blacksmith and millwright who lived in frontier country on a non-navigable river, could build the first practical steamboat is proof of his genius.

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<sup>5</sup> John Wilkinson, Ironmaster (1728-1808), developed machinery to bore cannon barrels.

## James Rumsey in Virginia

James Rumsey was born in Maryland in March 1743.<sup>6</sup> The Rumseys of Maryland were generally successful. William Rumsey (cousin) enjoyed membership in the American Philosophical Society. Benjamin Rumsey (cousin) was a delegate to the Continental Congress (1776-77).

Edward Rumsey, James' father, was a farmer. Despite the family's lack of advantages, Edward II (James' brother) became a doctor and practiced in Shepherdstown before moving to Lexington, VA and then to Kentucky. Edward II's son, Edward III (James' nephew), studied law and represented Kentucky in Congress from 1837 to 1839.

James Rumsey was not well-educated<sup>7</sup> in terms of formal schooling. However, by 1782 he had become an accomplished blacksmith, mechanic, sawyer, miller, millwright and builder living in Bath, Virginia,<sup>8</sup> the town so-named for its natural, warm-water mineral springs. By nature a jack-of-all-trades, Rumsey's

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<sup>6</sup> "James Rumsey was born at "Bohemian Manor", Cecil County, Maryland, 1743. His father, a farmer, with a large family and limited means, was unable to give his children many educational advantages. Rumsey had a strong mind, retentive memory and an indomitable will. He was a "natural mechanic", very studious and industrious. When the Revolutionary war broke out Rumsey promptly volunteered, a fact vouched for by Major Henry Bedinger, a Revolutionary patriot. At the close of the war, in 1783, with Nicholas Orrick as partner, Rumsey went into the mercantile business, at Bath, now known as Berkeley Springs, in Morgan County, West Virginia. In 1784 he was associated with Robert Throgmorton in a boarding house for visitors to the springs, as appears by their advertisement in the year's file of the "Maryland Gazette", published at Annapolis."

George M. Beltzhoover, Jr., "James Rumsey—Inventor of the Steamboat", *WV Historical and Antiquarian Society*, 1900. p. 8.

<sup>7</sup> "[...] Rumsey was an unusual combination of Southern gentleman and ingenious Yankee [...] Despite a rudimentary education, precarious finances, and almost ceaseless struggle, Rumsey clung to his gentility as perhaps only the downwardly mobile can. His polite manners did not, however, account for his ability to gain and keep the support of powerful patrons such as George Washington, Benjamin Franklin, and Thomas Jefferson. Rumsey impressed his contemporaries with a fertility of invention that has seldom been equaled."

*Note:* At time of publication: "Edwin T. Layton, Jr., a professor of the history of science and technology at the University of Minnesota, is president of the Society for the History of Technology."

Edwin T. Layton, Jr., "The Most Original", *Invention and Technology* magazine, Vol. 2, Issue 3, Spring 1987, pp. 50-56.

<sup>8</sup> Bath is the town's proper name; it is known popularly as Berkeley Springs, WV.

forte' was building water-powered gristmills. Rumsey lived in Baltimore before moving to Bath.<sup>9</sup>

Rumsey built at least two water-powered gristmills near Bath and operated one of them. He also built a bloomery (iron furnace) at his brother's farm. And he built and operated a water-powered sawmill from which he sold lumber to builders in the growing resort town of Bath which was America's first natural spa.

Rumsey partnered with George Michael Bedinger in 1782 to build and operate the gristmill located near Bath on Sleepy Creek. The partnership did not succeed as Mr. Bedinger found Rumsey to be a "most unsatisfactory partner" and "dreamy, absent-minded inventor."<sup>10</sup> Bedinger left Bath for Kentucky in 1784.

In 1784, Rumsey associated with innkeeper Robert Throgmorton at the Sign of the Liberty Pole and Flag inn. Gen. George Washington, a Bath landowner, often stayed at the inn. He met James Rumsey and hired him to build houses.<sup>11</sup>

In 1783-84, Rumsey was also a partner with Nicholas Orrick in a mercantile store in Bath. As to how Rumsey was able to partner with Mssrs. Bedinger, Throgmorton and Orrick at the same time in such diverse businesses is not explained in Rumsey's biographies. Rumsey was not a man of wealth. Therefore, we might assume that his contribution to these partnerships was as the builder (respectively) of the gristmill, the inn and the mercantile store.

In Rumsey's June 24, 1785 letter to George Washington, it is uncertain if Rumsey ever completed the general's "dwelling House" because Rumsey informs Gen. Washington that his sawmill burned to the ground in April.<sup>12</sup> Most of the lumber for the house had been sawn and stored at the mill, and it, too, burned. As of the letter's date, Rumsey had been unable to purchase lumber for Washington's house from any other area sawmill.<sup>13</sup>

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<sup>9</sup> "James Rumsey (late of Baltimore)" in an article published in the *Virginia Argosy*, October 9, 1784.

Turner, p. 14.

<sup>10</sup> Turner, pp. 6-7.

<sup>11</sup> George Washington's diary entry of September 6, 1784: Contracts with Rumsey to build a "dwelling House, Kitchen, and Stable" on Washington's lots in Bath, to be finished by July 10, 1785.

Turner, pp. 12-13.

<sup>12</sup> Turner, pp. 21-22.

<sup>13</sup> On January 31, 1786, Washington writes Rumsey to ascertain "the exact state in which my houses in Bath are." The general writes further that he wishes to "settle for the whole as soon as possible."

Turner, pp. 69-70.

In July 1785, George Washington recommended the hiring<sup>14</sup> of Rumsey to supervise operations of the Potomac Company, an enterprise that Gen. Washington and several investors<sup>15</sup> had formed to make the Potomac River navigable from Georgetown to Cumberland. None of the candidates who applied for the supervisor's position had experience in canal building. Rumsey didn't either.<sup>16</sup> But he was thought to be the most talented man available which won him the job.<sup>17</sup> Rumsey held the superintendent's position for about one year but found the task very frustrating.

Most of Rumsey's problems stemmed from the fact that the Potomac Company hired indentured servants as laborers (who were often referred to as "white slaves").<sup>18</sup> These servants, (ninety-three men and one woman), all recent immigrants, would "elope"<sup>19</sup> if given the chance and disturb the peace in surrounding

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<sup>14</sup> Hired: July 14, 1785. "His salary (including expenses) was set at £200 per year Virginia currency (approximately U. S. \$666/year), or about four times more than the company paid its laborers." Resigned after the July 4, 1786 board of directors meeting.

Robert J. Kapsch, *The Potomac Canal: George Washington and the Waterway West*, WVU Press, 2007. pp. 62, 68.

<sup>15</sup> James Rumsey purchased one share.

Andrea Sutcliffe, *STEAM: The Untold Story of America's First Great Invention*, Palgrave Macmillan, 2004, p. 9.

<sup>16</sup> "The board of the Potomac Company had hired Rumsey not as an engineer but as a qualified mechanic. They had failed to find a qualified canal engineer and were not willing to pay for one to come from Europe. This meant that the principal early engineering decisions of the company were to be made by Washington and the board of directors, and implemented by Rumsey."

Kapsch, p. 62.

<sup>17</sup> "Washington was interested in Rumsey for more than just his construction management capability. He was extremely interested in Rumsey's invention of a mechanical boat as a possible alternative to building expensive locks on the Potomac navigation."

Kapsch, p. 61.

<sup>18</sup> "In 1785, the Potomac Company's initial workforce was made up predominantly of indentured servants. Indentured service was a practice begun in the early seventeenth century in which poor Europeans signed a document, called an indenture, obligating them to work for five to seven years in America to repay the cost of their ocean passage. Upon arrival, the ship's captain sold the indenture to landowners and others needing labor. The holder of the indenture was required to provide food, clothing, and health care to his indentured servants for the duration of their employment. In the period from 1620 to 1800, it is estimated that as many as 75 percent of the immigrants to Virginia arrived as indentured servants."

Kapsch, p. 209.

<sup>19</sup> "In addition, a large number-about 10 percent-died within the first two years of their employment. On August 4, 1787, the Potomac Company did an inventory of the ninety-three indentured men and one woman they bought and found that approximately one-third had either died or run away."

Kapsch, p. 209.

villages. Rumsey found himself in the role of magistrate when rounding up run-aways and trying to settle the townsfolk's grievances.

In late March 1786, Rumsey found himself in the middle of a firestorm with the locals at Great Falls who claimed that canal workers had abused them with insults and ill-treatment.<sup>20</sup> His initial attempt to placate the citizenry failed which led to their forming an armed posse of fifty men to ride into the labor camp and make arrests.

Rumsey, alone, met and stopped the armed mob about a mile before it got to the campsite. He must have been cool under pressure and a skillful negotiator because he convinced the armed mob that he would deliver any suspect that it could identify to the local justices of the peace. The posse believed him and retreated. Rumsey prevented what surely would have been a bloody massacre

Rumsey also spent a great deal of his time as quartermaster ordering supplies. This work, though necessary, annoyed him with its routine.

He petitioned the company for higher wages but a pay increase was not forthcoming.<sup>21</sup> If nothing else, the Potomac Company should have at least given him a bonus for saving their indentured servants. Although he resigned his position with the Potomac Company, he nonetheless maintained his close friendship with George Washington.

One reason that Rumsey took the position with the Potomac Company was the certainty of a salary. Part of his salary went toward building his boat. Rumsey's petition for higher pay may have been related more to financing the boat rather than for job compensation. It certainly appears that the scope of Rumsey's supervisory position had turned out to be more time-consuming than he thought it should. With scant time to work on his boat, he probably looked for a higher salary as a way to earn money to hire Joseph Barnes to work on the boat full-time.

There was no greater promoter of using the Potomac River for national development than Gen. Washington. After canoeing downriver from Fort Cumberland in 1754,<sup>22</sup> Washington saw the Potomac as a viable inland water route to transport military supplies to the western frontier. The French and Indian War, however, delayed Washington from pursuing a Potomac strategy until after 1763.

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<sup>20</sup> Kapsch, pp. 229-232.

<sup>21</sup> Turner, p. 52.

<sup>22</sup> French forces allowed then-Major Washington (Virginia Militia) and his troops to withdraw to Fort Cumberland after surrendering at the battle of Great Meadows (Fort Necessity, PA).  
Kapsch, p. 10.

John Semple, owner of the Keep Triste iron furnace located on the Potomac between Shepherdstown and Harper's Ferry, was of similar thinking about the river's potential. Semple hoped to ship iron downriver to Georgetown as well as upriver, and he believed that a series of sluices dug into the shoals would allow shallow-draft boats or barges to navigate most of the Potomac. Semple had demonstrated the sluice concept in 1769 by digging a channel in a shoal upstream of his iron furnace to allow passage to Antietam Creek.<sup>23</sup> Semple corresponded frequently with Gen. Washington about the promise of navigation.

The Potomac navigation plan piqued James Rumsey's curiosity as well. Rumsey's first self-propelled riverboat design (the pole boat) utilized a moving carriage mounted in the hull and parallel with the keel. The cart was fitted with a bank of poles ("Shovers" as Rumsey described them)<sup>24</sup> on each side of the hull that dragged the river bottom. The shovers with their iron-tipped ends dug in as the carriage traveled backwards, thus 'poling' the boat forward. Using the reciprocating action of the carriage, Rumsey tried to emulate the movement of men walking back and forth on deck and poling the boat forward.<sup>25</sup>

The mechanism failed when the poles on one side would dig into the riverbed, but the poles on the opposite side would either slip or be too short to hit the bottom. This caused the boat to startle to the left or right.<sup>26</sup>

The pole boat did not utilize steam power when Rumsey first proposed it to Washington in September 1784.<sup>27</sup> Incorporating steam power came during the following winter as Rumsey made progress in improving his steam engine. Rumsey later patented the steam-powered pole boat in England in 1790.

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<sup>23</sup> "The problem of transportation between Keep Triste Furnace and Antietam Creek was serious enough to force Semple to improve navigation on this stretch of the Potomac River. Writing to George Washington in 1769, he reported that, 'The Gravelly Shoals below Shenandoah Falls [...] called House's has already this summer been opened and cleared, and a passage made through it for transportation of iron from Keep Triste Furnace to Antietam Forge.'"

William D. Theriault, "Friend's Orebank and Keep Triste Furnace," *West Virginia History*, 1989, Vol. 48, p. 50.

<sup>24</sup> Turner, p. 74.

<sup>25</sup> Sutcliffe, p. 3.

<sup>26</sup> Rumsey's letter to George Washington, Sept. 19, 1786. Turner, pp. 74-75.

<sup>27</sup> George Washington's diary entry of September 6, 1784: "Remained at Bath all day and was showed a Model of a boat constructed by the ingenious Mr. Rumsey, for ascending rapid currents by mechanism [pole boat]; [...] The Model, and its operation upon the water, which had been made to run pretty swift, [...] convinced me [...] that it might be turned to the greatest possible utility in inland Navigation [...]"

Turner, pp. 12-13.

The Potomac Company's navigation plan incorporated both sluices and lock chambers depending on each cataract and its fall.<sup>28</sup> Regardless of the type of passageway, a parallel tow path for horses would also have to be constructed. Rumsey's self-propelled pole boat negated the need for horses to pull a boat through either the sluice or the lock chamber and thus, would save considerable construction expense.

The Continental Congress (at Washington's urging) offered Rumsey the promise of a large land grant in the western territory if he could successfully demonstrate his pole boat on the Ohio River.<sup>29</sup> While better-suited for the shallow eddies of the Potomac, Rumsey's pole boat was impractical in deeper river channels such as the Ohio. But this setback proved temporary, if not beneficial, for Rumsey.

The years 1785-86 proved to be a turning point for Rumsey. His position with the Potomac Company required his move to Shepherdstown, and these changes, plus his frequent contact with Washington, gave him new perspectives. Also, Benjamin Franklin returned from France in 1785 after a nine-year stint as America's ambassador to that country. Ever the inventor himself, Franklin spoke to the American Philosophical Society at Philadelphia in December regarding water propulsion of boats.

Franklin presented a paper describing Daniel Bernoulli's thesis of using a water jet as a method to propel a boat. Franklin had dismissed the paddlewheel as a suitable propeller because it was similar in operation to an undershot waterwheel and thus, very inefficient in transferring power. Ben Franklin's speech may have been the catalyst that led Rumsey to design a waterjet-propelled boat.<sup>30</sup> For two

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<sup>28</sup> "To minimize costs, Washington and the first board of directors of the Potomac Company would choose in-river sluice navigation for Shenandoah Falls, Payne's Falls, and Seneca Falls. They decided that only the larger falls, Great Falls and Little Falls, would be equipped with bypass canals with locks."

Kapsch, p. 58.

<sup>29</sup> Congress offered a land grant of 30,000 acres if the boat could travel fifty miles per day for six days.

Sutcliffe, p. 7. *and*,

Land grant mentioned.

Edwin T. Layton, Jr., "James Rumsey: Pioneer Technologist," *West Virginia History*, 1989, Vol. 48, p. 13.

<sup>30</sup> "Benjamin Franklin helped begin all this activity. In December 1785, after his return from France, Franklin gave a paper before the American Philosophical Society in which he reported the conclusions of Daniel Bernoulli, one of Europe's leading scientists, that a boat might be advantageously driven by the force of reaction of a jet of water shot backward from it. Franklin added his own suggestion that the jet of water might be produced by a steam engine. Rumsey evidently heard about Franklin's proposal, and he designed a steamboat based on this plan."

Layton, "The Most Original", pp. 50-56.

years later, on December 3, 1787, Rumsey successfully demonstrated his steam-powered, waterjet-propelled boat at Shepherdstown.

The record is sketchy when trying to determine Rumsey's income and finances from July 1786 (when he resigned from the Potomac Company) to December 1787.<sup>31</sup>

With the successful demonstration of his steamboat, Rumsey knew that his experiments in steam and water propulsion had gone as far as they could in Shepherdstown. In early 1788, he traveled to Philadelphia to seek the help of the American Philosophical Society. He took with him his newly-published pamphlet entitled "A PLAN wherein the power of STEAM is fully shewn, By a new constructed Machine, for propelling Boats or Vessels, of any burthen, against the most rapid streams or rivers, with great velocity."<sup>32</sup>

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<sup>31</sup> "It seems unlikely that he [Rumsey] was still a partner in the Bath boarding-house or continued to operate his mills; a deposition made later that year [1787] by his brother-in-law Charles Morrow stated that Rumsey had 'for several years steadily pursued his boat scheme ... to the total neglect of every other kind of business.' (Morrow's affidavit from "A Short Treatise on the Application of Steam", 1788.) Sutcliffe, p. 53.

<sup>32</sup> Re-titled "A Short Treatise on the Application of Steam" on 2<sup>nd</sup> printing, May 1788.

## **James Rumsey in England**

Rumsey's primary sponsor, Benjamin Franklin, and seventeen other members of the American Philosophical Society formed the Rumseyan<sup>33</sup> Society in early 1788 and then raised funds for Rumsey to travel to England. These raised funds were an investment in Rumsey's inventions and success in obtaining foreign patents rather than a gift or stipend, and the Society hoped for a return on its investment. Franklin and others also gave Rumsey valuable letters of introduction to take with him.

Once in England, Rumsey met with James Watt and Mathew Boulton, Watt's partner in steam engine manufacturing. From their initial meeting, negotiations for a partnership between the parties seemed to blossom. However, once the terms of the partnership agreement were set to paper, Rumsey found that he could not agree with terms that he found more stringent than he believed were previously discussed.<sup>34</sup>

What most disturbed him most was the demand that he withdraw from his relationship with the Rumseyan Society. Rumsey felt he would dishonor himself among his friends if he did so. However, Messrs. Boulton and Watt were protecting themselves from essentially acquiring silent partners in America over whom they had no control. Messrs. Boulton and Watt saw nothing dishonorable in their proposal that Rumsey simply refund the Society's money prior to joining them as a partner. Rumsey was also reluctant to disengage the Society because he would need its support and influence when he applied for patents in other countries.

Other particulars of the agreement upset Rumsey as well. These matters dealt mostly with royalties and reimbursements.

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<sup>33</sup> Also Rumseian.

<sup>34</sup> Turner, pp. 143-146.

Rumsey's primary business adviser in London was Benjamin Vaughan,<sup>35</sup> a friend of Benjamin Franklin's. Vaughan had acted as an unofficial envoy during peace talks between Great Britain and the colonies<sup>36</sup> at the close of the American Revolution, and in this role, he frequently met with then-Ambassador Franklin in Paris. As Rumsey continued negotiations with Boulton & Watt, Vaughan advised him to take his plans and operations to Ireland where Watt's patents were unenforceable. We really don't know if Vaughan's advice was a negotiating ploy (an ultimatum), or a novel (if not cutthroat) business plan. But Vaughan's mention of setting up shop in Ireland to avoid Watt's patents did not sit well with Matthew Boulton who wrote this of Vaughan to James Watt: "This shews the principles of the man in so clear a point of view that I cannot express how much I detest him but perhaps you'll say I am in a passion. Perhaps I am and I hope I shall never be so void of feeling as to be insensible to such rascally principles; there is a syco-phantic affectation of respect and threat through his [Vaughan's] letter."<sup>37</sup>

Negotiations ended in September 1788. The parties were amicable, though, and Messrs. Boulton and Watt were robust in their encouragement to Rumsey in his future ventures.

The partnership may never have matured anyway because James Watt built only low-pressure (atmospheric) boilers, the reason centering on fear of explosion.<sup>38</sup> And that was not an unfounded fear because the iron of that age was rela-

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<sup>35</sup> "In 1783, as a result of his connections to then-Prime Minister Shelburne and his association with Franklin (having seen to the English publication of the first volume of Franklin's political writings), [Benjamin] Vaughan was dispatched to Paris to mollify Franklin and the American negotiators and assure them of good English intentions. Although he was barred as a dissenter from any official role in the negotiations, Vaughan played an important unofficial role in quickening the closure of the treaty and the formalization and recognition of American independence."

*Note:* Benjamin Vaughan served in Parliament (1793-94) and later moved to Hallowell, Maine. His brother, John, moved to Philadelphia in 1782 and joined the American Philosophical Society in 1784.

American Philosophical Society:

[www.amphilsoc.org/library/mole/v/vaughanb.htm](http://www.amphilsoc.org/library/mole/v/vaughanb.htm)

<sup>36</sup> Treaty of Paris negotiations 1782-83.

<sup>37</sup> Matthew Boulton to James Watt, August 15, 1788. Turner, p. 152.

<sup>38</sup> "Rumsey was also among the first to see the need of high pressure steam in the operation of steamboats. In retrospect it is obvious that steamboats and railroads needed compact power sources that yield more power for a given weight than was possible with steam engines operating at atmospheric pressure, such as Watt's. The advantages of high pressure had been obvious to Watt and others almost from the outset. But high pressure steam boilers present a major risk of destructive explosions. Watt avoided high pressure in order to ensure safety. Rumsey adopted high pressure steam, while inventing a type of boiler suited to high pressures. Layton, *James Rumsey: Pioneer Technologist*, p. 18.

tively weak for use in a pressure vessel. Rumsey, though, knew that high (or at least higher) pressure steam engines would be required to produce the power necessary to propel a boat at a reasonable cruising speed.

Boulton was critical of Rumsey's lack of testing his designs. Rumsey, Boulton thought, relied far too much on theory and *a priori* designs. But Rumsey's approach to invention was understandable as he never had adequate capital to build and test multiple prototypes. Boulton & Watt were so successful that they never faced the problem of having adequate capital.

Rumsey then proceeded on his own and received British patent #1673 on November 6<sup>th</sup> "for his invented methods of constructing Boilers for Distillation and other Objects, and for Steam Engines for various purposes."<sup>39</sup> This would be a bit-tersweet prize as Rumsey was now out of funds and would have to secure new working capital in a foreign land.

Rumsey wrote Capt. Charles Morrow on April 12, 1789 to say that he had met with Ambassador Thomas Jefferson in Paris and was confident that he would soon receive "a grant in that Country for my inventions."<sup>40</sup> On his return trip to London, three bandits stopped Rumsey's hired carriage at Blackheath Common and then proceeded to rob him and a fellow passenger named Parker. (*See Daniel Parker below.*) Fearing just such an attack, Mssrs. Rumsey and Parker had hidden their pocket watches and the most of their money.

The bandits were not satisfied with the few guineas that the men had on their persons. With pistols at their heads, the two gentlemen nonetheless stuck to their stories that they had no other money nor did they carry watches. Rumsey risked death to preserve his wallet and pocket watch, and this vignette of the Paris trip to visit Thomas Jefferson helps to illustrate Rumsey's successes as well as his harrowing financial condition.

For the next three years, Rumsey ran into problem after problem securing funding. He would find a backer only to have the backer fail financially. Or his backers were underfunded to start with. In one plan to raise money,<sup>41</sup> Rumsey

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<sup>39</sup> Turner, p. 155.

<sup>40</sup> Rumsey to Charles Morrow. *Rumsey Letters*, Library of Congress. Turner, pp. 162-164.

<sup>41</sup> Rumsey had partnered with Samuel Rogers and Daniel Parker on March 25, 1790. For their two-thirds share of the boat patent, they were to advance Rumsey £1,000 plus £1,000 in goods. As for the money, all they had was £800. Parker and Rogers were Americans living in London. Rumsey had met Parker on the stagecoach when returning to London the year before. Though Rumsey initially thought Parker was "honourable", Parker had embezzled \$2,300 in Spanish silver coins from a shipment being loaded on the *Empress of China*, the first American

sold an interest in his boat patent to Daniel Parker and Samuel Rogers to get money to buy hard-to-get and somewhat elegant merchandise in England. He then shipped everything to his brother-in-law, Capt. Charles Morrow,<sup>42</sup> a Shepherds-town merchant, for him to sell the dry goods at higher prices. But the scheme failed to pay off as the Virginia provincials were not wealthy enough to afford expensive, exotic goods.

By the summer of 1791, James Rumsey had so many creditors dunning him that he was certain to be locked away in debtors prison. He had even fallen out with the Rumseyan Society over money issues and referred to the society's members as "mostly Leaches and Sharks."<sup>43</sup> This was quite a change from the time when Rumsey thought it dishonorable for him to refund the Society's investment.

Just when Rumsey thought he was destined for jail, he received an unexpected (and lucrative) offer of employment. The (Irish) Earl of Carhampton hired him as a consulting engineer for the Royal Canal being built in Ireland.<sup>44</sup> Rumsey's experience with blasting rock<sup>45</sup> at Great Falls on the Potomac River would serve him well as the Irish engineers had been stymied by ledgerrock. Although the term of his service was just forty days, his daily fee of £10 was sufficient for him to rebuild his financial footing.

When Rumsey returned from Dublin, he settled in Liverpool for a time to forestall meeting with his London creditors. With Mr. R. C. Wakefield's management, Rumsey was able to temporarily clear up his biggest financial problems.

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merchant ship to sail to China (1784.) Rumsey found Rogers to be "a man of more cunning and duplicity than any man I ever met with."

Sutcliffe, pp. 135-136.

*And,*

Rumsey described his relationship with Rogers and Parker as "Connected with broken men" in a letter to Dr. McMechan, April 15, 1792.

Turner, pp. 193-195.

<sup>42</sup> Charles Morrow married Mary Rumsey, James' sister. James Rumsey married Mary Morrow, Charles' sister. The Morrow family was outside the focus of this article, but it appears that the Morrrows lived near the Rumseys in Maryland before locating in Virginia.

Turner, p. 4-5.

<sup>43</sup> Turner, p. 178.

<sup>44</sup> Turner, pp. 186-187.

<sup>45</sup> Rumsey was very surprised that Lord Carhampton sought him out given the number of experienced canal engineers in England. But Rumsey's experience in using explosives (black powder) for rock excavation must have been the reason because the Royal Canal project had come to a standstill due to unexpected rock formations.

Sutcliffe, p. 137.

From this point on, Rumsey concentrated on finishing his steamboat, the *Columbian Maid*.<sup>46</sup> Again, he went into debt to hire as many as fifteen workers to ready the boat. An unfortunate maritime accident also set back progress and raised costs.

The *Columbian Maid*, a cargo boat of 100 tons capacity,<sup>47</sup> sailed successfully at four miles per hour during a public trial on the Thames River, but Rumsey did not live to see it happen—he died a few weeks before.<sup>48</sup> Rumsey had planned to rename the *Columbian Maid* as the *Rumseyan Experiment* after it sailed successfully. His intentions after that were to return to “the peaceful shades of old Berkeley.”<sup>49</sup>

James Rumsey’s creative mind thrived while he was in England.<sup>50</sup> Rumsey received four British patents for some twenty various inventions, both new and past, and for boats, engines, waterwheels, mechanisms, and mills. He also envisioned a shallow-draft dry dock<sup>51</sup> for ship repairs which could sail to wherever needed. In Rumsey’s creative mind, the dry dock was the floating equivalent of a lock chamber, the difference being that the doors would hold the water out while workers repaired the ship’s hull.

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<sup>46</sup> “[...] it is unnecessary to add any reasons for the delay of the *Experiment* to so late a period, the mecheniry is now on board the vessel and is going slowly together, *I remain quite Sanguine*, she is a butifull vessel Burthen 101 & 45/94 tons I have called the *Columbian Maid* but think to change it to the *Rumseyan Experiment* as soon as success is ascertained.” James Rumsey (in London) to Charles Morrow (Shepherdstown), Aug. 4, 1789

Lyon G. Tyler, Ed., "Letters of James Rumsey: Inventor of the Steamboat", *William and Mary College Quarterly*, 1917, Vol. XXV, p. 30.

<sup>47</sup> Rumsey wrote to his brother, Edward, saying that the boat could sail to the East Indies. (See Turner, p. 157). By contrast, Rumsey estimated the “burthen” (capacity) of his Shepherdstown boat at 6 tons (See Rumsey, James, “A Plan...”, pamphlet, 1788).

<sup>48</sup> The *Columbian Maid* completed a successful test on December 15, 1792 and was to be publicly exhibited on December 23<sup>rd</sup>, the day after Rumsey died. That exhibition was delayed until January or February, 1793. After that, there is no record of the boat.

Sutcliffe, p. 142.

<sup>49</sup> Turner, p. 196.

<sup>50</sup> “Rumsey was a very prolific inventor. His four British patents literally teem with ideas for inventions.” Rumsey's British patents (number, year, brief description): #1673 (1788; piston pump, water-tube boiler); #1738 (1790, hydrostatic bellows, slide valve); #1825 (1791; hydraulic press); #1903 (1792; centrifugal pump, horizontal steam cylinder)”

Layton, *James Rumsey: Pioneer Technologist*, p. 18.

<sup>51</sup> Layton, *James Rumsey: Pioneer Technologist*, pp.18-19.

During this creative period, Rumsey designed “six families of water mills”<sup>52</sup> rather than individual mills, each being an improvement over its predecessor. In doing so, Rumsey explained the scientific principles underlying each family.

We are fortunate to have the records of Rumsey’s British patents because his three American patents went up in smoke in 1836 when the U. S. Patent Office burned. Only the U. S. patent index (which lists Rumsey’s patents but not the details of each one) survived the fire.

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<sup>52</sup> “Rumsey invented six families of water mills, along with numerous variations on these. In particular, Rumsey was aware of the scientific insight that all fluids had analogous properties. [...] All his inventions tacitly assumed the inefficiency of conventional mills where power is lost by the impact of the water upon the vane of a water wheel. (This insight is correct; impact leads to turbulence and to loss of power). [...] Rumsey’s fundamental insight was that impulse losses could be eliminated by having the water act gradually by its pressure rather than percussive impact [...] At some point prior to his death Rumsey came to see that mills that acted by reaction (analogous to the backward pressure exerted on the hand holding a garden hose when the water is turned on, or to the recoil of a cannon) also acted by gradual pressure rather than percussion.”

Layton, *James Rumsey: Pioneer Technologist*, p. 12.

## The First Steamboat

James Rumsey claimed that he invented the first steamboat. His steam engine had one cylinder; the engine's piston rod operated a piston water pump in like fashion. An intake valve allowed the pump to suction river water. Then that valve closed, and the pump forced the water through a discharge pipe at the stern. The result was jet propulsion.

Directly coupling the engine piston rod to the water pump piston was true genius, though Rumsey did not patent the direct-coupling idea. It would be 1840 before anyone did.<sup>53</sup>

On its demonstration run, Rumsey's steamboat carried passengers at a speed of three miles per hour, both upriver and down.<sup>54</sup> Those in attendance believed the boat to be carrying three tons—half of its maximum load.

James Rumsey had suffered much ridicule regarding his plan to power a boat with a steam engine. Most people thought Rumsey's steamboat was sheer folly.<sup>55</sup> But on December 3, 1787, the townspeople lined the riverbanks to cheer him on. Many dignitaries, including Gen. Horatio Gates,<sup>56</sup> were also in the audience. In no time at all, Rumsey's admirers realized they were witnessing a great invention and began singing their praise of the "flying boat."<sup>57</sup>

With the exception of himself and Capt. Charles Morrow, who manned the tiller, Rumsey allowed only ladies on board for the trial run.<sup>58</sup> It has been specu-

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<sup>53</sup> "This was an invention he [Rumsey] never sought to patent, but years later, in 1840, Henry R. Worthington obtained an influential patent for a direct-coupled pump."

Brooke Hindle, "James Rumsey and the Rise of Steamboating in the United States," *West Virginia History*, 1989. Vol. 48, p. 38.

<sup>54</sup> Rumsey repaired steam pipe leaks and sailed again on December 11<sup>th</sup> at a speed of four miles per hour.

Turner, p. 91.

<sup>55</sup> By the same token, Robert Fulton's *Clermont* was derided as "Fulton's Folly" when it sailed in 1807.

<sup>56</sup> Gen. Gates and several other distinguished guests wrote affidavits to support Rumsey's successful trial.

Turner, pp. 92-94.

<sup>57</sup> Turner, p. 81.

<sup>58</sup> While Turner reports only two men (Morrow and Rumsey) on board, some retellings of the story have Rumsey's friend, Dr. James McMechan, also on board. See: Turner, p. 88; Sutcliffe, p. 54.; Beltzhoover, p.18.

lated that he was fearful that male passengers might be too inquisitive<sup>59</sup> in their study of the power plant. But he may have had another motive for only having the ladies on board—to demonstrate the engine’s safety and the lack of soot and ashes from the boiler’s exhaust.

The only problems with Rumsey’s engine were the continual steam leaks. Rumsey was constantly re-soldering steam pipes and fittings. Such was the state of technology and industrial materials available in the frontier village of Shepherdstown.

After Rumsey published his pamphlet on steam power and made his claim of invention, inventor John Fitch countered with his own pamphlet<sup>60</sup> claiming that he invented the steamboat. Fitch demonstrated his steamboat on the Delaware River on August 22, 1787.

Fitch’s boat used a steam engine to operate banks of oars on each side of the hull. Additionally, his engine weighed several times more than Rumsey’s, and the boiler and works occupied 6-8 times the space. Fitch realized that his boat’s cargo area was consumed by the engine and works, and he set about to build a vessel “on a scale large enough for real use”<sup>61</sup> during the time period that Rumsey introduced and sailed his water-jet boat.

Technically speaking, Fitch’s steamboat was first. But if one is to compare apples to apples, Fitch powering oars is similar to Rumsey powering poles. Neither method of propulsion is practical for general navigation.

Although Fitch’s oar-driven boat sailed nearly four months ahead of Rumsey’s jet-boat, the difference between using oars and using a waterjet can be described as ‘light years’ in terms of technology and pure invention. Had Fitch in-

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<sup>59</sup> In April 1789, John Fitch traveled to Shepherdstown to spy on Rumsey’s boat. Though Fitch traveled incognito, Capt. Charles Morrow found him out and forced him to leave town. Fitch also had a list of contacts that Engelhart Cruse had provided him. Cruse visited Rumsey at his shop in Spring 1787; Rumsey later accused Cruse of stealing his secrets.

Turner, pp. 111-113, and 126-7.

*Note:* The goal of Fitch and other inventors was to secure an exclusive navigation contract with each of the states. The money to be made was in having a transportation monopoly, not in inventing the steamboat *per se*. The states were looking to award monopolies to the original inventor. Thus, the competitors were quite willing to pursue industrial espionage. Rumsey published his 1788 pamphlet as a way to claim he was the first steamboat inventor for the very reason of influencing state legislatures to grant him not only a patent but also steamship rights to carry freight and passengers.

<sup>60</sup> John Fitch, “The Original Steam-boat Supported”, 1788.

<sup>61</sup> Turner, p. 107.

stalled a steam engine on a Roman galley some 2,000 years ago, we would not call the galley a steamboat—we'd still call it a rowboat.

Fitch and Rumsey desperately fought for an exclusive steamboat patent. But the patent process<sup>62</sup> was much different then and neither man would ever be able to claim exclusive license for inventing the steamboat. John Fitch did receive a Pennsylvania patent. James Rumsey received patents from Virginia and Maryland. As the states were vested with authority to grant patents at that time, favorite sons were given special consideration over their competitors.

Beginning in 1790, federal patent law superseded the states' authority, and the Secretary of State was charged with investigating and approving patent claims. Secretary of State Thomas Jefferson was quite frustrated with the application of the law and essentially threw up his hands when it came time to issue a patent for the invention of the steamboat. Jefferson made a muddle of things by simultaneously awarding a steamboat patent (signed August 26, 1791) to John Fitch and James Rumsey as well as two other inventors, John Stevens<sup>63</sup> and Nathan Read<sup>64</sup>,

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<sup>62</sup> Under the Articles of Confederation which governed the nation at the time, the power to grant patents was vested with each state. Neither Fitch nor Rumsey could get an exclusive patent. Even in 1790, when Secretary of State Thomas Jefferson began issuing patents under the new federal law, patents were still not exclusive, and further, did not allow the patenting of a principle. British patent law at that time did allow inventors to patent a principle, and US patent laws later moved in that direction.

<sup>63</sup> "John Stevens (1749-1838) was a landowner and inventor who was an important pioneer in inventing the steamboat. Stevens attempted to build upon the foundation laid by Rumsey. He attempted to perfect Rumsey's water tube, high-pressure boiler, but failed to make the tubular boiler workable and reverted to the Watt-type atmospheric steam engine. His successful steamboat, the *Phoenix*, steamed the year following the successful demonstration by Fulton of the *Clermont*. Had Stevens not had to build his steam engine in America and learn by trial and error over a long period of time, it is quite likely that he would have had a working steamboat long before Fulton. Stevens linked the tubular boiler to screw propellers for propulsion. In this he may also have been inspired by Rumsey." Layton, *James Rumsey: Pioneer Technologist*, p.17.

<sup>64</sup> "Nathan Read was probably the most intriguing and capable of all the steam inventors. [...] At the time of his patent application, Read was a forty-year-old Harvard graduate who owned an apothecary shop in Salem, Massachusetts. He became interested in steamboats as a result of the Fitch-Rumsey pamphlet wars in 1788. [...] Read's application asked for patents for improvements on the steam engine, a steam-powered land carriage, and a paddle-wheel driven steamboat. He felt that Fitch and Rumsey had wrongly rejected paddlewheels [...] Read's drawing for a four-wheeled steam carriage show a single boiler in the front center that would deliver steam to directly to two cylinders, one for each front wheel. But when his plan for this early automobile was read to the House of Representatives in February 1790, some of the members struggled to contain their laughter. [...] On January 1, 1791, Read sent in a new patent application to replace his first, deleting the

therefore, giving no one an advantage.<sup>65</sup> Jefferson probably did the right thing by acknowledging the inventors but preventing any of them from having a commercial advantage. None of the steamboats were ready for commercial application.

In 1807, Robert Fulton demonstrated his *Clermont*,<sup>66</sup> and he is considered the father, and by some the inventor, of the steamboat. Fulton delivered a practical boat that was commercially acceptable.

It is important to note that Fulton did not invent anything on the *Clermont*.<sup>67</sup> Fulton exploited a technicality<sup>68</sup> in British export law and used his government position while he was in England to secure an export license for the Boulton & Watt steam engine that powered the *Clermont*. The *Clermont* was propelled by paddlewheels which were ancient technology.

Fulton benefited from his partnership with the powerful New York politician, Robert Livingston, who had secured a monopoly for watercraft to transport passengers on the Hudson River between New York City and Albany, a very lucrative route.

The *Clermont's* maiden voyage<sup>69</sup> (with crew only) started at New York City and ended at Robert Livingston's estate on the Hudson. The 100-mile trip took 24

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steam carriage and substituting his rowing machine for paddlewheels in a steamboat."

Sutcliffe, pp. 110-111.

<sup>65</sup> Sutcliffe, pp. 114-115.

<sup>66</sup> Originally, the *North River* steamboat, then changed to *Clermont*, the name of Robert Livingston's estate on the Hudson River.

<sup>67</sup> "Fulton's patents and specifications must therefore be considered either as mere importations, borrowed (in patent phraseology) from 'foreigners residing abroad,' or as bare-faced plagiarisms."

Bennett Woodcroft, *A Sketch of the Origin and Progress of Steam Navigation*, London, 1848. p. 80.

<sup>68</sup> "In 1806, Robert Fulton, after a string of failures in other endeavors, returned to America after living twenty years in Europe and made the steamboat a success. He was a shrewd and ambitious businessman who had money and advantages the early inventors could only dream of. Fulton found the perfect partner in Robert R. Livingston, whose political pull gained them a twenty-year navigation monopoly on the Hudson River—geographically and commercially a perfect place to run a steamboat. Unlike his predecessors in steamboat building, Fulton by then was able to hire European immigrants who had mechanical expertise. Ignoring (or perhaps unaware of) Franklin's warning, he used paddlewheels. By studying the failures and successes of the previous inventors, he knew what would work and what wouldn't. Probably most important, a few years earlier he had craftily added a clause to his British military contract that allowed him to purchase and export a Boulton & Watt steam engine."

Sutcliffe, pp. xv-xvi.

<sup>69</sup> Sutcliffe, pp. 184-185.

hours non-stop. The *Clermont* was bigger than the *Columbian Maid*, but it also boasted a much more-powerful Boulton-Watt engine. And yet, both boats could muster only four miles per hour.

In modern times, we can see how Fulton's success came about. Microsoft did not invent the internet browser, but it did deliver a commercially acceptable browser. And Microsoft's near monopoly on personal computer operating systems allowed its Internet Explorer to become the dominant browser. Times are not so different when governments pick the winners in a new field of technology.<sup>70</sup>

Robert Fulton and James Rumsey were acquainted due to an amazing coincidence. Benjamin West, the American painter, moved from Pennsylvania to London in 1763 and founded the Royal Academy of Arts a few years thereafter. A young Pennsylvania artist named Robert Fulton was encouraged to further his art studies under West, and he went to London in 1786. Benjamin West painted Rumsey's portrait (probably in 1788), and it was in West's London studio that Fulton and Rumsey became acquainted. Historians have long wondered if James Rumsey was Fulton's inspiration, but we will probably never know.<sup>71</sup>

The invention of the steamboat was the culmination of a thousand inventions. We should not try to tally up how many of those ideas came from James Rumsey but instead, see him as the visionary he was. Whereas Rumsey was often derided or called "Crazy Rumsey"<sup>72</sup> when he first spoke of building a steamboat, we

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<sup>70</sup> In 1798, the state of New York issued a monopoly for steamboat navigation to Robert Livingston. This exclusive right was later extended to the Fulton-Livingston Line until 1838. In the landmark case *Gibbons v. Ogden* (1824), the U. S. Supreme Court struck down state-granted navigation monopolies as violating the Commerce Clause of the U. S. Constitution. States were not allowed to interfere with interstate commerce.

<sup>71</sup> "Admiral Preble\* mentions 'letters written by Rumsey in London that speak of visits from a young American studying engineering who showed intelligent and sympathetic interest in Rumsey's labors. This young man was Robert Fulton who fifteen years after Rumsey's death gave the world a successful steamboat.'" \*(See: Preble, George Henry, *A Chronological History of the Origin and Development of Steam Navigation*, Philadelphia, L. R. Hammersly & Co., 1888.) *Magazine of History with Notes and Queries*, Vol. IV, No. 1, William Abbatt, NY. July 1906. p. 331.

<sup>72</sup> From Maj. Henry Bedinger's Account of Rumsey's Invention, Jan. 4, 1826: "All the work was performed and a variety of experiments with closed doors, whilst a mass of his acquaintances derided his schemes, pitied his folly, denounced his temerity, called him a conceited projector, etc. Nothing could or did divert him from this most ardent pursuit."

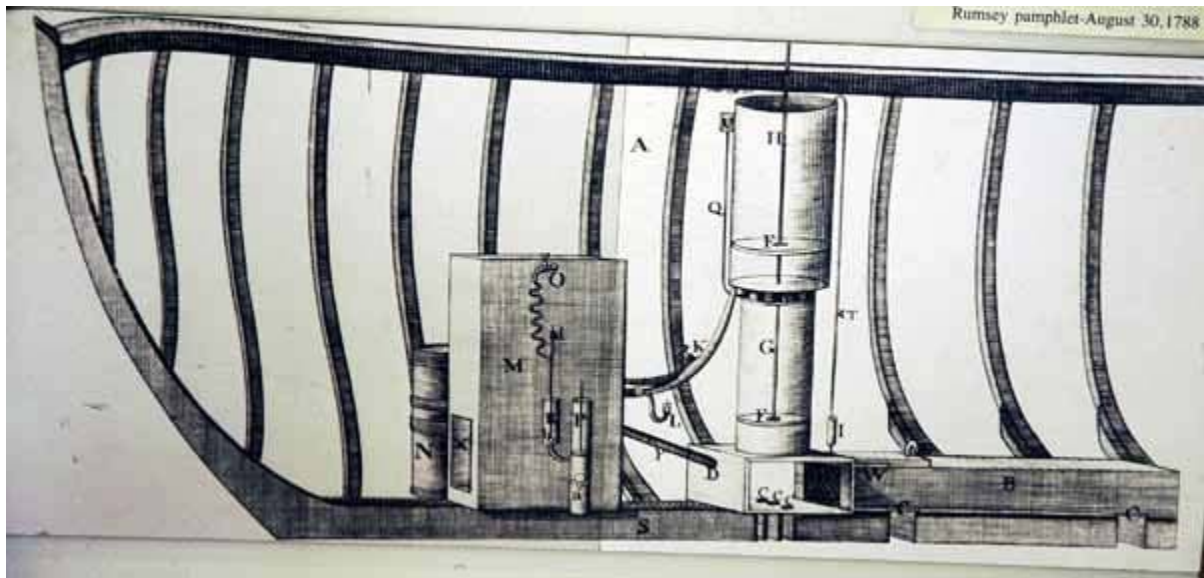
Danske Dandridge, "Historic Shepherdstown", The Michie Company, Charlottesville, VA, 1910. pp. 267, 270-271.

can now see that James Rumsey's steamboat (and not John Fitch's<sup>73</sup>) convinced the world that steam-powered transportation was practical.

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<sup>73</sup> "The competition which ensued between Fitch and Rumsey is fascinating. Fitch placed his major effort on Steamboating, and a minor interest in steam locomotives. He went through three successive companies and two more boats, one of which attained a speed of eight miles per hour and ran over two thousand miles on commercial schedules. Still, all of his efforts failed ultimately, and his designs had almost no influence on later steamboat builders."  
Hindle, p. 39.

## James Rumsey's Steamboat



Drawing of James Rumsey's steamboat

James Rumsey's description of his steamboat as given in his pamphlet "A PLAN wherein the power of STEAM is fully shewn":

"In the bottom of the boat on the Kelson is a trunk, the after end of which is open and terminates at the stern post; the other end is closed, and the whole trunk, according to its dimensions, occupies about three-fourths part of the length of the boat.

"On the closed end of the trunk stands a cylinder two and a half feet long; from this cylinder there is a communication by a tube to the river or welter under the boat; on the top of this tube, and within the cylinder there is a valve to admit the water from the river into the cylinder, and it likewise prevents its returning the same way. There is another communication which lets the water pass freely from the cylinder to the trunk through which it is discharged at the stern. On the top of this cylinder there stands another of the same length which is fixed to the under one by screws; in each of these cylinders there is a piston which moves up and down with very little friction; these pistons are connected by a smooth bolt passing through the bottom of the upper cylinder: the lower cylinder acts as a pump which draws water from the river through the tube of the valve before described.

"The upper cylinder acts as steam engine, and receives its steam from a boiler under its piston, which is then carried up to the top of the cylinder by the steam (at the same time the piston of the lower cylinder is brought up to the top, from its connection with the upper piston by the aforesaid bolt; they then shut the communication from the boiler and open another to discharge the steam for condensation: by this means the atmosphere acts upon the piston of the upper cylinder and its force is conveyed to the piston of the lower cylinder by the aforesaid connecting bolt, which forces the water then in the lower cylinder through the trunk with considerable rapidity; the reaction of which at the end of the trunk is the power that propels the boat forward."

## The Constant Inventor

When Rumsey arrived in Bath, he began to study waterwheels and mills in a scientific manner. No longer was he content just to build a better mill by trial and error. He explored the physics of converting stream flow into horsepower by calculating the respective efficiencies of undershot and overshot waterwheels.

Rumsey changed from being a craftsman to an inventor. An excellent example of this is displayed in his boiler design.

The purpose of a boiler is to heat water. Boilers in that era consisted of a large water tank with a central fire tube running through it. The hot surface of the fire tube (the flue from the firebox) heated the water.

Rumsey inverted this scheme by running water through a small diameter tube which was coiled inside the firebox.<sup>74</sup> The result was a huge increase in surface area by which to heat a small quantity of water.

John Fitch's steamboat used a conventional boiler which held 500 gallons (two tons) of water. Rumsey's boiler tubing held just 20 pints (twenty pounds). With Fitch's boiler, 500 gallons of water had to reach boiling before steam was produced. The savings in fuel and time to "make steam" with Rumsey's boiler are obvious. As Rumsey's boiler was supplied by freshwater from the river, there was no need to carry 500 gallons of water on board to make steam for the voyage.

In supporting Rumsey's claims, Joseph Barnes, Rumsey's brother-in-law and the carpenter and mechanic who assisted Rumsey in building the steamboat, offered this support:

"His [Rumsey's] new constructed boiler must exceed everything of that kind yet extant, as it will not hold more than twenty pints, and is his opinion, will make more steam than a five hundred gallon boiler in the common way; and from the observation he has made, has reason to believe, that six bushels of good coals will serve it for twelve hours. The weight of the present machine is about seven hundred pounds, and will not occupy more space than four flour barrels."— *Excerpt from Joseph Barnes' affidavit in response to John Fitch contesting Rumsey's claim of building the first steamboat. December 10, 1787.*<sup>75</sup>

Reaction wheels were evolving as mill engines in Rumsey's era. A reaction wheel (aka a 'hollow' wheel) is a vertical cylinder with angled water jets at the bot-

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<sup>74</sup> Layton, *James Rumsey: Pioneer Technologist*, p. 20.

<sup>75</sup> Affidavit No. 12, published in "A Short Treatise on the Application of Steam."

tom to discharge water. Water flowing from the millrace filled the cylinder and the cylinder then rotated as the angled water jets created thrust.<sup>76</sup> The rotating reaction wheel became a powered gear drive that could operate any type of mill.

Technology historian Edwin Layton explains Rumsey's contribution to the reaction wheel as thus:

“Rumsey's ‘hollow wheel’ design became a fourth family of mills when Rumsey came to see that such mills could be much more efficient if the water reacted against internal vanes inside the wheel, rather than reacting against the whole wheel at its exit. This last insight led directly to an ideal hydraulic motor (for which the term “turbine” was later coined) in which the limit of efficiency was, in principle, one hundred percent. (Rumsey died before he could patent this critical improvement, but he communicated it to his brother-in-law and mechanical assistant Joseph Barnes who was acting on his behalf in America while he was in Europe.)”<sup>77</sup>

Rumsey's genius<sup>78</sup> was to reverse the standard waterwheel to create turbine vanes. The standard wheel has buckets formed by angled blades which allow the wheel to catch water from the millrace and then discharge it smoothly. By reversing this concept—introducing water into the ‘hollow’ part of the wheel—and then allowing the water to discharge out through the buckets, we can see the analogous relationship of the angled bucket blades to turbine vanes.

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<sup>76</sup> Reaction wheel or Barker's mill: “Barker's mill was a hollow vertical cylinder with boxlike arms projecting from the bottom; water that was poured down through it would spin out from apertures on alternate sides of these arms, driving the mill by reaction.”

Layton, *The Most Original*, pp. 50-56.

<sup>77</sup> “Joseph Barnes to John Vaughn, September 21, 1792, and October 2, 1792, the latter containing Barnes's document “Calculation for a Machine upon the Principle of Reaction,” John Vaughn Papers, American Philosophical Society, Philadelphia.” Layton, *James Rumsey: Pioneer Technologist*, p. 12.

<sup>78</sup> “The steamboat, in my opinion, was not as great a technological accomplishment as Rumsey's work on the reaction wheel, an early water turbine. Rumsey's reaction wheel involved important theoretical and practical insights, which along with systematic testing, put it in a class by itself from a scientific and technological standpoint. And while turbines lack the visibility and glamour of steamboats, reaction wheels based on Rumsey's “hollow wheel” became the sturdy workhorses of American mills and factories through the first half of the nineteenth century. One can argue that their economic and social importance was comparable to that of steamboats.”

Layton, *James Rumsey: Pioneer Technologist*, p.18.

In his 1792 British patent, Rumsey wrote of various ways to use the fundamental principal of the Archimedean screw in mills and machines.<sup>79</sup> He so thoroughly understood the dynamics of a rotating screw against a fluid that he described a ship's screw propeller (and anticipated the airplane propeller!)

In nearly every aspect of his thinking, whether it was direct-coupling a water pump to the steam engine piston or designing the "turbine" reaction wheel, Rumsey was fifty years or more ahead of date that these concepts were put into general use. Only the limitations of materials, machines, tools and technology in the Eighteenth century prevented Rumsey from powering the *Columbian Maid* with a steam turbine engine and screw propeller.

For a perspective of technology in the 1790's, one need only remember that Eli Whitney patented the cotton gin in 1794, and then he introduced the use of interchangeable, machined parts in 1798. Prior to this development, everything was hand-made. As for the state of technology in the Potomac valley, machined parts did not appear until 1799 when the new federal armory at Harper's Ferry armory began manufacturing rifles.<sup>80</sup>

James Rumsey was a great inventor. However, he was not one to invent for a final product. Instead, his inventions were never quite complete because he would always see ways to improve them, and thus, keep working on them.

Rumsey referred to his Potomac River steamboat as the "Experiment." And he planned to rename the *Columbian Maid* as the *Rumseyan Experiment*. To James Rumsey, his life's work was a continuing experiment.

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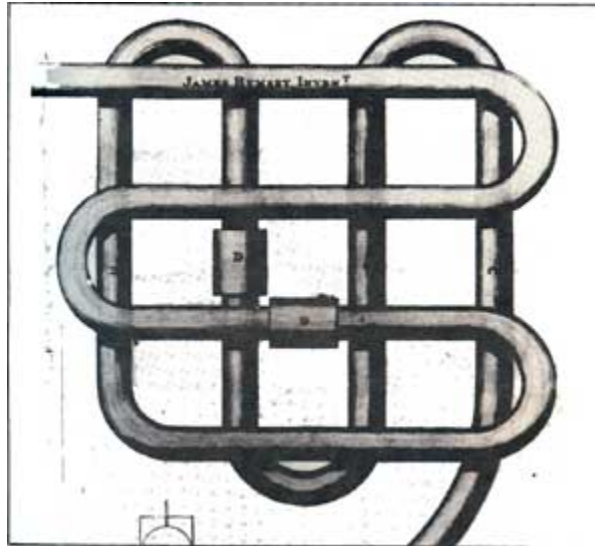
<sup>79</sup> "In this dazzling visual analysis [1792 British patent], Rumsey had shown that a screw propeller acts by reaction every bit as much as his jet-propelled steamboat. This is a very deep and important insight, not fully appreciated by engineers until generations after Rumsey's death. Rumsey's insight applies equally to airplane and ship propellers. Propellers act by the reaction of the fluid they push backward; the realization of this, and the inherent limits that this mode of propulsion placed upon aircraft speed was to be one key starting point for the modern invention of jet-propelled aircraft."

Layton, *James Rumsey: Pioneer Technologist*, pp. 24-25.

<sup>80</sup> "Then, in 1799, came the centerpiece of development, gratis the government—the nation's first armory was built at Harpers Ferry. Not merely an arms repository, Harpers Ferry Armory was a manufacturing plant. Rifles would now be made from machined, interchangeable parts, a revolutionary change in technology."

David G. Allen, "Jefferson County Ironworks", *Magazine of the Jefferson County Historical Society*, Vol. LXX, December 2004. pp. 98-99.

## James Rumsey's Boiler



The May 1788 issue of *The Columbian Magazine* featured an article about Rumsey's pipe boiler along with Rumsey's drawing and detailed description of its assembly and operation.<sup>81</sup> Rumsey stated that he invented this boiler in 1785 and offered supporting affidavits.

As there was no pipe available, the boiler tubing was made by blacksmiths. The tubing was actually a series of forged tubes, made in the same fashion as musket barrels. Nearby Antietam Forge supplied skelps<sup>82</sup> for the tubes. Rumsey noted that three tubes were welded end-to-end and then heated and bent to form "cavities like a bottle case." The tube sections were joined together with threaded couplings. The finished tubing was two inches in diameter and 200 feet long. Rumsey designed the capacity of the tubing based on his engine's steam requirements.

Blacksmiths Michael Entler and Jonathan Osborn are credited with forging the iron tubes. Blacksmith Philip Entler and his apprentice, Michael Fouke, worked on the engine and boiler. And Captain Jacob Haynes, a Frenchman who joined the American army during the Revolutionary War and served as an artificer

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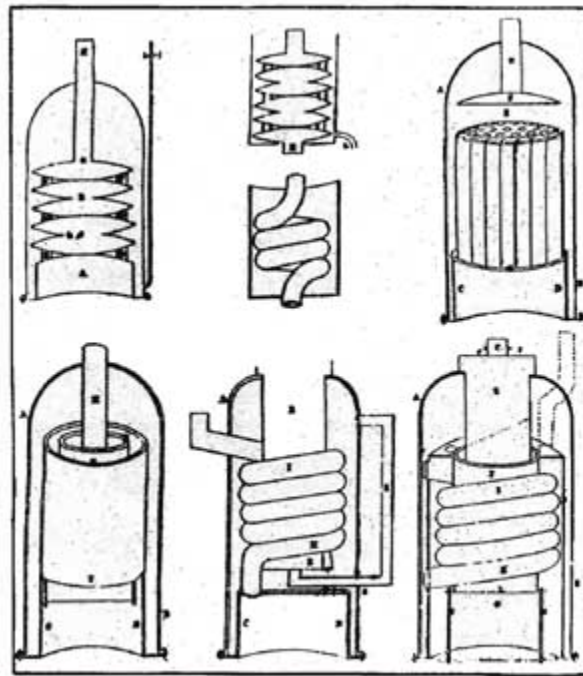
<sup>81</sup> Turner, p. 71-72.

<sup>82</sup> Skelps (flat iron bars) were approximately 1/2" thick. In this case, they were about 6" wide x 60" long. They were heated to yellow heat and then curled in a jig until the longitudinal edges butted together. The seam was forge-welded along its length, thus making the tube. Antietam Forge was located at the confluence of Antietam Creek and Potomac River, east of Shepherdstown and on the Maryland side of the river.

(blacksmith and mechanic) is known to have worked on Rumsey's engine. The boiler worked well except for steam leaks from the threaded pipe couplings.

Rumsey developed alternative schemes for tubular boilers in his 1788 British Patent as shown in the drawing below.

Rumsey knew that his tubular boiler produced steam at higher pressures than the conventional (atmospheric) boiler of his day, but he may not have known how much safer his boiler was. Much later on, scientists proved that the risk of explosion in a steam boiler is directly related to the diameter of the water vessel. Thus, Rumsey's boiler tubing with a diameter of just two inches was much safer than Fitch's boiler which was probably 3'- 5' in diameter.



## Epilogue

There are inventors like James Watt and Eli Whitney who pursue their inventions as manufacturers, and theirs are the stories of successful inventors that grace the history books. James Rumsey was not that kind of inventor.

Rumsey was, first and foremost, a skilled craftsman, and skilled craftsmen tend to be independent operators. As long as Rumsey controlled his project from its creative spark to its operation, such as building a gristmill, he was a happy man.

James Rumsey did not have a formal education as such. However, he was quite literate and possessed a healthy vocabulary. His preserved letters show us that he wrote in descriptive, yet concise, passages. He also was talented enough to write descriptions of his inventions which is difficult indeed. His letters also show us that he held his own when corresponding with learned men such as Thomas Jefferson and Benjamin Franklin.

Also, Rumsey studied mathematics and physics on his own. And he was proficient in these disciplines as he designed and built various test apparatuses to measure the efficiency of his water wheels.<sup>83</sup>

When George Washington hired him to supervise the Potomac Company, we see that Rumsey was not an organization man who enjoyed directing the labors of others. But we also see a man who, having never built canal, quickly mastered that task and would end up advising experienced civil engineers in Ireland when they had no solution for excavating rock. It is this instance that tells us that people intuitively looked at Rumsey as a great problem solver, no matter what the task.

In his various partnerships, Rumsey focused more on inventing than on the business aspects of the venture. When Rumsey met with Boulton & Watt, he most likely thought about his opportunity as an inventor. However, Matthew Boulton was a businessman. When he presented James Rumsey with a contract that

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<sup>83</sup> Rumsey's understanding of Newtonian physics came from *A Course of Experimental Philosophy*, by John T. Desaguliers, "which was a high-level exposition intended to enable craftsmen without advanced mathematics to use Newtonian science as the foundation for technology." (John T. Desaguliers (1683-1744); assistant to Sir Isaac Newton.)

Layton, *James Rumsey: Pioneer Technologist*, p. 23.

spelled out exactly what was expected of each partner, Rumsey was probably a bit fearful. He was, after all, 45 years old and had never worked under strict business rules.

It appears that every writer who has presented Boulton & Watt's partnership offer feels obliged to lament that Rumsey did not accept it. The reasoning is always the same—money, or the lack thereof when Rumsey went solo. In addition, there is a tendency to blame Benjamin Vaughan for giving Rumsey misguided advice. But to understand James Rumsey is to understand that he was a man who valued autonomy above all else. And once a man has thrived by his own autonomy, he is unwilling to surrender it for any price.

James Rumsey had a sad life in some respects. Though he never sought more than a reasonable salary and funding for research, he died a pauper—a public disgrace at the time. Several months before he died, Rumsey confided to Dr. James McMechan (in Shepherdstown) that he had visited London's debtors prisons knowing that he was destined to end up in one of those "horrid" jails.<sup>84</sup> His only son, James, was ravaged by scarlet fever which left him deaf and dumb.<sup>85</sup> His family received nothing from his estate.

From what we know of Rumsey's life, he never had roots, a home place as it were. As a millwright and builder, he most likely moved with his work, not staying long in any particular place. Bath was still a frontier town when he arrived there, and Rumsey certainly could have settled down with many business opportunities to support his family. But after a few years in Bath, he was off once again, this time to build a canal.

James Rumsey died in London and is buried there. He was 49. He gave a lecture at the Adelphi Hotel on the evening of December 20, 1792 and appeared to friends afterwards to have suffered a stroke. (His autopsy indicated a severe brain aneurism.) Rumsey remained "sensible, but almost speechless"<sup>86</sup> and died the next day.

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<sup>84</sup> April 15, 1792: "[...] I have frequently been in the prisons here, on purpose to make them familiar to me, as I have long expected that one of them must eventually become my abode; I will not describe them to you; they are too horrid for your contemplation; [...]"

Turner, pp. 193-195.

<sup>85</sup> Turner, p. 204.

<sup>86</sup> Letters: R. C. Wakefield to William West and John Brown Cutting to Thomas Jefferson.

Turner, pp. 198-201.

In a letter to then-Secretary of State Thomas Jefferson dated December 24, 1792, John Brown Cutting<sup>87</sup> wrote: "In a word in Mr. Rumsay we have lost a citizen the vigour and extent of whose intellect in this particular department of most useful science has seldom been surpass'd—and according to many of the best judges has very, very seldom been equal'd."<sup>88</sup>

George Washington, Thomas Jefferson, Benjamin Franklin and James Watt all vouched for James Rumsey's genius, and each of these men offered to aid Rumsey in ways that they could. James Watt wrote to Rumsey that Boulton & Watt made him offers that they "shall not probably make to any other man in like circumstances."<sup>89</sup> To have earned the trust and respect of these four men, four remarkable men who changed the world forever, is fitting praise, indeed.

James Rumsey's unmarked grave was initially in a pauper's cemetery, but the cemetery was later annexed by St. Margaret's Westminster Church. School-children in Shepherdstown took up a collection for a bronze plaque to announce Rumsey's burial there.<sup>90</sup>

Capt. Charles Morrow was more than just Rumsey's brother-in-law. Morrow was his trusted confidant and best friend. When Rumsey was abroad, Morrow represented him in his affairs in America. Rumsey also entrusted Morrow with raising his family while he was away from Shepherdstown. Charles Morrow died shortly before Rumsey, an event that Rumsey was unaware of when he passed on.

Morrow's death greatly complicated the settling of Rumsey's estate. That task was left to Edward Rumsey,<sup>91</sup> his brother, and to Joseph Barnes. Almost a decade passed before Rumsey's estate was finally settled in Europe and America.

Joseph Barnes, who married one of James Rumsey's sisters, spent time in England and Europe trying to clear up his brother-in-law's estate. He was later appointed as Consul to Sicily in January 1803 by President Thomas Jefferson.<sup>92</sup>

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<sup>87</sup> John Brown Cutting served as Apothecary General (buyer of medical supplies) during the Revolutionary War; he was living in London and was with Rumsey when he was stricken.

<sup>88</sup> "Jefferson Papers", Library of Congress.

Turner, pp. 199-201.

<sup>89</sup> Turner, p. 153.

<sup>90</sup> Conversation with Jay Hurley: Fund drive ca. 1956.

<sup>91</sup> James Rumsey made his Last Will and Testament before he left to go to London; named Edward, his brother, as executor. Turner, p. 215.

<sup>92</sup> "From the letters that Barnes wrote to Thomas Jefferson one learns that he remained abroad for a number of years. In 1803, Jefferson appointed Barnes consul to Sicily. Although he had been very insistent about securing the appointment, he

In 1839, Congressman Edward Rumsey (Whig, KY) proposed that a gold medal honoring James Rumsey be struck and presented to James Rumsey Jr.<sup>93</sup> The House of Representatives passed the resolution unanimously. Unfortunately, James Johnson, the lawyer representing James Rumsey's heirs, lobbied the U. S. Senate to nix the gold medal idea. Johnson hoped to lobby Congress to appropriate a cash award for his clients. The House Committee on Claims voted against appropriating such a cash award in 1842 and again in 1846 due to the "newness of our country and smallness of its revenues."<sup>94</sup> The proposal for a gold medal was never brought up again.

Shepherdstown has commemorated James Rumsey's life with two monuments—a millstone (from Rumsey's Sleepy Creek gristmill) in 1907 and a granite monument in 1915. The monuments came into being as a result of the efforts of the second Rumseyan Society formed in February 1906 to commemorate the inventor.

Rumsey moved from Bath to Shepherdstown in 1785 and lived there until March 29, 1788 when he left for London. Rumsey's family resettled sometime after 1792 in Kentucky.

Though he did not live there long, James Rumsey is still remembered with reverence in Shepherdstown. In 1987, a third Rumseyan Society celebrated the bicentennial of the "flying boat" by building a replica of the craft and sailing it on the Potomac.<sup>95</sup> The replica is on display at a local museum. The area's vocational-technical school is the James Rumsey Technical Institute,<sup>96</sup> and it proudly displays a model of the flying boat which previously was on display at the Smithsonian Institute in Washington, DC.

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never assumed the duties of the office, but appointed pro-consuls to act for him. On April 17, 1808, he wrote Jefferson of his intention to return to America [...]" Turner, p. 202.

<sup>93</sup> James Rumsey refers to his son (James Rumsey, Jr.) as "Ned" in his 1792 letter to Dr McMechan. In a letter to Charles Morrow, he calls him "Neddy." This may infer that James Rumsey's middle name was Edward.

Turner, pp. 120-121, 194.

<sup>94</sup> Turner, pp. 205-6.

<sup>95</sup> Conversation with Jay Hurley: The boat replica sailed on September 13, 1987, three months ahead of the actual bicentennial, due to weather considerations. Jay Hurley was lead man on the crew that built the replica.

<sup>96</sup> See: <http://www.jamesrumsey.net>

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## **Timeline**

- 1743            March: James Rumsey born in Cecil County, MD.
- 1754-1763    French and Indian War
- 1774            September 5: First Continental Congress convened.  
October 26: Congress adjourned.
- 1775            April 19: Revolutionary War begins; Battles of Lexington and Concord.  
May 10: Second Continental Congress convened.
- 1776            July 4: Final text of the Declaration of Independence approved.
- 1777            November 15: Congress issues the Articles of Confederation to the states for approval.
- 1779            Thomas Jefferson is governor of Virginia (to 1781).
- 1781            March 1: Articles of Confederation go into effect. Continental Congress is now the Congress of the Confederation (until 1789).  
October 19: Surrender of British army by Gen. Cornwallis at Yorktown.
- 1782            James Rumsey's name first appears in Bath, VA records.  
November: Preliminary peace articles were signed in Paris.
- 1783            September 3: War ends; Treaty of Paris signed
- 1784            January 14: Congress ratifies Treaty of Paris.  
September: James Rumsey meets George Washington and proposes the pole boat.
- 1785            July: James Rumsey hired by Potomac Company. Moves to Shepherdstown.  
Thomas Jefferson serves as Minister to France (until May 1789).
- 1786            July: James Rumsey resigns from Potomac Company.
- 1787            September 17: Philadelphia Convention adjourns after writing the United States Constitution.  
December 3 & 11: Two successful trials of Rumsey's steamboat at Shepherdstown.
- 1788            January--May: James Rumsey publishes claim of inventing the steamboat; receives support of the Rumseyan Society; travels to England.  
July 8: New Constitution in effect.  
November 6: Rumsey receives British patent #1673.

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- 1789      March 4: First United States Congress begins.  
            April 30: George Washington inaugurated as first President.  
            May: Thomas Jefferson appointed Secretary of State.
- 1790      March 23: Rumsey receives British patent #1738.
- 1791      August 25: Rumsey receives British patent #1825.  
            August 26: Secretary of State Jefferson issues a non-exclusive  
            steamboat patent to James Rumsey and three others.
- 1792      July 24: Rumsey receives British patent #1903.  
            December: James Rumsey dies in London. *Columbian Maid* has suc-  
            cessful test run.
- 1793      January-February: *Columbian Maid* has successful public trial.

## Of Bandits and Tooth Drawers: James Rumsey Meets Thomas Jefferson in Paris<sup>97</sup>

“As he was about to leave Paris, Rumsey sent this very formal note to Jefferson:

“Mr. Rumsey has the honor of returning Mr. Jefferson his most Sincere thanks for the friendship and attention he has received from him, Mr. Rumsey has taken the liberty to direct that if a letter Should come to the hotel where he lodged for him That it be forwarded through Mr. Barlow to Mr. Jefferson So that Should a letter come from the Minister Mr. Jefferson will receive it, and will much oblige Mr. Rumsey if he will open it and take Such measures on the Content, thereof as Mr. Jefferson thinks proper. Mr. Rumsey is Exceeding uneasey that his Suddent Departure prevented him from giving timely notice to Mr. Jefferson, that he might have had the pleasure of Caring his letters to England.

“Thursday Morning  
April 9th 1789”

“On the twelfth of April, Rumsey wrote to [Charles] Morrow:

“Dear Charles

“I arived here Last Evening about nine Oclock from Paris Which place I left on the 9th in the morning at 7 oclock, their is Expeditious traveling in Europe but the Expence Intolerable before I left Paris my business was in Such Strain that there is but little doubt but I Shall Soon obtain a grant in that Country for my inventions. Mr. Jefferson attends to the business for me in my absence, he has treated me With the greatest posable Civility. I dined at his house the day before I came away when he made me a present of a book and a pair of new invented tooth drawers<sup>98</sup> the two worth 7 dollars at least; there was at his house that day, a great number of nobility with their Stars & garters and their Countesses and ladyships; the reason that the number of them was remarkable on that day was on account of a yearly procession of all the Carrages in Paris, parading on a long field a few miles from the City these Carrages had to pass his house, the procession began at two oclock and lasted to about 7 forming two lines reaching from the City to the field and back again besides the field full, the Company in them was dressed (and their horses and Servants decorated) in the most superb manner that human folly Could Suggest. I need Say nothing about our return to London as it was by the Same rout we went to paris Except that we were Stopped and rob[b]ed on the famous black

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<sup>97</sup> Letters reproduced.  
Turner, pp. 162-164.

<sup>98</sup> Tooth drawers: Before dentistry became a discipline in the latter 19<sup>th</sup> century, charlatans and mendicants pretended to be able to cure dental problems. These people were often called “tooth drawers” (tooth pullers) as were their smallish pliers made by a blacksmith. In some lore, blacksmiths were said to be “dentists” but this attribution has more to do with their making “tooth drawers” rather than actually extracting teeth.

heath Common by three footpads. I was in a post Chase<sup>99</sup> with a Mr. Parker whom I have before mentioned. I had a pre Sentiment that Such a thing might happen and therefore hid all my money Except about one & a half guinies my watch I kept in my hand and the moment the rains of the horses was Siezed and the pistol presented to the postilion I threw her in the bottom of the Carrage among Some Straw, the doors was Soon opened and a pistol presented at each of our heads! We delivered what was in our pockets which by no means Satisfied them. Mr. Parker haveing used the Same precaution with his watch they Suspected we had hid them and made some Search, at the Same time Swareing most bitterly, that if we did not produce the watches that they would blow our brains out, however we stuck to our first *[illegible]* that we had none, and they at lenth Shut the doors and ordered us to drive on. Mr. Parker lost about twenty-one or two guinies, but we both Saved our watches, but I Can ashore you that this geting rob[b]ed is a very Serious Business, Especially when they get *[mutilated]* in geting the Expected booty, which was the Case with us, as the Cheif they got of Mr. Parker was French bank bills, in a pocket book, therefore they Supposed their prize was very Small.

“I Expect that the *[mutilated]* will nearly bring about the day of my Experiment Should I not be obliged to go again to france before that time. I have nothing new to inform you of Except my receiving letters from philadelphia that doath not give me much Satisfaction; poor barnes he has no Suspetion of mankind, and I doubt he will let our inventions be clogged by private Veivs; without Ever Suspecting it!”

[...]

/s/ James Rumsey

“It appears from the letters of Rumsey and Jefferson after the former's return to London, that the "new-invented tooth drawers," about which he had written so enthusiastically to Morrow, caused him almost as much concern as his boat project and other enterprises. He writes [to Jefferson]:

“London May 22d 1789.

“Sir,

“The first leasure hour I had, after my return from paris to london, was employed to find out a person that would advance Some money for the Tooth drawers, (that I had the honour of receiving from you) for the use of the inventor of them, Several persons Seemed willing to give Something for them, provided that they would answer the purpose well on Experiment, and wanted me to put them into their hands for that purpose, which I did not think proper to do, not knowing their Characters; I mentioned the Sircumstances to Mr. Vaughan, and he was kind enough to propose Shewing them to a Mr. Cline (or Kline) a famous annatomist, who he thought might be depended upon; I have this day Called upon Mr. Vaughan to know the result of the application; but to my great Surprise Mr. Vaughan informed me, that Mr. Cline ashored him, that Such had been in use in England, to his knowledge for upwards of Seven years Mr. Vaughan left them with Mr. Cline, and requested him to make them more public, as he Conceived them to be a useful

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<sup>99</sup> Post Chaise carriage (from: Chaise lounge): A lightweight, closed, four-wheeled carriage with a single seat that held two or three passengers and built for distance runs.

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machine; I confess I have my fears that Mr. Cline has not been Candid in this business, but as I know nothing of him, but what I heard from Mr. Vaughan; I therefore did not think it prudent to Express my doubts to him, I am realy Very Sorry that I am not able to give you a more Satisfactory account of this matter. I Shall however take Some pains to Discover whether Such a thing has been in use, in this Country, or not, and Shall let you know the result of my Enquiry.

“The Machine for my Vessel has not gone on so briskly as I expected, the case I beleive with all new inventions the Machanicks, not being able to execute them, with Such dispatch as they do those they are acquainted with, I Expect however that an other month will be near the time of Experiment--I am Sir under many obligations to you for your kind attention to my business in france, and Shall Ever remember your freindship with gratitude--I have the honor to be Sir with great Esteem your most obliged and Obt. hbl. Servt.”<sup>100</sup>

/s/ James Rumsey

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<sup>100</sup> “Your [...] obedient and humble servant” was a popular closing for business letters in that era.