

DAVID RITTENHOUSE.

THERE have been very few men, even among those possessed of extraordinary talents, who have been so entirely unskilled in the arts that attract popular attention, and have notwithstanding become so eminent during their own lives, as was David Rittenhouse. The people of provincial Pennsylvania fully believed they had found among themselves in the farmer's lad of the Wissahickon one upon whom the divine light of genius had fallen, and they came to him with offerings



TABLET IN GABLE END OF RITTENHOUSE'S MANSION.

of homage, as well as of pounds, shillings, and pence, perhaps all the more willingly because he shrank from the honor with an appearance of shyness if not of timidity. His career more nearly resembled that of Franklin than that of any other of his contemporaries. Both began life in an obscure way and under adverse circumstances; the fame of both as philosophers and men of science extended over the world; both were drawn into the politics of their day, and living in the same city, and being of the same way of thought, bore a conspicuous part in the Revolutionary struggle; and each at the time of his death was president of that learned society which had afforded them many of their opportunities.

Here, however, the parallel ends. Rittenhouse was more of a scientist, and Franklin more of a politician. With the boldness which comes of strength, blended with a sufficiency of shrewdness, Franklin went out into the world knowing there was much in it he wanted, and determined to get what he could. Despite of his admirable talents, his knowledge of men and affairs, his sagacious forecast of the future, and his magnificent work in various fields, he had many of the characteristics of an adventurer. In scanning the events of his life we can not help but wish that as an apprentice he had not run away from his master, that his relations with women had never become the subject of conversation, that he had given more credit to Kinnersley for his electrical experiments, and that he had not united with

the Quakers while they were in power, or had remained with them after they lost it. Rittenhouse, on the other hand, was altogether clean, simple, and pure, and in the supreme event of his life, the observation of the transit of Venus, after making the instruments, noting the contacts, and calculating the parallax, he left for his colleague, Dr. Smith, the preparation of the report for publication. While, therefore, it may well be that through lack of aggressiveness or through overnicety he failed to gather all that he might have secured, we approach him with full faith that whatever he did was his own work, and whatever he gained belonged to him.

He came of good ancestry. His paternal forefathers had long been paper-makers at the village of Arnheim, in Holland, and there belonged to the Mennonites—a religious sect which in creed and observances the Quakers much resemble, and which, according to some authorities, they have followed.

The Mennonites call themselves "Defenseless Christians," being strictly opposed to all warfare, and during the sixteenth and seventeenth centuries suffered terribly at the stake and by other methods of persecution. It was of Direk Willems, a Mennonite burned in 1569 for having been rebaptized and holding meetings in his house, that Motley tells a pathetic story, copied from Van Braught. To escape threatened capture he fled across a lake covered with thin ice. One of his pursuers, more eager than wise, followed, and breaking through, was unable to extricate himself. Willems, seeing the danger of his adversary, returned and assisted him to the shore, when the base wretch, with unequalled ingratitude, arrested his rescuer and hurried him away to prison. There were very nearly as many martyrs among the Mennonites in the city of Antwerp alone as there were Protestants burned to death in England during the whole reign of bloody Mary.

Willem Rittinghuysen, the first Mennonite preacher in Pennsylvania, came with his family and others of the sect to Germantown in 1688, and on a branch of the Wissahickon Creek, in Roxborough Township, built in 1690 the earliest paper mill in America. It is with reference to this mill that Gabriel Thomas, a quaint old chronicler of the seventeenth century,

says, "All sorts of very good paper are made in the German Town," and it supplied the paper used by William Bradford, the first printer in Pennsylvania, as well as the first in New York. Here, on the 8th of April, 1732, David Rittenhouse, a great-grandson of the emigrant, was born. His mother, Elizabeth Williams, was the daughter of Evan Williams, a native of Wales, and probably one of the Quaker converts who came from that country and settled a number of townships in Pennsylvania. When he was three years old, his father, Matthias, removed with his family to a farm in Norriton, now Montgomery County, and naturally enough he determined that David, the oldest son, should follow the same pursuit. As soon, therefore, as he was strong enough to be of assistance, he was put to the ordinary farm-work, and he ploughed and harrowed, sowed and reaped, like all the boys by whom he was surrounded. His tastes, however, ran in another direction, and one of those occurrences which are sometimes called accidents gave him an opportunity to gratify them. An uncle, who was a carpenter, died, leaving a chest of tools, and among them a few books containing the elements of arithmetic and geometry and some mathematical calculations. These things, valueless to every one else, became a treasure to David, then about twelve years old, and they seem to have determined the bent of his life. The handles of his plough, and even the fences around the fields, he covered with mathematical calculations. At the age of eight he made a complete water-mill in miniature. At seventeen he made a wooden clock, and afterward one in metal. Having thus tested his ability in an art in which he had never received any instruction, he secured from his somewhat reluctant father money enough to buy in Philadelphia the necessary tools, and after building a shop by the roadside, set up in business as a clock and mathematical instrument maker. His days were given to labor at his chosen trade, and his nights to study. By too close application he injured his health, contracting an affection of the lungs, attended with great pain, that clung to him all of his life, and seriously interfered with his writing, but he solved the most abstruse mathematical and astronomical problems, discovering for himself the method of fluxions. For a long time he believed

himself its originator, being unaware of the controversy between Newton and Leibnitz for that great honor. "What a mind was here!" said Dr. Benjamin Rush, later, in a burst of enthusiastic admiration. "Without literary friends or society, and with but two or three books, he became before he had reached his four-and-twentieth year the rival of two of the greatest mathematicians of Europe."

He mastered the *Principia* of Newton in an English translation, and became so engrossed in the study of optics that he wrote of himself in 1756, during the French and Indian war, that should the enemy invade his neighborhood, he would probably be slain making a telescope, as was Archimedes while tracing geometrical figures on the sand. In 1751, the Rev. Thomas Barton, of Lancaster County, an alumnus of Trinity College, Dublin, who afterward married the sister of Rittenhouse, and became a professor in the University of Pennsylvania, went to Norriton to teach school, and making the acquaintance of the young philosopher and clockmaker, they became warm friends. Barton supplied him with books from which he obtained a knowledge of the Latin and Greek languages, and two years later brought to him from Europe a number of scientific works. Though his clocks had become celebrated for their accuracy, and he had obtained a local reputation for astronomical information, it seems to have been through Barton that the attention of men of learning was first drawn to him. Among these were Dr. William Smith, provost of the university, John Lukens, surveyor-general (another Pennsylvania Dutchman, whose direct paternal ancestor, Jan Lucken, settled in Germantown in 1683), and Richard Peters, provincial secretary. Through the last-named he was called upon in 1763 to perform his first public service, and one of very serious importance. It was provided in an agreement between the Penns and Lord Baltimore, settling the disputed boundary of their respective provinces, that a circle should be drawn with a radius of twelve miles around the town of Newcastle. With instruments of his own manufacture, Rittenhouse laid out this circle topographically, and alone he made a number of tedious and intricate calculations in such a satisfactory manner that he was tendered extra compensation. The astronomers Mason and Dixon, furnished with the best instruments for the purpose

that could be made in England, accepted Rittenhouse's circle without change when, in 1768, they completed their famous line, which for so many years divided the Free from the Slave States. The point where the forty-first degree of latitude, the northern limit of New Jersey, reaches the Hudson, was fixed by Rittenhouse at the re-

honorary degree of Master of Arts, because, as was said by the provost, of his improvement by the felicity of natural genius in mechanics, mathematics, and astronomy.

Very early in his career his attention was drawn to the variations in the oscillations of the pendulum, caused by the ex-



BIRTH-PLACE OF DAVID RITTENHOUSE, GERMANTOWN, PENNSYLVANIA.

quest of a commission appointed by New York and New Jersey in 1769, and in this peaceful way, by an appeal to the telescope rather than ordnance, were settled between adjacent independent States questions which in other lands have frequently led to sanguinary wars. On the 20th of February, 1766, he married Eleanor, daughter of Bernard Colston, a Quakeress, and the following year the University of Pennsylvania conferred on him the

pansion and contraction of the material of which it is made, and appreciating the importance of an accurate chronometer, he devised a novel and satisfactory plan of compensation by attaching to the pendulum a bent tube of glass partially filled with alcohol and mercury. In 1767 he wrote a paper for the

Pennsylvania Gazette upon the famous problem of Archimedes, and made some experiments upon the compressibility of water, reaching the conclusion, notwithstanding the tests of the Florentine Academy, that it was compressible. The same year he made a thermometer based upon the principle of the expansion and contraction of metals. An index moved upon a flat surface over a semicircle which was graduated according to the Fahrenheit de-

grees of heat. During the present century Breguet has obtained much reputation by inventing anew this forgotten instrument.

A greater mechanical design was, however, now in contemplation than any he had before undertaken. He conceived the idea of endeavoring to represent by machinery the planetary system. Similar attempts had previously been made, but all had represented the planetary movements by circles, being mere approximations, and none were able to indicate the astronomical phenomena at any particular time. The production of Rowley, a defective machine, giving the movement of only two heavenly bodies, was bought by George I. for a thousand guineas. Rittenhouse determined to construct an instrument not simply to gratify the curious, but which would be of practical value to the student and professor of astronomy. After three years of faithful labor, in the course of which, refusing to be guided by the astronomical tables already prepared, he made for himself the calculations of all the movements required in this delicate and elaborate piece of mechanism, he completed, in 1770, his celebrated orrery. Around a brass sun revolved ivory or brass planets in elliptical orbits properly inclined toward each other, and with velocities varying as they approached their aphelia or perihelia. Jupiter and his satellites, Saturn with his rings, the moon and her phases, and the exact time, quantity, and duration of her eclipses, the eclipses of the sun and their appearance at any particular place on the earth, were all accurately displayed in miniature. The relative situations of the members of the solar system at any period of time for five thousand years backward or forward could be shown in a moment. It is not difficult to appreciate the enthusiasm with which this proof of a rare genius was received more than a century ago, but it is entertaining to witness the expression of it.

"A most beautiful machine. . . . It exhibits almost every motion in the astronomical world," wrote John Adams, who was always a little cautious about praising the work of other people. Samuel Miller, D.D., in his Retrospect, said: "But among all the contrivances which have been executed by modern talents, the machine invented by our illustrious countryman Dr. David Rittenhouse, and modestly called by him an orrery, after the production of Graham, is by far the most curious

and valuable, whether we consider its beautiful and ingenious structure, or the extent and accuracy with which it displays the celestial phenomena."

"There is not the like in Europe," said Dr. Gordon, the English historian; and Dr. Morse, the geographer, added, anticipating what has actually occurred: "Every combination of machinery may be expected from a country a native son of which, reaching this inestimable object in its highest point, has epitomized the motions of the spheres that roll throughout the universe."

His friend Thomas Jefferson wrote: "A machine far surpassing in ingenuity of contrivance, accuracy, and utility anything of the kind ever before constructed. . . . He has not indeed made a world, but has by imitation approached nearer its maker than any man who has lived from the creation to this day."

Barlow, the author of that ponderous poem the "Columbiad," put in rhyme:

"See the sage Rittenhouse with ardent eye
Lift the long tube and pierce the starry sky!
He marks what laws the eccentric wanderers bind,
Copies creation in his forming mind,
And bids beneath his hand in semblance rise
With mimic orbs the labors of the skies."

Two universities vied with each other for its possession, and after Dr. Witherspoon, of Princeton College, had secured it for £300, Dr. Smith, of the University of Pennsylvania, wrote, with a slight touch of spleen: "This province is willing to honor him as her own, and believe me many of his friends regretted that he should think so little of his noble invention as to consent to let it go to a *village*." Smith was mollified, however, by an engagement immediately undertaken to construct a duplicate, and he delivered a series of lectures on the subject to raise the money required. Wondering crowds went to see it, and after the Legislature of Pennsylvania had viewed it in a body, they passed a resolution giving Rittenhouse £300 as a testimony of their high sense of his mathematical genius and mechanical abilities, and entered into an agreement with him to have a still larger one made, for which they were to pay £400. It even found its way into the field of diplomacy, for when Silas Deane was in France endeavoring to arrange a treaty of alliance between that country and our own against Great Britain, he suggested to the secret committee of Congress that the orrery be presented to Marie

Antoinette as a *douceur*. It was somewhat injured by the British troops while in Princeton during the war.

The year 1769 is memorable in the annals of astronomy. During that year occurred the transit of Venus—a phenomenon which offers the best means for calculating the distances between the heavenly bodies. It had up to that time never been satisfactorily observed. No man then living could ever have the opportunity again, because it would not recur for one hundred and five years. Astronomers all over the world were alive to its importance. Arrangements were made for taking such observations as were possible in the capitals of Europe, and the governments of England and France sent expeditions for the purpose to Otaheite, Hudson Bay, and California. As early as June 21 in the preceding year, Rittenhouse read before the American Philosophical Society a series of calculations showing the time and duration of the coming transit. The Legislature of Pennsylvania gave £200 sterling toward the expense of buying a telescope and micrometer and the other outlays, and on the 7th of January, 1769, the society appointed three committees to make observations in three different localities. One of these committees, consisting of Rittenhouse, Dr. William Smith, John Lukens, and John Sellers, was to repair to the home of Rittenhouse at Norriton, and to him they intrusted all of the preliminary arrangements. In November he began the erection of an observatory, which was completed in April. He continued for months a series of observations to determine the exact latitude and longitude of the place, and to test the accuracy of his time-pieces. Thomas Penn sent from Europe a reflector, used by Smith; a set of glasses intended for Harvard University, but which came too late to be forwarded, Rittenhouse fitted into a refractor for Lukens; his own telescope he retained. Several other necessary instruments, including a device for keeping time, he made with his own hands, and, like all of his construction, they were admitted to have been better than could have been obtained abroad. According to Smith, the committee trusted in this respect entirely to the extensive knowledge of Rittenhouse, and when he and the others arrived, two days before the transit, they had nothing to do but adjust the telescopes to their vision. A rainy day, even a passing cloud, would have made

all the labor vain, but fortunately it happened to be perfectly clear. The previous anxiety, the sense of responsibility at the critical moment, the delight consequent upon the great success, constituted a sequence of emotions too exciting for the physically delicate Rittenhouse, and when the contact had ended he swooned away. The observations, according to the testimony of Maskelyne, the royal astronomer of England, were excellent and complete. Rittenhouse at once made calculations to determine the parallax of the sun, and gave them to Dr. Smith, who added his own, and prepared a report to the society, which was printed in its proceedings; and so it happened that the first approximately accurate results in the measurement of the spheres were given to the world, not by the schooled and salaried astronomers who watched from the magnificent royal observatories of Europe, but by unpaid amateurs and devotees to science in the youthful province of Pennsylvania.

Said a learned English author: "There is not another society in the world that can boast of a member such as Mr. Rittenhouse, theorist enough to encounter the problem of determining from a few observations the orbit of a comet, and also mechanic enough to make with his own hands an equal-altitude instrument, a transit telescope, and a time-piece."

In the year 1769 there was also a transit of Mercury, a phenomenon by no means so rare or of such moment as that of Venus, but still of importance. Observations of it were made by Rittenhouse, Smith, Lukens, and Owen Biddle, and were published by the American Philosophical Society. The following year he calculated the elements of the motion and the orbit of a comet then visible, showing himself, by comparison with European investigators engaged in the same task, capable of performing the most difficult of computations in physical astronomy, and adding to his already extended reputation. In fact, these achievements had given him so wide a fame that his powers could no longer remain pent up in Norriton, and with the prospect of many advantages both in the way of his handiwork and of his science, he removed to Philadelphia, the American centre of learning and intelligence. He still gained his livelihood by mechanical labor, and it is curious to find him as late as 1775 assuming charge, at a small salary,

of the State-house clock. About this time the almanacs of the day began to announce to their readers that, "as to the calculations, I need only inform the public they are performed by that ingenious master of mathematics, David Rittenhouse, A.M., of this city, etc." And "our kind customers are requested to observe that the ingenious David Rittenhouse, A.M., of this city, has favored us with the astronomical calculations of our almanac for this year; therefore they may be most firmly relied on." Soon after his removal his wife died, and in December, 1772, he married Hannah Jacobs, a member of a distinguished and influential Quaker family in Chester and Philadelphia counties. In 1771 he made some experiments on the electrical properties of the gymnotus; in 1772, after constructing the necessary instruments, he and Samuel Rhoads, for the Assembly of Pennsylvania, surveyed and ascertained the levels of the lands lying between the Susquehanna and the Delaware, with a view to the connection of those two rivers by a canal; in 1773 he was appointed president of a commission to make the river Schuylkill navigable, a duty which they performed by constructing rough dams, and which was continued for a number of years; and in 1774 he and Samuel Holland, commissioners from their respective provinces, fixed the northeastern extremity of the boundary between New York and Pennsylvania.

In 1770 he prepared for the publications of the American Philosophical Society a paper giving a method of ascertaining the true time of the sun's passing the meridian that attracted the attention of Von Zach, the Saxon astronomer. He was chosen one of the secretaries of that society in 1771, and on the 24th of February, 1775, he read before it an oration upon the subject of astronomy. This oration is the most elaborate of his literary productions. The language is simple, the style strong and clear, and it displays much research and special knowledge. In it he traces the history of astronomical discoveries and progress down to the time at which he wrote, but the most interesting portion of the address, as a test of his own acumen, is that in which he endeavors to forecast the future, and to point out the most promising paths for further investigation. The possibility of the existence of the planets that were then unknown

seems to have occurred to him, for he says, "The telescope had discovered all the globes whereof it is composed, at least as far as we yet know." He believed in the existence of beings differing from man more or less in their natures on the other planets. The spots on the sun he conjectured to be solid and permanent cavities, darkened by matter that occasionally and accidentally collected in them. But it was among the fixed stars that with correct inference he expected the greatest discoveries to be made; and the Milky Way, whose mysteries the telescopes of his day were not powerful enough to unravel, whetted his fancy and aroused his eloquence. The Milky Way, composed of millions of small stars, seemed to him to be a vein of closer texture running through material creation, which he supposed to be confined between parallel planes of immeasurable extent. The discoveries of Herschel and others subsequently verified many of his hypotheses. "We shall find sufficient reason to conclude," he says, "that the visible creation, consisting of revolving worlds and central suns, even including all those that are beyond the reach of human eye and telescope, is but an inconsiderable part of the whole. Many other and very various orders of things, unknown to and inconceivable by us, may and probably do exist in the unlimited regions of space. And all yonder stars innumerable, with their dependencies, may perhaps compose but the leaf of a flower in the Creator's garden, or a single pillar in the immense building of the Divine Architect." His sentiments on some other subjects were occasionally interwoven. Frederick the Great he called the tyrant of the North and scourge of mankind. He commiserated with those who, because their bodies were disposed to absorb or reflect the rays of light in a way different from our own, were in America doomed to endless slavery. The rapid growth of the American colonies seemed to him to indicate an early fall. He dreaded the introduction of articles of luxury, and the growth of luxurious tastes, through a too easy intercourse with Europe. "I am ready to wish—vain wish," he added—"that Nature would raise her everlasting bars between the New and the Old World, and make a voyage to Europe as impracticable as one to the moon."

In March of the same year the American Philosophical Society presented for the

consideration of the Assembly a plan for the prosecution of discoveries in astronomy, geography, and navigation, to which they said they were urged by some of the greatest men of Europe. It contemplated the erection of a public observatory by subscription upon a lot of ground to be granted by the proprietaries, who had expressed their concurrence. It should be furnished with the necessary instruments, which would be of but little expense, because the gentleman who it was proposed should conduct the design was capable of constructing them all in the most masterly manner. He should receive an annual salary both in the capacity of public astronomer and as surveyor of roads and waters. Here the captains and mates of vessels, and young men desirous of obtaining practical knowledge, should be taught the use of instruments and receive other instruction, and the observations made should be published annually for the benefit of learned societies at home and abroad. "We have a gentleman among us," they went on to say, "whose abilities, speculative as well as practical, would do honor to any country, and who is nevertheless indebted for bread to his daily toil in an occupation the most unfriendly both to health and study." To give him an occasion to use his genius for the advantage of his country would be an honor which crowned heads might glory in, but which Pennsylvania ought not to yield to the greatest prince or people on earth. Should the present opportunity be neglected, whole centuries might not afford another.

The fact that such a design should be seriously proposed and favorably entertained at that early period shows a remarkable appreciation of the abilities of Rittenhouse, and a regard for the interests of science which is certainly creditable to the society, the Legislature, and to public taste. It was the habit of the day to compare Rittenhouse to Newton, and who can say that if this scheme could have been carried into execution, and he could have devoted the remainder of his days to quiet study and investigation in those pursuits in which unquestionably he was a master, the parallel would not have been justified? Fate, however, determined otherwise. It was not to be. America had other work to do, and her science must bide its time, though it be for ages. The whirlwinds of war were about to be let loose over the land, and even then the drums were beat-

ing in the town of Boston. A month later occurred the battles of Concord and Lexington. The next we see of Rittenhouse he was busily engaged in military rather than astronomical problems, and henceforth his time, his energies, and his talents were in the main occupied with sublunary affairs. He had made many clocks; their leaden weights were now needed for bullets, and it was ordered by the Committee of Safety that he and Owen Biddle "should prepare moulds for the casting of clock weights, and send them to some iron furnace, and order a sufficient number to be immediately made for the purpose of exchanging them with the inhabitants of this city for their leaden clock weights." He understood the measurement of heights and the establishment of levels, and was therefore sent to survey the shores of the Delaware to ascertain what points it would be best to fortify in order to prevent a landing of the enemy. The Committee of Safety appointed him their engineer in October, 1775, and in this capacity he was called upon to arrange for casting cannon of iron and brass, to view a site for the erection of a Continental powder mill, to conduct experiments for rifling cannon and musket balls, to fix upon a method of fastening the chain for the protection of the river, to superintend the manufacture of saltpetre, and to locate a magazine for military stores on the Wissahickon. The Assembly appointed him one of the Committee in April, 1776, and in August he was elected its vice-president. As presiding officer he issued in November two proclamations, printed in the form of handbills, one of which announced to the citizens that the enemy were advancing, and that only the most vigorous measures could prevent the city from falling into their hands. "We therefore entreat you by the most sacred of all bonds, the love of virtue, of liberty, and of your country, to forget every distinction, and unite as one man in this time of extreme danger. Let us defend ourselves like men determined to be free." The other was addressed to the colonels of battalions, and informing them that General Howe with his army was already at Trenton, continued, "This glorious opportunity of signaling himself in defense of our country, and securing the rights of America forever, will be seized by every man who has a spark of patriotism in his bosom."

In March, 1776, he was elected a member of the Assembly from the city of Philadelphia, and later a member of the Convention which met July 15, 1776, and drafted the first Constitution for the State of Pennsylvania. No delegate to the Convention was intrusted with more important duties than he, and frequently he presided over its deliberations. He was one of the committee which drafted the frame of government, and subsequently, together with Benjamin Franklin and William Vanhorn, he revised its language. A committee of which he was a member prepared an address to the people setting forth the reasons for the different actions which had been taken. On the 8th of April, 1777, David Rittenhouse, Owen Biddle, Joseph Dean, Richard Bache, and John Shee were appointed a board of war for the State of Pennsylvania; and in the fall of that year, after the British army had entered within its borders and secured possession of Philadelphia, he was one of the Council of Safety, to whom the most absolute powers were temporarily granted. In order to provide for the preservation of the commonwealth, they were authorized to imprison and punish, capitally or otherwise, all who should disobey their decrees, to regulate the prices of all commodities, and to seize private property, without any subsequent liability to suit because of any of their proceedings. Surely no other twelve men were ever vested with greater powers over their fellow-beings than these.

On the 14th of January, 1777, he was elected by the Assembly the first State Treasurer under the new Constitution, and he was unanimously re-elected to the same position in each of the succeeding twelve years, and until he finally refused longer to serve. In consequence of the fluctuating values of both the State and Continental currencies, and their almost constant depreciation, together with the unusual demands for funds and the difficulties in the way of their collection incident to a state of war, it was an office of great trial and responsibility, for which the small commissions afforded a very inadequate compensation. It occupied his time and annoyed him so much that he once wrote to his wife while hundreds of miles away in the forest, surrounded by savages, that nothing so reconciled him to his present deprivations "as the aversion I have to the plagues of that same office." When

the approach of the British army and the subsequent capture of Philadelphia in the fall of 1777 made necessary a withdrawal of the government departments, the Treasury was removed to the second story front room of the house of Mr. Henry in Lancaster. The family of Rittenhouse were at Norriton, so near to the lines of the enemy that the presence there of a member of the Council of Safety and Treasurer would have been attended with great risk, and he was therefore compelled to endure an anxious separation from them until the following June. In addition to the Treasury, he was trustee of the Loan Office for ten years, from 1780 to 1790, at which latter date it was superseded. The Loan Office was established in 1723 for the purpose of providing a circulating medium of exchange, and was authorized to loan bills of credit, which were legal tenders, upon the security of mortgages upon real estate. The duties of this office required the exercise of the greatest prudence in the issue of the bills and the nicest care in the valuation of the mortgages, and it is a tribute to the practical judgment of Rittenhouse, who was sole trustee, that its affairs were finally closed entirely without loss.

The disputes between Pennsylvania and Virginia upon the question of boundaries became serious, and in 1779 George Bryan, John Ewing, and David Rittenhouse for the former State, and James Madison and Robert Andrews for the latter, were appointed commissioners to adjust them. They entered into an agreement to extend Mason and Dixon's line due west five degrees of longitude from the river Delaware, and from its western extremity to draw a meridian to the northern limit of Pennsylvania, for the southern and western boundaries of that State. This agreement was subsequently ratified, but uncertainty as to the exact location of the line led to numerous collisions between settlers claiming under grants from the two States, and even hostilities were threatened. At one time the authority of Congress was invoked in the interest of peace. It finally became necessary to run and mark the lines, and in 1784 Pennsylvania appointed as commissioners for that purpose John Ewing, David Rittenhouse, John Lukens, and Thomas Hutchins. They accepted the appointment in a letter in which they say, "An anxious desire to gratify the astronomical world in the per-

formance of a problem which has never yet been attempted in any country by a precision and accuracy that would do no dishonor to our characters, while it prevents the State of Pennsylvania from the chance of losing many hundred thousands of acres secured to it by our agreement at Baltimore, has induced us to suffer our names to be mentioned in the accomplishment of the work."

The commissioners on behalf of Virginia were James Madison, Robert Andrews, John Page, and Andrew Ellicott. In April Rittenhouse was busily engaged in constructing the necessary instruments, and in June he, with Lukens, Page, and Andrews, erected an observatory at Wilmington, Delaware, where they made a series of sixty observations of the eclipses of the moons of Jupiter before their departure. Page and Lukens were unable to endure the fatigue and labor of a six months' journey through the wilderness, and returned home, but the others accomplished their task with entire accuracy and certainty, and having ascertained the lines and the southwestern corner of Pennsylvania, marked them with stones and by killing trees. The following summer the western boundary of that State was fixed by Rittenhouse and Andrew Porter on behalf of Pennsylvania, and Joseph Neville and Andrew Ellicott on behalf of Virginia. For that portion of the line north of the Ohio River, Ellicott also acted for Pennsylvania. It was the most important work of the kind in which Rittenhouse was ever engaged, and to the general confidence in his skill was largely due the settlement of this serious and alarming controversy. In 1786 he and Andrew Ellicott on behalf of Pennsylvania, and James Clinton and Simon Dewitt on behalf of New York, were engaged in fixing the boundary between those two States. The New York representatives relied entirely upon the Pennsylvanians for a supply of instruments, and there was no sector suitable for the purpose, at least in that part of America. Rittenhouse therefore made one, which was used in determining the line, and which, in the language of Ellicott, was most excellent. On the 2d of December, 1785, Congress appointed Rittenhouse, with John Ewing and Thomas Hutchins, a commission to run a line of jurisdiction between the States of New York and Massachusetts, which work was performed in 1787, and constituted, says Dr. Rush, his

farewell peace-offering to the union and happiness of his country.

After Congress had determined upon the establishment of a mint, Rittenhouse was appointed its first director, April 14, 1792, by President Washington. He was extremely reluctant to undertake the task, but his mechanical knowledge and ability seemed to make him especially fitted for the organization of an institution whose successful working depended upon the construction and proper use of delicate machinery, and at the urgent solicitation of both Jefferson and Hamilton he consented. When it had been running for three years, however, finding that he could be relieved from what he felt to be a burden, and that the pressing necessity for his services no longer existed, he resigned.

The absorption of so much of his time since the beginning of the Revolutionary war in the performance of public duties, important and honorable as were the offices he held, was not only a source of regret to himself, but seems to have been generally regarded in the light of a sacrifice. As early as 1778, Jefferson felt impelled to write to him: "I doubt not there are in your country many persons equal to the task of conducting government, but you should consider that the world has but one Rittenhouse, and never had one before. . . . Are those powers, then, which, being intended for the erudition of the world, are, like air and light, the world's common property, to be taken from their proper pursuit to do the commonplace drudgery of governing a single State—a work which may be executed by men of ordinary stature, such as are always and everywhere to be found?" The royalist party were fully as reluctant to see him participating in political affairs, and their sense of the loss to science would seem to have been equally as keen. A Tory poet published in the *Pennsylvania Evening Post*, December 2, 1777, these lines:

"TO DAVID RITTENHOUSE.

"Meddle not with state affairs;
Keep acquaintance with the stars;
Science, David, is thy line;
Warp not Nature's great design,
If thou to fame wouldst rise.

"Then follow learned Newton still;
Trust me, mischievous Machiavel
Thou'lt find a dreary coast,
Where, damped the philosophic fire,
Neglected genius will retire,
And all thy fame be lost.

"Politics will spoil the man
Formed for a more exalted plan.
Great Nature bids thee rise,
To pour fair science on our age,
To shine amidst the historic page,
And half unfold the skies.

"But if thou crush this vast design,
And in the politician's line
With wild ambition soar,
Oblivion shall entomb thy name,
And from the rolls of future fame
Thou'lt fall to rise no more."

The Rev. Jonathan Odell, also a loyalist, contributed to Rivington's *Royal Gazette*, of New York, for September 8, 1779, a long poem on "The Word of Congress," which contains the following:

"There dwelt in Norriton's sequestered bowers
A mortal blessed with mathematic powers.
To whom was David Rittenhouse unknown?
Fair Science saw and marked him for her own.
His eye creation to its bounds would trace,
His mind the regions of unbounded space.
Whilst thus he soared above the starry spheres,
The word of Congress sounded in his ears;
He listened to the voice with strange delight,
And swift descended from his dazzling height;
Then mixing eager with seditious tools,
Vice-President-elect of rogues and fools,
His hopes resigned of philosophic fame,
A paltry statesman Rittenhouse became."

Though the public affairs with which he was associated would have been sufficient to have exhausted the energies of a man of even more than ordinary abilities, and must necessarily have engrossed much of his attention, it must not be supposed that he abandoned his astronomical and philosophical studies. At the suggestion of Colonel Timothy Matlack, the Assembly, in April, 1781, granted him £250 for an observatory, which he erected probably at that time in the yard attached to his residence, at the northwest corner of Seventh and Arch streets, in Philadelphia, and which Lalande says in his *Astronomie* in 1792 was the only one in America. The publications of the American Philosophical Society contain between the years 1780 and 1796 no less than seventeen papers written by him upon optics, magnetism, electricity, meteors, logarithms and other mathematics, the improvement of time-keepers, the expansion of wood by heat, astronomical observations upon comets, transits, and eclipses, and similar abstruse topics. Even during the trying period of 1776, 1777, and 1778, while these publications were suspended, and the war was surging around his own home, he and Smith, Lukens, and Biddle found time to

note some observations upon a transit of Mercury and two eclipses of the sun. Within a week after the evacuation of Philadelphia by the British, Rittenhouse was in the city, seated by his telescope, watching an eclipse. In 1776 he wrote a defense of the Newtonian system for the *Pennsylvania Magazine*, and in 1782 invented a wooden hygrometer. From 1779 to 1782 he was Professor of Astronomy in the University of Pennsylvania, and also a trustee and vice-provost of the same institution.

In this connection an interesting incident is narrated in the *Life and Times of Dr. William Smith*. The announcement of the death of Franklin was brought by a messenger to a party of gentlemen consisting of Thomas McKean, Henry Hill, Thomas Willing, Rittenhouse, and Dr. Smith, who were dining with Governor Thomas Mifflin at the Falls of Schuylkill. A fierce thunder-storm happened to be raging at the same time. Impressed by the event and the circumstances under which they heard it, Smith wrote at the table this impromptu:

"Cease, cease, ye clouds, your elemental strife!
Why rage ye thus, as if to threaten life?
Seek, seek no more to shake our souls with dread!
What busy mortal told you Franklin's dead?
What though he yields at Jove's imperious nod,
With Rittenhouse he left his magic rod!"

He succeeded Franklin as president of the American Philosophical Society upon the death of the latter in 1790. He was elected a fellow of the Academy of Arts and Sciences of Boston in 1782; the College of New Jersey gave him the honorary degrees of Master of Arts in 1772, and Doctor of Laws in 1789; the College of William and Mary, in Virginia, gave him the honorary degree of Master of Arts in 1784, designating him as *principem philosophorum*; but the highest distinction of this character he ever received, and the highest in the world then attainable by a man of science, was his election as a foreign member of the Royal Society of London in 1795.

One of the closing events in the life of Rittenhouse has frequently been the subject of adverse criticism. The French people were then in the throes of their Revolution. The assistance given by France at the critical period of our war for independence, and the fact that she was now apparently in a death-struggle in an effort to secure her own liberties, appealed most

forcibly to the sympathies of the American people.

Genet, a warm-blooded and, as it proved, a not very discreet young Frenchman, was sent as minister from the republic to this country. When the news came of his arrival at Philadelphia, where Congress was sitting, a meeting of citizens was called in Independence Square, and Rittenhouse was appointed chairman of a committee to draft resolutions. These resolutions, a little glowing in their tone, but carefully drawn so as not to conflict with the American position of neutrality, declared the cause of France to be that of the human race, and expressed the strongest sympathy with her in her struggles for "freedom and equality," as well as attachment, fraternal feeling, and gratitude. The assemblage then formed in line, and walked three abreast around to the City Tavern, where they presented their address to Genet, who said the citizens of France would consider that day as one of the happiest in the career of the infant republic. Democratic societies, whose *raison d'être* was in the main hostility to England and sympathy for France, sprang into existence all over the United States, and one was organized in Philadelphia, with Rittenhouse as president. Among its members were A. J. Dallas, Peter S. Duponceau, Colonel Clement Biddle, Benjamin Rush, Cæsar Rodney, B. F. Bache, Stephen Girard, George Logan, Cadwalader Morris, and others of the most distinguished residents of the city. Doubtless the French example and party zeal somewhat heated their imaginations, and they took strong ground concerning the pending European struggle. They resolved to use no address save that of "Citizen," to suppress the polite formulas of ordinary correspondence, and to date their letters from the 4th of July, 1776. Rittenhouse had no participation in these grave trifles, and increasing infirmities having prevented him from attending the meetings, he within a year resigned the presidency. He did not withdraw, however, in time to save his reputation from political attack, and Cobbett, the porcupine, as he called himself, of the day, says, fiercely: "This Rittenhouse was an atheist. . . . How much he received a year from France is not precisely known. The American Philosophical Society is composed of a nest of such wretches as hardly ever met together before; it is impossible to find words to de-

scribe their ignorance or their baseness." Later generations of men have not been prone to look at the French Revolution through the lens of Burke, and the fact that the Democratic party came into power at the close of the administration of John Adams did much to whiten the work of the earlier democratic societies, and to make it appear that Rittenhouse and his friends had only been a little in advance of the current.

The few remaining years of his life were spent in comparative retirement, during which the physical difficulties he had been laboring under from youth gradually cumulated, and his power of resistance diminished. He died on the 26th of June, 1796, his last words being an expression of gratitude to a friend for some slight attention, and of confidence in the future—"You have made the way to God easier."

There is a bust of him from life by Ceracchi, and a portrait by Peale. Dr. Benjamin Rush read a eulogy before the American Philosophical Society in the presence of the President and Congress of the United States, the Legislature of Pennsylvania, foreign ministers, judges, and men of learning of the time. One of the city squares bears his name. His home on Arch Street was long known as "Fort Rittenhouse," because, pending a dispute as to jurisdiction between Pennsylvania and the United States in 1809, it was guarded for three weeks by State militia to prevent the service of a mandamus issued by the Federal courts.

Though he had never received any regular training, his attainments were extensive. In addition to the classics, he mastered the French, German, and Dutch languages. From the German he translated the drama of *Lucia Sampson*, published by Charles Cist, and the *Idyls of Gesner*; and in the *Columbian Magazine* for February, 1787, is a copper-plate print of the Ohio Pyle Falls from one of his sketches. A man of culture said he was never in his presence without learning something. He elicited the admiration of all the great men of his day, unless it be John Adams, who could find no remarkable depth in his face, called him an anchorite, and sought perhaps to disparage his reputation by alluding sharply to Philadelphia as "the heart, the censorium, the pineal gland of the United States." In person he was tall and slender, and the expression of his countenance was soft

and mild. He had such a nice sense of honor that he refused to invest in the loans of the State while he was Treasurer, and when compelled to pay certain extravagant bills for the Mint, had them charged against his own salary. His modesty, partly due, doubtless, to the repression and religious seclusion through which his forefathers had for centuries passed, and partly to certain apparently feminine traits in his character, amounted to a diffidence which was his chief defect. His tender sympathies went out to all of his fellows, and were catholic enough to embrace the negro slaves and the Conestoga Indians who had fallen a prey to the vengeful instincts of the border. His tastes were simple and plain, his wants few, and his greatest pleasures were found within the circle of his own home. No higher tribute was ever accorded to hu-

man rectitude than was offered to him by the author of the Declaration of American Independence. "Nothing could give me more pleasure," wrote that statesman in a private letter to his daughter Martha, "than your being much with that worthy family, wherein you will see the best examples of rational life, and learn to imitate them."

Such was the career and such the character of David Rittenhouse. When, a few years ago, Pennsylvania was called upon to place in the Capitol at Washington the statues of her two worthiest sons, she ought to have taken her warrior Wayne, and beside him set her philosopher Rittenhouse, who in his ancestry best represents that quiet and peaceful religious thought which led to her settlement, and in himself the highest intellectual plane she has yet reached.

LOVE AND DEATH.

BEING THE STORY OF THE PRINCESS SAVITRĪ.

(FROM THE THIRD BOOK OF THE MAHÁBHĀRATA.)

THE story of SavitrĪ—of which there is here for the first time translated from the Sanskrit the more interesting and poetical portion—occurs as an episode in the Vana Parva of the *Mahābhārata*, toward the conclusion of that book. It is recounted by the sage Markandeya to the Paudu princes, then sojourning in the Great Forest, as an example of what may be accomplished by a virtuous woman inspired by "love that stronger is than death." The original, with its curious pictures of antique times, is older than Homer.

Markandeya told them how there was once a good and famous King of the Mādras who enjoyed every happy fortune except the possession of offspring. The lack of children saddened his declining years, and he sought by penances and religious observances to obtain the favor of Brahmā in this regard. His prayers were heard, and his Queen bore him a daughter, who was named SavitrĪ. She grew up beautiful as Lakshmi, the Goddess of Grace and Prosperity, and as pure in heart and sweet in nature and manners as she was fair. None of the neighboring kings or princes ventured to aspire to the hand of so surpassing a damsel, so her royal father left the choice of a husband to herself.

The Princess, with this view, quitted her home for a time, travelling in a golden chariot, escorted by many attendants, and after some wandering entered a wooded country, where she met the Prince Satyavān, son of King Dyumutsena, who was living there in retirement, amid pious observances, his father, who was blind, having been driven from his throne. The Prince and Princess fell in love with each other, and she returns home to communicate the news of her choice. At her father's palace she meets a holy seer, Narada, who, upon learning the name and lineage of the lover to whom SavitrĪ has betrothed herself, bewails her selection. He admits that Satyavān is as deserving as he is handsome and manly, a Prince in every way noble, generous, and valiant, true to all duties and tender in all relations of life. But a fatal shadow darkens the youth of SavitrĪ if she unites herself with him. The Prince is doomed to die on the first anniversary of his wedding day, and no care, no caution, no affection, will be able to avert such a doom. This awful warning is confided to SavitrĪ and her father only. The latter entreats his daughter to make another and happier choice, but the Princess answers that in giving her heart and pro-