David Rittenhouse | Encyclopedia.com

(*b*. Paper Mill Run, near Germantown, Pennsylvania, 8 April 1732; *d*. Philadelphia, Pennsylvania, 26 June 1796)

technology, astronomy, natural philosophy.

Rittenhouse, the son of Matthias and Elizabeth Williams Rittenhouse, was raised on his father's farm in Norriton, about twenty miles north of Philadelphia. His paternal ancestry was German Mennonite and maternal, Welsh Quaker, but no strong denominational loyalty was encouraged in his home. In his mature years, Rittenhouse maintained a Presbyterian Church membership. His education was largely informal, and he was regarded as self-taught. On 20 February 1766 he married Eleanor Coulston, by whom he had two daughters; following her death, he married Hannah Jacobs toward the end of 1772. Rittenhouse's health was seldom good but seldom seriously impaired, the primary difficulty probably being a duodenal ulcer. Except for the wartime occupation, surveying expeditions, and summers in Norriton, he spent most of his life after 1770 in Philadelphia.

As one of the leading Philadelphia mechanics, Rittenhouse played an important role in the American Revolution. He participated in formulating the radical Pennsylvania Constitution of 1776 and served on the Board of War and as vice-president of the Council of Safety—with occasional responsibility for executive leadership of the state. From 1777 through 1789 he was treasurer of Pennsylvania.

Basically, Rittenhouse was a maker of clocks and mathematical instruments. His long-case clocks were novel not in their mechanism but in their fine workmanship. Three included small orreries, one had only a single hand, and his astronomical clock used a compensation pendulum of his own design. His masterpieces in clockwork were two large orreries in which he achieved beauty and a high degree of precision. Rittenhouse's instruments, many of which have been preserved, were superior to those previously produced in America. He made surveyors' compasses, levels, transits, telescopes, and zenith sectors as well as thermometers, barometers, at least one hygrometer, and occasional eyeglasses. He made early use of spider webs for cross hairs in telescopes, and he erected a collimating telescope in his observatory. Rittenhouse's fine surveying instruments were used for laying out national boundaries years after his death. Because he constructed vernier compasses, they became known in America as Rittenhouse compasses; and his improvement on Franklin's Pennsylvania fireplace was called the Rittenhouse stove.

Most of Rittenhouse's science and much of his nonpolitical service were closely related to his making of clocks and instruments. Starting as a manufacturer of surveying instruments, he became the most celebrated American surveyor, serving on commissions that marked portions of Pennsylvania's boundaries with Maryland, New Jersey, New York, and what became the Northwest Territory, and portions of New York's boundaries with New Jersey and Massachusetts. Beginning in 1773, Rittenhouse supplied the astronomical calculations for almanacs in Pennsylvania, Maryland, and Virginia. During the Revolution he helped to design the Delaware River defenses and worked on the production of saltpeter and guns—including experimentation with telescopic sights for rifles and rifled cannon. He provided informed advice when Thomas Jefferson was working out his report on weights and measures; and as first director of the U.S. Mint (1792–1795), he produced and put into operation machinery that was new to him but for which his clockmaking career had prepared him.

Astronomy was Rittenhouse's primary scientific study, a pursuit to which he moved easily from his orreries, telescopes, and surveying. He began to study mathematics and science at an early age, first attaining recognition in the observation of the transit of Venus of 1769, which was important because of worldwide efforts to establish the sun's parallax. On this occasion Rittenhouse emerged as the leading figure in the American Philosophical Society's observations and in its initial volume of *Transactions*. He made many of the instruments and assembled all of those used by the Norriton observation group; he carried through key related observations and projections and contributed to the best American calculation of the parallax. Rittenhouse established a Philadelphia observatory, where he kept daily records and conducted regular observations, publishing data and calculations on meteors, comets, Jupiter's satellites, Mercury, Uranus (following its discovery), and various eclipses. In calculating planetary orbits and positions, he worked out some solutions of his own. Rittenhouse's mathematical work was largely related to the study of astronomy, his best paper being an original solution for finding the place of a planet in its orbit. He also devised an arithmetical method for calculating logarithms and published a paper on the sums of (he several powers of the sines—an offshoot of a study of the period of a pendulum.

Rittenhouse's other work in science was experimental, except for descriptive accounts of the effects of lightning and a few papers on meteorology, geology, and aspects of natural history that he published in magazines. He experimented with various compensation pendulums, with the expansion of steel, and with the expansion of wood—for which he obtained good values. After familiar experiments with magnetism, Rittenhouse produced a very clear statement of the concept of magnetic dipoles. In an investigation of diffraction, he constructed plane transmission gratings, using fine wire across a frame. With one of these gratings he observed six orders of spectra, obtained good values for their angular displacement and clearly stated the law governing their displacement. Rittenhouse also studied and correctly reported the primary causes of the illusion of reversible relief. This work was picked up and passed into subsequent literature after his death. Even this paper, however, was characteristic of most of his work, in that it represented an isolated study, not part of a continuing dialogue or investigation.

Rittenhouse succeeded Franklin as president of the American Philosophical Society, which he strengthened in its role as a platform of science; nearly all of his scientific papers were published in its *Transactions*. His craftsmanship supported science by providing precise scientific instruments. More directly, he contributed data and new information as well as several fruitful ideas in fields now widely separated. Although he wrote occasional speculative and mathematical pieces and others on the history of science, his scientific contributions were almost wholly observational and experimental.

BIBLIOGRAPHY

I. Original Works. All of Rittenhouse's papers, unless otherwise noted, are in *Transactions of the American Philosophical Society*. His papers on the transit of Venus are "Projection of the Ensuing Transit of Venus," in *Transactions*, **1** (1771), 4; "Observations at Norriton," *ibid*., 13–22; "Account of the Contacts," *ibid*., 26–28; "Delineation of the Transit of Venus," *ibid*., 36–38; and [Method of Finding Parallax], *ibid*., appendix, 59–60.

Other astronomical papers are "Observations on the Comet," in *Transactions*, **1** , 37–45; "An Easy Method of Deducing the True Time of the Sun's Passing the Meridian," *ibid*., 47–49; "Account of a Meteor," *ibid*., **2** (1786), 173–176; "New Method of Placing a Meridian Mark," *ibid*., 181–183; "Observations of a Comet," *ibid*., 195; "Astronomical Observations," *ibid*., 260–263; "Astronomical Observations," *ibid*., **3** (1793), 153–155; and "An Account of a Comet," *ibid*., 261.

His mathematical papers are "A Method of Finding the Sum of the Several Powers of the Sines," in *Transactions*, **3** , 155–156; "To Determine the True Place of a Planet," *ibid*., **4** (1799), 21–26; and "Method of Raising the Common Logarithm," *ibid*., 69–71.

His experimental papers are "Explanation of an Optical Deception," in *Transactions*, **2** , 37–42; "An Account of Some Experiments in Magnetism," *ibid*., 178–181; "An Optical Problem," *ibid*., 202–206; "On the Improvement of Timekeepers," *ibid*., **4** , 26–28; and "On the Expansion of Wood by Heat," *ibid*., 28–31. The orrery paper is "A Description of a New Orrery," in *Transactions*, **1** (1771), 1–3.

On lightning and electricity, he wrote "Account of Several Houses in Philadelphia Struck With Lightning," in *Transactions*, **3** , 119–122, with John Jones; "An Account of the Effects of a Stroke of Lightning," *ibid*., 122–125, with Francis Hopkinson; and "Experiments on the *Gymnotus electricus*," in *Philadelphia Medical and Physical Journal*, **1** , pt. 2 (1805), 96–100, 159–161.

His papers on natural history are in *Columbian Magazine*, **1** (1786–1787), 49–53, 284, 301–303. His essay on the history of astronomy is *An Oration* (Philadelphia, 1775). Locations of MSS and of clocks and instruments are in Hindle (below).

II. Secondary Literature. The most recent biography is Brooke Hindle, *David Rittenhouse* (Princeton, 1964). William Barton, *Memoirs of the Life of David Rittenhouse* (Philadelphia, 1813), is of continuing value for its insights and for excerpts of letters now lost. The most important evaluations of aspects of Rittenhouse's science are Thomas D. Cope, "The Rittenhouse Diffraction Grating," in *Journal of the Franklin Institute*, **214** (1932), 99–104; and W. Carl Rufus, "David Rittenhouse as a Mathematical Disciple of Newton," in *Scripta mathematica*, **8** (1941), 228–231.

Brooke Hindle