



## STARS OF DESTINY

**A**MONG THE PRACTICAL MEN OF VISION in our country's history is one who left a career of science for his duty to his country and became great in both. This man was David Rittenhouse—astronomer, mathematician and patriot. David Rittenhouse came into the world April 8, 1732. His great grandfather, a Dutchman, had already established the first paper manufactory in America. It can still be seen today in Fairmont Park, Philadelphia, where Paper Mill Run flows into the Wissahicken Creek. And in a house adjoining this mill, David

Rittenhouse was born. That same year his father moved to a farm at Norriton, Pennsylvania.

There on the farm young David Rittenhouse grew up. His first great decision came when he was only fourteen—an age at which most boys had given scant thought to the stars of destiny. It happened one afternoon in his mother's kitchen. His mother was busy cooking supper. His father had just stormed angrily in from the farm yard. . . .

MR. RITTENHOUSE: Where's David?

MRS. RITTENHOUSE: He's out fetching some wood for the fire.

MR. RITTENHOUSE: It's good he's doing something useful!

MRS. RITTENHOUSE: He's always doing something useful. He's a hard worker and you know it. What have you got your Dutch up about now?

MR. RITTENHOUSE: You can save your opinions about the Dutch. They're the only race could make a living with so many of your Welsh around here.

MRS. RITTENHOUSE: The Welsh know a good bargain when they see it. That's why I married you.

MR. RITTENHOUSE: No use trying to get around me with that.

MRS. RITTENHOUSE: What's wrong with Davy?

MR. RITTENHOUSE: You'll hear when I see him.

MRS. RITTENHOUSE: Well, here he comes. But whatever it is, I'm on his side. Come in, Davy.

DAVID RITTENHOUSE: Here's your wood, ma. Hello, father. Feels like rain.

MRS. RITTENHOUSE: That isn't rain. It's just your father looking like a thunder cloud. Shut the door, Davy.

DAVID RITTENHOUSE: Yes, ma. I hope it doesn't rain till tomorrow.

MR. RITTENHOUSE: David, what do you mean wasting your time when there's so much work to be done?

DAVID RITTENHOUSE: I don't remember wasting any time, father.

MRS. RITTENHOUSE: How do you know he was wasting his time? Haven't you got anything better to do than snoop around on Davy?

MR. RITTENHOUSE: I didn't have to snoop. There's plenty of evidence on every building around here. They're covered with numbers and drawings. Even the woodshed's full of them!

DAVID RITTENHOUSE: That's why I hope it won't rain tonight. I have a calculation on the spring house that's only half finished. It's only written in charcoal, you know.

MRS. RITTENHOUSE: What's only written in charcoal?

MR. RITTENHOUSE: Figures and nonsense! I couldn't make head nor tail of it.

DAVID RITTENHOUSE: Well, neither can I with

some of it. But I will. Where did you put Uncle's book of Newton, ma? That "Principia."

MRS. RITTENHOUSE: It's there on the shelf.

MR. RITTENHOUSE: Elizabeth, I knew those things your brother left David would take his mind off his work.

DAVID RITTENHOUSE: I only need my body for most of the work I do. I let my mind go over Newton's "Principia."

MR. RITTENHOUSE: I suppose you don't have to quit work to write all that stuff on the buildings.

DAVID RITTENHOUSE: No, father. I write that at lunch time, or when the horses are resting at the plow, or while I drive the cattle home from pasture.

MR. RITTENHOUSE: How about the woodshed?

DAVID RITTENHOUSE: I keep my most important work there out of the weather. But I only write it down while I'm catching my breath.

MRS. RITTENHOUSE: He brings in all the wood we need. Now you let Davy do all the figuring he has a mind to.

MR. RITTENHOUSE: I don't take no stock in it.

MRS. RITTENHOUSE: Well, what of it—so long as Davy does? You're mighty proud of it too, Matthias. I notice you've still got that water mill model he made when he was only eight years old.

DAVID RITTENHOUSE: Now I've got Uncle's tool chest, I can make almost anything. I wish I had more time to give to making things.

MRS. RITTENHOUSE: What would you like to make, Davy?

DAVID RITTENHOUSE: I think I'd like to make clocks.

MR. RITTENHOUSE: Why clocks?

DAVID RITTENHOUSE: Because people need them, and can't get them. I could make a shop in one end of the woodshed.

MR. RITTENHOUSE: But I need you on the farm.

MRS. RITTENHOUSE: He'll be good at that kind of work, Matt. Let him do it.

DAVID RITTENHOUSE: I'll be on the farm when you need me most. But I can make clocks in winter and they'll bring in money when we have a bad year.

MRS. RITTENHOUSE: Well, Matthias? Is that practical enough to suit you?

MR. RITTENHOUSE: All right, Davy—Give it a try. . . . But don't forget your chores.

DAVID RITTENHOUSE: Yes, father!

As the years passed by, the name of David Rittenhouse on fine clocks drew the attention of many celebrated men. When his brother-in-law, the Reverend Thomas Barton, became a professor in the College of Philadelphia, now the University of Pennsylvania, he introduced David to Dr. Smith, Provost of the College. Rittenhouse was then only 31 years old. Dr. Smith was greatly impressed. And one day, as David was tinkering in his shop, a knock was heard on the

door. Rittenhouse invited the caller inside and was surprised to discover that Dr. Smith had brought a friend.

DAVID RITTENHOUSE: Why, Dr. Smith! Come right on in. I'm glad to see you.

DR. SMITH: Thanks, David. . . . I've brought a friend with me. Mr. John Lukens, Surveyor-General of the Province.

DAVID RITTENHOUSE: How do you do, sir?

JOHN LUKENS: Delighted to make your acquaintance, Mr. Rittenhouse.

DR. SMITH: I hope the new clock is ready. I'm eager to see it.

DAVID RITTENHOUSE: You're just in time, then. I was testing the chimes.

DR. SMITH: We heard them. But what is this on the dial? It looks like the sun and moon.

DAVID RITTENHOUSE: That's what they are—and all the planets. I figured out a planetary machine that works with the time pieces.

DR. SMITH: I've read of something like this being owned by the Earl of Orrery in England. Named after him.

DAVID RITTENHOUSE: Yes. The Orrery. I hope to make a better one than his some day.

DR. SMITH: What? Ah, yes. Of course. But this clock is most ingenious, isn't it, Lukens?

JOHN LUKENS: (*skeptically*) Ye-es. But will it keep good time?

DAVID RITTENHOUSE: I'll guarantee it's absolutely accurate.

JOHN LUKENS: Indeed? And how do you know that?

DAVID RITTENHOUSE: I've checked it against the movements of the heavenly bodies themselves.

DR. SMITH: Why, David, that would take astronomy!

JOHN LUKENS: (*amused*) Who ever heard of a clock-maker being an astronomer?

DAVID RITTENHOUSE: You did, sir, the moment you heard of me. A clock must measure the same time measured by the sun and moon. So I taught myself astronomy. That's how I got the data for the planetary machine here.

JOHN LUKENS: You certainly go to a lot of trouble to make a clock.

DAVID RITTENHOUSE: Not to make a good clock. And I find a great deal of pleasure in astronomy.

JOHN LUKENS: Astronomy would make surveying easy for you.

DAVID RITTENHOUSE: And accurate. Only by using astronomy can we find the exact latitude and longitude of any place on earth. The trouble is that now we have only places on maps. Nobody knows where they are on the actual ground.

DR. SMITH: That's a good way to explain it. No wonder the colonies are in endless boundary disputes!

DAVID RITTENHOUSE: Exactly, sir. Every man knows he has a farm, but no man knows where on Earth it is!

DR. SMITH: That's the trouble with the suit Pennsylvania and Maryland have been fighting for 20 years in the British Court of Chancery. Even now that it's settled, they still don't know where their boundaries are on the ground.

JOHN LUKENS: We soon will. Mr. John Penn has ordered us to anticipate the findings of the court's commissioners by making our own survey.

DR. SMITH: Indeed? And when will you start?

JOHN LUKENS: As soon as Mr. Rittenhouse is ready.

DAVID RITTENHOUSE: Sir?

JOHN LUKENS: I rode out with Dr. Smith today to see if you would undertake to survey the boundary lines between Pennsylvania and Maryland.

DAVID RITTENHOUSE: But what will become of my work here?

DR. SMITH: It will still be here, David, when you come back.

DAVID RITTENHOUSE: But there is still another reason.— No, I'm afraid I can't do it.

JOHN LUKENS: (*slightly sarcastic*) Of course, the northern boundary of Delaware does present an

awkward problem. Surveying the circumference of a circle with a radius 12 miles from Newcastle is something new to our geometry.

DAVID RITTENHOUSE: It isn't that, sir.

DR. SMITH: Whatever it is, I'm sure David has a good reason.

DAVID RITTENHOUSE: The truth is, gentlemen, there's a young lady, the daughter of a neighboring farmer, Miss Eleanor Colston.—We were planning to be married. I can't take a wife on a surveying trip.

DR. SMITH: I'm sure she'll wait for you, David.

JOHN LUKENS: And you will have fame and honor to offer her then.

DR. SMITH: You surely cannot refuse this service to the Province.

DAVID RITTENHOUSE: Well, gentlemen, if you put it that way. All right, Mr. Lukens. I'll go.

JOHN LUKENS: Good. The Proprietor will thank you, sir.

The result of the surveying expedition won the clock-maker a bonus. The line David Rittenhouse surveyed as the boundary between Pennsylvania, Delaware, and Maryland, was later checked and found astronomically correct by two commissioners sent out from England. Their names were Mason and Dixon. Moreover, Rittenhouse was the first to actually measure one degree of the meridian on this earth. The work took several months, and the instruments

Rittenhouse used he made himself. The next year he married Miss Eleanor Colston and they lived on the farm at Norriton which his father had turned over to him. One evening in 1767, Rittenhouse was working late in his shop, when his wife entered.

ELEANOR RITTENHOUSE: Why, David Rittenhouse, what on earth are you doing? I called you to supper an hour ago.

DAVID RITTENHOUSE: Sorry, Eleanor, I'm putting the finishing touches on my Orrery. You remember the invention of the Earl of Orrery? Not that this is an Orrery, really. It's much more like the real thing.

ELEANOR RITTENHOUSE: What real thing?

DAVID RITTENHOUSE: The solar system.

ELEANOR RITTENHOUSE: That machine?

DAVID RITTENHOUSE: Yes, dear. It reproduces the movements of all our planets and their satellites exactly in the proper relations.

ELEANOR RITTENHOUSE: At what time?

DAVID RITTENHOUSE: Why, at any time you want. It'll show their exact position as it was or will be any time within 5000 years.

ELEANOR RITTENHOUSE: Let me feel your forehead, David. You must be feverish.

DAVID RITTENHOUSE: Well, I am a little excited, Eleanor. The Earl of Orrery just had a toy that showed a few globes going around in circles. But my machine places all the planets in the proper ellipses

and conforms to Kepler's completed theory originated by Copernicus.

ELEANOR RITTENHOUSE: What on earth are you talking about?

DAVID RITTENHOUSE: About my Orrery.

ELEANOR RITTENHOUSE: I think you'd better come get your supper. You're getting light-headed.

DAVID RITTENHOUSE: All right, dear. Just a moment. I want to show you how it works. You see the motions of this main face here are registered on dials that give the exact relationships to the year, month, and day.

ELEANOR RITTENHOUSE: Any day in 5000 years?

DAVID RITTENHOUSE: Yes. And incidentally, notice where I have it now. At the time of the birth of our Saviour. See how the three planets (*the planetarium can authenticate this*) come together in conjunction. In Judea it must have looked like a very large bright star.

ELEANOR RITTENHOUSE: Everybody knows about the Star of Bethlehem.

DAVID RITTENHOUSE: Yes. But not everyone knows it might have been composed of these three planets.

ELEANOR RITTENHOUSE: What are these other two faces for?

DAVID RITTENHOUSE: This one shows the moon and its monthly eclipses. This other shows the move-

ments of Jupiter and his moons, and Saturn with his ring and satellites.

ELEANOR RITTENHOUSE: I can't believe it.

DAVID RITTENHOUSE: But you can see it . . . Look—I'll make it work for you. . . . See them revolving? And there the moon goes from the quarter to the full.

ELEANOR RITTENHOUSE: Yes. It works all right. But now I can't believe a human being could make it—not even you.

DAVID RITTENHOUSE: You can be sure it didn't just pop together by itself, Eleanor.

ELEANOR RITTENHOUSE: What are you going to do with it?

DAVID RITTENHOUSE: The College of New Jersey at Princeton wants to buy it.

ELEANOR RITTENHOUSE: I should think you'd rather let our own College have it, David.

DAVID RITTENHOUSE: I'll make another for them. Just now we need all the money we can get.

ELEANOR RITTENHOUSE: What for?

DAVID RITTENHOUSE: I want to move into town where I can be close to things.

ELEANOR RITTENHOUSE: But, David. We've always lived on a farm. I'd be afraid to live in town.

DAVID RITTENHOUSE: Well, I could use the money to build an observatory out here.

ELEANOR RITTENHOUSE: An observatory? What on earth do you want to observe?

DAVID RITTENHOUSE: Nothing on *earth*. I want to observe the heavens. There'll be a transit of Venus across the Sun in 1769. I want to see it.

ELEANOR RITTENHOUSE: All right, David. If you want to, I think you should. You seem to know so much about stars and such things—but you don't know how to take care of yourself. Now, come to supper.

DAVID RITTENHOUSE: All right, my dear. I'll do whatever you say.

ELEANOR RITTENHOUSE: But, David, I really am proud of you. Don't let anything turn you aside, not even me. Follow your star.

When Rittenhouse finished his Orrery, which was the mechanical forerunner of our modern marvel, the Planetarium, he took it to the great scientific organization called the American Philosophical Society, whose president was Benjamin Franklin. As Franklin was absent in London on business for the Colonies, another member of the society, Thomas Jefferson, looked at the machine. He had nothing but praise for its creator.

THOMAS JEFFERSON: Mr. Rittenhouse, as an artist, you have established as great a proof of mechanical genius as the world has ever produced.

DAVID RITTENHOUSE: Mr. Jefferson, your praise embarrasses me.

THOMAS JEFFERSON: But it's well deserved. Your friend, Provost Smith, tells me you have plans for observing the Transit of Venus?

DAVID RITTENHOUSE: Yes. Conditions for this rare phenomenon will be perfect here.

THOMAS JEFFERSON: What special advantage, except the honor, will there be in seeing this?

DAVID RITTENHOUSE: By taking sights on Venus as it passes across the body of the Sun, we can figure more exactly the solar parallax, and find out how far the Earth is from the Sun.

THOMAS JEFFERSON: What places have been selected for official observation?

DAVID RITTENHOUSE: The astronomers in Europe have sent expeditions to Lapland, Hudson's Bay, California territory and Peking.

THOMAS JEFFERSON: And none to these Colonies?

DAVID RITTENHOUSE: No. Though conditions are best here in our Province. I'm building an observatory of my own at Norriton.

THOMAS JEFFERSON: We must build another near the Philosophical Society in State House Square.

DAVID RITTENHOUSE: But where will you get the equipment for it? Telescopes, micrometers, timekeepers, many things. I've had to make my own.

THOMAS JEFFERSON: We must and shall do our best to give America her proper place in the world of science.

The Pennsylvania State Legislature voted money. Benjamin Franklin sent a telescope from London. On the day of the Transit of Venus across the Sun, conditions were perfect. Rittenhouse was assisted at Norriton by Provost Smith and John Lukens. At the State House Square other scientists watched. At a third point, Cape Henlopen in Delaware, Oren Biddle observed through another telescope. At first, the findings of Rittenhouse were ignored in Europe because they were at variance with the preconceived ideas there, but when all the reports were in, he was found to have computed the exact average of all readings, placing the Sun 96 millions of miles distant from the Earth. That same year he again distinguished himself, this time in the field of physics. One evening he burst into the house with a new apparatus.

DAVID RITTENHOUSE: Eleanor! Eleanor! Where are you?

ELEANOR RITTENHOUSE: Land sakes, David. What's a-fire?

DAVID RITTENHOUSE: Nothing but the Sun, Eleanor. And I can measure every degree of it here with this. Look!

ELEANOR RITTENHOUSE: Nonsense, David. You can't measure temperature without mercury. Even I know that. And there's no mercury in that thing.

DAVID RITTENHOUSE: But Eleanor, you know that metal expands with heat and contracts with cold.

ELEANOR RITTENHOUSE: Yes. I know that.

DAVID RITTENHOUSE: Well, this is a metallic thermometer.

ELEANOR RITTENHOUSE: Your eyesight's better than mine if you can see metal expanding.

DAVID RITTENHOUSE: I've devised an instrument to do that for me. The change in the metal moves a hand on this dial here. It's marked in degrees Fahrenheit. Look. See, it shows a rising temperature as I bring it closer to the fire.

ELEANOR RITTENHOUSE: How do I know that's the right temperature?

DAVID RITTENHOUSE: Here is a mercury thermometer. They have the same reading.

ELEANOR RITTENHOUSE: Well, I'm past being surprised by you any more, Davy. But what put it into your head?

DAVID RITTENHOUSE: I had to find some way to make clock pendulums that wouldn't change their length with changes of temperature. This is the same principle.

ELEANOR RITTENHOUSE: You have so many inventions, Davy. I think we ought to move into town now, if you still want to.

DAVID RITTENHOUSE: I do, but we can't afford it. It costs more money to live in town. Until the heavens provide enough money, we'll have to continue to live off the ground. Is that someone knocking?



ELEANOR RITTENHOUSE: Yes. Who can that be? Come in!

DAVID RITTENHOUSE: Dr. Smith! This is a pleasant surprise.

DR. SMITH: Good day, David. Good day, Mrs. Rittenhouse. David, you must prepare to move to town at once. Your personal opportunity and your duty to your fellowmen are both there.

DAVID RITTENHOUSE: But I think I should stay here at Norriton.

DR. SMITH: The choice is no longer yours, David. The State Assembly has chosen for you.

DAVID RITTENHOUSE: I don't understand you, sir.

DR. SMITH: They have made you one of the three commissioners of the Loan-office.

DAVID RITTENHOUSE: What!

DR. SMITH: That's not all. They've given you an outright grant of 300 pounds and appropriated another 400 pounds for a third Orrery double the size of the others.

ELEANOR RITTENHOUSE: David!

DAVID RITTENHOUSE: But, Dr. Smith, why have they done all this?

DR. SMITH: I'd best tell you in their own exact words, David. As "a testimony of the high sense which this House entertains of his mathematical genius and mechanical ability."

DAVID RITTENHOUSE: I'm honored more than I deserve.

DR. SMITH: We feel we are honored to have you one of us.

ELEANOR RITTENHOUSE: At least you can enjoy the company of your scientific friends, in town.

DR. SMITH: You'll be a welcome neighbor for members of the Philosophical Society. It's a great opportunity, David. A great career is opening up before you. Already your reputation is world-wide.

DAVID RITTENHOUSE: And all I wanted to do was to make a good clock.

DR. SMITH: You're making an even better citizen.

But Rittenhouse's enjoyment of work and research in the city was doomed to be short lived. In 1775 he was made a member of the Committee of Public Safety. When Benjamin Franklin was called to the new General Congress, Rittenhouse was elected to take the place he vacated in the State Assembly. He was a member of the State Constitutional Convention and under the new State Constitution he was elected State Treasurer. His public career now took all his time and energy. In the year 1785, when the United States was an independent nation, Benjamin Franklin was Governor of Pennsylvania. One day he called Rittenhouse to a conference.

DAVID RITTENHOUSE: You sent for me, Dr. Franklin?

DR. FRANKLIN: Yes, Mr. Rittenhouse. Your suc-

cess in anticipating Mason and Dixon's Line, and in completing the line between Pennsylvania and Virginia last year, make you a logical choice for a new task.

DAVID RITTENHOUSE: I hope I'm done with surveying, Governor. My duties as commissioner of the new loan-office added to my other offices already prevent me from all scientific research.

DR. FRANKLIN: Without a peaceful and prosperous country there will be no one to benefit from further research.

DAVID RITTENHOUSE: What do you want me to do?

DR. FRANKLIN: Survey the line between our State and New York. As soon as possible. If we do not get our State boundaries settled quickly, our new States will soon be at each other's throats.

DAVID RITTENHOUSE: I'll begin at once, while you draw up the terms of the treaties.

DR. FRANKLIN: Your astronomy, Mr. Rittenhouse, will set the terms. Then our peace will be from Heaven.

As soon as David Rittenhouse had marked the 43rd parallel on the ground between the Empire and the Keystone States, the Congress of the Confederation had him survey the land disputed between New York and Massachusetts. He also surveyed and found practical the route of a canal joining the Schuylkill

and Susquehanna Rivers. He built an observatory in the garden of his city home. He declined re-election as State Treasurer and concluded his service with the loan-office. On Franklin's death, Rittenhouse succeeded him as President of the Philosophical Society, and was elected a member of the Royal Society of London. He hoped at last to continue his long interrupted career in science. But the rise of the new government of the United States made further demands on him in the public service. On July 1st, 1792, he was called to the office of President Washington.

PRESIDENT WASHINGTON: Mr. Rittenhouse, your work as trustee of the Pennsylvania loan-office was very distinguished.

DAVID RITTENHOUSE: Thank you, Mr. President. But I have retired from all State affairs. I think at last I have earned some time for my scientific work.

PRESIDENT WASHINGTON: Earned it, yes, beyond doubt and many times over, but by that very experience, your country has great need of you.

DAVID RITTENHOUSE: I can think of no office that can't be filled better by some one else.

PRESIDENT WASHINGTON: But I can. You alone are best qualified for the new executive office I must appoint today. For 13 years you were treasurer of our richest State. As trustee of its loan-office you made it the most profitable and yet of greatest benefit to the individual of any in America.

DAVID RITTENHOUSE: It seemed imperative, since the loans were the basis of our currency.

PRESIDENT WASHINGTON: Exactly! And our currency is now in great confusion.

DAVID RITTENHOUSE: In point of fact, sir, we have no national currency.

PRESIDENT WASHINGTON: We shall have.

DAVID RITTENHOUSE: To have a currency we must first have a place to coin it.

PRESIDENT WASHINGTON: We'll have our own national mint as soon as it can be built and equipped. I need your help.

DAVID RITTENHOUSE: If I might, I could suggest a man for chief coiner. His name is Henry Voight.

PRESIDENT WASHINGTON: His name's familiar.

DAVID RITTENHOUSE: He is a watch-maker.

PRESIDENT WASHINGTON: A watch-maker for such a position?

DAVID RITTENHOUSE: I am a clock-maker, sir.

PRESIDENT WASHINGTON: Of course! I forgot.

DAVID RITTENHOUSE: But Voight has made bigger things than watches. He made the engine for John Fitch's steamboat. I met him on the trip to Burlington.

PRESIDENT WASHINGTON: Ah, that's where I heard of him. Who else can you suggest for the staff?

DAVID RITTENHOUSE: But why should I select the staff?

PRESIDENT WASHINGTON: Because, Mr. Rittenhouse, I've selected you for the first director of the United States Mint.

DAVID RITTENHOUSE: I appreciate the honor, Mr. President, but I have set my heart on retiring to my observatory and spending my few remaining years in . . .

PRESIDENT WASHINGTON: Mr. Rittenhouse, I understand. But the business of our country, our credit, our prosperity, demand a sound and adequate currency. No one is so well suited for this task as you. I beg this further sacrifice of you. You will accept?

DAVID RITTENHOUSE: When you put it that way, Mr. President, I must accept.

PRESIDENT WASHINGTON: Good. And please accept also my thanks, and the nation's gratitude.

Four years more, and the work of David Rittenhouse, self-taught scientist, was done. But his inventions lived after him—and inspired the minds of many who followed. After his death, in 1796, an unusual tribute was paid to his memory. A memorial service was held in Philadelphia, and a eulogy was delivered in the presence of the Mayor, the City Council, the State Assembly, and the President and the Congress of the United States. It was a fitting last word of praise for a great pioneer scientist and patriot.