

THOMAS PAINE: SCIENTIST-RELIGIONIST

BY RALPH C. ROPER

WHEN the great German-English astronomer, Sir William Herschel, first opened his inquiring eyes on the immense starry heavens (1738), Thomas Paine had already been creeping about, intent on more mundane explorations. He was nine months Herschel's elder. The paths of these newcomers were destined to cross frequently, although I find no evidence that either was aware of the other.

At the age of nineteen, Herschel, with nothing more than a French crownpiece in his pocket, reached London from Hanover. Paine, who had been born in Thetford, had gone to London, where he was eking out less than a fair living. Herschel was a musician; Paine, a staymaker—of ship stays. Later, when the one was conducting concerts, the other was teaching school, and occasionally preaching on the side, as a Methodist.

Both Herschel and Paine became amateur astronomers by studying the same book, Ferguson's *Astronomy*, and by listening to the same scientific and philosophical lectures at the Royal Society. To Sir Joseph Banks, president of the Society, both men submitted reports of their scientific discoveries: Herschel's, dealing with the stars of the Milky Way; and Paine's, showing the use of the arch in the construction of iron bridges. When Herschel was at Sunderland in 1761, dining "at Mr. Walker's," he was at the very same place where Paine's iron bridge—the first iron bridge traveled by commerce—was built over the River Wear, by the Messrs. Walker Foundry.

At about the same time that Herschel received a medal from the Royal Society, in recognition of his brilliant achievements in the field of astronomy, Paine was in Paris receiving the plaudits of the King and Queen of France, who, according to the French historian, Lamartine, "loaded Paine with favors." He had gone there with Colonel Laurens to secure aid for Washington's army. Incidentally, it took sixteen ox-teams to haul from Boston to Washington's headquarters the 2,500,000 livres of silver and a

convoy ship of clothing and military stores, given by France to the colonies. The victory at Yorktown soon followed.

Herschel was given the honorary degree of LL.D. by Oxford University at about the same time that the University of Pennsylvania celebrated the 4th of July by granting to Paine the degree of M.A.

In 1786, Herschel was elected a member of the American Philosophical Society at Philadelphia, of which Paine had been a member for a number of years. He had prepared the preamble to the act incorporating the Society, February 14, 1780, and was Clerk of the Pennsylvania Assembly at the time the act was adopted.

And so ran, in part, the lives of these two "inspired amateurs" of astronomy who came to similar conclusions as to the immensity of the heavens.

The scientific activities of Paine cannot be considered separately from his religious opinions. He always approached the study of science from the viewpoint of religion, and the study of religion from the viewpoint of science. To him, the study of science was the study of God. One cannot rightly understand the scientific and religious views of Paine, nor of Franklin, Jefferson, and other Deists of their time, whether in America, France, or England, unless one realizes that they were essentially nature worshippers—God worshippers through nature. Paine built all his political, religious, and scientific principles upon the laws of nature—the laws of God. Whether occupied in the formation of a democratic constitution, or the founding of a church, or the construction of a bridge, he invariably turned to the laws and principles established by "The Great Mechanic of the Universe," "The God of Order and Harmony."

With the intrepid Thetford staymaker, all science was divine science, since God was "the Creator of Science" and all of its principles. The triangle, gravitation, and the planetary motions were all the creations of the "Almighty Power," "The Creator of the

Universe," "The Original Teacher," and "The First Philosopher."

Our first secretary of foreign affairs and his successor of one hundred and thirty-six years later, William J. Bryan, agreed upon one point, however much they disagreed upon others: that our schools and colleges tend to produce atheists. The Great Commoner, in one of his lectures, charged that the colleges were developing infidelity and atheism. "Why should the children be taught," queried Bryan, "that it is more important to know the age of the rocks than to trust in the 'Rock of Ages'? Why should the emphasis be placed on the distance between the stars than upon Him who binds 'the sweet influence of Pleiades,' 'looses the bands of Orion,' and 'guides Arcturus with His suns'?"

Rising, as it were, from the grave, and speaking again his own words, Paine could have joined the great orator in common protest against the teachers of science: "What has man to do with the Pleiades, with Orion?" asked Paine, picking up almost the very words of Bryan. And then he answered his own question: "The Almighty Lecturer, by displaying the principles of science in the structure of the universe, has invited man to study and to imitation. It is as if He had said to this globe we call ours, 'I have made an earth for man to dwell upon, and I have rendered the starry heavens visible, to teach him science and the arts. He can now provide for his own comfort, AND LEARN FROM MY MUNIFICENCE TO ALL, TO BE KIND TO ONE ANOTHER'."

Continuing in his reasoning, Paine declared that "it has been the error of the schools to teach astronomy and all other sciences and subjects of natural philosophy" as accomplishments of man; whereas, he insisted, these subjects should be taught religiously, "with reference to the *Being* who is the author of them; for all the principles of science are of divine origin. Man cannot make, invent, or contrive principles; he can only discover them, and he ought to look through the discovery to the Author."

To teach science as an accomplishment of scientists (Paine was living in an age far different from ours) is to "generate in the pupils a species of atheism. Instead of look-

ing through the works of creation to the Creator himself, they stop short and employ the knowledge they acquire to ascribe everything they behold to innate properties of matter, and jump over all the rest by saying that matter is eternal."

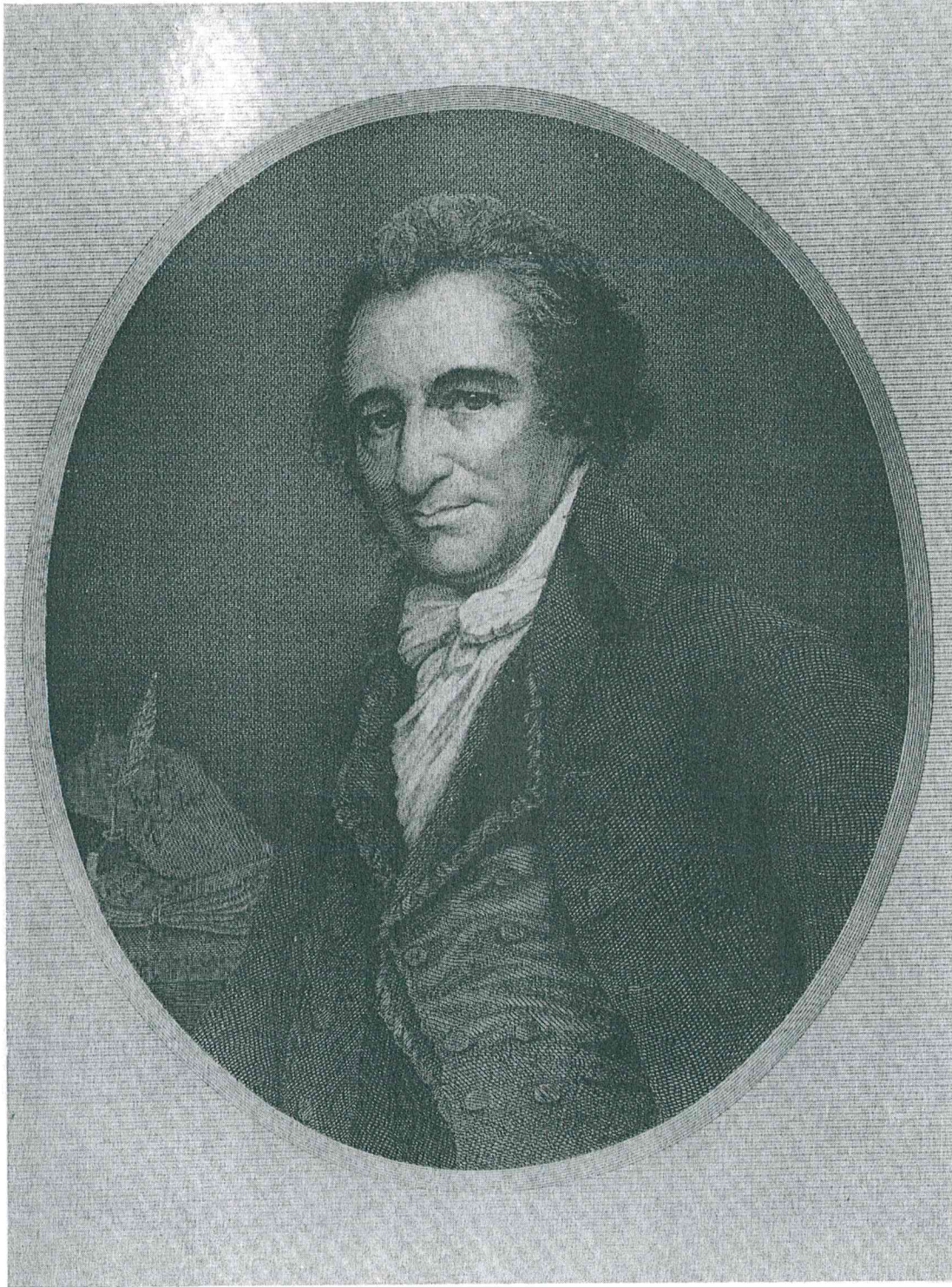
Secular schools were not alone to blame. Religious instruction, Paine insisted, had also gone wrong. Just as science should be taught religiously, so religion should be taught scientifically.

According to Paine's views, religion should not be taught solely from "opinions in written or printed books," but "in the works of the books of creation." The study of religion "in the books of opinions has often produced fanaticism, rancor, and cruelty of temper; and from hence have proceeded the numerous persecutions, the fanatical quarrels, the religious burnings and massacres, that have desolated Europe." Whereas, the teaching of religion "in the works of the Creation produces a direct contrary effect. The mind becomes at once enlightened and serene, a copy of the scene it beholds: information and adoration go hand in hand; and all the social faculties become enlarged."

And so, this preacher of science and apostle of "the religion of humanity"—a phrase which he himself coined—believed that every clergyman should be a philosopher, and every church a school of science.

"The Bible of Creation is inexhaustible in texts. Every part of science, whether connected with the geometry of the universe, with the systems of animal and vegetable life, or with the properties of inanimate matter, is a text as well for devotion as for philosophy—for gratitude as for human improvement. It will perhaps be said, that if such a revolution in the system of religion takes place, every preacher ought to be a philosopher. *Most certainly*; and every house of devotion a school of science."

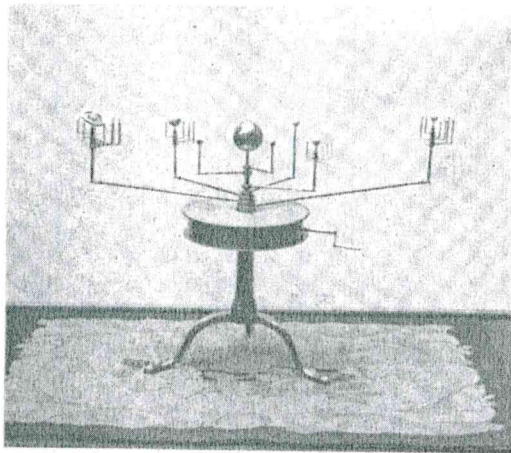
Under such a plan, they could render religion "the most delightful and entertaining of all studies," wherein "scientific instruction" could be given freely "to those who could not otherwise obtain it." "The mechanic of every profession will there be taught the mathematical principles necessary to render him proficient in his art; the cultivator will there see developed the principles



THOMAS PAINE, 1737-1809

Courtesy of Philip B. Wallace

ENGRAVED AFTER A PORTRAIT PAINTED IN 1792 BY HIS FRIEND, GEORGE ROMNEY, RENOWNED ENGLISH ARTIST.



Courtesy of Francis P. Witmer

PLANETARIUM WITH SUN

ONE OF THREE MECHANICAL SET-UPS OF AN ORRERY MADE IN 1791 BY MESSRS. W. & S. JONES OF LONDON.

of vegetation; while, at the same time, they will be led to see the hand of God in all things."

Is the day approaching when such teachings will be recognized as indispensable to the larger spiritual and material abundance, when God and men may join forces to make a better world in which God and men may live more happily together?

But what about God's revelation to man?

But some, perhaps, will say: Are we to have no Word of God—no revelation? I answer, Yes; there is a Word of God; there is a revelation.

THE WORD OF GOD IS THE CREATION WE BEHOLD, and it is *this word*, which no human invention can counterfeit, that God speaketh universally to men.

It is only in this Creation that all our ideas and conceptions of a Word of God can unite. The Creation speaks a universal language independently of human speech or human language, multiplied and various as they be. It is an ever-existing original, which every man can read. It cannot be forged; it cannot be counterfeited; it cannot be lost; it cannot be altered; it cannot be suppressed. It does not depend upon the will of man whether it shall be published or not; it publishes itself from one end of the earth to the other. It preaches to all nations and to all worlds; and this Word of God reveals to mankind all that is necessary for man to know of God.

Do we want to know His power? We see it in the immensity of the Creation. Do we want to contemplate His wisdom? We see it in the unchangeable order by which the incomprehensible whole is governed. Do we want to contemplate His munificence? We see it in the abundance with which He fills the earth. Do we want to contemplate His mercy? We see it in His not withholding that abundance even from the unthankful. In fine, do we want to know

what God is? Search not the book called the Scripture, which any man might make, but the Scripture called the Creation.

Twenty-one years before Herschel wrote his final conclusions (1818) on the *Nebulae*, "Island Universes," "Nebular System," "Planetary Clouds," "1500 universes," and "how the heavens move," Thomas Paine had discussed in *The Age of Reason* essentially the same subjects. The first part of this book was mainly a treatise on astronomy.

Astronomer Paine enjoyed nothing more than to study the plurality of worlds, systems, and universes of worlds, in the infinitude of space; in which our little earth "is suspended, like a bubble or balloon in the air," like "the smallest grain of sand is to the size of the world," or "the finest particle of dew to the whole ocean." And so on and on he penetrated into space, trying to find the end, "till the fatigued imagination returns and says, *There is no end.*"

Wrote Herschel in 1817: "Our sun, with all the stars we can see with the eye, are deeply immersed in the Milky Way, and form a component part of it."

Wrote Paine in 1797: The sun and its system of planets, "immense as it is, is only one system of worlds. Beyond this, at a vast distance into space, far beyond all power of calculation, are the stars called fixed stars. They are called fixed because they have no revolutionary motion, as the six worlds or planets have that I have been describing. Those fixed stars continue always the same distance from each other, and always in the same place, as the sun does in the center of our system."

Then, here again Paine anticipated Herschel: "The probability, therefore, is that each of those fixed stars is also a sun, round which another system of worlds, or planets, though too remote for us to discover, performs its revolutions, as our system of worlds does around our sun." Paine theorized that these worlds, like our own, are populated with human beings, or beings of some kind. His reasoning was not based alone on his peering into the infinity of spaces. He looked about him and saw the earth and the waters and the air filled with life, from the largest animals to those "totally invisible without the assistance of a microscope. Every tree,

every plant, every leaf serves not only as a habitation but as a world to some numerous race, till animal existence becomes so exceedingly refined that the effluvia of a blade of grass would be food for thousands."

And then Paine queries: Since no part of the earth is unoccupied by life, "why is it to be supposed that the immensity of space is a naked void, lying in eternal waste? There is room for millions of worlds as large or larger than ours, and each of them millions of miles apart from each other."

Discussing further his theory of the plurality of worlds:

But it is not to us, the inhabitants of this globe, only, that the benefits arising from a plurality of worlds are limited. The inhabitants of each of the worlds of which our system is composed enjoy the same opportunities of knowledge as we do. They behold the revolutionary motions of the earth, as we behold theirs. All the planets revolve in sight of each other, and, therefore, the same universal school of science presents itself to all. Neither does the knowledge stop here. The system of worlds next to us exhibits, in its revolutions, the same principles and school of science to the inhabitants of their system as our system does to us, and in like manner throughout the immensity of space.

Our ideas not only of the Almightyness of the Creator, but of His wisdom and beneficence, become large in proportion as we contemplate the extent and the structure of the universe. The solitary idea of a solitary world rolling or at rest in the immense ocean of space gives place to the cheerful idea of a society of worlds so happily contrived as to administer, even by their motion, instruction to man. We see our earth filled with abundance, but we forget to consider how much of that abundance is owing to the scientific knowledge the vast machinery of the universe has unfolded.

And then, in his characteristic way, which made for him many and bitter enemies among the orthodox theologians of his day, Paine criticised what he believed to be the exclusiveness of the Christian faith:

But, in the midst of these reflections, what are we to think of the Christian system of faith that forms itself upon the idea of one world only, and that of no greater extent, as is before shown, than twenty-five thousand miles? An extent of which a man walking at the rate of three miles an hour, for twelve hours in a day, could he keep on in a circular direction, would walk entirely around in less than two years. Alas! What is this to the mighty ocean of space, and the almighty power of the Creator?

From whence, then, could arise the solitary and strange conceit that the Almighty, who had millions of worlds equally dependent on His protection, should quit the care of all the rest, and come to die

in our world, because, they say, one man and one woman had eaten an apple?

Could a man be placed in a position, and endowed with the power of vision, to behold at one view, and to contemplate deliberately, the structure of the universe; to mark the movements of the several planets, the cause of their varying appearances, the unerring order in which they revolve, even to the remotest comet; their connection and dependance on each other, and to know the system of laws established by the Creator, that governs and regulates the whole, he would then conceive, far beyond what any church theology can teach him, the power, the wisdom, the vastness, the magnificence of the Creator; he would then see, that all the knowledge man has of science, and that all the mechanical arts by which he renders his situation comfortable here, are derived from that source; his mind, exalted by the scene, and convinced by the fact, would increase in gratitude as it increased in knowledge; his religion and his worship would become united with his improvement as a man; any employment he followed, that had any connection



Courtesy of The University of Pennsylvania
MOON SECTIONS OF RITTENHOUSE ORRERY

with the principles of creation, as everything of agriculture, of science and of the mechanical arts have, would teach him more of God, and of the gratitude he owes to Him, than any theological Christian sermon he now hears.

Had Thomas Paine never "purchased a pair of globes," or used a telescope, he might never have incurred the enmity of the fundamentalists of his day, and might have been listed among the world's sainted men.

It is exceedingly difficult in this day to comprehend how it could have been possible, even in his day, that his belief in the plurality of worlds could have been a major contributing cause of his downfall in popularity. As the inspirer of the English romantic poets and recognized leader of the 18th century revolutionary movement, perhaps no man had a greater following in England, France, and America than Paine. Yet, the publication of *The Age of Reason* (1794-95) was disastrous to his reputation. Announcement of his belief in a plurality of worlds and in the Bible of Creation brought upon him a plurality of attackers. Even as late as 1817, eight years after Paine's death, the battle was still raging.

Among the many who arose to attack his religious and scientific theories, was the Rev. Thomas Chalmers, D.D. If there are other worlds, said he, "how can we reconcile the fact with the silence of the Scriptures?" "What about revelation?" Quoting from "Mr. Andrew Fuller, in answer to Paine," Chalmers continued: "If our world be only a small province, so to speak, of God's vast empire, there is reason to hope that it is the only part of it where sin entered, except among the fallen angels; and that the endless myriads of intelligent beings in other worlds are all the hearty friends of virtue, of order, and of God." In which case, Mr. Fuller concluded, there would have been no need for the Creator to send his Son to the other worlds, as He had found it necessary to do as to the earth.

Defending the inerrancy of the science of the Bible's story of creation, and other stories, Dr. Chalmers in his answer to Paine declared: "Thus the Bible is made to speak all opinions, whether philosophical or religious. Philosophy must submit to the authority of divine revelation; until the mind is willing to make this book the standard of truth, and the foundation of knowledge, it will find no rest amidst the wanderings of the imagination, the ebullitions of vanity, and the fluctuations of sentiment."

It was a sad day for Paine to look back to—the day when he became a "master of the globes and of the orrery." How his expert operation of a miniature planetarium could have thus brought upon him an everlasting

curse, is as interesting as it is incomprehensible in our time.

The Hayden Planetarium in New York City and similar places in other cities are visited by millions of people, without the least thought that they might thereby be guilty of heresy. They see the possibility of a plurality of worlds exhibited before their very eyes. There is the orrery that wrecked Paine's fame! Yet, orthodox and liberal, Catholic, Jew, and Protestant, members of all faiths and of none, flock to see the orrery in its demonstrations of our planetary system, and come away rejoicing at the marvelous scientific and spiritual lessons they have received. Each and all go away blessed and confirmed in their own religious convictions.

In order to understand the connection of the orrery in Paine's life, and the possible cause for the curse it brought upon him, let him tell his own story: "After I had made myself master of the globes and of the orrery, and conceived an idea of the infinity of space, and the eternal divisibility of matter, and had obtained at least a general knowledge of what is called natural philosophy, I began to compare, or, as I have before said, to confront the eternal evidence these things afford with the Christian system of faith."

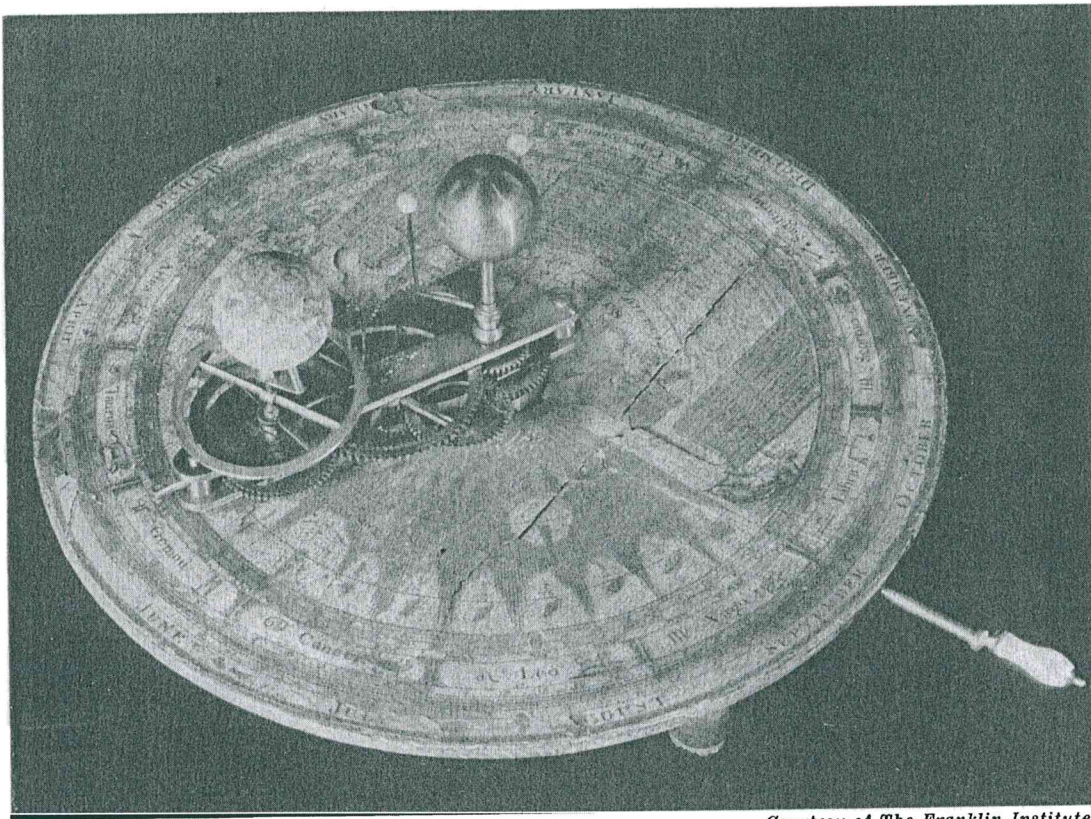
And so, more than a century and a half ago, astronomer Paine was busy with his little planetarium, reaching the conclusion that "THE HAND THAT MADE US IS DIVINE."

In describing the orrery, Paine added this interesting footnote: "As this book may fall into the hands of persons who do not know what an orrery is, it is for their information I add this note, as the name gives no idea of the uses of the thing. The orrery has its name from the person who invented it. It is a machinery of clockwork, representing the universe in miniature, and in which the revolution of the earth round itself and round the sun, the revolution of the moon round the earth, the revolution of the planets round the sun, their relative distances from each other and their different magnitudes, are represented as they really exist in what we call the heavens."

Why did Paine's belief in the plurality of worlds and in the Bible of Creation destroy his popularity? His contemporary, William Pitt, gave the answer when he said

that science and philosophy are all right, but they must be discussed among scientists and philosophers only. The masses must have none of them. That was the prevailing opinion of the time. Theology was not yet freed from the traditional chains that bound it to dogma and bigotry. The earth and its people played the most important part, indeed, the exclusive part, in the economy of the universe. That the Creator might possibly be

In the United States, Paine's *Age of Reason* and his theories of the universe stirred up a veritable hornet's nest among the clergy and the colleges. "The effect of *The Age of Reason* on the community," declares Woodbridge Riley in his *American Thought*, "may be easily imagined. The clergy attacked it, the colleges criticized it, but the populace read it." The book spread like wild fire, especially throughout the West and the



Courtesy of The Franklin Institute

SMALL HAND-DRIVEN ORRERY

MADE IN 1795 BY MESSRS. W. & S. JONES OF LONDON. ONCE OWNED BY J. B. PRIESTLEY, FRIEND OF PAINE.

equally interested in other worlds and other peoples seemed to be a body blow to Christianity itself. Paine wrote *The Age of Reason* for the masses to read, and they read it. That was his unpardonable sin.

But Paine did not write for the multitude alone. The intellectuals of his time also read the book, some with avidity to satisfy their craving for freedom of thought and expression in religion, and others to prepare themselves to launch bitter attacks and to heap vituperation upon Paine and his book.

South. I recall that in the pioneer days in the West, debating clubs and cracker barrel forums discussed the many theological issues that the book raised. Lincoln read it and wrote a similar book on the Bible. Fortunately for him and the country, his friend Hall threw the manuscript into the stove. Paine's book was published; Lincoln's was not. Publicity has much to do with men's reputations.

Paine's most prolific and distinguished opponent in the United States was President

Timothy Dwight of Yale University. As the leader of the opposition, he did much to make Paine the recognized leader of the Deistic movement that swept the country. At Harvard University, the situation became complicated: students neglected their studies to read Paine's book! And why not? Had not the president of Harvard requested Paine to write a poem on *The Invention of Letters*, and had it not been delivered in Cambridge on the day of the annual commencement, July 15th, 1795? Down at Princeton University, "*The Age of Reason* was opposed by the philosophy of common sense," declares Riley.

The Deistic movement waned and finally disappeared. An important outgrowth was the New England Transcendentalism. "It denied the need of miracle, revelation, dependence on an outward standard of faith; it affirmed the need of intuition, mystic ecstasy, inward dependence upon an immanent life. As the philosopher of Concord exclaimed: 'Here is now a perfect religion, which can be set in an intelligible and convincing manner before all men by their reason'."

Paine not only dabbled in the physical sciences, but also in the metaphysical. The spiritual side of science was more attractive to him. Much as Emerson was a mystic, so was Paine, and both got their greatest inspiration from the teachings of the Orient.

Paine and Emerson both stressed the creative power of THOUGHT. To which Paine added MOTION. Thought and Motion—these were the creative forces of both God and man. Paine characterized God as "Universal Mind," the "First Cause"—the Mind that had spoken the Word and thereby had called forth the universe, and had sustained it by motion. This was Paine's theory of creation—quite in line with the Genesis story.

In thus advancing the theory of the control of mind over matter, that mind preceded matter, Paine seems to have anticipated some present-day scientists, including Sir James Jeans, Sir Arthur Stanley Eddington, Professor Robert A. Millikan, and others, who seem to believe (quoting the words of Jeans) that "science almost approaches unanimity" in its claim that "the stream of knowledge is headed toward non-mechanical reality";

that the universe now begins to look more like "a great thought than like a machine"; and that scientists now suspect that mind should be hailed as "the creator and governor of the realm of matter."

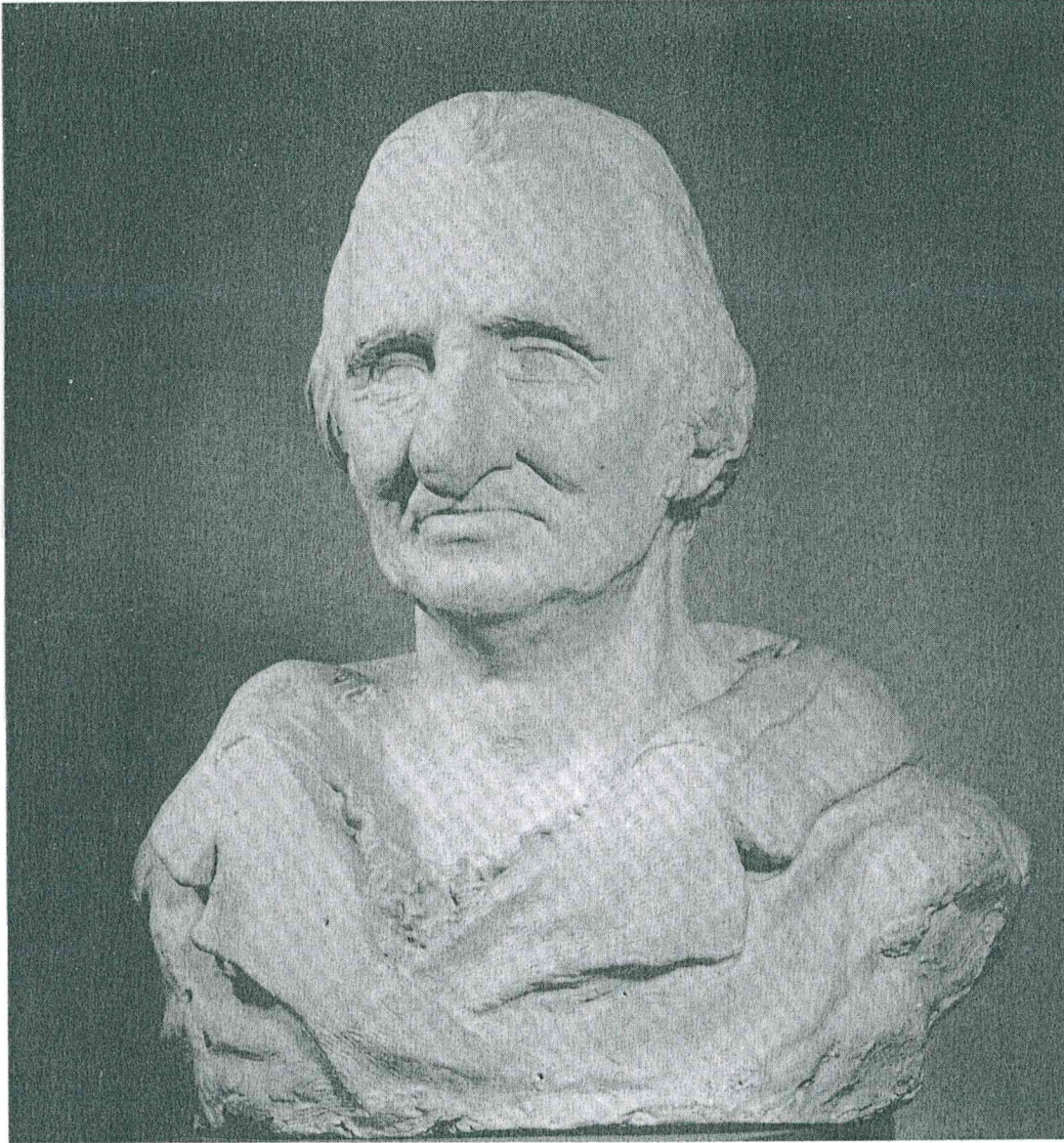
That Paine delved into the realm of metaphysics, and discussed, in his characteristic way, the creative powers of thought and motion, are matters which have not heretofore been pointed out, I believe, in any biographical or periodical writings on Paine. Let us, then, take a look at Paine, the metaphysician.

Paine delighted to speculate in theories of thought creations, thought vibrations, the power of motion, and how we get our thoughts, as he did to experiment in concrete forms of government or in the motive power of steam and gunpowder.

First of all: how do thoughts get about? Paraphrasing Paine's words: Thoughts get about, man knows not how, and once released, they cannot be recalled. They wind their progress from nation to nation, and conquer by a silent operation. Man finds himself changed, he scarcely perceives how. Thoughts are more powerful than armies. "An army of principles will penetrate where an army of soldiers cannot go; it will succeed where diplomatic management would fail; it is neither the Rhine, the Channel, nor the Ocean that can arrest its progress; it will march on the horizon of the world, and it will conquer." Behold, the power of thought!

Paine conceived God as a Being of mind and will, "a Being whose power is equal to His will." His definition comprehends the power to *will* into existence that which he wished to create. The will of man, declared Paine, "is of infinite quality," the limits of which "we cannot conceive." But how "exceedingly limited is his power of acting compared with the nature of his will. If man's powers were equal to his will, he would be God," for "he would will himself eternal, and be so. He could will a creation, and could make it."

"In this progressive reasoning," continued Paine, "we see in the nature of the will of man half of that which we conceive in thinking of God; add the other half, and we have the whole idea of a Being who could make the universe, and sustain it by perpetual motion;



Courtesy of The New-York Historical Society, New York City

BUST OF THOMAS PAINE, BY JOHN WESLEY JARVIS

because He could create that motion.”
 “How numerous are the degrees, and how immense is the difference of power, from a mite to a man.”

“Since, then, everything we see below us shows progression of power, where is the difficulty in supposing that there is, at *the summit of all things*, a Being in whom an infinity of power unites with the infinity of the will? When this simple idea presents itself

to our mind, we have an idea of a perfect Being that man calls God.”

“It is comfortable to live under the belief of the existence of an infinite protecting power; and it is an addition to that comfort to know that such a belief is not a mere conceit of the imagination,” but “a belief deducible by the action of reason upon the things that compose the system of the universe; a belief arising out of visible facts.”

Emerson put forth the idea that thoughts are immortal once they are vibrated into the ether; that the ether is an infinite reservoir of our thoughts; that we may pick them up out of the ether if we are mentally attuned to its vibrations; and that we may think the thoughts of Plato and of the saints.

Paine divided thoughts into two kinds: "those that we produce in ourselves by reflection and the act of thinking, and those that bolt into the mind of their own accord." And then he made a statement, which, if science should ever sustain it, might account for Paine's uncanny capacity for knowledge: "I have always made it a rule to treat these voluntary visitors with civility, taking care to examine, as well as I was able, if they were worth entertaining, and it is from them that I acquired almost all the knowledge that I have."

What a challenging statement! Did Paine there disclose the secret of his extraordinary powers? Did he write and act under "inspiration"? Dr. Alexis Carrel, Nobel prize winner and Rockefeller Foundation authority, has said that "great discoveries are not the product of intelligence alone"; that "all great men are endowed with intuition," which "phenomenon in former times was called inspiration."

But motion, Paine believed, had to accompany thought to make it creative. Here was his theory: "The universe is composed of matter, and, as a system, is sustained by motion. Motion is *not a property of matter*, and without this motion the solar system could not exist." The motion that upholds the solar system "operates to *perpetual preservation*, and to prevent *any change* in the state of the system."

"When, therefore, we discover a circumstance of such immense importance that without it the universe could not exist, and for which neither matter, nor any nor all the properties can account, we are by necessity forced into the rational conformable belief in the existence of a cause superior to matter, and that cause man calls God."

And then Paine hurled his famous challenge at the atheists: "Who then breathed into the system the life of motion? What power impelled the planets to move?" "Where will infidelity, where will atheism,

find cause for this astounding velocity of motion, never ceasing, never varying, and which is the preservation of the earth in its orbit?" "The atheist who affects to reason, and the fanatic who rejects reason, plunge themselves alike into inextricable difficulties."

Professor Harry Hayden Clark of the University of Wisconsin, long a student and writer on Paine's ideas and activities, suggests that he may have derived his explanation of planetary motion from Newton, who, in his letters to Bentley, "postulates a divine power as necessary to explain planetary motion." Professor Clark observes that Paine saw "in the structure of the universe," "an unerring regularity of the visible solar system," "the God of Order and Harmony," "the Supreme Architect of the Universe." Declared Paine: "This harmony in the works of God is so obvious that the farmer in the field, though he cannot calculate eclipses, is as sensible of them as the philosophical astronomer. He sees the God of Order in every part of the visible universe."

But, how did motion begin? Here was Paine's answer: The "Power that *called* us into being." To have *sounded* the *call* was enough to have started all the machinery of the universe into action!

Paine's theory that God *called* forth the universe, and *called* motion into action to sustain His creation, was more in harmony with the Genesis story of creation than his attackers realized. We are told that "the Spirit of God *moved* upon the face of the waters." Four times in the first chapter of Genesis, we find the expression: "And God *called*." The phrase "And God *said*" appears nine times in the same chapter. It thus seems, according to the Bible, that God *spoke*, and His handiwork came forth into being.

Let us now turn to the field of applied science and invention. In this field also, Paine demonstrated considerable genius. His friend, Joel Barlow, once wrote: "Biographers of Paine should not forget his mathematical acquirements and his mechanical genius." Among his numerous inventions were a planing machine, a new crane, a smokeless candle, a wheel of concentric rim, a scheme for using gunpowder as a propel-

lent, and other items. Dr. John Wakefield Francis, who, as a young man, had known Paine, in his recollections of *Old New York*, praises Paine's "timely" article, written in 1806, entitled, "The Cause of Yellow Fever."

Paine's real contribution to the invention of the steamboat has been established. Paine, Fitch, Rumsey, and Fulton conducted their experiments independently. They were all close friends. Sir Richard Phillips, who assisted Fulton in his steamboat experiments on the Thames, gives credit to Paine in a controversy between Fitch and Rumsey, both of whom admitted Paine's priority in the application of steam to navigation. Fulton, to whom Paine gave all of his papers and experiments, received all the credit for the steamboat.

Newton saw an apple fall, and announced the law of gravitation. Paine watched a spider spin its web, and designed the first cast-iron bridge. Patent No. 1667 for his bridge was issued to Paine by "His Most Excellent Majesty King George the Third," whom Paine had characterized as the "Royal Brute" in the fight for American Independence. James Parton has reminded us that it was the principle of Paine's arch that "now sustains the marvelous railroad depots that half abolish the distinction between indoors and out." And Dr. Robert Collyer, at the opening of the Brooklyn bridge, observed that to Paine belonged the credit of the great invention, and deplored the fact that ignorance and bigotry had meanly denied it to him.

I have in my possession a picture of the cast-iron bridge built over the River Wear at Sunderland. Paine's patent was issued in 1788. I also have a letter, dated November 7th, 1936, signed by J. A. Charlton Deas, Director of the County Borough of Sunderland, Public Libraries, Museum and Art Gallery, of Sunderland, certifying as to the bridge built under Paine's patent. The

writer states: "The Wearmouth Bridge Foundation Stone was laid with Masonic honours, 24th September, 1793; the bridge was opened 9th August, 1796. . . . Built of cast iron and with a span of 236 feet, it was one of the most daring structures ever built in this material." The writer further states: "In 1859 the roadway was leveled and the structure widened and strengthened by Robert Stephenson. When the bridge was demolished in 1929 (having become too narrow for modern traffic), the original cast iron ribs were found to be in perfect condition."

The famous Cathedral of Notre Dame in Paris housed, for a time, the religious services of The Society of Theophilanthropists, which was founded by Paine and five families, in 1797. The name, a combination of three Greek words, signify God, Love, and Man. Paine delivered the inauguration sermon entitled "The Existence of God." Throughout his writings, we find an intense belief in a common unity, a common brotherhood, and a common faith—faith in the ultimate freedom of all mankind. Freedom of body, freedom of mind, and freedom of soul. To these freedoms he dedicated his life. Great men and women of science, in all countries, may well consecrate their lives to the achievement of these freedoms, in the spirit of '76, as expressed by Paine in these words:

These are the times that try men's souls. The summer soldier and the sunshine patriot will, in this crisis, shrink from the service of their country; but he that stands it *now*, deserves the love and thanks of man and woman. Tyranny, like hell, is not easily conquered; yet we have this consolation with us, that the harder the conflict, the more glorious the triumph. What we obtain too cheaply, we esteem too lightly: it is dearness only that gives everything its value. Heaven knows how to put a proper price upon its goods; and it would be strange indeed if so celestial an article as FREEDOM should not be highly rated.

Thomas Paine, Citizen of the World, well said: "The world is my country, and to do good is my religion."