

A New Way of Looking at the Universe

If you were an educated person at the beginning of the sixteenth century, you would have believed that the universe was shaped like an onion. You would have held a **geocentric** view of the universe. That is, you would have believed that the earth was at the center of all things and surrounding it were layers of revolving transparent substances in the shape of spheres. Stuck into these layers of invisible material were the Sun, the Moon, the planets, and the stars. Because you would have believed that motion was unnatural, you would suspect that the planets and the stars were being pushed by angels. This was the universe of Ptolemy, a Greek astronomer and geographer who had lived almost 1,300 years before the Renaissance. Ptolemy remained the most important authority on astronomy in the early sixteenth century. However, this orderly picture of the universe was about to be challenged.



A Renaissance scholar

In the Middle Ages, people relied on religion to answer questions about the meaning of life and people's relationship to nature. Religion, however, offered little on day-to-day physical matters like how to increase the speed of ships, how to fire cannons more accurately, or how to cure disease. Behind these kinds of questions was the big question: "How is the physical world structured?". For the answers to concrete problems in nature, Europeans relied on three major traditions.

The first tradition was the one practiced by artisans and engineers. It was their job to find practical solutions to ordinary problems. Blacksmiths worked at improving horse-shoes and swords. Engineers erected dams and built roads. Together they invented windmills and plows. By the sixteenth century, these men had attained a down-to-earth understanding of the way nature operated. Sometimes they could even control it. The bigger picture, however, was left to somebody else.

The second tradition was that of the magicians. They could be found at all levels of society. So-called "wise" men and women in villages used omens, herbs, and spells to explain the works of nature, and they tried to control it by these means. In the cities, learned **alchemists** experimented with strange liquids, powders, animal parts, and metals to unlock the secrets of the universe. They sought to control nature by turning one element into another. They also experimented in curing wounds and sickness. Others called **astrologers** sought to understand the future by reading secrets revealed in the stars. Although these magicians went about practicing their arts in different ways, they all believed that nature was organized in regular, predictable structures. If one could discover those underlying structures, then one could command the universe!

The third tradition was practiced by the natural philosophers. These men could be found mainly in universities. Here, it was believed that the nature of the universe was

revealed in ancient books. Their favorite author was Aristotle. They also read Ptolemy's works on geography and astronomy and Galen's writings on medicine. The Renaissance interest in ancient languages and books added to the natural philosophers' understanding of these authorities. By the sixteenth century, scholars had already begun to graft new ideas onto older theories. For example, Renaissance map-makers used Ptolemy's ideas to make their own maps of the world, much of which Ptolemy had never known.

In the sixteenth century, these three traditions began to come together due to the printing press and the rising interest in the natural world. A good example of the results can be seen in the ideas of Nicholas Copernicus (1473–1543). He was perplexed because Ptolemy's geocentric view of the universe did not always explain the observed movements of the planets. For instance, at times the planets appeared to be moving backwards around the earth. Nothing in Ptolemy's theory would explain this. Copernicus solved the problem by proposing a radical solution. In 1543, he published a book entitled *On the Revolution of the Celestial Spheres*, which argued that the Sun was in the center of the solar system, not the earth. This is a **heliocentric** or Sun-centered view. He said that the earth and other celestial bodies were in constant motion around the Sun. Copernicus provided a more consistent explanation of the planets' movements than did Ptolemy. As widely held as this view became, it would be almost a century before Copernicus's theory was proven. However, this Polish astronomer inspired a new generation to observe the night sky differently.

Another pioneer in modern science was an alchemist known as Doctor Paracelsus (1493–1541). He realized that knowledge about the human body came only from close observation and experimentation. His studies led him to reject the early sixteenth-century notion of the four humors. The humors were believed to be the four main fluids in the body: **blood, phlegm, and red and black bile.** (They were also known as hot, cold, wet, and dry.) Most medical doctors at the time believed that health was maintained by keeping the four humors in balance. The common practice of **bloodletting**, which involved draining controlled amounts of blood from the body, was intended to correct an imbalance of the humors. An individual's horoscope at the time of birth was also thought to influence one's balance of humors. Therefore, astrologers were as important as medical doctors in achieving cures. Paracelsus' experimental methods led him to believe that an illness could be treated and cured with medicine designed for just that illness. As a result, he laid the foundation for the use of modern medicine.

Other pioneers followed Copernicus and Paracelsus as the practice of modern science continued to develop in the sixteenth century. By the mid 1500s, three central characteristics of modern science were widely accepted. First, it was important to be boundlessly curious. Second, a scientist should reject old assumptions and methods unless they could be proven as true. Third, the way to test ideas was through experimentation and careful observation. Because the important discoveries during these years were so radical, historians call these developments the Scientific Revolution.

Activities

1. Write a skit in which representatives of the three major traditions debate about the nature of the physical world.
2. Draw a map of Ptolemy's view of the universe (for good sixteenth-century examples, see *The Panorama of the Renaissance* edited by M. Aston.)