The Scientific Revolution

By Eman M. Elshaikh

The familiar story of the Scientific Revolution runs from Copernicus to Newton, but the full story extends far beyond Europe, beyond men, and beyond the sixteenth and seventeenth centuries.

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The universe doesn't revolve around our planet. That's common knowledge now. However, we used to think Earth was the center of the universe, and that the universe was made up of simple elements like earth, water, air and fire. Then we had the Scientific Revolution. Soon we had 118 elements, penicillin, a moon landing, and scooters you can rent through an app.

Or that's the usual story, anyway. The Scientific Revolution is often portrayed as a series of amazing discoveries by brilliant men in the sixteenth and seventeenth centuries.

And these smart guys did more than think up good ideas. They are said to have *revolutionized* our thinking and our world. Copernicus, for example, put the sun at the center of the cosmos. Newton transformed how we think about motion, force and gravity.

But is that really how it happened? Was the Scientific Revolution about great male, European scientists? Was it as revolutionary as the familiar historical narratives describe? And what effects did it have on the world?

Was it revolutionary?

OK, it was kind of revolutionary. But it wasn't totally new. We're sometimes told that the Renaissance and the Scientific Revolution emerged out of the medieval "Dark Ages." We're told people then were ignorant. But women and men did plenty of scientific stuff during the medieval period. They laid the groundwork for the Scientific Revolution.

Humans have *always* experimented and calculated. Archaeologists have even found evidence of astronomical observations from the Neolithic, or Stone Age, period. So experimentation and mathematical models took on a new form during the Scientific Revolution. Still, they were not revolutionary practices.

Most of the change was slow and fragmented. Throughout these two centuries, people maintained many of the same ideas, and religion continued to influence scientific thinking. But what really made the Scientific Revolution so revolutionary was the scale of it. Ideas were shared at a much larger, unseen scale. Technologies like the printing press and long-distance navigational tools helped create massive networks. Ideas could now meet and blend. There was simply more information, being absorbed by many more people.

A page from Nicole Oresme's 1377 treatise showing the celestial spheres. Nicole Oresme, a medieval French scholar, explored whether the Earth or the Sun moved in his philosophical investigations. Public domain.

Was it European?

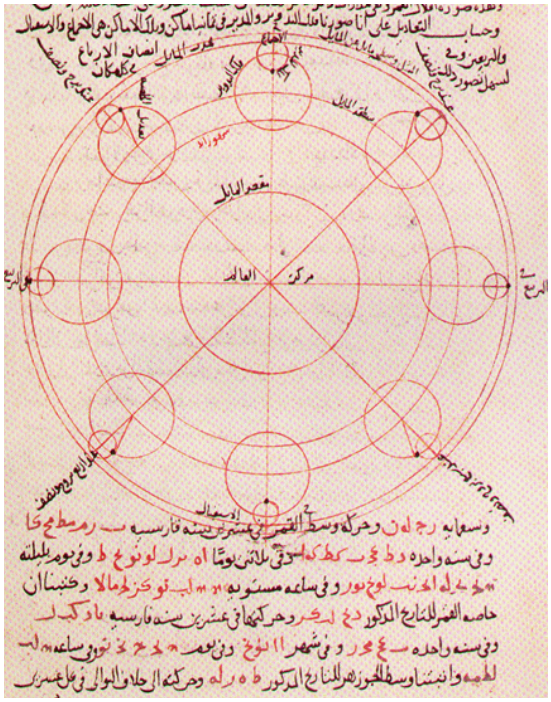
The Scientific Revolution has traditionally been described as a European affair. More recently, however, historians question that. They look for a global story. Gravity, starry skies and insects can be seen in all parts of the world.

First, those so-called "Dark Ages" were pretty "bright" outside of Europe. There was a lively intellectual life in both the Islamic world and China. There were likely global links to the European Scientific Revolution. Even the Greek texts that inspired modern science and reason had to travel through the Islamic world to get back to Europe. Scholars in cities like Cairo, Damascus and Baghdad took on huge projects. They translated ancient sources from Greek and other languages into Arabic.

Scholars at an Abbasid library, called the House of Wisdom, in Baghdad. This was one center of the Translation Movement and intellectual activity more broadly.
Illustration by Yahya al-Wasiti, 1237. Public domain.

Many Scientific Revolution achievements also have non-European antecedents (things that came before). Indian ideas about mathematical methods inspired the modern system of mathematical proofs, some research suggests. Others point to Arab and Persian astronomers' contributions to the Copernican system. Others argue that there were broader intellectual shifts that paved the way. A heliocentric (sun-centered) model was in the making for a while. Intellectuals across Asia had been questioning an Earth-centric model for centuries. They created space for Copernicus to build his new system.

But this is a pretty big historical debate. Some scholars admit there may be similar ideas across cultures. Still, they say, that doesn't necessarily mean they reached European thinkers. Yet, others believe that these cross-cultural influences must have existed. There were huge networks and connections across Afro-Eurasia at the time. Despite debates, there's general agreement that the European Scientific Revolution relied on earlier knowledge systems both within and outside of Europe.



A lunar model by the Arab astronomer Ibn al-Shatir, who may have influenced Copernicus' computations. However, it's also possible that both men made these calculations independently. Public domain.

Whose revolution?

The Scientific Revolution's effects spread widely. However, it was generally limited to a small group. Most were elite and highly educated. Also, women weren't usually given access to scientific communities. French mathematician and physicist Émilie du Châtelet was one exception. She famously translated Newton's work into French. Her comments on his work led to great debates about the conservation of energy. That was Newton's idea that energy is neither created nor destroyed. She helped clarify the idea and promote Newton's principles across Europe. But there were other women who participated as mathematicians, naturalists, astronomers, chemists and scientific illustrators.

Soon, science became a formal institution and a job. It also became even harder for women to participate. This had not been the case before. Things like astronomical observation were mostly done in private homes and were open to women. Experimental science was also considered something of a hobby, like cooking. It was not seen as painstaking as the "manly" scholastic task of learning ancient Greek and Latin. But when science became regarded as an important, respected profession, women were excluded right away. It was like there was suddenly a sign on a treehouse reading: "No Girls Allowed."

Portrait of the French mathematician and physicist Émilie du Châtelet working on some calculations. Painted by Maurice Quentin de La Tour. Public domain.

Women were routinely denied access to spaces like this, as well as universities. This further cemented ideas about what kind of knowledge was "important" and who could make it. Women were considered too emotional and unscientific in their thinking to produce objective truth. Regardless, women continued to make important contributions to science.

Ideas from the Scientific Revolution often reinforced gender and racial ranking systems. There was a widespread belief that nature was a "feminine" force—think Mother Nature. Nature was seen as chaotic and needing to be controlled. These led to ideas about how to control the body and births. Racial others[1] were also grouped into the world of disorderly nature. Ideas about race emerged.[2] Just as some scientists tried to classify plants and animals, scientists also attempted to classify humans according to skin color. This began around the time of the Scientific Revolution. This idea was further developed in the eighteenth and nineteenth centuries. Often it was used to prove that imperialism—countries taking over foreign lands—and slavery were reasonable.

Illustration by Maria Sibylla Merian, a Swiss naturalist. Despite her detailed and realistic botanical observations, some considered Merian as simply an illustrator and not a scientist, though her male counterparts were given more prestige and recognition for similar work. Public domain.

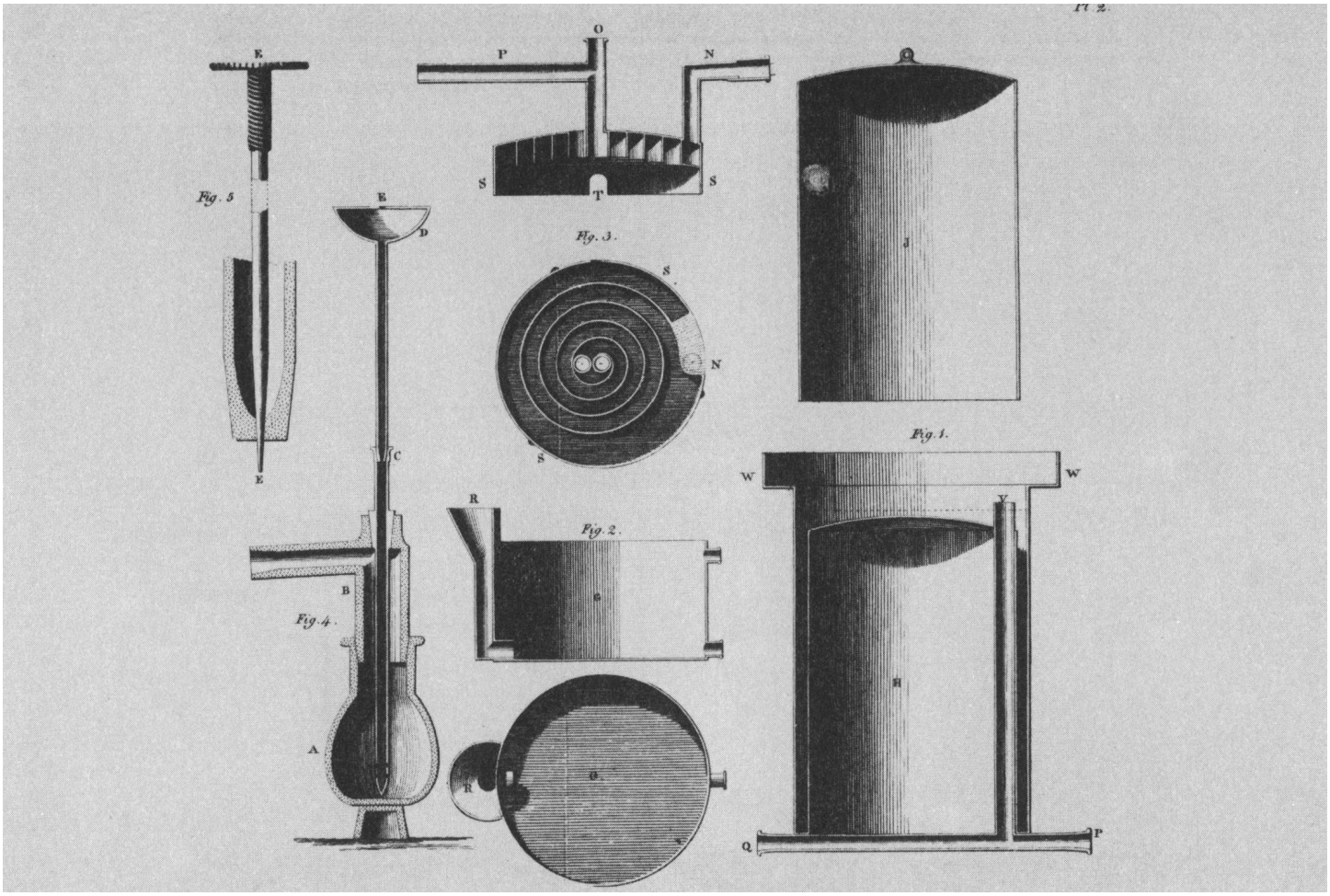
Did it cause the Industrial Revolution?

The Scientific Revolution led to the creation of new knowledge systems, social hierarchies, or ranking systems, and networks of thinkers. It also affected production and distribution. But it's tricky to draw a direct link. People started to think about nature as machinelike and orderly. They understood it as something that could be ruled and manipulated. But did that directly *cause* the Industrial Revolution?

On the one hand, the Scientific Revolution was about theory and ideas. It did not apply to actual devices and machines. Most people who invented key industrial technologies were not scholars at all. They had learned through practical apprenticeships, a form of job training. In fact, many inventions came *before* the theory. For instance, scientists came up with the second law of thermodynamics by studying Watt's engine!

1 The word "other" can refer to the otherness of marginalized people. Anyone not belonging to the most powerful or privileged class can be a type of "other." That could be due to race, gender, religion, socio-economic status, etc.
2 It's hard to say exactly when people started thinking about race. Still, it's definitely not a natural and ancient idea. Of course, people had a sense of others outside their community. They knew who they often looked down upon, but that wasn't the same as seeing people as different races. For Europeans in the medieval period, humans were sorted into Christians, Jews, and heathens. For ancient societies, people were sorted into those who were citizens of the state or empire and those who lived outside of this system—barbarians.

But in general, people were better educated. Scientists and industrialists did work together. The steam engine would never have taken off were it not for the partnership between engineer James Watt and industrialist Matthew Boulton.



This apparatus was designed to administer gasses for medical purposes and was another Boulton-Watt collaboration. Public domain.

So, as historians, we can't exactly use a scientist's exactness in showing the links between the Scientific Revolution and Industrial Revolution. But that's because production and distribution on the scale of the Industrial Revolution are *incredibly complex*. The links look less like single threads and more like several overlapping spiderwebs. But without a doubt, the Scientific Revolution made the Industrial Revolution *possible*. We see how historical events depend on each other and on certain conditions being in place. Medieval European, Muslim, Chinese and Indian scholars created the conditions for the Scientific Revolution by coming up with many ideas. Similarly, the Scientific Revolution lighted a path that—centuries later, with the help of steam and coal power, money, and labor—led to the Industrial Revolution.

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Eman M. Elshaikh

The author of this article is Eman M. Elshaikh. She is a writer, researcher, and teacher who has taught K-12 and undergraduates in the United States and in the Middle East and written for many different audiences. She teaches writing at the University of Chicago, where she also completed her master's in social sciences and is currently pursuing her PhD. She was previously a World History Fellow at Khan Academy, where she worked closely with the College Board to develop curriculum for AP World History.

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