

the true death knell of the geocentric model was sounded by Galileo's observation in 1610 of the moons circling the planet Jupiter. Like Copernicus, who avoided exposing his radical ideas to any but a few fellow astronomers until they were published posthumously in his epic *De Revolutionibus*, Galileo had feared opposition by the church until his friend Cardinal Barberini ascended to the papacy as Urban VIII. Regrettably, Galileo's maladroitness in court politics led his enemies to denounce him to Pope Urban, who was then currying favor with Protestant princes. The pope issued an edict requiring that Galileo recant his support of the heliocentric model.

As the popular version has it, opposition to the Copernican heliocentric model, both by religious leaders and by some outspoken academics, was based on several factors. Primarily, though, it was based on opposition to any change in the accepted Aristotelian beliefs and adherence to the status quo that has bedeviled scientific innovation to the present day.

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It is important to get the history right when we are teaching physics. I feel compelled to point out, though, that in attempting to correct physicists' understanding of the history, Mano Singham's article "The Copernican Myths" actually creates a new myth: namely, the idea that physicists distort history when they present the development of the heliocentric solar system.

Singham begins with a "breezy version of the Copernicus story," supposedly the version related in numerous physics textbooks, and then informs us that, "apart from the final sentence, not much" of that version is true. He only gives one reference for the "breezy" version: the introductory text by Paul Fishbane and coauthors.¹ If we check the pages Singham references, however, almost nothing of that version can be found. On page 1, Fishbane and coauthors write, "Blind reverence for authority impedes scientific progress," but they clearly have in mind the issue of scientific, not religious, authority.

Little of Singham's version of the "myth" can be discerned in the other pages of Fishbane and coauthors referred to by Singham (pages 320 and 321). Religious authority is not mentioned at all. Fishbane and his coau-

thors could be faulted for their apparently derogatory use of the phrase "culturally imposed belief"—couldn't we equally well say that Paul Dirac's theory of the electron was based on a culturally imposed belief in differential equations?—but their history, brief as it is, is essentially correct.

I have checked the other introductory physics texts on my shelf, and I find even less of Singham's "breezy" picture in those books. I can only conclude that Singham's version is a straw man, an invention of Singham's. The "Copernican myths," it seems, are completely mythical.

Historical context can be useful in introductory physics as a way to motivate discussion of a topic and to provide color and promote interest. Teachers and authors should certainly strive to present history correctly. But it is a disservice to textbook authors to ascribe to them errors they did not commit. And there is no point in creating new myths in the attempt to correct the old ones.

Reference

1. P. Fishbane, S. Gasiorowicz, S. Thornton, *Physics for Scientists and Engineers*, 2nd ed., Prentice Hall, Upper Saddle River, NJ (1996).

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The persistence of myths in the history of science is demonstrated by the fact that even Mano Singham's article is not free of them. He mentions Martin Luther's alleged statement against heliocentrism in 1539 as one of the prominent voices of the Protestant opposition to Copernicus's ideas. In the most frequently quoted version of that statement, Luther is alleged to have branded Copernicus as a fool who will turn the whole science of astronomy upside down. However, historian of science Andreas Kleinert from Martin Luther University in Halle, Germany, has shown that "the famous citation from Luther's table talks is next to worthless as an historical source, that Luther never referred to Copernicus or to the heliocentric world system in all his voluminous writings, and that there is no indication that Luther ever suppressed the Copernican viewpoint."¹ Luther was not responsible for the Protestant opposition to Copernicanism, nor did he lead a crusade against it. His opinion about the heliocentric system was indifferent or ignorant but not hostile.

Reference

1. A. Kleinert, *Berichte z. Wissenschaftsgesch.* 26, 101 (2003).

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At the end of his historical account, Mano Singham observes, "The story of the Copernican revolution shows that the actual history of science often bears little resemblance to the popular capsule versions." In the case of the Copernican revolution, that is particularly true, because the heliocentric model of the solar system, although frequently attributed to Copernicus, is actually from an ancient Greek astronomer, Aristarchus of Samos (circa 310–230 BC).¹

In view of religious criticisms of Copernicus, it is particularly interesting to note that Aristarchus was criticized by Cleanthes the Stoic, who said that Aristarchus should be charged with impiety, as Plutarch wrote, albeit many years later.² So not only did Aristarchus anticipate Copernicus, but Cleanthes the Stoic anticipated the criticism of Martin Luther's lieutenant, Philipp Melancthon, who, as Thomas Kuhn reports, recommended that severe measures be taken to restrain the impiety of the Copernicans.³ Most students, before taking a course in astronomy or in the history of science, don't know about Aristarchus, although they have all heard about Copernicus. Even Stephen Hawking, in *A Brief History of Time* (Bantam Books, 1988), makes no mention of Aristarchus of Samos.

About 100 years after Aristarchus, Seleucus the Babylonian, a major astronomer of his time, proclaimed that Aristarchus's heliocentric model was not just hypothetical but true. Seleucus, not unexpectedly, also came in for criticism because he advocated the heliocentric model.

Presentations of the history of astronomy and physics should give more recognition to these pre-Copernican astronomers; otherwise, we are simply perpetuating another myth. It would be more appropriate to emphasize that Copernicus's great and enduring accomplishment was that he got the heliocentric model moving forward again after it had been held back for 1800 years. Properly highlighting Aristarchus's contribution also serves to illustrate that science can undergo retrograde motion in its development, as indicated by the enormous length of time the Ptolemaic model held sway, despite the fact that approximately 300