

Galileo's Daughter: An important contribution to the history of science

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Dava Sobel, Galileo's Daughter: A Historical Memoir of Science, Faith, and Love, Walker & Co., ISBN 0802713432, 448 pp., \$27.00

According to Albert Einstein, Galileo is the father of modern science. It was Galileo who first published his findings in the vernacular, in this case, Italian, instead of Latin. Galileo insisted on the importance of experimentation over speculation. He improved the newly invented telescope, and turned it skyward.

Galileo challenged the Aristotelian and Ptolemaic notions of the immutable universe with the earth as its center, by discovering orbiting satellites around the planet Jupiter, as well as transient sunspots. He published a treatise on the geometric and military compass, studied the tides, the movement of falling bodies and projectiles, and examined the properties of floating objects. His final work, *Two New Sciences*, written while under house arrest, laid the foundation for the science of physics. Much has been written about his accomplishments and his place in history.

Dava Sobel has written a heartfelt and timely work that further illuminates Galileo's place in history. *Galileo's Daughter*, despite the somewhat misleading title, is first and foremost a biography of the great scientist, consisting primarily of narrative, interspersed with the hitherto unpublished letters from Virginia, by far the most talented of Galileo's three "illegitimate" children. Sobel is a great admirer of Galileo, and so the use of Virginia's actual correspondences adds depth to Galileo's stature and overall humanity, while introducing the reader to a woman, remarkable in her own right, but destined by the conventions of her time to live out her life in cloistered poverty.

Virginia's letters to her father, both in celebration of his achievements and in grief over his fate before the Inquisition, are a touching counterpoint to Galileo's own predicament. The letters appear almost as a distraction, at first, but as the story unfolds, the lives of father and daughter become more intertwined. Unfortunately, Galileo's own letters in reply were burned or buried by the sisters after Virginia's death, probably out of fear of reprisal from the Inquisition.

The story of Galileo, now four centuries on, still resonates. Perhaps this is the reason for the new book's immediate popularity. The struggle waged by Galileo to popularize as well as convince people of his generation of the correctness of the Copernican view of the cosmos, and the vicious and vindictive character of the Catholic Church's attack on the scientist, has its echo in the crisis of contemporary culture, especially in the US.

With the story of Galileo we witness the opening acts of the centuries-old conflict between science and religion—a conflict between two irreconcilable philosophical outlooks. The fact, as the author points out, that Galileo remained a devout Catholic, while espousing views on the nature of the universe that were deemed profoundly subversive by the church, adds a certain poignancy to his life. Galileo experienced both exhilaration at the discovery of what he sincerely believed to be secrets revealed by God, and anguish over the stupidity, stubbornness and ruthlessness of those opposed to him.

Galileo Galilei was born in Pisa in 1564. His father, Vincenzo, was a noted musician who was active in a group calling itself the Camerata (the Room). Their work to adapt classical Greek and Roman mythology to music ultimately led to the invention of opera. Sobel's description of Vincenzo reveals a humanist, with a strong anti-authoritarian streak—traits that would rub off on the young Galileo.

Galileo rose to prominence in that period lying between the Renaissance and the Enlightenment—a period dominated by the "Counter-Reformation," the Catholic Church's reaction to Protestantism that culminated with the ravages of the Thirty Years War. Centuries-old religious conceptions were being challenged by a new science, given impetus by the heliocentric (sun-centered) theory of Copernicus and the unveiling of the human body's inner workings by Vesalius, who, if nothing else, confirmed that men and women, the Book of Genesis notwithstanding, have the same number of ribs.

The Vatican's convening of the eighteen-year long Council of Trent in 1545 was a declaration of war on the growing secularism. The Council condemned the notion of an individual interpretation of Biblical scripture, advanced by Luther. Books and ideas were banned, a turn of events that would ultimately brand the advocacy of Copernican theory as heresy, thus laying the basis for the persecution of Galileo. In 1600, the noted humanist Giordano Bruno was burned at the stake in Rome. At the time, Galileo was teaching mathematics at the University of Padua.

Galileo's use of the telescope to view celestial bodies created a sensation. Not only had the philosopher discovered the Jovian moons, he had shattered the notion of the sun's perfection by discovering blemishes on its surface. For Galileo, each discovery confirmed more completely the primacy of motion over static immutability in the universe. "There is perhaps nothing in nature older than motion," he would later write.

But even as Galileo's fortunes rose—he became the court mathematician for the Medici's, and secured a position for his two unwed daughters in the convent at San Mateo—opposition to his published work, *The Starry Messenger*, began to build. Dava Sobel makes liberal use of Galileo's eloquent and passionate defense of the heliocentric universe. The scientist's rhetorical style has both a time-honored and a modern ring to it. Some of this is wonderful stuff!

"To ban Copernicus now that his doctrine is daily reinforced by many new observations and by the learned applying themselves to the reading of his book, after this opinion has been allowed and tolerated for those many years during which it was less followed and less confirmed, would seem in my judgment to be a contravention of truth, and an attempt to hide and suppress her the more as she revealed herself the more clearly and plainly," Galileo wrote in his Letter to the Grand Duchess Cristina.

Even more to the point, Galileo railed against the hearsay method of his accusers. "I cannot but be astonished," Galileo wrote, "that Sarsi [a fictitious name] should persist in trying to prove by means of witnesses something that I may see for myself at any time by means of experiment. Witnesses are examined in doubtful matters which are past and transient,

not in those that are actual and present. A judge may seek by means of witnesses to determine whether Pietro injured Giovanni last night, but not whether Giovanni was injured, since the judge can see that for himself.”

Galileo attempted to demonstrate the antiquity of the heliocentric view by citing Pythagoras and even Biblical scripture. The attempt at the latter would result in his first encounter with the Inquisition. Sobel places the whole scope of the growing conspiracy against Galileo into focus. In 1616, Pope Paul V assembled the cardinals of the Holy Office to rule against Copernicanism, the result being the notorious Edict of 1616, which silenced Galileo, while exonerating him of heresy. The prime mover of these events was Roberto Cardinal Bellarmino, the so-called “hammer of the heretics,” who had served as the inquisitor in the trial of Giordano Bruno. At about the same time, another supporter of Copernicus, the Carmelite father Paolo Antonio Foscarini, was arrested, and died suddenly at the age of 36. His crime had been to quote from Copernicus's *De revolutionibus* and the Bible to support his position.

Meanwhile, Galileo's oldest daughter had become Suor Maria Celeste of the order called the Poor Clares. The members of this order lived in abject poverty and isolation, depending solely on alms and contributions. Their days were spent in toil, prayer, and self-denial—and yet, within this stifling milieu, Galileo's daughter excelled. She was the most literate person in the convent, having been taught by her father, while still a child, to read and write. Suor Maria Celeste also became expert in the healing arts, such as they were. Additionally, in an act that mirrored the anti-authoritarian spirit of her family, she campaigned against corruption in the priesthood.

Her letters sometimes reflected the desperate straits that the convent experienced, and she would regularly ask her father for material assistance, which he freely and lovingly rendered. Their isolation, however, did afford them some protection from the plague outbreaks that periodically ravaged Tuscany during the 1600s. In one letter, concerned over her aging father's health, she wrote: “Most Beloved Lord Father ... I am heartsick and worried. I assume that you will use every possible precaution to protect yourself from the danger, and I fervently urge you to make great effort in this endeavor; I further believe that you possess remedies and preventatives proportionate to the present threat, wherefore I promise not to dwell on the subject.”

When Pope Paul V died and was replaced by Mafeo Cardinal Barbarini, who became Pope Urban VIII in 1626, Galileo saw it as an opportunity to challenge the Edict of 1616. Thus, he began working on his most famous treatise, the *Dialogue*. In the *Dialogue*, published in 1632, Galileo introduces three characters who debate the question of the nature of the universe. One of these characters is Simplicio, who most closely conformed to the stubbornly ignorant opponents of Copernicanism.

A principal topic of discussion in the *Dialogue* concerned the enormity of the universe. However, Galileo avoided open speculation about its possible infiniteness, as that question had been used to persecute Giordano Bruno. Basing himself on Copernicus's work, Galileo brilliantly predicted that powerful instruments would some day reveal the stellar parallax, that is, the small apparent movement of stars at great distances due to the earth's orbital motion, a process finally confirmed in 1838.

It was these “dangerous” ideas that led to Galileo's trial in Rome in 1633. While the 70-year-old scientist had his supporters in the Catholic Church, even in Rome, his interrogation before the Inquisition was a chilling affair. The inquisitors addressed Galileo in the third person, as if to extinguish even the hint of direct contact with the accused. Here is an excerpt from *Galileo's Daughter*:

“Q. That he explain what is in the book he imagines was the reason for the order that he come to the city.

“A. It is a book written in dialogue, and it treats of the constitution of the world, or rather, of the two chief systems, that is, the arrangement of the heavens and of the elements.

“Q. Whether, if he were shown the said book, he would recognize it.

“A. I hope so. I hope that if it shown to me I shall recognize it.”

Pope Urban VIII, who had earlier in his life held great respect for the old scientist, had become adamant that Galileo be punished. Thus, Galileo was convicted of heresy and his *Dialogue* was banned, and would remain so for 200 years. The Church's proscription failed to completely suppress its publication and distribution, however. In secret, Galileo and his supporters procured a Dutch printer to publish the *Dialogue*, and a lively black market for the work arose. Galileo, after a short house arrest in Siena, would be bound to his Arcetri home. While he was supposedly prohibited from receiving visitors, the great English poet John Milton was a guest at Galileo's house, as was his former student, Evangelista Torricelli, who would later invent the barometer.

During this most difficult period for the aging scientist, his oldest daughter became his closest confidant. In fact, Dava Sobel points out that Suor Maria Celeste was probably instrumental in securing entry for Galileo's friends into his house in Arcetri, in order to destroy possibly incriminating documents. Although her letters are full of religious imagery, her sadness and outrage over her father's fate are undeniable: “My dearest lord father,” she writes. “Now is the time to avail yourself more than ever of that prudence which the Lord has granted you, bearing these blows with that strength of spirit which your religion, your profession and your age require. And since you, by virtue of your vast experience, can lay claim to full cognizance of the fallacy and instability of everything in this miserable world, you must not make too much of these storms, but rather take hope that they will soon subside and transform themselves from troubles into as many satisfactions.”

Galileo outlived his daughter, who died of dysentery in 1634. Upon his own death in 1642, he was buried in a modest room with no monument. Later, in 1737, Galileo's remains were moved to a marble sarcophagus. As the wooden coffin was extracted for removal, another coffin lay underneath containing the remains of his daughter, Virginia. *Galileo's Daughter* is an important contribution to the story of one of the great figures in science, and to the history of science as a whole.



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