

Hypatia of Alexandria[†]

“She was a person who divided society into two parts: those who regarded her as an oracle of light, and those who looked upon her as an emissary of darkness.”¹

A slight scientific renaissance occurred in the fourth-century Alexandria, illuminated by the most famous of all women scientists until Marie Curie. For fifteen centuries Hypatia was often considered to be the *only* female scientist in history. Even today, for reasons that have more to do with the romanticising of her life and death than with her accomplishments, she is frequently the only woman mentioned in histories of mathematics and astronomy.²



Hypatia of Alexandria

Hypatia is the earliest woman scientist whose life is well documented. Although most of her writings have been lost, numerous references to them exist. Furthermore, she died at a convenient time for historians. The last pagan scientist in the western world, her violent death coincided with the last years of the Roman Empire. Since there were to be no significant advances in mathematics, astronomy or physics anywhere in the West for another 1000 years, Hypatia has come to symbolise the end of ancient science. Though the decline had already been in progress for several centuries, after Hypatia came only the chaos and barbarism of the Dark Ages.

When Hypatia was born in AD 370, the intellectual life of Alexandria was in a state of dangerous confusion. The Roman Empire was converting to Christianity and

[†] Taken from *Hypatia's Heritage—A History of Women in Science from Antiquity through the Nineteenth Century* by Margaret Alic (Beacon Press, 1986).

¹ Elbert Hubbard, *Great Teachers*, Vol. 10 of *Little Journeys to the Homes of the Great*. (Cleveland: World Publishing, 1928, p. 280).

² Elbert Hubbard's portrait of Hypatia was fanciful and sarcastic. Following the *Chronicle* of John of Nikiu, a Coptic bishop who rewrote history to fit his Christian prejudices, Hubbard asserted that Hypatia hypnotised her student with satanic wiles. Other writers identified her as an alchemist. Charles Kingsley, the popular nineteenth-century novelist, also fictitiously portrayed the life of Hypatia. Kingsley had her killed at the age of 25 instead of 45, and imagined her as a fanatical neoplatonist caught up in political intrigue. Hypatia never married and for centuries historians haggled over the question of her chastity.

Richardson's *The Star Lovers* exemplifies the treatment accorded women scientists in histories, on those occasions when they are discussed at all. Although he includes a chapter on women astronomers, he ignores some of the most important ones and generally ridicules those he does mention. Much of the chapter is devoted to the moon craters named after women astronomers! Heading the list is Hypatia: 'A learned woman who died defending the Christians [sic]'. She is followed by Catherina: 'an extremely learned young woman of noble family who died in AD 307 defending the Christians'.

more often than not the Christian zealot saw only heresy and evil in mathematics and science: ‘ “mathematicians” were to be torn by beasts or else burned alive’. Some of the Christian fathers revived the theories that the earth was flat and the universe shaped like a tabernacle. Violent conflicts among pagans, Jews and Christians were spurred on by Theophilus, Patriarch of Alexandria. It was not a propitious era in which to become a scientist, or a philosopher.

Hypatia’s father, Theon, was a mathematician and astronomer at the Museum. He closely supervised every aspect of his daughter’s education. According to legend, he was determined that she develop into a ‘perfect human being’—this in an age when females were often considered to be less than human! Hypatia was indeed an exceptional young woman. She travelled to Athens and Italy, impressing all she met with her intellect and beauty. Upon her return to Alexandria, Hypatia became a teacher of mathematics and philosophy. The Museum had lost its pre-eminence and Alexandria now had separate schools for pagans, Jews and Christians; however, Hypatia taught people of all religions and she may have held a municipal Chair of Philosophy. According to the Byzantine encyclopaedist Suidas, ‘she was officially appointed to expound the doctrines of Plato, Aristotle, &c’. Students converged on Alexandria to attend her lectures on mathematics, astronomy, philosophy and mechanics. Her home became an intellectual centre, where scholars gathered to discuss scientific and philosophical questions.

Most of Hypatia’s writing originated as texts for her students. None has survived intact, although it is likely that parts of her work are incorporated in the extant treatises of Theon. Some information on her accomplishments comes from the surviving letters of her pupil and disciple Synesius of Cyrene, who became the wealthy and powerful Bishop of Ptolemais.

Hypatia’s most significant work was in algebra. She wrote a commentary on the *Arithmetica* of Diophantus in 13 books. Diophantus lived and worked in Alexandria in the third century and has been called the ‘father of algebra’. He developed indeterminate (Diophantine) equations, that is, equations with multiple solutions. (A common example of this type of problem is the variety of ways of changing a pound using different denominations of pence—50p, 20p, etc.). He also worked with quadratic equations. Hypatia’s commentaries included some alternative solutions and many new problems subsequently incorporated in the Diophantus manuscripts.

Hypatia also authored a treatise *On the Conics of Apollonius* in eight books. Apollonius of Perga was a third-century-BC Alexandrian geometer, the originator of epicycles and deferents to explain the irregular orbits of the planets. Hypatia’s text was a popularisation of his work. Like her Greek ancestors, Hypatia was fascinated by conic sections (the geometric figures formed when a plane is passed through a cone). After her death, conic sections were neglected until the beginning of the seventeenth century when scientists realised that many natural phenomena, such as orbitals, were best described by the curves formed by conic sections.

Theon revised and improved upon Euclid's *Elements* of geometry and it is his edition that is still in use today. Hypatia probably worked with him on this revision. Later she co-authored with him at least one treatise on Euclid. Hypatia also wrote at least one book of Theon's work on Ptolemy. Ptolemy had systematised all contemporary mathematical and astronomical knowledge in a 13-book text which he modestly called a *Mathematical Treatise*. Mediaeval Arab scholars renamed it the *Almagest* ('Great Book'). Ptolemy's system remained the leading astronomical work until Copernicus in the sixteenth century. Hypatia's tables for the movements of the heavenly bodies, the *Astronomical Canon*, may have been part of Theon's commentary on Ptolemy, or a separate work.

In addition to philosophy and mathematics, Hypatia was interested in mechanics and practical technology. The letters of Synesius contain her designs for several scientific instruments including a plane astrolabe. The plane astrolabe was used for measuring the positions of stars, planets and the sun, and to calculate time and the ascendant sign of the zodiac.

Hypatia also developed an apparatus for distilling water, and instrument for measuring the level of water, and a graduated brass hydrometer for determining the specific gravity (density) of a liquid.

Fourth-century Alexandria was a centre for neoplatonic scholars. Although Hypatia may have studied at the neoplatonic school of Plutarch the Younger and his daughter Asclepigenia in Athens, she subscribed to a more tolerant, mathematically-based neoplatonism.² There was rivalry between the neoplatonic schools of Alexandria and Athens, with the Athens school emphasising magic and the occult. But to the Christians, all Platonists were dangerous heretics.

That Hypatia became enmeshed in Alexandrian politics is indisputable. Her student Hesychius the Jew wrote:

“Donning the philosopher's cloak, and making her way through the midst of the city, she explained publicly the writings of Plato, or Aristotle, or any other philosopher, to all who wished to hear. . . The magistrates were wont to consult her first in their administration of the affairs of the city.”

As a pagan, an espouser of Greek scientific rationalism and an influential political figure, Hypatia thus found herself in a very dangerous position in an increasingly Christian city. In 412 Cyril, a fanatical Christian, became Patriarch of Alexandria, and intense hostility developed between Cyril and Orestes, the Roman Prefect of Egypt, a former student and long-time friend of Hypatia. Soon after taking power, Cyril began persecuting

² The Athenian school was later taken over by Asclepigenia's daughter, Asclepigenia the Younger. This eastern branch of neoplatonism also included other women such as Sosipatra, wife of the prefect Cappadocia. It has commonly been assumed that Hypatia was a neoplatonist in the tradition of Plotinus; but Rist presents evidence that the philosophy of Plotinus did not become well established in Alexandria until late in the fifth century, and that neither Hypatia nor Synesius were particularly interested in his doctrines.

Jews, driving thousands of them from the city. Then, despite the vehement opposition of Orestes, he turned his attention to ridding the city of neoplatonists. Ignoring Orestes' pleadings, Hypatia refused to abandon her ideas and convert to Christianity.

Hypatia's murder is described in the writings of the fifth-century Christian historian, Socrates Scholasticus:

“All men did both reverence and had her in admiration for the singular modesty of her mind. Wherefore she had great spite and envy owed unto her, and because she conferred oft, and had great familiarity with Orestes, the people charged her that she was the cause why the bishop and Orestes were not become friends. To be short, certain heady and rash cockbrains whose guide and captain was Peter, a reader of that Church, watched this woman coming home from some place or other, they pull her out of her chariot: they hail her into the Church called Caesarium: they stripped her stark naked: they raze the skin and rend the flesh of her body with sharp shells, until the breath departed out of her body: they quarter her body: they bring her quarters unto a place called Cinaron and burn them to ashes.”

This took place in March 415, just over a century after the pagans had murdered Catherine, a Christian Alexandrian scholar. Hypatia's murderers were Parabolans, fanatical monks of the Church of St Cyril of Jerusalem, possibly aided by Nitrian monks. Whether Cyril directly ordered the murder remains an open question. At the very least he created the political climate that made such an atrocity possible.³ Cyril was later canonised.

Orestes reported the murder and asked Rome to launch an investigation. He then resigned his office and fled Alexandria. The investigation was repeatedly postponed for 'lack of witnesses' and eventually Cyril proclaimed that Hypatia was alive and living in Athens. Hypatia's brutal murder marked the end of platonic teachings in Alexandria and throughout the Roman Empire.

With the spread of Christianity, the appearance of numerous religious cults and widespread religious chaos, interest in astrology and mysticism replaced scientific investigation. In 640 Alexandria was invaded by the Arabs and what was left of the Museum destroyed. But even though Europe had entered the Dark Ages, Greek science was to survive in Byzantium and flourish in the Arab world.

³ Edward Gibbon implied that Cyril was so jealous of Hypatia's influence and popularity that he 'prompted, or accepted, the sacrifice of a virgin, who professed the religion of the Greeks'. Rist suggests that the mob was maddened by Lenten fastings.