Hypatia of Alexandria
Sebastian Augusthy

Hypatia’s life

Hypatia of Alexandria was born around 355 CE in Egypt. The exact date of her birth is uncertain, however records suggest that it was between 350 and 370 CE. She studied in Athens and Italy before working at the Platonist school at Alexandria, and has gained the title as the first notable female mathematician and astronomer. She was a strong advocate of logical thinking and mathematical studies, which led her to the Platonist school in Alexandria where she taught philosophy, in particular, the works of Plato and Aristotle. Hypatia was the daughter of the mathematician Theon Alexandricus, who worked on many collaborative works with Hypatia, and according to the Byzantine encyclopedia, was the last professor at the University of Alexandria. He is known to have tutored her in math, astronomy, and philosophy. He also taught her about world religions and the benefits of leading a healthy life. Nothing is known of her mother.

In my research, I realized that not much has been written about Hypatia either, except for her contributions to mathematics and astronomy, which have also been questioned as to whether it was really her work or her father’s. Her students consisted of both Christians and Jews. She was so famous that people traveled from other cities just to attend her lectures. Hypatia was a Pagan, who was respected by many Christians. She did not act or behave like a woman of her time and preferred to dress like a scholar with a philosopher’s cloak, rather than like a traditional woman. She is also known to have driven her chariot in order to move freely around the empire. She was a virgin. An example of her un-conventionalism was when she stopped a suitor by showing him her menstrual rags, explaining that there is no beauty in sexual desires. As a noted historian writes, “The most detailed accounts we have of Hypatia’s life are the records of her death. We learn more about her death from the primary sources than we do about any aspect of her life.”

Hypatia was different than the women of her time. Her father Theon refused to impose the traditional role of a woman on her, instead, treated her like a son raised in the Geek tradition. The historian Slatkin writes, “Greek women of all classes were occupied with the same kind of work, mostly centered around the domestic needs of the family. Women cared for the young children, nursed the sick, and prepared the food”. But Hypatia led a life in academics, which was mostly held by men at that time. She was never known to have married and supposedly remained celibate throughout her life immersing herself in learning and teaching.
Hypatia’s mathematical works

Hypatia goes down as the last great Alexandrian mathematician and philosopher. She wrote a commentary on The Conics of Appolonius of Perga, which divided cones onto sections by a plane thereby making geometry intelligible to her students and ultimately to the modern world. She also edited the works On the Conics of Appolonius making them easy to understand, which helped the work to survive the course of time. Her most notable contributions to astronomy and science include the charting of celestial bodies and the invention of the hydrometer, used to determine the relative density and gravity of liquids. Men from all over crowded around her to hear her ideas on philosophy. She taught neo-platonic ideas to the Pagans and Christians alike. Hypatia was also considered a great female inventor.

She also figured out a way to distill water from other liquids and calculate the level of water in it.

By using geometry she was able to explain the universe better. For example she was one of the first people to try to explain Aristarchus lunar dichotomy. She came up with the idea that the earth moved around the sun not in a circular motion but in an elliptical motion. She also invented the astrolabe for ship navigation.

Ancient writers agree that Hypatia was a woman of enormous intellectual power. Deakin writes, “The breadth of her interests is most impressive. Within mathematics, she wrote or lectured on astronomy (including its observational aspects – the astrolabe), geometry and algebra. She also made advances in computational techniques, all this as well as engaging in religious philosophy and aspiring to a good writing style. Her writings were, at best, an outgrowth of her teaching in the technical areas of mathematics. In effect, “she was continuing a program initiated by her father: a conscious effort to preserve and to elucidate the great mathematical works of the Alexandrian heritage.”

“Reserve your right to think, for even to think wrongly is better than not to think at all,” is one of her many philosophical sayings. Her views on independence and strength made her a tough personality. Hypatia has had such a huge influence on women all over the world that many plays, movies and numerous books have been written and dedicated to her. The fact that Hypatia was surrounded by religious supporters even though she was a Pagan was testament to her wisdom and the impact she had on people.

Collaboration with other scholars
Very few of Theon’s writings have survived. His commentary (a copy of a classical work that incorporates explanatory notes) on Euclid’s Elements was the only known version of that cardinal work on geometry until the 19th century. But little is known about his and Hypatia’s family life. Even Hypatia’s date of birth is contested—scholars long held that she was born in 370 but modern historians believe 350 to be more likely. The identity of her mother is a complete mystery, and Hypatia may have had a brother, Epiphanius, though he may have been the only favorite pupil of Theon. Theon taught mathematics and astronomy to his daughter, and she collaborated on some of his commentaries. Theon was the director of the museum. The museum functioned as a university. Hypatia was an important faculty of the library where she wrote on mathematics and astronomy. She worked on algebraic equations and sections of cones. She invented astrolabe, a ship navigation device. It is thought that Book III of Theon’s version of Ptolemy’s Almagest—the treatise that established the Earth-centric model for the universe that wouldn’t be overturned until the time of Copernicus and Galileo—was actually the work of Hypatia. She was a mathematician and astronomer in her own right, writing commentaries of her own and teaching a succession of students from her home. Letters from one of these students, Synesius, indicate that these lessons included how to design an astrolabe, a kind of portable astronomical calculator that would be used until the 19th century.

Beyond her father’s areas of expertise, Hypatia established herself as a philosopher in what is now known as the Neoplatonic School, a belief system in which everything emanates from the One. (Her student Synesius would become a bishop in the Christian church and incorporate Neoplatonic principles into the doctrine of the Trinity.) Her public lectures were popular and drew crowds. “Donning [the robe of a scholar], the lady made appearances around the center of the city, expounding in public to those willing to listen on Plato or Aristotle,” the philosopher Damascius wrote after her death.

Hypatia collaborated with her father, Theon Alexandricus on numerous works. These works include: A commentary on the 13-volume Arithmetical by Diophantus, a commentary on the Conics of Apollonius, Edited the existing version of Ptolemy’s Almagest, Edited her father’s commentary on Euclid’s Elements and The Astronomical Canon (Possibly a new edition of Ptolemy’s Handy Tables.) Hypatia’s fame surpassed her father, Theon when she described eclipses dateable to 364.
Historical events that marked Hypatia’s life.

The city of Alexandria, founded by Alexander the Great in 331 BC, quickly grew into a center of culture and learning for the ancient world. At its heart was the museum, a type of university, whose collection of more than a half-million scrolls was housed in the library of Alexandria. Alexandria, Egypt was a place of learning that brought philosophers from far and wide. The library of Alexandria had over 20,000 scrolls and books. Alexandria was a flourishing pagan city in 415 CE because of this.

Only very little is known about Hypatia. A small part of that very little is her math. She edited books in Astronomy, Geometry and Algebra. At the time of her death, she was the greatest mathematician of the world and especially the Greco-Roman world. She was also considered as a famous philosopher meaning she was the great thinker.

Hypatia learned mathematics from her father Theon. She has contributed to Algebra, Geometry and Astronomy. Hypatia is credited for making Astronomical Tables. There is evidence that the first four volumes of Diophantus’ arithmetic books were based on Hypatia’s Commentary. The source of this information is Suda.

Even before 415 CE the city was divided with Jews, Christians and pagans fighting in the street. One day in 415 CE when Hypatia was going home a Christian mob took her from her carriage and dragged into a church. Hypatia was stripped naked and beaten to death with roof tiles. They took her mangled remains and burned them to ashes and this was just the start. Hypatia’s close friend Orestes was a pagan and was blamed by Cyril, the Christian Archbishop of Alexandria for stopping Orestes from accepting the “true faith”. People considered her an obstacle to those who followed Christianity. Alexandria was considered a center for learning during the time and as Christianity grew, so did the factions among them. It was stated that Alexandria ceased to be a center of learning and culture.

After Hypatia’s death, all intellectuals left Alexandria. The temple of Serpais was destroyed along with the great library and university by setting fire. All the scrolls were lost forever. Hypatia’s death came to symbolize the end of the classical world.

Around A.D. 400, Alexandria was a violent mixture of cultures that included Christians, Jews and Pagans. Alexandria was under the direct pressure from the Roman Empire. Though the Roman Empire split into the Western Empire (that ruled Rome) and the Eastern Empire (ruled by Constantine), the main religion of the Roman Empire continued as Christianity. At the time of Hypatia’s murder, the local governor of Alexandria was Orestes. Though a Christian, he was sympathetic to other religions, but under the pressure of the cruel bishop Cyril of Alexandria, he could not help Hypatia. She had to die in the hands of Christian-lynch mob delegated by bishop Cyril.

The authentic accounts of Hypatia come from the writings of the early Christian Church. Also, the 10th century encyclopedia, Suda, has a long description of Hypatia. Some of these statements are contradictory. Patrological Graecae gives a description of Hypatia’s death. Out of their anger, the men killed her by hitting with tiles and burnt her alive.

Alexandria underwent a slow decline beginning in 48 B.C., when Julius Caesar conquered the city for Rome and accidentally burned down the library. (It was then rebuilt.) By 364, when the Roman Empire split and Alexandria became part of the eastern half, the city was engulfed by fighting among Christians, Jews and pagans. Further civil wars destroyed much of the library’s contents. The last remnants likely disappeared, along with the museum, in 391, when the archbishop Theophilus acted on orders from the Roman emperor to destroy all pagan temples. Theophilus tore down the temple of Serapis, which may have housed the last scrolls, and built a church on the site.
Significant historical events around the world during Hypatia’s life

In 351 CE, at age 40, a German named Ulfilas who was converted to Christianity in Constantinople, translates the bible while working with his fellow Goths.

In 363 CE, Constantine the Great (57 Roman Emperor) son of Flavius Vaearius Constantitis becomes the new emperor of Rome. Lacking hostility towards the Jews, he rescinds the law that forbids marriage between Jews and Christians. He rescinds the laws that ban Jews from entering Jerusalem and takes away the privileges that were given to the Christian clergy.

In 378 CE, Christianized Germans called Goths invade the Roman Empire.

In 391 CE, Emperor Theodosius issues the destruction of the great pagan temple at Alexandria, Egypt.

In 393 CE, Theodosius prohibits pagan worship. He makes Christianity the religion of the Roman Empire. He abolishes the Olympics.

In 395 CE, Christian emperors killed the Pagans, Jews and Arian Christians. Pagan temples were robed of valuables. Libraries had been destroyed.

In 407 CE, the greatest Roman Empire invasion occurs on the winter of 406-407 across Rhine. Germanic tribes defeated Gaul all the way to Pyrenees.

In 410 CE, Goths take over Rome. Pagans thought that this was the work of Rome’s old gods and blamed the Christians.

In 413 CE, Christianity was blamed for the fall of Rome. The Roman Empire was said to be influenced by God and by demons.

In 415 CE, all local Christians hated Hypatia of Alexandria. She is pulled from her chariot and taken to a church where she was beaten with room tiles and burnt to death.
Significant mathematical progress during the Hypatia’s lifetime

One of Hypatia’s heroes was Aristarchus of Samos. He was one of the earliest mathematicians to place the sun as the center of the known universe with the earth moving around it.

To get a good understanding of Hypatia’s contributions in the field of mathematics, it is important to understand her times and the knowledge that came before her. The early fifth century was a time of major religious and social upheavals. Being a philosophy teacher, she taught “higher” mathematics and logic as a means of disciplining the mind. Hypatia, according to Hesychius, worked on various branches of mathematics such as arithmetic, geometry and astronomy. The Suda Lexicon also says that she wrote three books, “a commentary on Diophantus, the astronomical canon, and a commentary on Appolonius’ Conics.”

The ancient Greeks changed trigonometry into an ordered science. Astronomy influenced the advancements in trigonometry. Early progression in trigonometry was in spherical trigonometry because of its vast use in astronomy. The three main figures that made the evolution of trigonometry were Hipparchus, Menelaus and Ptolemy. They like many others have had their works lost in time.

”Even if he did not invent it, Hipparchus is the first person of whose systematic use of trigonometry we have documentary evidence.” (Heath 257). Not much is there about Hipparchus. He was one of the best astronomers of his time. Unfortunately nearly all his works were lost in time. Hipparchus produced a table of cords that was used in early trigonometry. He also wrote 12 books about cords in a circle which went missing.

Connections between history and the development of mathematics

Math is always being shaped by history. During the fourth century, most mathematicians were pagans. This was because the Pagans believed that everything in the world had to be justified. When Christianity started out, they wanted to get back at all the people who had offended them. As a result, fights started between Jews, Christians and the Pagans. The Jews and the pagans were being forced to convert to Christianity and when they did not they were hated. As a result, Christians stopped listing to the pagan mathematicians. Some mathematicians were so scared that they left Alexandria. This stopped the advancement of math in that region.

The Christians went to the Library of Alexandria where they overtook the place and burnt all the scrolls that they could find. This caused some of the best scholarly books to be gone forever. The only pagan that stayed and fought till the end was Hypatia. In the end she was killed so that people would lose hope and convert to Christianity.
Hypatia lived during the transition between the Hellenistic Age and the Age of Faith, which did not help her in any way. She kept to her ideas and did not let others influence her in any way. Hypatia was said to be “woman who didn’t know her place.” She was not only beautiful, but also in every way, but intelligent on issues that men were concerned about. Even though she surrounded herself with men, in teaching them, and speaking in the councils, she still cherished being a woman and remained a virgin all her life. Some sources mentioned that she was married to Isidore, a philosopher, but could not find more information to substantiate that.

Hypatia was a great philosopher who loved astronomy. She always wondered about the world and its mysteries. She made the hydrometer and discovered ways of diluting liquids. These things made Hypatia a great woman of ancient times. Her contributions are still felt in this modern era because she laid the foundations for modern-day mathematics. It is hard to imagine a woman playing the kind of role that she did in those times. She stands as a symbol of dedication and determination. Her father’s role in her life was instrumental in making her the woman she became. She started to pave the way for women who came after her to excel in fields that were mostly for men. She closed the gender gap by proving that women were as capable as men in any field they chose.

Hypatia was born in an age where Christians were violently killing people who didn’t convert. I was very surprised to learn about this. I am a Christian and to learn about the darker side to my religion’s past was shocking. While writing this paper I learned that even the past was full of violence. I also learnt that violence cannot destroy good deeds. For example, Hypatia made the hydrometer even though people where being killed out on the streets. She never gave up and like her; I hope to succeed in my field.

Researching Hypatia and her role in mathematics and philosophy turned out to be much more interesting than I had expected. I was prepared to find information on a person that I never heard of and frankly, wasn’t much interested in. I couldn’t imagine her contributions to be as important and enlightening, and was pleasantly surprised. As a person in the engineering program, it was very informative to learn about a mathematician and woman who fought the odds and still was able to come out on top. She thought in ways that people could only dream of. This is a skill I hope to have some day.
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