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Between Heaven and Earth! A Poem-Collage Pair About Hypatia of Alexandria

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Synopsis

The poem-collage pair presented here is a work of collaboration between the mathematician and poet, Sarah Glaz, and the collage and ceramic artist, Mark Sanders. The piece is part of their larger joint poem-collage project involving the history of mathematics. Included as background is a brief discussion on the history and mathematics involved, and a reflection on several landmark locations and some of the relevant imagery appearing in the poem and the collage.

Hypatia's Alexandria by Sarah Glaz

Alexander the Great dreamed her into being:
Alexandria—
the city that inspired a thousand poets.

She survived his early demise
and flourished on her own,
rising from the silt of the delta
with the Pharos lighthouse
awake day and night
guarding her body,
the Museion spinning the light of ideas
like beacons in the dark,
and a library to rival
the papyrus-scroll collection of the gods.

The desert winds blew fire
down her back,
the breath of the Mediterranean
cooled her face,
and the well at the mouth of the Nile
marked water levels
for the priests at the Temple of Serapis,
The Lord of Life Forever,
who performed sacred rites
bringing forth
inundations.

The *Book of The Dead* leaves this earth,
leaping through time
towards us,
calling on us to travel
deep into the past,
where the daughter of Theon
taught philosophy and mathematics,
wrote a commentary on
the six books of Diophantus's *Arithmetica*,
composed a treatise on Apollonius's *Conics*,
and assembled a new edition
of Ptolemy's *Almagest*;

and where she died dragged by her hair along the Street of the Soma,
her skin shredded into a thousand ribbons by oyster shells.

She still haunts our dreams.

Hypatia's Alexandria by Mark Sanders

Historical and mathematical background

Hypatia (370–415 CE) was the first woman known to have made a substantial contribution to the development of mathematics. She lived in the legendary city of Alexandria during the turbulent period of its decline. The story of Hypatia's achievements and her tragic death are inextricably linked to the fate of the city itself.

Alexandria, a Greek city situated in Egypt at the mouth of the Nile, was founded in 331 BCE by Alexander the Great. After Alexander's death, the city prospered under the Ptolemaic rule, becoming a thriving metropolis and a major trading hub on the Mediterranean shore. It remained the center of Hellenistic culture of the ancient world till its sacking by the Arabs in 641 CE.

The early Ptolemies devoted themselves to making Alexandria the center of Hellenistic intellectual life.

They built the Museum (also spelled, Museion—seat of the muses), a forerunner of the modern university, and its library, known as The Great Library of Alexandria, which housed the largest collections of papyrus scrolls in the ancient world. At the height of its glory, The Great Library of Alexandria contained about half a million papyrus scrolls, some of which were housed in a near-by annex, the Serapeum—the temple complex of the Greco-Egyptian god Serapis. The Museum was an institute of research and pursuit of learning, attracting a large number of scholars from the furthest reaches of the Hellenistic world. In particular, under the royal patronage, science and mathematics flourished at the Museum like in very few other periods of time in history.

The school of mathematics at the Museum was founded by Euclid (323–285 BCE), who was brought to Alexandria for this purpose by Ptolemy I. The Golden Age of Greek mathematics that had started with the establishment of Euclid's school, lasted till mid-second century BCE, when Ptolemy VII banished from Egypt all scholars and scientists who had not demonstrated their loyalty to him. During its heyday, the Museum produced, in addition to Euclid himself, other distinguished scholars whose work determined the course of future mathematics: Archimedes, Eratosthenes, and Apollonius were all educated or otherwise affiliated with the Museum and trained in the mathematical tradition established by Euclid.

The last two centuries of the pre-Christian era saw the growth of Roman power. Caesar laid siege on Alexandria in 48 BCE. During the siege a fire broke out at The Great Library of Alexandria burning a substantial number of papyrus scrolls. Those were replaced by Mark Anthony as a gift to his lover, Cleopatra, the Queen of Egypt. The later double-suicide of Anthony and Cleopatra marked the end of the Ptolemaic rule of Egypt. In 30 BCE Augustus entered the city in triumph, and established a military regime headed by the Prefect of Alexandria, a Roman military commander.

The Romans had little interest in mathematics beyond its applications to engineering projects. Other factors also determined the decline of mathematical scholarship in

Alexandria. The first few hundred years of the Common Era saw the spread of Christianity throughout the Roman Empire, including the city of Alexandria. The new religion diverted much of the scholarly attention from science and philosophy to theology. In addition, the new religion identified Greek learning and scholarship with pagan beliefs and practices. Whereas Christians were formerly persecuted for their faith, they now applied against paganism the same persecution that was once unleashed on them. The formerly peaceful streets of Alexandria became the scene of unruly mobs who, relying on the encouragement of Roman officials, were looting and vandalizing Greek centers of learning and pagan establishments.

Nevertheless, mathematics still made progress at the Museum, now a small enclave of rationality in a sea of destruction and turmoil, driven by such luminaries as Claudius Ptolemy, and Diophantus. Over one hundred years later, this was still the setting in which the last Greek Alexandrian scholar who had made a contribution to mathematics, Hypatia, lived and worked. The source of the history of Alexandria recounted so far is [1].

Hypatia was the daughter of Theon of Alexandria (335–405 CE), one of the last mathematicians at the Alexandria Museum, and most likely, studied mathematics under the guidance of her father. Theon wrote commentaries on several of Claudius Ptolemy's books and Hypatia continued her father's work on Claudius Ptolemy's *Almagest*. She also wrote commentaries on both Apollonius of Perga's *Conics* and on Diophantus' *Arithmetica*. *Almagest* is a treatise in astronomy and involves early uses of trigonometric notions, *Conics* is a treatise in geometry involving conic sections (ellipses, parabolas and hyperbolas), and *Arithmetica* is a treatise in early algebra and number theory and includes the first attempts at symbolic algebraic notation. Unfortunately, none of Hypatia's works survived, and we are left with admiration for the breadth of her mathematical knowledge, without being able to savor and assess her original contributions to each subject.

Hypatia lectured at the Museum on mathematics and Neoplatonist philosophy. She was a charismatic and influential teacher, attracting large audiences and many distinguished listeners. Among them was the philosopher Synesius of Cyrene, who later became bishop of Ptolemais. Some of the letters Synesius wrote to Hypatia survived in the Vatican Archives, including one in which he asks Hypatia for help with the construction of an astrolabe.[1]

This period saw the escalation of tension between Christianity and paganism in Alexandria, culminating in the razing of the Serapeum and the destruction of its library by Alexandria's bishop, Theophilus. Hypatia's work was not affected by this development; she was permitted to continue her teaching and scholarly activities unimpeded. In about 400 CE, Hypatia became the head of the Platonist school of Alexandria.

[1] An astrolabe is an ancient hand-held instrument used for taking astronomical measurements. See [3] for more on the mathematics of the astrolabe.

After Theophilus' death, in spite of the support and admiration of highly regarded Christians, like Synesius of Cyrene, the Christian leaders of Alexandria, and in particular, Cyril, the new bishop, regarded Hypatia's Neoplatonic philosophy as heretical. Moreover, her high profile in the city and her friendship with the Roman prefect, Orestes, with whom Cyril was engaged in a power struggle, endangered Cyril's political aspirations. He spread false rumors about Hypatia's lectures, claiming that under the guise of scholarship she promoted paganism. As she returned one day from her classes, she was waylaid by a gang of Christian zealots, dragged by her hair to a nearby church, slashed to death with oyster shells, after which her body was dismembered and set on fire. The extent of Cyril's involvement in the murder remains a mystery to these days.

Euclid and Hypatia are like two bookends holding a large body of knowledge between them. Euclid marks the beginning and Hypatia marks the end of Alexandrian mathematics. The Museum itself survived in its drastically reduced capacity till the conquest by the Arabs in 641 CE, when what was left from its fabulous library was set on fire and completely destroyed.

Because ancient historical sources reporting on even more ancient times are scarce and not always reliable, some of the history recounted in them is open to interpretation. This is true of all ancient sources, the best we can hope for is to come close to the truth. Antiquity combined with Hypatia's spectacular life and death made her the subject of many fanciful accounts. The sources of the history of Hypatia recounted here are [1, 2, 12].

Reflections on locations and imagery

In this section we offer some information on a few landmark locations in Alexandria and some of the relevant imagery appearing in the poem and the collage as a way to make both reading and viewing more informed and enjoyable.

The Pharos Lighthouse. One of the scientific achievements of antiquity was the building of the Pharos lighthouse, which guided the merchant ships arriving at the port of Alexandria. Constructed during the reign of Ptolemy II (280–247 BCE), The Pharos lighthouse was an engineering marvel considered to be one of the Seven Wonders of the Ancient World [1, 11]. On the map shown in Figure 1, The Pharos Lighthouse is located at the eastmost tip of Pharos Island. The Pharos Lighthouse appears in the second stanza of the poem.

The site of Hypatia's death. The *Canopic Way* (called in the map, Canobic Street) was the principal thoroughfare of ancient Alexandria, traversing the city between east and west. The *Canopic Way* was intersected on the western side of the city by the *Street of the Soma*, which was the site of the tomb of Alexander the Great, the site of his actual body (*soma* means body in Greek). Close to the intersection of the two roads was the Museum and The Great Library of Alexandria.

Figure 1: The map of Ancient Alexandria, Rice University Digital Scholarship Archives. Map's origin unknown. Image is in the public domain. https://scholarship.rice.edu/handle/1911/9433, accessed 2023-01-23.

At the seaward end of the *Street of the Soma* stood the two obelisks known as Cleopatra's Needles. They were part of a building complex called the *Caesareum*—a pagan temple that was converted into a church, and in which, according to legend, Hypatia had been murdered. The *Street of the Soma* appears in the last three lines of the poem. Both Cleopatra's Needles appear in the collage, one appears on top of the central golden astrolabe; the other appears at the bottom of the collage slightly to the left, in a more contemporary setting. The obelisks were given to the cities of London and New York in the 19th century, and can be viewed on the banks of the Thames River in London and in Central Park in New York City [11]. All named ancient locations are clearly marked on the map above.

The Serapeum. Walking south along the *Street of the Soma* and then a few blocks westward, one arrived at the temple complex called the Serapeum, where a large number of the papyrus scrolls were housed. At the height of its glory the scrolls in the Serapeum numbered about 200,000. For that reason, the library at the Serapeum was called *The Daughter of the Great Library of Alexandria.*[2] The deities worshipped

[2] For this and more on the Serapeum, see the web resource "The Library in the Serapeum," available at https://penelope.uchicago.edu/~grout/encyclopaedia_romana/greece/paganism/daughter.html, last accessed on January 26, 2023.

in the Serapeum were the Greco-Egyptian god, Serapis, and his consort, the Egyptian goddess, Isis. The worship of Isis involved a source of water, such as a well, symbolic of the life-giving power of the waters of the Nile. This echoed the more mathematical considerations involved in measuring water levels and predicting the extent of the annual Nile floods, which were carried out by Egyptian priests at other locations.[3] The Serapeum appears in the third stanza of the poem.

Images of Hypatia and her murder in art. On the bottom left corner of the collage appears Hypatia's image from Raphael's "School of Athens," where she won her place due to her scientific accomplishments.[4] At the bottom right corner of the collage appears Hypatia's image from Charles William Mitchell's 1885 painting "Hypatia," positioned as emerging from an oyster shell, ironically reflective of Botticelli's "Birth of Venus".[5] The image of Hypatia's murder from Louis Figuier's 1865 drawing "Death of the philosopher Hypatia, in Alexandria" appears to the right of the ancient cover of Diophantus' *Arithmetica*.[6] On the top right corner of the collage appears the most widely recognized image of Hypatia, Jules Maurice Gaspard's illustration from E. Hubbard's book *Little Journeys to the Homes of Great Teachers* [10].

Images related to Hypatia's legacy as a modern heroine and feminist icon. The Egyptian goddess, Hathor, appearing prominently on the left side of the collage, was considered the personification of the sky. In this way she links to Hypatia's work in astronomy. A maternal figure, Hathor was the protector of women. Appearing in the collage painted on a scrap of papyrus, Hathor is a symbol for the nurturing and empowering connection between women through the ages. On the top left corner, just above the image of Hathor, we find an image evoking women's struggle to obtain equal rights, a suffragette being led away by the police. The image of the figure engulfed by fire under Gaspard's profile of Hypatia is Joan of Arc being burned at the stake. About one thousand years apart, Joan of Arc and Hypatia suffered the same fate. Both were celibate women of strong convictions, who engaged in activities that were traditionally male: Joan of Arc became a military leader, Hypatia was a philosopher and mathematician. Both died witches' deaths, their bodies devoured by flames; their murders motivated by politics as well as by religious fanaticism. And in both cases, the murder may have also been driven by anger towards women who dare to be pioneers in entering a male dominated field.

[3] For more on the mathematics of these measurements, see the `Wikipedia` article on the Nilometer, the historical structure used to carry out these measurements, at `https://en.wikipedia.org/wiki/Nilometer`, last accessed on January 26, 2023.

[4] Readers may read about Raphael's "School of Athens" on the relevant `Wikipedia` article, available at `https://en.wikipedia.org/wiki/The_School_of_Athens`, last accessed on January 26, 2023. The *Journal of Humanistic Mathematics* has also published a handful of articles, including one in this very issue, about various mathematical features of this famous work.

[5] For more on Mitchell and a public domain image of the painting, see `https://en.wikipedia.org/wiki/Charles_William_Mitchell`, last accessed on January 26, 2023.

[6] See `https://commons.wikimedia.org/wiki/File:Mort_de_la_philosophe_Hypatie.jpg` for a public domain photographic reproduction of this work of art.

Their deaths made them into powerful feminist symbols, as well as heroic figures for the courage to pursue their chosen path in the face of great adversity.[7]

For interested readers, Sarah and Mark's other poem-collage collaborations involving the history of mathematics can be found at [5, 6, 7, 8, 9]. More poetry authored by Sarah can be found in Sarah's poetry collection *Ode to Numbers* [4], and more collages created by Mark can be found in Mark's galleries, *Peace and Outrage,* on Etsy[8] and Instagram[9].

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[7] For more on Joan of Arc, readers may begin with the `Wikipedia` entry: https://en.wikipedia.org/wiki/Joan_of_Arc, last accessed on January 26, 2023.

[8] Mark Sanders Etsy gallery: Peace and Outrage, https://www.etsy.com/shop/PeaceAndOutrage?ref=search_shop_redirect, accessed 2023-01-23.

[9] Mark Sanders Instagram gallery: Peace and Outrage, https://www.instagram.com/peaceandoutrage/, accessed 2023-01-23.