Ancient Egypt's Religious Need For Mathematics

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Introduction

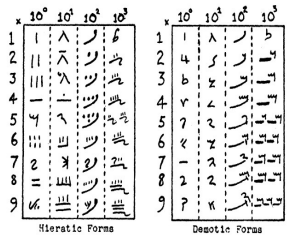
Ancient Egyptians are known for their mathematical prowess. To understand what inspired this progress, we must contextualize the mathematical procedures that were developed and used at the time. In ancient Egypt, mathematics was developed for utility -- e.g., counting goods, measuring land, determining taxes -- and was not particularly focused on theory or determining mathematical truths. A prominent scholar of ancient Egyptian mathematical papyri, T. Eric Peet, commented that "interest in or speculation concerning a subject for its own sake was totally foreign to their mind" (Archibald). This assessment reflects the attachment to tradition which is clear in Egyptian culture.

However, ancient Egyptian mathematicians (scribes) developed the skills to keep up with the advancements in Egypt such as population growth, the increasing size and intricacy of architecture, and a changing economy, while maintaining use of traditional methods.

The standardization of these methods contributed to Egypt's exceptional achievements in mathematics, architecture, and culture. The religiously motivated behaviors of ancient Egyptians stimulated mathematical development.

Math

Our main sources for information about Egyptian mathematics are documents that contain plans, calculations, or practice problems. Most famous are the Rhind Mathematical Papyrus (pictured), the Moscow Mathematical Papyrus, the Kahun Papyri, and the Egyptian Mathematical Leather Roll, all dating c. 1800-1600 BC (Rossi). These documents depended on a nationwide standardized measurement system, which is a significant advancement for that time.



Hieratic and Demotic forms, Boyer.

Though hieroglyphic writing was famously used on monuments, ancient Egyptian scribes used a script called hieratic to write numbers on papyrus, as demonstrated in the Rhind and Moscow papyri. This script evolved further into demotic. Egyptians were of the first cultures to develop a base 10 number system, in which symbols replace each other in a 1 for 10 fashion. This system is used today for arithmetic. Preceding this development, the Sumerians used a base 60 number system, which we continue to use for circles and time. This transition allowed for far fewer symbols and the potential for larger calculations.

Since tradition was core to Egyptian culture, the actual process, or algorithm, of calculation was not adjusted significantly in ancient Egypt. Rather, transitioning to the base ten number system and to hieratic improved efficiency and standardization. These subtle advancements increased the capabilities of Egyptian mathematicians.

The Rhind papyrus was written for scribes to learn and to practice everyday calculations. It contains reference tables and around 80 problems. Some of these are arithmetic, others are word problems, contextualized as calculations of goods such as cattle (problem 67), pyramid dimensions (problems 56-59), or proportions of precious metals (problem 62). This papyrus can be considered a workbook for learning and referencing mathematical procedures (Imhausen).

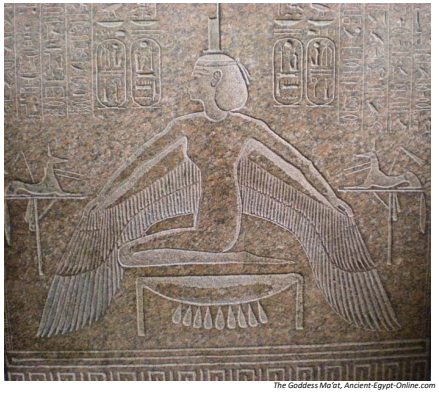

Rhind Mathematical Papyrus, housed at the British Museum

Ancient Egypt is known for its unprecedented architectural feats, such as the pyramids, which require precise calculations in geometry and materials. The Egyptians could approximate the areas of a circle, triangles, and quadrilaterals, and they likely understood the Pythagorean Theorem well before Pythagoras "discovered" it, and they used decimals and fractions.

Egyptian mathematics consist primarily of arithmetic to calculate object counts, land measurements, and architectural dimensions. This organization and standardized methodology was quite advanced for the time.

Religion

Egyptian religion was polytheistic and pluralist. It was also deeply intertwined with the state. Laws were believed to be handed down by the gods, and the king was responsible to follow and enforce them. The laws were personified in the goddess Ma'at, a woman with a feather on her head, representing order and balance (David). In the Christian faith, the Garden of Eden or heaven parallels this concept. It is the state in which everything is as it was intended to be upon creation.


The Goddess Ma'at, Ancient-Egypt-Online.com

Maintenance and monitoring *ma'at* was the responsibility of the king. If chaos ensued in the nation, *ma'at* had been disturbed, and changes were necessary to reestablish favorable standing with the gods.

The pyramids are an expression of the religiosity of the kings in Egypt. The vizier to the king Djoser, Imhotep, constructed the first pyramid. He inscribed in his pyramid walls that "a stairway to the sky is set up for me that I might ascend on it to the sky" documented in the Pyramid Texts, spell 267. The pyramids are an evolution of the mastaba, a palace for the kings *ka* (soul) to live for eternity. The pyramids had multiple meanings, but "embracing one magical identification did not mean rejecting others" (Stiebing, 137). With multi-faceted religious significance, building increasingly elaborate pyramids was necessary for kings to maintain their position as a credible leader of religion in Egypt.

Scribes

Scribes were authorities in many aspects of Egyptian culture. They were the creators, teachers, and executors of mathematical processes. The role of a scribe was highly esteemed, and superior to other professions. Since the scribe was "literate and numerate," he was decisive in dealings with other professionals.

Scribes were the authors and the audience of mathematical manuscripts. In mathematics education texts, the phrase "if a scribe tells you" precedes data announcement, which implies that scribes additionally provided a necessary link in data collection and communication, not just calculation procedures.

However, the roles of scribes were of wide variety. Daily tasks may include counting, teaching, or general project leadership to serve the king, the gods, and maintain religiosity in Egypt. Scribes were also responsible for taking census of the nation for tax purposes. Additionally, temple scribes performed transcription and composition of texts onto papyri and temple walls.

Scribes who were leaders in mathematics were vital to the establishment and expression of religion in Egypt since their mathematical work was connected in some way to the religion of Egypt. Elaborate archaeological projects were overwhelmingly religious, and scribes were central to the planning and execution of these projects. Thus, the intertwining of mathematics and religion was intrinsic in the scribes' role in ancient Egypt, embodying the connection between the two subjects in the nation.

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Nilometers and the Palermo Stone

The Nile River was vital to ancient Egypt's economy. It provided fertile agricultural land and transportation. The god Hapy was the personification of the inundation. The inundation was symmetric and predictable, contributing the Egyptians sense of balance, or *ma'at*. To further measure this occurrence, measurements were taken of the Nile using Nilometers. They were placed in various locations throughout the valley, including Aswan and south of Cairo. Rituals were performed annually at some to "ensure satisfactory inundation" (David).

The production of these Nilometers required a scientific understanding of the rise of the river during the Nile's annual floods. The Nilometers were often lines cut into the naturally carved walls of the river. It also required a measurement system for organized documentation. These were used to predict the level and timing of the floods. This process and analysis required mathematical problem solving.

A fragment of a stele called the "Palermo stone" holds records of these measurements. Annual measurements of the Nile's height were recorded during and after the reign of King Djer (First Dynasty, c. 3000 BC). In the Palermo stone, the Nilometers read 5 cubits, 1 palm, 1 finger, which is around 2.7 meters (Imhausen). This demonstrates a standardized measurement system, which is a significant factor in why Egyptians were capable of such incredible architecture.

The Nilometers and documentation of their use on the Palermo stone is evidence of the use of mathematics to explore the religious concept of *ma'at*.


The Palermo Stone, Encyclopaedia Brittanica and the Regional Museum of Archaeology, Palermo

Conclusion

Egyptian practitioners of mathematics used primarily arithmetic and geometry. These skills were essential to the religiosity of the nation and the state. The physical expression of religion is evident in the incredible monuments and pyramids of ancient Egypt, while the concept of *ma'at* was mathematically measured as inundations of the Nile. Many of our most informative documents concerning mathematics in ancient Egypt were written by or for scribes, and often had religious context. This demonstrates an intertwining of religion and mathematics.

Though modern western religion and science sometimes seem to be at odds, it is clear they fueled each other in ancient Egypt.

Future Research

Scribes were vital to the continuation of the development of religious thought and practice. Since they fulfilled varying roles in ancient Egypt, this prompts curiosity about their social positions and personal life. It is clear that as a whole they were quite influential in mathematics and religion, but were any specific scribes influential in both, directly? Were scribes specialized, or did all scribes receive a "general education," all attaining proficiency in science, religion, and literacy?

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