2.2. Babylonia: Sources

Note. In this section we list several collections of clay tables from Mesopotamia. Having described Sumerian cuneiform numerals in Supplement. Additional Numeral Systems, we move forward in time to the Babylonian clay tablets. We give some history on the deciphering of the cuneiform writing on the clay tablets, and some history of Babylonia itself. We give some biographical information on a key contributor to our understanding of Mesopotamian mathematics, Otto Neugebauer.

Note. In the last 200 years, archaeologists have found some half-million clay tablets in the Mesopotamian region (which includes present-day Iraq and parts of Iran, Kuwait, Syria, and Turkey). The tablets range in size from a few square inches (so that they could be held in a single hand) to about the size of a sheet of paper. About 400 of the clay tablets address mathematical topics, mostly mathematical tables and lists of math problems. These tablets are in various collections at European museums in Paris (The Louvre), Berlin (Vorderasiatisches Museum), and London (The British Museum). There are also collections in the United States at Yale University (Yale University Babylonian Collection), Columbia University (the George Plimpton Collection of Columbia University Libraries; this collection includes the most famous mathematical clay tablet, Plimpton 322, which we describe in 2.6. Babylonia: Plimpton 322), the University of Pennsylvania (Penn Museum), the University of Illinois Urbana-Champaign (the Spurlock Museum of World Cultures, and Cornell University (in the Department of Near Eastern Studies and the Kroch Library Asia Collections). In the Mesopotamian region itself, there are collections in The National Museum of Iraq (the museum suffered from looting in the 2003 Iraq war; some of the stolen artifacts have been returned), the Istanbul Archaeological Museum in Turkey, and the Museum of Anatolian Civilizations in Ankara, Turkey. A nice internet source on cuneiform collections is the Cuneiform Digital Library Initiative; this includes additional information on each of the collections mentioned above. Each of these websites were accessed 6/8/2023.

Note. Cuneiform writing was not deciphered until around 1800. The story is rather similar to that of the Rosetta Stone (which was used by Jean-François Champollion [December 23, 1790–March 4, 1832] to decode Egyptian heirogyphics). It involves the "Behistun Inscription" on a rock face at Mount Behistun near the city of Kermanshah, Iran. Today, it is a UNESCO World Heritage Site.

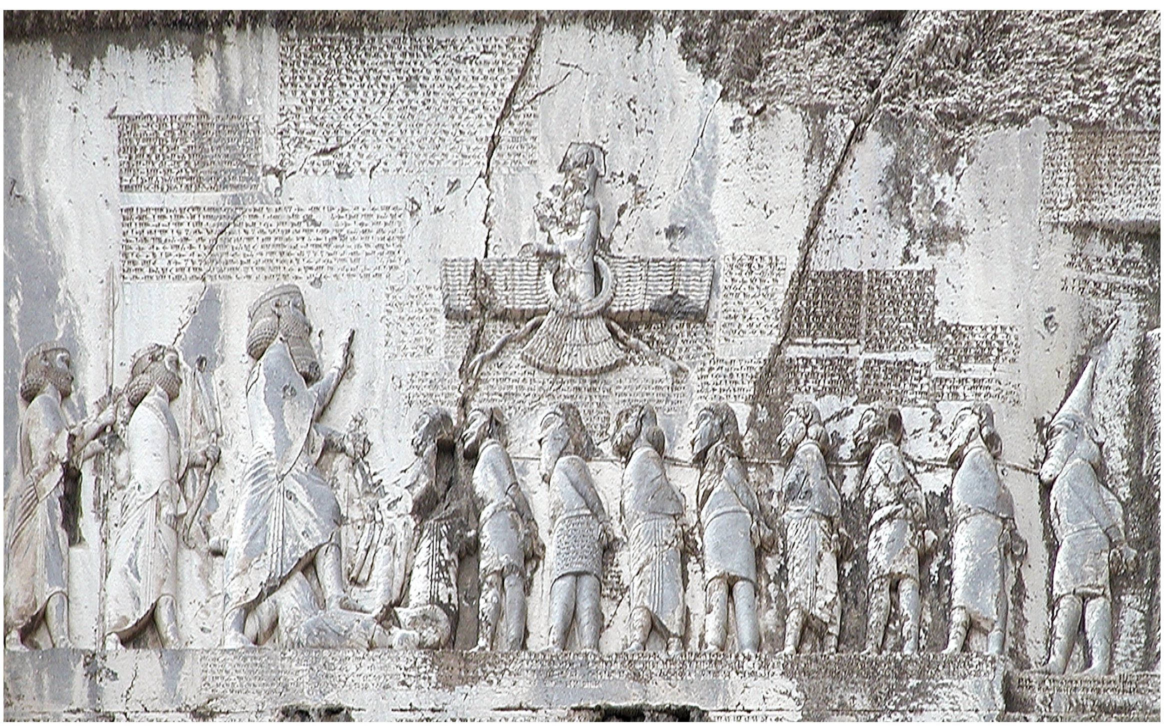


Image from the Wikipedia page on the Behistyn Inscription (accessed 6/8/2023)

We turn to Peter Rudman's *How Mathematics Happened* (Prometheus Books, 2007) for details (see his page 245):

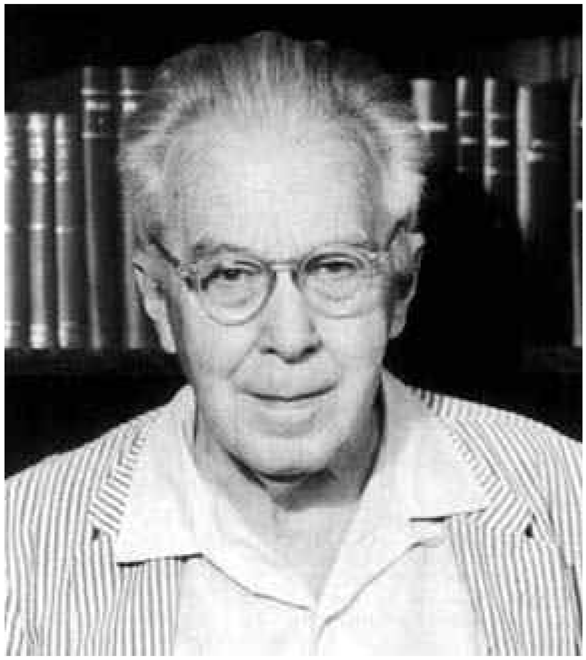
> "In the 1830s, Henry Rawlinson [April 5, 1810–March 5, 1895; he was president of the Royal Geographic Society in the 1870s], then an officer in the British army, learned of a large cuneiform inscription high up on a cliff of a mountain called Behistun in present-day Iran, some 250 km east of Baghdad. With great risk to his life, Rawlinson scaled the cliff, some 100 meters above ground level, and suspended from ropes succeeded in copying most of this *Behistun Inscription*. . . . The inscription had been commissioned by Darius I of Persia in 510 BCE and gave his boastful account of how he had come to the throne of the Persian empire. . . . The same story had been inscribed in three different types of cuneiform writing: Old Persian, Babylonian, and Elamite. The Old Persian symbols were the simplest and, with its similarities to contemporary Persain dialects, Rawlinson succeeded in deciphering this part of the inscription in 1846. Then with the aid of his deciphered Persian text, Rawlinson completed deciphering the more difficult Babylonian cuneiform by 1857."

It should be commented that Rawlinson did not work in a vacuum. Previous work on translating the Behistun Inscription had been done by George Friederich Grotefend (June 9, 1775–December 15, 1853), as mentioned by Eves on page 40.

Note. We saw in Supplement. Additional Numeral Systems that Sumerian reign over Mesopotamia gave way to Babylonian control. The result was the "The Old

Babylonian Empire" (or First Babylonian Empire) dated from circa 1894 BCE to circa 1595 BCE. This was followed by the Kassite dynasty (1595-1155 BCE). Between about 1155 BCE and 900 BCE parts of the area was under the control of the Akkadians, Assyrians, Arameans, and Suteans. The Assyrian period ranges from circa 900 BCE to circa 610 BCE, Babylonia was under constant Assyrian control. The Neo-Babylonian Empire (or Second Babylonian Empire, or Chaldean Empire) marks the last period of Babylonia before the conquest by the Persian Empire in 539 BCE. These historical notes are based on the Wikipedia pages on Babylon and the Neo-Babylonian Empire (accessed 6/8/2023). In addition Sumerian mathematical tablets, there is a second group from the time of King Hammurabi (in the early 18th century BCE; he is famous for codifying the laws of Babylonia into the *Code of Hammurabi*) to about 1600 BCE, and a third group from about 600 BCE, through the Persian conquest and its absorption into the Seleucid Empire (a center of Greek culture) up to about 300 CE (Eves, page 41).

Note. Otto Neugebauer (May 26, 1899–February 19, 1990) published *Mathematical Cuneiform Texts* (with coauthor Abraham Sachs) in 1945. In *How Mathematics Happened* (Prometheus Books, 2007), Peter Rudman refers to Neugebauer's work as a "virtuoso" and states: "I can only marvel at his having been able to decipher algebraic content from a jumble of barely identifiable indentations in chunks of clay" (see Rudman's page 246; if you continue reading Rudman's book you will find that he criticizes some of Neugebauer's interpretations). Born in 1899 in Innsbruck, Neugabauer joined the Austrian army in 1917 and spent time in a prison camp in Italy. After his release, he studied engineering and physics at the University of Graz (Austria) from 1919 to 1921, then studied math and physics at the University of Munich, and finally in 1922 studied math at the University of Göttingen (Germany). While there he published a math paper with a colleague; this would be his only mathematical (*per se*) publication! He shifted his attention to the history of math and complete his dissertation (on Egyptian unit fractions) in 1926 under the direction of Richard Courant and David Hilbert (wow!). In 1927 he joined the staff at Göttingen and lectured on the history of ancient mathematics. This is when his attention turned to Babylonian mathematics. At this time, the plentiful clay tablets had not been thoroughly studied. He later published a three volume work, *Mathematische Keilschrift-Texte* ("Mathematical Cuneiform Texts," published between 1935 and 1937). Neugebauer was involved in the building of a new Mathematical Institute at Göttingen (completed in 1929) and the founding of a new research journal, the prestigious *Zentralblatt für Matematik* (in 1931). With the rise of the Nazis in 1930s Germany, Neugebauer moved to the University of Copenhagen (Denmark) in 1934. Ultimately, he resigned from the editorial board of *Zentralblatt für Matematik* due to Nazi interference. He moved to the United States in 1939, where he worked at Brown University and started the American Mathematical Society's *Mathematical Reviews.* In 1947 he was appointed Professor of the History of Mathematics at Brown. He published *The Exact Sciences in Antiquity* in 1951 (covering both math and astronomy; this book is still in print by Dover Publications) and the three volume *History of Ancient Mathematical Astronomy* in 1975, among other articles and books. He received a number of awards for his work. He retired from Brown University in 1969 and spent time at the Institute of Advanced Study at Princeton, which made him a permanent member in 1980. This historical information and the image below are from the MacTutor biographical page on Otto Neugebauer (accessed 6/9/2023).



Note. It is no coincidence that Neugebauer studied both ancient mathematics *and* ancient astronomy. Astronomical observations require numerical measurements of time and position, which in turn requires some mathematical knowledge. The fact that the sun, moon, planets, and stars appear on the celestial sphere is motivation for the study of spherical trigonometry, for example. An agricultural society needs an understanding of the timing of the seasons, and this is dealt with by the position of the sun. Large circular structures can be used to determine sunrise and sunset at key times of the year (the equinoxes and solstices). Examples of such structures can be found worldwide: Stonehenge in England (dating from around 3000 BCE), the Sun Dagger of the Anasazi in New Mexico (dating from around 1250 CE), Gaocheng Observatory in Dengfeng, China (dating from 1279 CE), and Machu

Picchu observatories in Peru (Inca structures dating from the 1400s). For more information on this, see the Ancient Observatories, Timeless Knowledge webpage of Stanford University (accessed 6/9/2023).

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