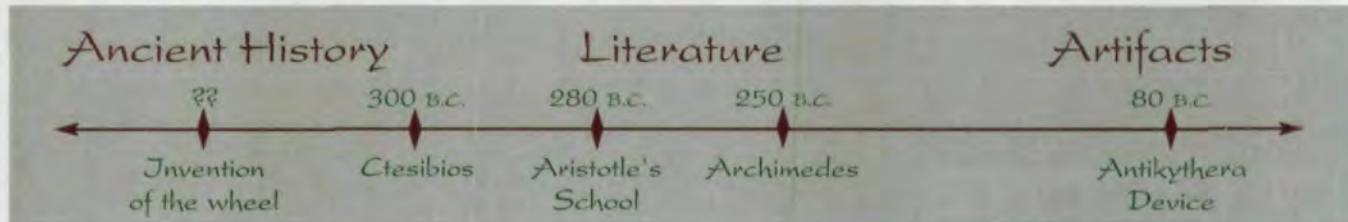


A Brief History of Gears

Gear Technology's bimonthly aberration — gear trivia, humor, weirdness and oddments for the edification and amusement of our readers. Contributions are welcome.



No one is quite sure when gears were invented. It's universally agreed, however, that they've been transmitting motion in one form or another for quite a long time.

The earliest accounts of gears come from ancient Chinese and Greek literature. However, many of these references are vague and unreliable. With some of these texts, it's difficult to say where history begins and mythology leaves off. To make matters worse, the literature very often contains descriptions of devices that may or may not have included gears.

Most of the hard evidence we have of ancient gear development comes from the Eastern Mediterranean. For example, a work called *Mechanical Problems* came out of Aristotle's school around 280 B.C. It describes parallel wheels in mesh, although it doesn't specifically mention toothed wheels of any kind, and these might have been friction disks rather than gears.

Another classical inventor who may have contributed to gear science was Ctesibios of Alexandria (circa 300 B.C.), who was a barber by trade and whose inventions included an incredibly accurate water clock. The clock included an early form of rack and pinion gearing, according to accounts written by Vitruvius nearly three centuries later (circa 25 B.C.).

The clearest early evidence of the practical use of gears comes from Archimedes (circa 250 B.C.), whose screwed devices were the precursors of modern worm gearing. His designs for

war machines included many gear components. Archimedes may also have been one of the early developers of astronomical clockworks.

By the time of Heron of Alexandria (circa 60 A.D.), it's clear that gearing had been developed and was widely considered as an acceptable means for transmitting motion and solving mechanical problems. Heron describes the use of parallel gear trains to raise a very heavy load with little effort. He also incorporated Archimedes-type screw drives in his odometer (odometer), a device for measuring distances travelled by a cart.

Judging from the history books is one thing. Finding hard evidence of actual gears is another. The biggest problem in finding archaeological evidence of gears is that early gear materials were not built to last. Gears made during the classical era were probably made of bronze. When bronze tools and mechanical pieces broke, they were simply melted down and refashioned into something else.

The oldest surviving geared mechanism is the Antikythera device, a precision mechanism that was probably crafted around 80 B.C. The device lay undisturbed for centuries off the tiny Mediterranean island of Antikythera, among a shipwreck filled with marble and bronze statues and other treasures. Although the device received early attention as some type of astrolabe or celestial calculator, its complexity was not fully understood until it was studied by the late Derek de Solla Price, a Yale professor of science history. He wrote the

definitive work on the subject, *Gears from the Greeks—The Antikythera Mechanism, A Calendar Computer from ca. 80 B.C.* Although the book was published in 1974, it remains one of the best studies of early gearing.

Gears from the Greeks describes a device that included more than simple gears. In fact, the Antikythera device contains more than thirty gears arranged in a complex differential gear train. It was used to mechanically calculate the position of the sun and moon. Archaeologists date its manufacture to around 80 B.C., but this astronomical device's complexity is far greater than anything previously ascribed to that time period, and the gear train is certainly more sophisticated than anything described in the literature of the period.

Dr. Price concluded that the Antikythera gears must either have been the stroke of individual genius or that they had been under continuous development since the time of Archimedes. Either way, the sophistication of the Antikythera device is remarkable ◉

References:

- 1 Price, Derek de Solla. *Gears from the Greeks: The Antikythera Mechanism, A Calendar Computer from ca. 80 B.C.* Science History Publications, a div. of Neale Watson Academic Publications, Inc., New York, NY, 1974.
- 2 Price, Derek de Solla. "An Ancient Greek Computer." *Scientific American*, June 1959, p. 60-67.

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