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Claudius Ptolemy

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Ptolemy with an armillary sphere model (Joos van Ghent and Pedro Berruguete, 1476; original painting in the Louvre, Paris); Public domain in its country of origin and other countries and areas where the copyright term is the author's life plus 100 years or fewer; **Wikimedia Commons**.)

Egyptian mathematician, astronomer, and geographer Ptolemy, a.k.a. Claudius Ptolemaeus (c. 90 – 168), arguably the most renowned scholar who worked out of Alexandria's library, compiled his geographical description of the known world or *oikumene* in c. 125.

The oldest extant manuscripts are from 12th and 13th-century codices.

He seems to have focussed on 'correcting and improving' the work of his predecessors rather than investigating these matters himself.

However, with much of what had gone before lost to us, it is hard to distinguish between Ptolemy's original work and the material he recycles.

His best-known works are the **Megiste**, his 'great compendium of astronomy' (**Almagest** in Arabic), and his **Geographike Hyphegesis** (a.k.a. **Geographia** or **Geography**).

He also investigated the musical scale, chronology, astrology and optics.

The **Almagest**'s thirteen books placed the earth well and truly in the centre of the universe with the Moon, Mercury, Venus, Sun, Mars, Jupiter and Saturn rotating around it against a backdrop of fixed stars on the outer edge of the cosmos.

A complicated theory of epicycles explained the apparent regularity of planetary motions.

Starting from first principles, Ptolemy used carefully selected observations to describe

- the features of his geocentric universe (Book 1),
- spherical astronomy (Book 2),
- solar and lunar theory (Books 3, 4 and 5);
- eclipses (Book 6);
- the fixed stars, listing the stars visible from Alexandria (Books 7 and 8)
- and a detailed study of matters relating to the planets (Books 9 to 13).

Much of his astronomy seems to be drawn from Hipparchus.

While some scholars see Ptolemy as a mere compiler of other people's works, the orderly exposition of his subject matter, based on mathematical and deductive principles rather than a jumble of observations, seems to have rationalised an existing confusion of models.

In any case, the **Almagest** is the only surviving source for much of what he covers.

Ptolemy's model of a succession of enclosed spheres on which the heavenly bodies moved in a fixed and circular pattern about the earth might not have seemed to be the way the heavens worked in reality.

Discrepancies were explained away while his followers refused to scrutinise the assumptions the model was built around.

As a result, his notions fixed astronomy on the wrong lines for the next fourteen hundred years.

Still, despite its misconceptions and inadequacies, the Ptolemaic system proved adequate until the age of Columbus, Copernicus and Galileo.

Similarly, Ptolemy's **Geography** reworked now-lost works by Marinos of Tyre and others into a comprehensive catalogue of more than eight thousand locations in the *oikoumene* (the known world).

Ptolemy gives Marinus due credit for his gazetteer listings but takes the contents further, assigning his locations a latitude and longitude and an estimate of the distance between them while disparaging the accuracy of Marinus's measurements.

Earlier, Hecataeus, Herodotus, and Strabo had constructed narratives by sifting through a repository of travellers' tales.

While his predecessors attempted to separate fact from fiction, retaining material they considered credible, they invariably included details they doubted.

Ptolemy worked differently.

He started with details of his methodology and instructions for drawing a world map, employing latitude, longitude and two different projections (Book 1).

From there, his catalogue with brief descriptions of topographical features comprised Books 2 to 7.

Finally, Book 8 broke Ptolemy's world map down into twenty-six individual maps covering smaller areas from western Europe and northern Africa to India.

While it seems logical that maps may have accompanied original copies of the **Geography**, none have survived. There is a strong possibility that the work was essentially a "do it yourself" exercise.

A tenth-century Arab description of a coloured map may have referred to an original document or a later copy.

However, we know Ptolemy's world map extended from Britain and northwest Africa to India and the Malay peninsula.

The complete set, in combination, might have comprised the first atlas, but the result would have delivered a distorted view of the world.

While Ptolemy's details are reasonably accurate close to home, numerous minor distortions exist.

A fundamental error in one of the few pieces of astronomical data Ptolemy employed exaggerates the size of the Mediterranean basin.

A lunar eclipse observed simultaneously at Carthage in north Africa and Arbela in Mesopotamia on 20 September 331 BCE provided the data.

However, a report from Arbela suggested a time difference of three hours.

Since they are two hours apart, Ptolemy's Mediterranean is around 50% larger than it should be.

A similar error came when Ptolemy tackled another critical measurement.

While Marinos had been reasonably diligent and had generally interpreted his predecessors' data correctly, he seems to have made a fundamental error in dealing with Eratosthenes' remarkably accurate calculation of the earth's circumference.

Eratosthenes had documented his result (252,000 *stadia*), and Strabo endorsed the figure.

However, Marinos failed to realise that the *stadion* used when Eratosthenes made his calculation was not the stadion used in his day.

Ptolemy made the same mistake but compounded it by miscalculating the length of a degree of latitude.

The result was a monumental blunder.

Reducing the earth's circumference from a reasonably accurate figure of 252,000 stadia at 157.5 metres to 180,000 stadia at 184 metres apiece would have significant consequences in the age of Columbus and Magellan.

A third error adjusted the east-west length of the *oikoumenē* to 180 degrees, where Marinus' figure of 225 degrees.

As a result, the extremities of his world map are grossly distorted.

Further afield, the **Geography** shows that the Greeks knew more about the Indian Ocean than Ptolemy's predecessors.

They were now coasting along East Africa as far as Rhapta, sailing to Ceylon, and around the Bay of Bengal, to the mouth of the Ganges. A few adventurers reached The Golden Chersonese (the Malay Peninsula).

Ptolemy's **Almagest** was known to some in the Middle Ages, thanks to the derivative astronomical treatise of the ninth–century Arab scholar, Alfraganus and translations which began appearing from the twelfth century.

Ptolemy's **Geography**, on the other hand, fell into obscurity. It offered the most sophisticated cartographic models conceived.

Still, it was lost to European learning until the beginning of the fifteenth century.

From that point of rediscovery, knowledge of Ptolemy snowballed, and his geographical treatise soon became a standard reference.

When printing presses revolutionised the world of letters, Ptolemy's Geography's circulation soared, ensuring it became a seminal influence through the Age of Discovery. [1]

Both works were considered authoritative until Copernicus proposed an alternative to the **Almagest**'s geocentric view of the universe, and navigators brought some of Ptolemy's geographic assumptions into question.

He was, however, the first to lay out the basic principles of modern cartography, introducing latitudes and longitudes, orientating his maps with the north uppermost and the east on the right, and devising projections to represent a portion of the spherical earth on a plane surface.

His first projection was conical, with straight meridians converging at the North Pole and curved parallels of latitude.

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[1] Avan Judd Stallard, **Antipodes: In Search of the Southern Continent**, p. 27.

A second projection used curved meridians as well as curved parallels.

Both projections were, in effect, well ahead of their time.

Longitude was a matter of guesswork and estimation until the late eighteenth century.

As a result, many coordinates were based on deductions or calculations from written sources rather than direct observation.

Florentine scholar Jacobus Angelus brought a manuscript copy of the Geography he found in Constantinople to Italy.

His translation into Latin appeared in 1406. The first printed edition without maps appeared in Vicenza (1475). The first illustrated edition appeared in Bologna two years later.

It swiftly became the most sought-after publication of its day. Twenty-six of its sixty-one leaves were engraved maps in the first Renaissance atlas of the ancient world.

The rediscovery of **Geographia** signalled a golden age of map-making.

The new editions of the Ptolemy atlas – vividly instructional and genuinely exciting – established the novel concept of cartography as both art and science.

They also triggered the first craze for collectors, with maps and globes expressing wealth and influence. [2]

The 1482 Ulm edition saw the first recent maps added for comparison. Twenty more went into Martin Waldseemiiller's edition (1513).

Gastaldi's new translated edition (1584) included sixty more as the atlas expanded to include more detail.

Mercator's edition (1578) included his interpretation of the classical maps. The last significant edition came from Girolamo Porr in 1598.

While Ptolemy's work had been circulating in the Arab world since the 8th century, Geography was a revelation in Renaissance Europe.

While the projection would change and the geography would expand, Ptolemy's worldview set a template we still recognise.

His concepts continued to influence geographical thought long after the Columbian discoveries.

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[2] Simon Garfield, **On the Map: Why the world looks the way it does**, pp. 103-104.

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