



ERATOSTHENES' MAP OF THE OECUMENE

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Received 26 April 2012; accepted 21 June 2012

Abstract. Eratosthenes (circa 276 B.C.–194 B.C.) is considered a famous scientist of ancient Greece. He was a mathematician and geographer. Born in Cyrene, now Shahhat (Libya), he was appointed to teach the son of the Egyptian King Ptolemy III Euergetes. In 240 B.C., he became the third chief librarian the Great Library of Alexandria. Eratosthenes laid basics for mathematical geography. He was the first to calculate precisely in an original way the Earth meridian's length between Syene and Alexandria. For this purpose he used perpendicular projection of the sun rays during summer solstice (06.22) near the town Syene, now Aswan. His estimation of the length of the Earth's radius (6300 km) is close to present estimation (6371 km). He calculated that a year possesses 365.25 days. He also emphasized the significance of maps as the most important thing in geography. Eratosthenes was the first one to use the term “geographem” to describe the Earth. In this way he legitimized the term of geography. He also put into system geographical information from various sources in order to obtain a map of the world as precise as possible.

Keywords: ancient geography, Eratosthenes, maps design, stadia, meridian, parallel, Balts.

1. Introduction

It was Alexandria which took the leading position in science from Athens since the middle of the third century before Christ. In 332 B.C. Alexandria was founded in the former Egyptian settlement Rhacotis by Alexander Macedonian; the town was named in the founder's honour. The town served as a placement of Alexander the Great sarcophagus. During the reign of Ptolemaic dynasty (305–30 B.C.) Alexandria was the capital city of Egypt and since 200 B.C. the town was the capital of Hellenistic world of science with famous museums, university and library. Scientists here were highly appreciated. In 280 B.C. a special town for the scientists called Mouseion (patronized by the Muses) was established: it included science academy with half a million manuscripts in the library and astronomical observatory. The library of Alexandria is considered to be the oldest in the world and includes treasury of civilization, the centre of science, art, different religions, languages and cultures. Here well-known philosophers and scientists were working, Euclid, the founder of the fundamentals of geometry and Archimedes, developer of the fundamentals of hydrostatics (Archimedes law). Circa 100 A.D. the Old Testament was translated into Greek and called *Septuagint* (Teepke 2002).

Alexandria was also famous for one of the Seven Wonders of the World – the Pharos Lighthouse, which according to verified data was 134 meters high. It was

erected in 280 B.C. during the reign of Ptolemy II. It was the first lighthouse in the world and nearly the only one on Earth as it had copper mirrors, reflecting fire flames. The lighthouse made of white marble had 3 cascades; its peak was decorated with a bronze sculpture, its light being visible 50 km away. In 14th c. i.e. in 1303 and 1323 it suffered from the earthquakes and was ruined. So, it resulted in standing for about 1500 years. At that time the lighthouse was one of the highest buildings on Earth surpassed only by the pyramids of Giza (Fig. 1). Its image was used on the coins of those times. The majority of towns, founded by Alexander Macedonian disappeared, however Alexandria has remained up to the present. The lighthouse was completely destroyed in 1480 by Egyptian sultan of Mamelukes Quaitbay, who used the ruins of the lighthouse to build defensive forts of Alexandria.

Great mathematicians of Alexandria were generally interested in geometry and astronomy. The movement of stars and the Sun was used for positioning the Earth. Alexandria had the most famous school of geographers, among them were known for their works Aristarchus (310–250 B.C.), the founder of the theory of analogy, Hipparchus (160–125 B.C.), the founder of astrolabe, Strabon (Strabo) (60 B.C.–20 A.D.), the author of “History” and “Geography” and Cl. Ptolemy (100–178 A.D.), predecessor of the Renaissance of cartography (Kudaba 1980).



Fig. 1. Pic. of Alexandria lighthouse by Magdalena van de Passe

2. Dicaearchus' map

Eratosthenes chose for essential improvement the most precise known map of oecumene (inhabited territories) devised by Aristotle's pupil Dicaearchus of Messina (345–285 B.C.) (Fig. 2). Dicaearchus having used geographical discoveries and taking into account the descriptions by the traveller Pytheas named in his map Europe, Libya (*Libye*), Arabia (*Arabes*), Persia (*Perse*), India (*Indiens*) and Sri Lanka (*Taprobane*). Besides the Atlantic Ocean (*Atlantique*) he also named the Black Sea (*Pont Euxin*), the Caspian Sea (*M. Hyreanienne*), the Mediterranean Sea (*Mer Interieure*), the Red Sea (*G. Arabique*) and the Arabian Sea (*Mer Erythree*). The map also included best known rivers, such as the Nile (*Nil*), the Indus (*Indus*), the Ganges (*Ganges*), the Syr Darya (*Jaxartes*), and the Amu Darya (*Oxus*). The map also named and marked towns, nowadays considered as historical, such as *Gades* (Cadiz), *Carthage*, *Memphis*, *Tyr* (Saida), *Thebes*, *Babilone* (Babylon), and *Suses* (Susa). According to geography historians, the map presents quite precisely West European coastline as well as both geographical position and islands configuration of the British Islands (Samas 1997).

Dicaearchus was the first one to use mean parallel and mean meridian in his map. He drew them across Rhode Island in the Mediterranean Sea. The Island at that time was considered to be Helios, the Sun's God cult centre. The Island was chosen most likely because of the Rhodes Colossus (The Sun's God Helios's 36 m high sculpture, created in the second century B.C.), which was famous as one of the wonders of the world.

3. Eratosthenes' map

The information about the maps, devised by Eratosthenes, reached the modern world only due to the writings of Strabon (68 B.C.–19 A.D.) and Cleomen. Eratosthenes handed the Royal palace of Egypt a world map which had been devised trying to keep the selected scale using rectangular projection, where the world had been pressed to the point so that its parallels and meridians made perpendicular angles (Harwood 2008).

Eratosthenes, as well as previous geographers, drew a right line, called diaphragm, across the Strait of Gibraltar, the Strait of Messina, Rhode Island and Taurus Mountains up to the very end of the oecumene in the East (Chomskis 1979). Eratosthenes, treating Rhode Island as the crossroads of mean parallel and mean meridian, in his map additionally drew 10 parallels and 11 meridians across the local objects, set by measurements. In this way he received a geographical grid. It later served as a basis to use cylindrical cartographical projection. Both parallels and meridians have their own names after the corresponding local objects. Next to the grid there are line values in stadia (1 stadium is about 0.152 km). They stretch from the equator and from the very western meridian in the Ethiopian Ocean (*Ocean Ethiopien*). In Dicaearchus' of Messina map the same ocean is called Atlantic Ocean (*Atlantique*). The map has a notice in the SW corner that every degree starting from the equator consists of 700 stadia.

Eratosthenes's map, devised in 220 B.C., depicts the centre of civilization of that time (the Mediterranean Sea) including available geographical knowledges of that

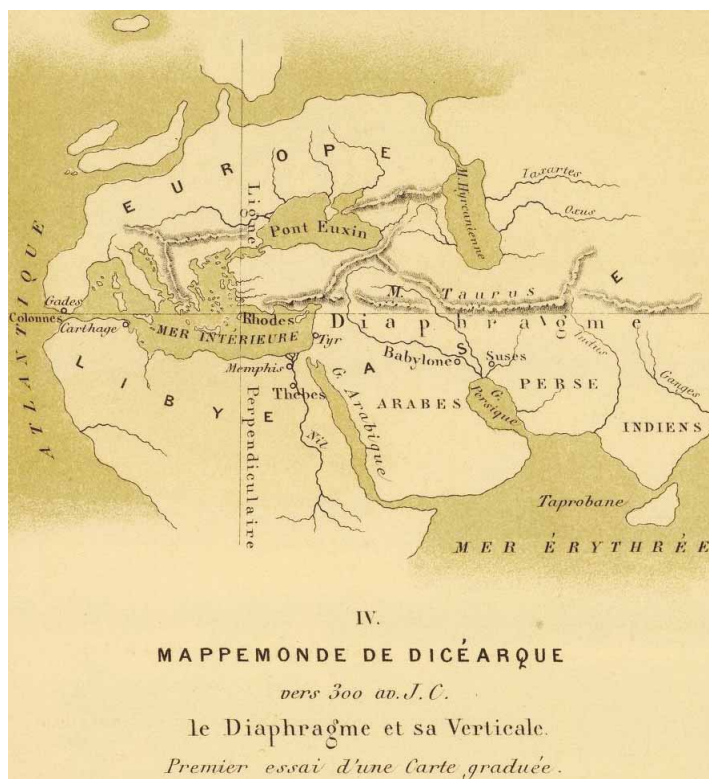


Fig. 2. Mappa mundi by Dicaearchus (from Rumsey Map Collection 2009)

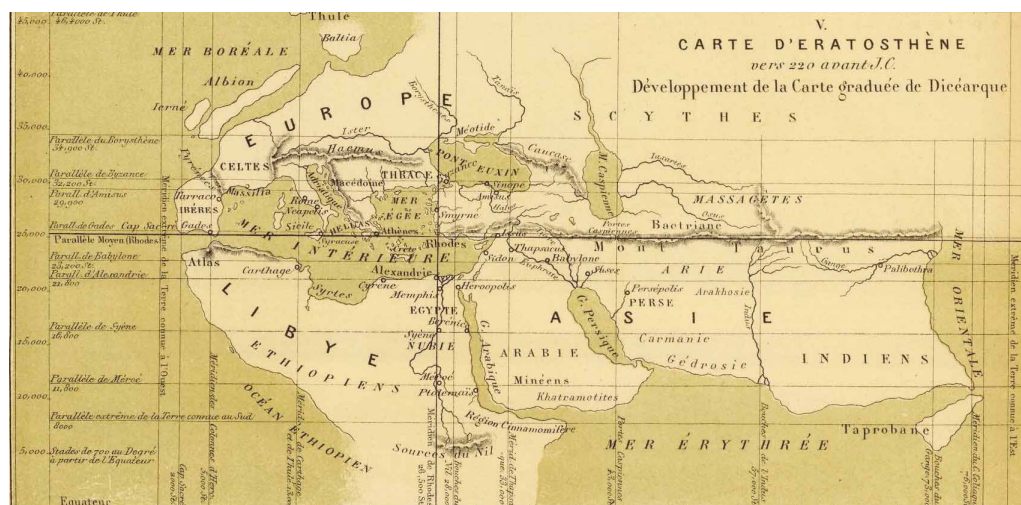


Fig. 3. Mappa mundi by Eratosthenes

period about the settled areas of the world. The map covers Europe and a part of Asia up to the Indian Ocean the Bay of Bengal (*Mer Orientale*) and Sri Lanka (*Taprobane*) (included), in the South it includes the Ethiopian Ocean (*Ocean Ethiopien*), Northern and Central Africa with pointed names of Libya, Ethiopia and Nubia, limiting itself to the Arabian Sea (*Mer Erythree*) (Fig. 3).

The stretch of the map according to the mentioned values of marginal parallels and meridians is a rectangle of 12 000×6000 km. The researchers of Eratosthenes map claim that he had marked quite many locations based on astronomical measurement.

It is possible to give a present geographical name to every name of Eratosthenes map grid with the exception of Thules meridian. We may only guess it might be the present Iceland. This island was described by a Greek traveller and geographer Pytheas of Massalia (320–285 B.C.) as the one to the North from the British Islands at a distance of 6-day travelling; after one more additional day you will see the frozen Cronian Sea. The sun sets here only for 2 or 3 hours. Later exponents of Thule Island guess that Pytheas himself had never visited the island; he only managed to collect the data about this Northern island or coastline. According to F. Nansen it could have been Iceland or Norway.

Even more dispute was received regarding an overland unlimited area in the North nearby marked as *Baltia*. Pytheas in his description confirms that on his way home he sailed through a wide channel and reached an island, rich in amber, which was supposedly collected by local inhabitants for fuel. It is a question whether Pytheas really visited or not the Baltic coastline, he may have just heard of it; but this is the first time name *Baltia* was mentioned. On the basis of this fact, the linguist Nesselmann (1811–1881) suggested calling the inhabitants of the Baltic coastline (Latvians, Lithuanians and Prussians) by a common name as the Balts (Statkutė de Rosales 2009).

4. Geographical net of Eratosthenes' map

The content of the map is limited that period of time by the farthest known meridians and parallels of the Earth with their named values in stadia. Western meridian with zero stadium was selected without identifying it with any concrete local object; the meridian was drawn in the ocean next to the coastline of West Europe and Africa.

The eastern outside meridian with 80 000 stadia is made behind the Hindustan Peninsula and Ceylon Island ignoring the mapping of farther Asian territory. It is necessary to state that the Hindustan Peninsula is unrealistically pulled east, so its deformity captures attention the most. The majority of inside meridians are identified with not very precisely concretized objects (*Bouches*

de Nil – the Nile entry, *p. Caspiennes* – the Gates of the Caspian Sea, *Bouches de Indus* – the Indus entry, *Bouches du Gange* – the Ganges entry). As the deltas of the great rivers in the map created more than two thousand years ago could have been notably different, the precision of marked meridians is not analyzed in the article. Regarding the deformity of the map in the East meridian, lined across *C. Coliaque* Cape has got inaccurate marking in stadia. Nowadays this Cape of Hindustan Peninsula is called Cape Komari (Comorin) (Kindersley 2005).

Northern outside parallel with 46 400 stadia marking crosses in the North Thule Island, while the bottom outside parallel in the South with 8000 stadia marking crosses the Ethiopian Ocean (*Ocean Ethiopien*), the Nile (*Nil*) source, the Arabian Sea (*Mer Erythree*) and finally crosses Ceylon (*Taprobane*) Island. A surprising fact here is that the top parallel of Thule with its marking quite precisely repeats the northern geographic co-ordinate of Iceland. However, the same cannot be said about the southern co-ordinate connected with Ceylon Island where the map deformity is noticeable.

A famous ancient Greece astronomer Hipparchus of Nicaea (160–125 B.C.) while criticizing the map of Eratosthenes developed a few geometrical methods of globe meridians and parallels projection onto a plane and coined “geographic co-ordinates” notion to talk about different the Earth surface points, and also showed the method how to set them.

Table 1. Parallels of the Eratosthenes' map

Names of parallels	Present map names	Values of parallels in stadia and degrees	Present values of parallels	Note
De Thule	Iceland	46 400–66°18'	66°00'	North of Iceland
Du Borysthene	Dnieper entry	34 900–49°52'	46° 35'	Parallel was also called by the name of Olbia (Gedgudas 1994), Ukraine at present
De Byzance	Istanbul	32 200–46°00'	41°00'	Byzantium – capital of the Eastern Roman Empire next to the entrance to Bosphorus
D'Amisus	Samsun	29 900–42°42'	41°17'	Settlement in the North of Turkey next to the Black Sea
De Gades	Cadiz	Nondigital parallel	36°32'	Cadiz – town in the SW part of Spain and gulf with the same name
De Rhodes	Rhode Island	25 000–35°43'	36°00'	Greece
De Babylone	Vanished city of Babylon	23 200–33°08'	33°10'	Historical city (Kindersley 2005), today Iraq
D'Alexandrie	Alexandria	21 800–31°08'	31°12'	Egypt
De Syene	Aswan	16 800–24°00'	24°05'	Aswan is also known as the name of the dam, Egypt
De Meroe	Meroe	11 800–16°52'	16°56'	Place of pyramids in Upper Nubia near the Nile, towards North from Khartoum next to Kabushiya settlement (Sudan)

5. Conclusions

1. The table comparing the Eratosthenes map parallel values of Alexandria, Syene (Aswan), Babylon and Meroe with parallel values of present settlements proves the differences to be minor and the measurements, conducted by Eratosthenes at that time, are sufficiently precise (see Table 1).
2. The map named *Borysthene* (the Dnieper) parallel which in 372 A.D. in cartography was called as Olbia (Gedgaudas 1994) after the name of international port above the Dnieper entry of that period. It proves the importance of the port of Amber Road.
3. Inscription BALTIA in mapping for the first time in the history of cartography was used in the map of Eratosthenes.
4. While compiling the map, Eratosthenes did not have enough geographical information regarding the oecumene's eastern part, so this part of map includes the biggest error.

References

- Chomskis, V. 1979. *Kartografija*. Vilnius: Mokslas. 336 p.
- Gedgaudas, Č. 1994. *Tikrosios Lietuvos beieškant*. Kaunas: Aušra. 359 p.
- Harwood, J. 2008. *Pasaulis žemėlapiuose*. Mūsų knyga. 192 p.
- Kindersley, D. 2005. *Conicise. Atlas of the world*. DK, London, New York, Munich, Melbourne, Delhi. 350 p.
- Kudaba, Č. 1980. *Geografinės kelionės ir atradimai*. Vilnius: Mokslas. 294 p.
- Rumsey, D. 2009. Internetinė kartografinė svetainė. Available from Internet: www.davidrumsey.com/about/articles/about
- Samas, A. 1997. *Žemėlapiai ir jų kūrėjai*. Vilnius: Mokslo ir enciklopedijų leidybos institutas. 197 p.
- Statkutė de Rosales, J. 2009. *Senasis aisčių giminės metraštis*. Česlovo Kudabos labdaros fondas, Kaunas. 275 p.
- Teeple, J. B. 2002. *Timelines word of history*. London. 666 p.
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