catalogue included into his oeuvre? Our answer is in the positive. We have developed a method to serve this end, tested it on several veraciously dated catalogues, and then applied it to the Almagest. The reader shall find out about our results in the present book.

Let us now cite some brief biographical data concerning the astronomers whose activities are immediately associated with the problem as described above. These data are published in Scaligerian textbooks. One must treat them critically, seeing as how the Scaligerian version of history is based on an erroneous chronology (see Chron1 and Chron2). We shall consider other facts that confirm it in the present book.

5. HIPPARCHUS

Scaligerian history is of the opinion that astronomy became a natural science owing to the works of Hipparchus, an astronomer from the "ancient" Greece who lived around 185-125 B.C. He is also believed to have been the first to discover the equinoctial precession, which shifts the equinox points across the ecliptic in the reverse direction from which the longitudes are counted in over the course of time. Ecliptic longitudes of all stars grow as a result. Specialists in the history of astronomy tell us the following: "Very little is known about the life of Hipparchus. He was born in Nicaea (nowadays the city of Iznik in Turkey), lived in Alexandria for a while and worked on the Isle of Rhodes, where his astronomical observatory was erected ([395], page 43).

It is believed that the explosion of a nova was the impetus which had made Hipparchus compile a catalogue of stars in the first place. Pliny the Elder (23-79 A.D.) is usually quoted in this respect – he reports that Hipparchus "discovered a new star as well as yet another star that came into being around that time". According to other sources ([395], page 51), Hipparchus noticed the explosion of a nova in 134 B.C. "This led Hipparchus to the idea that certain changes are likely to take place in the stellar world – they are too slow to be discovered within the lifetime of several generations. He decided to compile a 850-item star catalogue in order to provide his distant descendants with such an opportunity" ([395], page 51).

Ptolemy's Almagest tells us about the catalogue of Hipparchus. The catalogue itself has not survived. However, it is believed that the ecliptic longitude and latitude of each star was indicated there, as well as the magnitude. It is believed that Hipparchus localised the stars using the same terms as the Almagest: "the star on the right shoulder of Perseus", "the star over the head of Aquarius" etc ([395], page 52).

One invariably ponders the extreme vagueness of this star localization method. Not only does it imply a canonical system of drawing the constellations and indicating the stars they include – another stipulation is that there are enough identical copies of a single star chart in existence. This is the only way to make the verbal descriptions of stars such as the above work and help a researcher with the actual identification of stars. However, in this case the epoch of the catalogue's propagation must postdate the invention of the printing press and the engraving technique, since no multiple identical copies of a single work could be manufactured earlier.

Nearly the entire body of information that we have on the "ancient" Greeks' star science comes from the two surviving works – Ptolemy's "Almagest" and a work of Hipparchus entitled "A Commentary to Aratus and Eudoxus", written around 135 B.C. ([614], page 211). The issue of stellar mobility – in other words, whether or not individual stars move individually in relation to the sphere of immobile stars, was already discussed by Ptolemy, whose verdict was negative (in particular, Ptolemy begins the VII volume of the Almagest with an analysis of certain star configurations cited by Hipparchus, a long time before Ptolemy's own epoch, claiming the configurations in question to be valid for his epoch as well ([704], page 210; also [614], page 212).

"Judging by this example and several others, Ptolemy claims to have demonstrated the constancy of relative stellar positions" ([614], page 213). Therefore, according to Scaligerian history, the proper star motion issue first emerged in the II century A.D.

6. PTOLEMY

According to A. Berry, "The last glorious name we encounter in the history of Greek astronomy is that of Claudius Ptolemy. We know nothing about his life, apart from the fact that he lived in Alexandria around 120 A.D. His fame is largely based on the enormous astronomical tractate known as the Almagest – it is our primary source of information on Greek astronomy, which can by all means be considered the definitive encyclopaedia of mediaeval astronomy.

Several lesser astronomical tractates are ascribed to Ptolemy as well – some of them are unlikely to be authentic, though. Also, Ptolemy was the author of a valuable work on geography, and, possibly, a tractate on optics as well. Among other things, the optics discipline includes the study of light refraction in the atmosphere of the Earth; it is explained in the book that the light of a star … as it enters our atmosphere … and penetrates its lower and denser layers, must eventually become curved or refracted. As a result, the star will appear closer to the zenith as seen by the observer … than it is in reality" ([65], pages 64-65).

It is however unclear whether or not the author of "Optics" could calculate refraction as a stellar latitude function. On the other hand, it is known that "Walther was the first to successfully attempt an introduction of atmosphere refraction compensation … which Ptolemy could barely conceive of" ([65], page 87). However, the character in question lived in the XV century A.D. – Bernhard Walther, 1430-1504 ([65], page 85).

So how does one date Ptolemy's "Optics"? The fact that refraction compensation remained a complex task even in the times of Tycho Brahe, or the second half of the XVI century A.D., will be related separately, in the Tycho Brahe section. One can't help suspecting that the "ancient" Optics of Ptolemy were written in this very epoch of the XVI-XVII century.

As for the name of the Almagest, this is what we learn from A. Berry: "The name of the main manuscript translates as 'The Great Work', although the author himself refers to his book as 'The Mathematical Work'. The Arabic translators, whether out of respect or accidentally, translated 'The Great Work' as 'The Greatest Work', which is why the Arabs knew Ptolemy's book as 'Al Magisti', later known as 'Almagestum' in Latin, and, finally, into 'Almagest'" ([65], page 64).

7. COPERNICUS

We shall select just a few necessary facts from the entire body of available materials associated with Copernicus. Nicolaus Copernicus (1473-1543) is one of the greatest astronomers of the Middle Ages and the author of the heliocentric theory. His ancient portrait can be seen in fig. 0.7, and another one in fig. 0.8.

Incidentally, "his name was transcribed in a variety of ways – by Copernicus himself as well as his

Fig. 0.7. Ancient portrait of Copernicus (1478-1443). Taken from [1160], page 310.

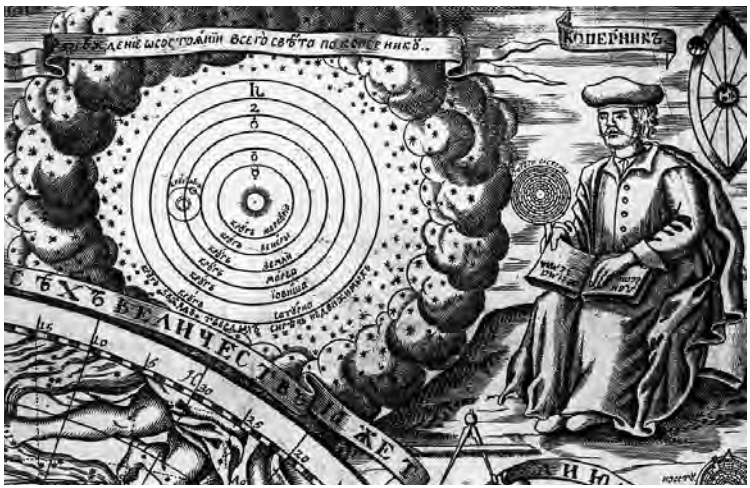

Fig. 0.8. Ancient drawing of Copernicus on the "Cosmosphere" of Vassily Kiprianov. Taken from [90], page 212.

Fig. 0.9. The heliocentric system of the world according to Copernicus, as drawn in the atlas of Andreas Cellarius (Amsterdam, 1661). Taken from [1160], page 9.

Fig. 0.10. Fragment. A drawing of Copernicus from a 1661 atlas. Taken from [1160], page 9.

contemporaries. He would occasionally write his name as 'Coppernic', reserving the Latin form of the name, 'Coppernicus', for his scientific works. Much less frequently he used the form 'Copernicus'" ([65], page 90). By the way, could the name 'Copernic' be a derivative of the Slavic word for "competitor", which is "*sopernik*"? In the epoch that preceded the establishment of rigidified grammar rules the letter "C" could stand for both "S" and "K".

The name "Sopernik" is in perfect concurrence with the scientific side of the matter – namely, the prominent scientist can be regarded as a competitor of his colleague Ptolemy and the author of a new conception and theory. The very concept of competition usually implies a certain chronological propinquity, if not actual contemporaneity, of the competitors.

A. Berry reports: "The crucial idea associated with the name of Copernicus, owing to which 'De Revolutionibus' is one of the seminal works in astronomical literature par none but the Almagest and Newton's 'Principia', is that, according to Copernicus, the visible motions of the celestial bodies are, for the greater part, different from their true motions, reflecting the motions of the observer carried away by the Earth" ([65], page 95).

Copernicus places the Sun at the centre of the Solar System, thus creating a heliocentric system of the Universe, qv in fig. 0.9. In the lower right corner we see a portrait of Copernicus (fig. 0.10).

Copernicus reports having encountered a passage in one of Cicero's works, which had reflected the opinion of Hecataeus that the Earth revolves around its axis on a daily basis. These ideas were inherited from the Pythagoreans. Philolaus claimed that the Earth moved around a central fire. It is perfectly clear that his stance is already heliocentric in nature. Therefore, the "ancient" Pythagoreans and Philolaus must have been contemporaries of Copernicus, or, alternatively, his immediate predecessors.

The idea that the Earth might not be the only centre of motion and that Venus and Mercury could also revolve around the Sun is believed to be an "ancient" Egyptian theory, which was also supported by Marcian Capella in the V century A.D. "Nicolaus Cusanus, a more modern authority (1401-1464) similarly inclined to believe in telluric motion, either wasn't noticed by Copernicus or deemed important enough … It is noteworthy that Copernicus remains taciturn about Aristarchus of Samos, whose ideas of telluric motion were defined perfectly well [see Chapter 11 for more details – Auth.]. It is possible that the reluctance of Copernicus to refer to such an authority as Aristarchus can be explained by the fact that the

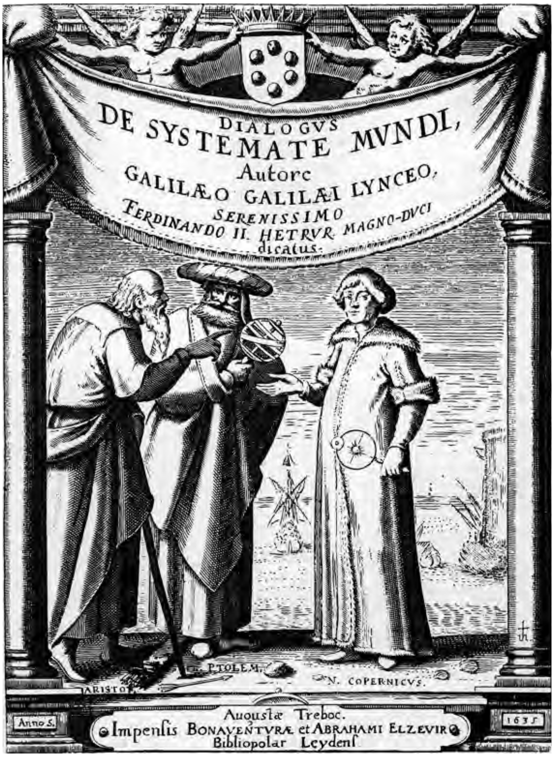

Fig. 0.11. Ancient engraving dating from 1635, found on the title page of ***De Systemate Mundi*** by Galileo Galilei. We see the "ancient" Aristotle and Ptolemy, likewise the mediaeval Copernicus, who had lived in the XVI century, drawn as contemporaries. Ptolemy is wearing a turban on his head. This is how the artist of the early XVII century saw things; consensual Scaligerian chronology should naturally deem this quite odd. A publication of Leiden, Bon. and Abr. Elsevier, 1635. Titular etching. Taken from [35], page 58, sheet XXXII.

later was accused of heresy for his scientific views" ([65], pages 95-96).

According to A. Berry, "the plan of 'De Revolutionibus' is similar to that of the Almagest in general" ([65], page 97). O. Neugebauer is perfectly correct to remark as follows: "There is no better way to convince oneself that the astronomical science of the Middle Ages concurs to that of the antiquity than to perform a comparative study of the Almagest … and 'De Revolutionibus' by Copernicus. The two works are parallel - chapter by chapter, theorem by theorem and table by table" ([571], page 197).

The book of Copernicus is concluded by a star catalogue with 1024 stars in it. Specialists in the history of astronomy tell us that the catalogue "is basically identical to the catalogue of Ptolemy, the main difference being that the former counts the latitudes off the Gamma of Aries and not the vernal equinox point" ([395], page 109). Therefore, the initial reference point did not necessarily coincide with the vernal equinox in the XVI century, whatever the reason. The practice of choosing a different point as the beginning of the coordinate system may also have existed before the XVI century – in the epoch of Ptolemy, for instance. Berry also informs us of the following: "Whenever there were discrepancies between the Greek and Latin version of the Almagest, caused by the inattentiveness of the scribes or the printers, Ptolemy would accept either version without trying to verify both by new observations" ([65], page 103).

Our book pays a great deal of attention to the precision of the observations carried out by different astronomers. It would therefore be expedient to cite some data concerning the degree of precision that Copernicus had aspired to achieve. As A. Berry points out, "We have become so accustomed to associate the renaissance of astronomy … with the growing meticulousness of observation fact collection, believing Copernicus to be the primary figure of the Renaissance, that it would make sense to emphasise the fact that he was by no means a great observer. His instruments were of his own construction for the most part, and greatly inferior to the instruments of Nassir-Eddin and Ulugbek [the astronomers of the Muslim period who lived in 1201-1274 A.D. and 1394-1449 A.D., respectively – Auth.]. Moreover, they were even worse than the instruments that he could have ordered from the craftsmen of Nuremberg, had it been his intention; the observations of Copernicus were few (27 are mentioned in his book, and we know of a dozen or two more from other sources), and he was apparently unconcerned with attaining a particular degree of precision. The positions of stars that he had measured, which served him as the primary source of reference and were therefore of the greatest importance, allowed for discrepancies of 40' – greater than the visible diameter of the Sun or the Moon. Hipparchus would doubtlessly consider a discrepancy of this sort a grave error" ([65], page 93).

In fig. 0.11 we see an old engraving from the title

Fig. 0.12. The title page from the ***Celestial Atlas*** by Doppelmaier. The "ancient" Ptolemy and the mediaeval scientists of the XVI-XVII century (Copernicus, Kepler and Brahe) are drawn as contemporaries, or at least as scientists of the same epoch, conversing between themselves. Taken from [926], page 73.

page of "The Two Primary World Systems", a book by Galileo Galilei that came out in 1635 ([35], page 58, sheet XXXII). The early XVII century artist portrays three scientists here – the "ancient" Ptolemy and Aristotle next to the mediaeval Copernicus. They are depicted as contemporaries involved in a discussion of scientific problems. Today we are told that all such mediaeval artwork (which is rather plentiful, as a matter of fact) happens to be of a metaphorical nature. Modern historians interpret the conversation between Copernicus and the "ancient" scientists as a symbol used by the mediaeval artist in order to emphasise the spiritual proximity between the great scientists of the past and present. This is why the three are portrayed side by side, conversing at ease (fig. 0.12). This may indeed be the case. And yet everything we have learnt about Scaligerian chronology (see Chron1 and Chron2) implies the potential viability of a different version – namely, that we are to take mediaeval artwork of this sort literally and to see precisely what they show us. It is very likely that the consensual metaphorical interpretation of such artwork, which fuses the "antiquity" and the Middle Ages together, is a mere consequence of Scaligerian chronology, which arbitrarily ascribes certain mediaeval contemporaries to different epochs, severing all possible connections between them. Ptolemy, for example, has been cast into deep antiquity, whereas Copernicus more or less retained his own epoch – the XVI century.

As a matter of fact, Ptolemy's headdress looks just like a turban (see fig. 0.11). Could it be the result of his being an Ottoman scientist? Ptolemy also wears the turban-like headdress in yet another ancient portrait – see figs. 0.13 and 0.14.

In fig. 0.15 we see an old piece of artwork dating from 1666. It is evasively labelled "allegorical" – historians have no qualms about writing such things as