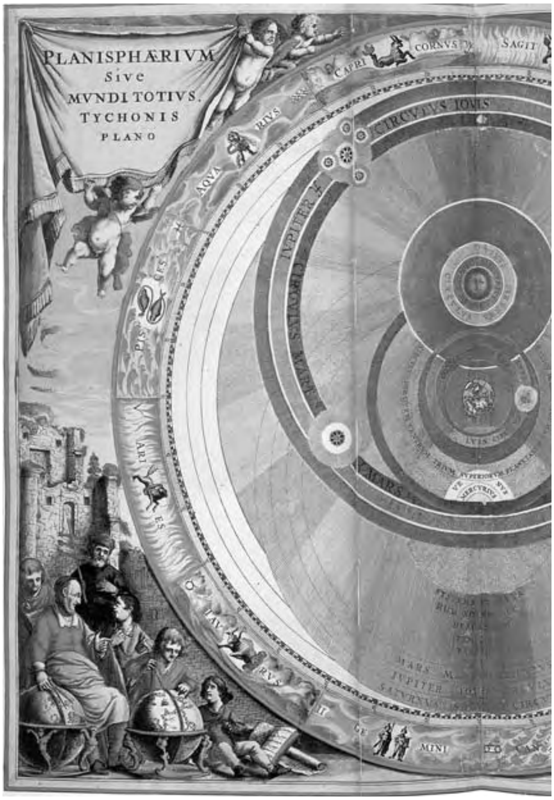


Fig. 0.26. A diagram of the Universe according to Tycho Brahe, taken from the atlas by Andreas Cellarius of Amsterdam and dating to 1661. Taken from [1058], page 20. Left half of the map.

Fig. 0.27. A diagram of the Universe according to Tycho Brahe, taken from the atlas by Andreas Cellarius of Amsterdam and dating to 1661. Taken from [1058], page 20. Right half of the map.

whose surface was covered by thin sheets of brass and depicted the Zodiacal belt, the equator and the positions of 1000 stars; their coordinates were calculated over the many years of Tycho's observations. He was proud of his creation, claiming 'No globe of this size, manufactured with as much diligence and finesse, has ever been made anywhere in the world to the best of my knowledge' … Alas, this true miracle of science and art was destroyed in a blaze in the second half of the XVIII century" ([395], page 127).

According to the evidence of Tycho's contemporaries, his work stamina was just as amazing as the meticulousness of his scientific research. He checked and re-checked the results of numerous observations personally, striving to bring them to perfection. In figs. 0.26 and 0.27 we reproduce the diagram of Tychonian cosmology taken from the atlas of Andreas Cellarius published in 1661 in Amsterdam ([1058], page 20). We see Tycho Brahe in the lower right corner (fig. 0.28).

This phase of success ended rather abruptly. Christian IV, the new King of Denmark, expropriated Tycho Brahe's estates, which had been providing him with the funds necessary for maintaining the observatory in a constant state of functionality. In 1597 Tycho left Denmark and eventually settled down near Prague, founding a new observatory there. Johannes Kepler began his career as Brahe's apprentice (see fig. 0.29). On 13 October 1601, Tycho Brahe fell ill and died on 24 October 1601 at the age of 55. The famous Uraniborg observatory was destroyed completely – there isn't a single trace of it in existence

Fig. 0.28. A fragment of the previous illustration depicting Tycho Brahe.

today. Alternatively, it could have been located in an altogether different place (see Chapter 10).

"In 1671 Picard went to Denmark in order to find out about the fate of Tycho Brahe's observatory on the Isle of Hven. Picard found a pit filled with rubbish where the magnificent castle had formerly stood, and was forced to conduct excavations in order to locate the foundation" ([65], page 181). Thus, a great deal of information about the life and work of Tycho Brahe has been lost, notwithstanding the fact that he didn't really live all that long ago. "The was hardly anyone to use the large instruments of Tycho after his death – most of them perished in the epoch of the Bohemian civil wars. Kepler managed to obtain a copy of Brahe's observation records, but they were raw and unedited. Publications were few and far between" ([65], page 127).

It is believed that around 1597-1598 Tycho Brahe "distributed some handwritten copies of his 1000-star catalogue. Only 777 stars had been observed and measured properly, and so Tycho made haste to register all the rest of the stars, wishing to add to the traditional number" ([65], page 126).

Let us linger on the precision of Tycho Brahe's observations for a while. In the epoch of Copernicus, a single measurement step equalled 10' – just like it did in the Ptolemaic epoch, since 10' also constitute the value of the Almagest precision margin. It is believed that Tycho Brahe managed to make the measurements of the equatorial star coordinates some 50 times more precise – namely, the average precision margin of the coordinates of eight referential stars measured by the wall quadrant equals 34.6" (33.2" in case of the astronomical sextant). This level of precision is believed to be close to the theoretical possible precision limit for any astronomical observations conducted before the invention of the telescope ([395], pages 128-129).

However, such great precision of equatorial stellar coordinate measurement was compromised by the transition to the ecliptic coordinate system, which requires the knowledge of the angle between the ecliptic and the equator. Tycho Brahe's calculations of this angle yielded the figure of $\varepsilon = 23° 31' 5"$, which exceeds the true value by 2'. This can be explained by the fact that Tycho corrected his star declination measurements taking refraction and solar parallax into account. "Following Aristarchus of Samos, he accepted the theory [? – Auth.] that the distance between the Earth and the Sun was 19 times greater than that between the Earth and the Moon, which makes solar parallax equal 1/19th of the lunar parallax, or 3'. Tycho wrote the following in this respect: 'the ancients appear to have carried out the measurement in question with enough attention to detail for us to adopt the end value as sufficiently reliable'. He made a mistake, though …" ([395], page 129).

Thus, the precision margin of the ecliptic stellar coordinates in Tycho Brahe's equals 2' or 3'. We shall confirm this result independently, using our catalogue dating method; in particular, it allows us to estimate the real precision of star observations as conducted by the ancients.

As we learn from A. Berry, "obviously enough, the true precision of Tychonian observations fluctuated significantly, depending on the character of the observation, the diligence of the observer, and the period of Tycho's life when the observation was carried out. The discrepancy between the coordinates of the nine stars that form the basis of his star catalogue and their equivalents yielded by the best modern observations is smaller than 1' in most cases (equalling 2' in case of just a single star). This error was caused by refraction primarily – Tycho's familiarity with the latter phenomenon could not have been anything but perfunctory. The positions of other stars must have been measured with less precision. Still, we shall hardly be that much off the mark if we assume that in most cases the precision margin of Tycho's observations did not exceed 1' or 2'.

According to one of the most frequently quoted passages of Kepler's oeuvre, errata of 8' were completely out of the question for Tycho's planetary observations" ([65], page 128).

A. Pannekuk reports: "Tycho estimated the direct ascensions and declinations of his referential stars, totalling 21, with the greatest precision; the mean error value is less than 40" as compared to modern data" ([643], page 229).

A. Berry suggests the following reasons why Tycho Brahe was the first to attain a sufficiently high level of observation precision: "To a certain extent, such precision can be explained by the size and the excellent construction of his instruments – this is something that the Arabs and other observers had always sought to achieve. It goes without saying that Tycho used brilliant instruments – however, they became a great deal more efficient in his hands for two reasons, the first being his innovative use of minor mechanical accessories, such as special dioptres or particular kinds of horizontal gradation, and the second, the fact that the motion range of his instruments was very limited, which would substantially enhance their stability as compared to the devices that can be directed at any part of the celestial sphere.

Another great improvement was his systematic compensation of the inevitable mechanical imperfections that affect even the best of the instruments as well as the more constant errata. For example, it had been long known that the refraction of the light in the atmosphere makes the stars seem located somewhat higher than they really are. Tycho endeavoured to carry out a series of observations in order to estimate the value of this shift for different parts of the celestial spheres. He came up with a rather rudimentary refraction table as a result, and made regular refraction compensation an integral part of all his further observations" ([65], page 129).

Fig. 0.29. An ancient portrait of Johannes Kepler. Taken from [926], page 69.

Apart from that, Tycho Brahe accounted for the parallax effect. "He was among the first scientists to appreciate the full importance of numerous repetitions of the same kind of observations under varying conditions so as to make all the assorted random errata introduced by individual observations neutralise each other" ([65], page 129).

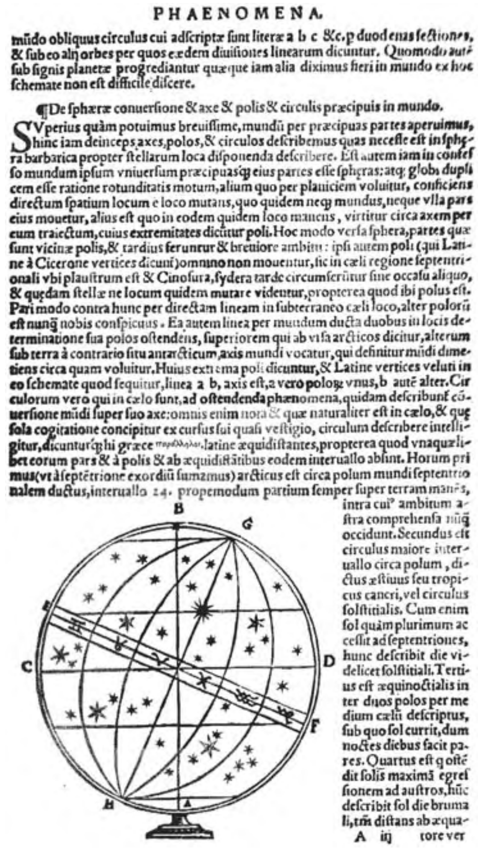
All the above facts demonstrate that Tycho Brahe was a perfectionist and a very meticulous astronomer of great professionalism. This makes the following circumstance, pointed out by A. Berry, as well as many other authors, seem very odd indeed: "Unfortunately, he did not measure the distance to the Sun, accepting the veracity of the extremely rough estimate that had remained unaltered since the very epoch of Aristarchus, passing from one astronomer to another" ([65], page 130). From the consensual point of view, this "institution of astronomical heritage" must have been about two thousand years old in the epoch of Tycho Brahe. If he did in fact consider this information "ancient", why didn't he verify it, being the brilliant professional that he was? It would be all the more natural given that "he had made corrections and new measurements to define nearly every astronomical value that was of any importance at all" ([65], page 129).

In fig. 0.30 we see a page from a 1537 edition of the Almagest.

9. IMPORTANT RESEARCH OF THE ALMAGEST BY THE ASTRONOMER ROBERT NEWTON AND HIS BOOK ENTITLED "THE CRIME OF CLAUDIUS PTOLEMY"

We shall occasionally compare our results to the results of Robert Newton's fundamental scientific research of Ptolemy's Almagest ([614]). A portrait of Robert Newton can be seen in fig. 0.31.

Robert Newton (1919-1991) was a prominent American scientist. Let us cite some facts about him from the official obituary of 5 June 1991 (died 2 June 1991 in Silver Spring, MD, USA). "He was a scientist of international renown due to his research concerning the shape and the motion of the Earth … He was a specialist in the theory of ballistics, electronic physics, celestial mechanics and satellite trajectory calculation. His career started in APL's Space Department in 1957, where he was put in charge of the satellite motion research … He is to be credited with his fundamental contribution to the major improvements in navigation precision … He was head of the space exploration programme and the developer of the satellite navigation lab's analytical aspects … He was the chief architect of the Navy's Transit Satellite Navigation System, which was developed in the laboratory in the 1960's. This navigation system is still used by more than 50.000 private, commercial and military vessels and submarines … His research of satellite motion made it feasible to calculate the shape of the Earth with greater precision, which has resulted in more precise measurements … R. Newton was a member of the Ad Hoc Committee on Space Development Director Board and became the leader of APL's Space Exploration Group in 1959 … In the


PHAENOMENA.

mũdo obliquus circulus cui adſcriptæ ſunt literæ a b c &c. p duodenas ſectiones, & ſub eo alij orbes per quos eædem diuiſiones linearum dicuntur. Quomodo autẽ ſub ſignis planetæ progrediantur quæque iam alia diximus fieri in mundo ex hoc ſchemate non eſt difficile diſcere.

¶De ſphæræ conuerſione & axe & polis & circulis præcipuis in mundo.

SVperius quàm potuimus breuiſſime, mundũ per præcipuas partes aperuimus, hinc iam deinceps axes, polos, & circulos deſcribemus quas neceſſe eſt in ſphæra barbarica propter ſtellarum loca diſponenda deſcribere. Eſt autem iam in confeſſo mundum ipſum vniuerſum præcipuasq; eius partes eſſe ſphæras: atq; globi duplicem eſſe ratione rotunditatis motum, alium quo per planiciem voluitur, conficiens directum ſpatium locum e loco mutans, quo quidem neq; mundus, neque vlla pars eius mouetur, alius eſt quo in eodem quidem loco manens, virtitur circa axem per eum traiectum, cuius extremitates dicitur poli. Hoc modo verſa ſphera, partes quæ ſunt vicinæ polis, & tardius feruntur & breuiore ambitu: ipſi autem poli (qui Latine à Cicerone vertices dicunt) omnino non mouentur, ſic in cæli regione ſeptentrionali vbi plauſtrum eſt & Cinoſura, ſydera tarde circumferũtur ſine occaſu aliquo, & quędam ſtellæ ne locum quidem mutare videntur, propterea quod ibi polus eſt. Pari modo contra hunc per directam lineam in ſubterraneo cæli loco, alter polorũ eſt nunq̃ nobis conſpicuus. Ea autem linea per mundum ducta duobus in locis determinatione ſua polos oſtendens, ſuperiorem qui ab viſa arcticos dicitur, alterum ſub terra à contrario ſitu antarcticum, axis mundi vocatur, qui definitur mũdi dimetiens circa quam voluitur. Huius extrema poli dicuntur, & Latine vertices veluti in eo ſchemate quod ſequitur, linea a b, axis eſt, a vero polorũ vnus, b autẽ alter. Circulorum vero qui in cælo ſunt, ad oſtendenda phænomena, quidam deſcribunt cõuerſione mũdi ſuper ſuo axe: omnis enim nota & quæ naturaliter eſt in cælo, & quę ſola cogitatione concipitur ex curſus ſui quaſi veſtigio, circulum deſcribere intelligitur, dicunturq; hi græce παράλληλοι, latine æquidiſtantes, propterea quod vnaquæli-bet eorum pars & à polis & ab æquidiſtãtibus eodem interuallo abſint. Horum primus (vt à ſeptẽtrione exordiũ ſumamus) arcticus eſt circa polum mundi ſeptentrionalem ductus, interuallo 24. propemodum partium ſemper ſuper terram manẽs, intra cui⁹ ambitum aſtra comprehenſa nũq̃ occidunt. Secundus eſt circulus maiore interuallo circa polum, dictus æſtiuus ſeu tropicus cancri, vel circulus ſolſtitialis. Cum enim ſol quàm plurimum acceſſit ad ſeptentriones, hunc deſcribit die videlicet ſolſtitiali. Tertius eſt æquinoctialis inter duos polos per medium cæli deſcriptus, ſub quo ſol currit, dum noctes diebus facit pares. Quartus eſt q oſtẽdit ſolis maximã egreſſionem ad auſtros, hũc deſcribit ſol die brumali, tm̃ diſtans ab æquatore ver

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Fig. 0.30. A page from a 1537 edition of the Almagest.

late 1970's he also became involved in the research of the ancient astronomical records of solar and lunar eclipses … This research gave him a reason to doubt the information contained in the main oeuvre of the famous astronomer Claudius Ptolemy and to accuse the latter of fraud in his book, "The Crime of Claudius Ptolemy" … Among other things, R. Newton was the Professor of Physics at the Tulane University and the University of Tennessee, having also worked for the Bell Telephone Laboratory … and developed the missile ballistics at the Allegany Ballistic Laboratory, Cumberland".

We believe it to be perfectly appropriate to voice our attitude towards the famous book of Robert Newton – "The Crime of Claudius Ptolemy" ([614]), since it has become rather controversial among the modern authors of works on the history of astronomy. I.

A. Klimishin, for instance, writes the following about Newton's book in [395]: "What we encounter here is an intent to prove that nearly the whole bulk of Ptolemy's observations, which constitute the foundation of the Ptolemaic theory of solar, lunar and planetary motion, happens to be a fraud" ([395], page 56). I. A. Klimishin doesn't counter Robert Newton's conclusions with any ostensible astronomical or statistical argumentation, opting to abandon the factual discussion of the issue altogether and contenting himself with the following statement: "And yet the main reason for Ptolemy's universal fame was his theory of planetary motion, which had made it feasible to calculate the positions of planets dozens of years into the future, no less!" ([395], page 56). However, the value of the Ptolemaic model can by no means shed any light on the Almagest star catalogue's compilation history or indeed reveal anything about the origins of the Almagest in general. Similar statements of disagreement with the conclusions made by Robert Newton (containing no counter-argumentation of any substance) have been voiced by a number of other specialists in the history of astronomy, such as Gingerich ([1153]).

In reality, the book of Robert Newton encapsulates his fundamental research of the Almagest with the aid of mathematical, astronomical and statistical methods. It contains a vast body of statistical material and several deep conclusions that sum up many years of Robert Newton's labour. These results elucidate the nature of difficulties associated with the interpretation of the astronomical data contained in the Almagest. It has to be emphasised that Robert Newton hadn't a iota of doubt about the veracity of the Almagest's consensual dating (which falls over the period between the II century B.C. and the II century A.D.). Robert Newton was no historian, and he had to rely on the Scaligerian version of history, using it as the chronological framework for his own research. The main corollaries of Robert Newton can be formulated as follows:

1) The astronomical environment that corresponds to the beginning of the A.D. era (as calculated with the aid of modern theory) is at odds with the "observation material" included in Ptolemy's Almagest.

2) The surviving version of the Almagest does not contain any original astronomical observation data at all – the Almagest data are the end product of somebody's conversions and calculations aimed at making the initial observation data fit another historical epoch. Moreover, a substantial part of the "observations" included in the Almagest also result from later theoretical calculations included in the Almagest ex post facto as "the observations of the ancients".

Fig. 0.31. A portrait of Robert Newton, the American scientist (1919-1991).

3) The Almagest could not have been compiled in 137 A.D., which is the epoch that the "ancient" Ptolemy's lifetime dates to in the consensual history of today.

4) Consequently, the Almagest was compiled in some other epoch and requires a new dating. Robert Newton himself has made the assumption that the Almagest was in need of "extra age", or a shift backwards in time that would place it in the epoch of Hipparchus – circa the II century B.C., that is. However, this does not alleviate any of the fundamental problems discovered by Robert Newton.

5) Robert Newton had initially agreed with the consensual hypothesis about the Almagest containing Ptolemy's own claim that all of his observations were carried out by none other but Ptolemy himself – allegedly around the beginning of the reign of Antoninus Pius, a Roman emperor. The Scaligerian dating of his reign is 138-161 A.D. Robert Newton makes the instant self-implied conclusion that Ptolemy was lying as a result. Actually, we shall deal with the issue of just how strongly the information contained in the Almagest implies that Ptolemy carried out all of his stellar observations by himself during the reign of Antoninus Pius.

In other words, Robert Newton opines that Ptolemy himself (or somebody else acting on his behalf) was a fraud, seeing as how the Almagest data are presented as the results of actual astronomical observations when they really owe their existence to conversions and theoretical calculations.

As a serious and renowned scientist faced by the necessity of voicing a number of straightforward accusations against Ptolemy or his editors, Robert Newton remained uncertain about the best form of his scientific results' publication. At the very least, this is the motivation he voiced in a private missive to A. T. Fomenko, which had concerned with the history of the creation and publication of his book ([614]) in 1977 (R. Newton and A. T. Fomenko exchanged a few letters about the problems of historical chronology in the 1980's). However, Robert Newton has finally considered his discovery of the situation with the Almagest important enough to obey his duty of a scientist and even use his accusations as the headers of some of his books' paragraphs ([614]). Let us quote some of them, since they really do speak volumes.

"5:4. The alleged observations of the equinoxes and the solstices by Ptolemy.

5:5. The fabricated solstice of 431 B.C. (the solstice of Meton).

5:6. Ptolemy's observations aimed at the estimation of the ecliptic declination angle and the latitude of Alexandria.

6:6. Four fabricated lunar eclipse triads.

6:7. Proof of fraud.

6:8. The culprit.

7:4. Fraudulent calculations and miscalculations.

10:5. The falsification of data.

11:5. Falsified data concerning Venus.

11:6. Falsified data concerning the external planets" ([614], pages 3-5).

In the very first lines of his foreword to [614], Robert Newton says the following. "This book tells the story of a certain crime against science. I am neither referring to carefully planned criminal activity of any sort, nor indeed to the kind of crime committed with the aid of such devices as hidden microphones, messages ciphered in microfilm, and so on. I am referring to a crime committed by a scientist against his learned peers and apprentices and a betrayal of professional integrity and ethics – a crime that has forever deprived humanity of certain fundamental information pertaining to the most crucial fields of astronomy and history.

I have demonstrated that the crime in question was indeed committed in four of my previously published works … When I began my work on this book, my objective had been to collect the materials scattered across several publications into a single book … However, by the point that I'd written the first third of this book, I have discovered the evidence that proves the crime in question to be rooted much deeper that I had expected initially. The present work is therefore a collection of old and new evidence to testify to the commission of the crime in question" ([614], page 10).

Robert Newton concludes his book as follows:

"This is a final summary of results. All of Ptolemy's own observations that he uses in the 'Syntax' [the Almagest – Auth.] have turned out fraudulent, inasmuch as their veracity could be tested. Many of the observations ascribed to other astronomers are also part of Ptolemy's fraud. There are theoretical errata galore in his work, and it also reveals a lack of comprehension on the part of the author … His models for the Moon and Mercury contradict the most elementary observations and must be considered a failure. The very existence of the 'Syntax' has resulted in the loss of many authentic works written by the astronomers of Greece – we have ended up with the legacy of a single solitary model, and we even lack so much as the certainty of whether this contribution to astronomical science can actually be attributed to Ptolemy at all. I am referring to the equant model, which was used for Venus and the external planets. Ptolemy greatly diminishes its value by a somewhat improper application of the model in question. It is becoming perfectly clear that no statements made by Ptolemy can be accepted at face value, unless they are confirmed by independent authors unaffected by Ptolemy's influence. All the research based on the 'Syntax' must be started from scratch once again, be it historical or astronomical.

I am yet unaware of the other people's possible opinions; still, I can make but a single final judgement: the 'Syntax' has turned out more detrimental to astronomy than any other book ever written, and the astronomical science would benefit greatly, had this book never existed.

Therefore, Ptolemy is by no means the greatest astronomer of the antiquity, but rather an even odder figure: he is the most successful con man in the history of science" ([614], pages 367-368).

A number of other scientists are also rather sceptical about the part played by Ptolemy in the history of science. In particular, A. Berry relates the following: "There is a great deal of controversy in what concerns the astronomers' opinions of Ptolemy's merits. In the Middle Ages, his astronomical authority was considered decisive … Modern critics have discovered the fact that Ptolemy's works were largely based on those of Hipparchus (actually, Ptolemy never made any secret of it), and that the results of his own observations, if not de facto fraudulent, are largely substandard at the very least" ([65], page 72).

Therefore, Robert Newton has proven the necessity of re-dating the Almagest – astronomically as well as mathematically. This leads us to the following question – which epoch does the Almagest really pertain to? As we have mentioned earlier, Robert Newton himself suggests moving it backwards in time - to the epoch of Hipparchus. Other points of view are also viable; we shall discuss them in detail below. At any rate, Robert Newton does not discuss the problem of dating or even address it. Is it at all possible to find a historical epoch that would fit the Almagest better and effectively solve the problems discovered by Robert Newton, as well as the earlier researchers, no matter how distant from the Scaligerian dating of the Almagest? As we shall see further on, Robert Newton's suggestion to mitigate the controversy by means of shifting the Almagest backwards in time (into the epoch of Hipparchus, that is) doesn't lead us anywhere. This is why we have to ask the obvious question of whether there may be other possible shifts of the Almagest dating to consider – possibly, amounting to longer periods than 200 or 300 years. This question of ours is perfectly justified from the mathematical and astronomical point of view, and finding a correct answer is nothing short of a duty from the independent researcher's point of view.

The publications of R. Newton were followed by a work of Dennis Rowlins ([1365]), wherein he uses an independent method to prove that the stellar longitudes contained in Ptolemy's catalogue have been recalculated and altered by someone. In other words, D. Rowlins claims that the stellar longitudes that we find in Ptolemy's catalogue could not have been observed in the epoch of 137 A.D. The research results of Robert Newton and Dennis Rowlins can be found in [1119] and [1120].

Furthermore, such works as [1119], [1120] and [1182] address the issue of the southernmost Almagest catalogue stars' waning brightness. The matter is that the stars that aren't elevated sufficiently high above the horizon lose a lot of their luminosity, due to the fact that the human line of eyesight approximates the surface of the Earth. As a result, the ray travels further in the atmosphere than in case of the stars situated further away from the horizon. This is why the southern stars appear dimmer to the observer than they really are. Our analysis of the southernmost Almagest stars' luminosity has revealed that the observations of these stars were carried out somewhere far in the south. In particular, these considerations rule out the very possibility that Ptolemy performed his observations anywhere in the vicinity of the Isle of Rhodes, which happens to be the consensual localization of his observation point ([1182]). Alexandria in Egypt fits somewhat better – yet we shall find out that even Alexandria does not quite satisfy to the stipulations of the Almagest data. The luminosity estimate of the southernmost stars implies an even more austral latitude.

We must also note that the coordinates of the stars in question are measured exceptionally badly, with discrepancies of several degrees, qv below. If the Almagest is indeed a product of the late Middle Ages, this circumstance is easy enough to explain. Apparently, the austral stars were added to Ptolemy's catalogue as a result of observations carried out somewhere far in the South – possibly, India, and not Alexandria, or the deck of a ship sailing the South Atlantic. The luminosity of the stars was measured correctly, though, unlike their coordinates. This may be explained by the possible imperfections of the southern observatories, or a poor concurrence of different observatories' data. Finally, if the southernmost stars were indeed observed from some vessel, the low precision of the end result is even less of a mystery.