Fig. 11.9. Star chart of the Northern Hemisphere from an edition of the Almagest that allegedly dates from 1551. These charts differ from the edition of presumably 1527 in just one respect, which is rather noteworthy. Constellation figures are wearing mediaeval attire here. Taken from [543], inset between pages 216 and 217.

Europe in the early XV century as a method of replicating drawings, eventually leading to the invention of typeset fonts.

It is believed that the engraving technique was invented in Holland and Flanders, to be imported by France and Italy later on. The oldest dated engraving to date is believed to be the wooden print entitled "St. Christopher", marked with the date of 1423. This precedes Gutenberg's invention of the printing press by some 15-20 years ([544], Volume 4, pages 221-222). As for the fact that printed engravings weren't known previously, it is obvious from the very history of this invention. The first prints were made with the same method that is employed in the manufacture of

Fig. 11.10. Star chart of the Southern Hemisphere from an edition of the Almagest that is allegedly dated to 1551. One must note that we see the figures wear mediaeval clothes. Taken from [543], inset between pages 216 and 217.

rubber stamps today – areas that had to be white were carved into the wood; a wooden plank smeared with paint could make a crude print on paper. However, this method didn't survive for long. Already in 1452 the Florentine goldsmith Tommaso Finiguera took the next step forward. He carved the artwork on a silver plate, covered the latter in a mixture of oil and soot and pressed the plate against a wet cloth. The resulting print was of high enough quality. Tommaso Finiguera repeated the process with sheets of damp paper and discovered that if one kept on rubbing paint into the engraving at a constant rate, an infinite number of prints could be made. This artwork replication method was further perfected by the famous Italian

artist Mantegna (1431-1506; see [797], page 756). He is the author of some 20 plates with mythological, historical and religious scenes – for instance, the seven sheets from the series entitled "Battles of Sea Gods", dating from circa the alleged year 1470.

This is how the manufacture of engravings began – soon also in Germany. A few years later, Albrecht Dürer's (1471-1528) ascension to fame begins – he becomes known as the Nuremberg author of outstanding quality engravings in wood and metal. They were characterised by meticulous design, excellent shading, correct perspectives etc. A whole school of prominent engraver artists came into being.

It would obviously be easier to publish the engravings of star charts (marked 1515 by Dürer) separately than to make them part of a whole illustrated book, such as the Almagest. Dürer himself could have made as many prints as he wanted without the aid of professional book publishers. He wasn't an astronomer (at any rate, these star charts are his only astronomical work). However, not being an observer astronomer, Dürer, who was carrying out the order of some astronomer or publisher, made a number of grave errors in his star charts in order to preserve the elegance of the figures. Let us merely point out the most vivid examples.

The constellation of Ara (the Censer) looks exquisite and perfectly natural in Dürer's rendition – a flat drawing, that is, qv in figs. 11.8 and 11.10. However, if we are to transfer the map's contents to the real celestial sphere, the censer becomes inverted, and the flame faces the wrong direction, making the torch burn upside down (fig. 11.11). What astronomer with experience of real observations could have pictured it in such an awkward manner?

Furthermore, the winged Pegasus also looks seemly and natural in Dürer's flat drawing (figs. 11.7 and 11.9). However, once we transfer the artwork onto the celestial sphere, "Pegasus flies upside down from dawn until dusk, like a wounded bird" ([544], Volume 4, page 209; see fig. 11.12). It is also obvious that no real astronomer of old would ever depict this "winged constellation" in such an awkward manner – hanging upside down on the celestial sphere. This is a blunder of Dürer's. Also, the constellation of Hercules becomes inverted once we project it onto the celestial sphere.

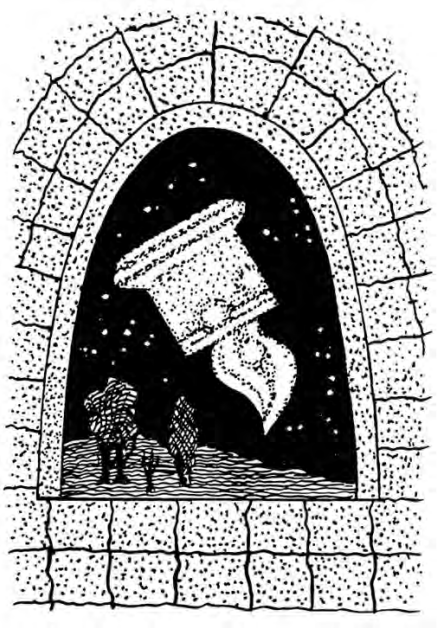

Fig. 11.11. The inverted Ara, as transferred to the celestial sphere from Dürer's map. An astronomer observing the real sky would hardly have drawn it in this manner.

Fig. 11.12. The inverted Pegasus, as transferred to the celestial sphere from Dürer's map. An astronomer observing the real sky would hardly have drawn it in this manner.

All these errors are only observable on the celestial sphere, though, and Dürer's flat drawings conceal them well enough – Pegasus stands on its legs, the Censer's flame is directed upwards etc. It is therefore perfectly clear that their positions were chosen by Dürer in correspondence with the artistic stipulations of a flat drawing. Dürer's errors are perfectly natural. He had a flat sheet of paper at his disposal, after all, and not the curved celestial sphere, and so he was trying to create a certain artistic impression. The manufacture of the engravings obviously took a tremendous amount of labour. Therefore, even if Dürer's client had indeed been horrified by the above absurdities, he had no other option but to sanction the publication of this "art", canonising these brand new detailed star charts. Especially since Dürer, to whom the charts were nothing but a work of art, could have commenced the distribution of the prints himself, without having to wait for the Almagest to come out.

Dürer's "inverted Pegasus" clearly bothered some astronomers – Copernicus, for one. He lived in the alleged years 1473-1543 ([797], page 626). As he was publishing his own star catalogue, which, as we already know (see more details and comparative tables in [544], Volume 4, pages 223-232), was but a slight modification of Ptolemy's Almagest catalogue, Copernicus tried to "rectify" the description of Pegasus. Being too timid to undertake an action as bold as an attempt to draw a corrected version of Dürer's star charts, which Copernicus must have considered a faithful replica of the "ancient Classical charts", presumed lost, he simply changed the order of lines in the description of Pegasus, putting the lowest lines on top and vice versa. More specifically, if the Almagest lists "the star in the mouth (on the snout)" as number 17 in the constellation of Pegasus ([704], page 236), Copernicus names it first ([544], Volume 4, page 228). Au contraire, if the Almagest describes the first star as "the bellybutton star, common with Andromeda's head", Copernicus lists it as the last star of the constellation (#20). However, this "correction attempt" was naïve and doomed from the very start for the simple reason that the mere mechanical replacement of the table's top lines by its bottom lines and vice versa may have corrected the table, but not the actual stellar disposition on the celestial sphere, since the limb-based localization of stars would remain the same all along.

N. A. Morozov wrote as follows: "The attempt of Copernicus to correct the list of a constellation figure's parts and not the figure itself was, of course, extremely naïve, but the fact remains: he didn't make any alterations in the Almagest numeration for any other constellation" ([544], Volume 4, page 225). What we see is a vestige of the undercover struggle between the common sense of the XVI century astronomers and the astronomical absurdity of certain fragments of Dürer's star charts, sanctified by Ptolemy's authority.

Acknowledging Dürer's authorship of all the absurdities inherent in the disposition of certain constellations, we come up with the implication that any constellation drawing that repeats Dürer's errors must postdate Dürer. Now let us revert to the Almagest.

Once again, let us reiterate that the locations of dim stars are described verbally in the Almagest – "in the mouth of Pegasus", "above the left knee", "on the horn of Aries" and so on. The text of the Almagest states it directly that the descriptions in question refer to Dürer's star charts (comprised in the Almagest) explicitly. Indeed, let us return to the constellation of Pegasus. The Almagest describes the first star of this constellation as "the bellybutton star", whereas the "star in the mouth" is one of the last ones listed (#17; see [704], page 236). Since the Almagest catalogue lists the stars from the north to the south, the "bellybutton star" must lay further to the north. Indeed, the Almagest indicates its latitude as 26 degrees. The "star in the mouth" lays further south; its Almagest latitude equals 22 degrees and 30 minutes ([1358], page 358). Therefore, the author of the Almagest is moving in the right direction – from the North to the South, thus confirming the awkward inverted position of Pegasus. We see this to be the case with other constellations as well. Therefore, the author of the Almagest definitely refers to Dürer's star charts as attached to the Almagest.

And so, the compiler of the catalogue and the author of the Almagest refers to the star charts that comprise Dürer's absurdities. Consequently, all the verbal descriptions in question could only end up as part of the Almagest text after 1515. This leads us to the hypothesis that not only the star catalogue, but

also a number of other important chapters of the Almagest (as we know them today) were created or edited in the XVI century the earliest – possibly as late as the early XVII century.

Each of the oddities listed above can be explained within the paradigm of Scaligerian chronology with greater or lesser ruses and allowances. Yet their combination proves too heavy to allow any substantial refutation of the obvious evidence that the main part of the Almagest must be dated to the Renaissance epoch, or even the XVI-XVII century.

N. A. Morozov writes as follows: "All of the above makes me consider the Almagest a comprehensive collection of all the astronomical observations and knowledge to have accumulated between the definition of the 12 zodiacal constellations in the beginning of the new era and the XVI century; individual observations contained in the book must have been made hundreds of years ago. The objective of any serious researcher of this book is to date individual pieces of information that it contains to one century or another" ([544], page 218).

Hipparchus and Ptolemy may well have existed as real astronomers – however, their lifetimes must apparently be dated to a much later epoch. Hipparchus and Ptolemy may have been active in the epoch of the XIII-XVI century A.D. We have already voiced the hypothesis that the "ancient Hipparchus" might be a mere phantom reflection of the famous astronomer Tycho Brahe (1546-1601). The Almagest was published relatively soon after its completion in the XV-XVI century; it is most likely to have been edited in the epoch of the XVI-XVII century. The chronologists of the Scaligerian school misdated the Almagest to deep antiquity – most likely, the erroneous dating was deliberate.

Other mediaeval star catalogues (such as the catalogue of Al-Sufi, qv above) present us with similar problems.

2. THE ALMAGEST AND HALLEY'S DISCOVERY OF PROPER STAR MOTIONS

Today it is believed that proper star motions were first discovered by Edmond Halley in 1718. P. G. Kulikovskiy reports the following in his "Stellar Astronomy": in 1718 "E. Halley (1656-1742), having compared contemporary positions of Arcturus, Sirius and Aldebaran to their positions in the catalogue of Hipparchus, discovered the proper motion rates of these stars: over the course of 1850 years [under the assumption that the catalogue of Hipparchus had already been dated to the II century B.C.: 1718 + 132 = 1850 years – Auth.], the ecliptic longitudes of these stars altered by a shift on 60', 45' and 6', respectively" ([453], page 219). The longitudes in question have been rendered to a single epoch.

The first question that we have can be formulated as follows. How could Halley discover the proper motion of Aldebaran? The matter is that the time interval in question (presumably, around 2000 years) changed the position of Aldebaran by a mere 6' which is known to us from modern sources. However, the precision margin of Ptolemy's catalogue (based on the catalogue of Hipparchus) equals 10', no less. It is pointless to discuss an effect whose influence is too small for the instruments to measure, not to mention the fact that the de facto precision of the measurements made by Ptolemy and Hipparchus is a great deal lower than 10'. So how could Halley possibly discover the proper motion of Aldebaran, a star whose position altered by a mere 6' over the course of 2000 years?

Another question is as follows. What proper motion rates did Halley ascribe to Arcturus and Sirius? The same book of P. G. Kulikovskiy reports the following: "In 1738 G. Cassini (1677-1756) calculated the precise proper motion rate of Arcturus, having compared his measurements to the observations of J. Richet (? – 1696) made 60 years earlier" ([453], page 219). Therefore, Halley's estimate of the proper motion rate of Arcturus wasn't "precise". His calculations for Sirius must have been even less precise, since the star in question is slower than Arcturus.

It would be apropos to mention that Halley was by no means the first to consider the possibility that the stars might be mobile. This issue was discussed heatedly by the astronomers of the XV-XVI century A.D., long before Halley. Moreover, in Scaligerian chronology, the first such enquiry was made in "deep antiquity" – some 2000 years before Halley. Apparently, the question was formulated by none other but the "ancient" Hipparchus, or Tycho Brahe, in our reconstruction.

Pliny the Elder, the famous Roman historian and natural scientist (allegedly 23-79 A.D.) wrote: "Hipparchus … studied the new star that appeared in his age; its mobile luminosity [the star in question might be a comet – Auth.] led him to the idea that celestial bodies that we consider immutable might move as well. He decided to undertake an endeavour that would be bold even for a god – to list the stars for posterity and to count them with the aid of instruments of his own invention, which made it possible to measure the position and magnitude of individual stars. This way it would be easy to tell whether or not the stars could disappear and reappear, move around or grow brighter or dimmer. He bequeathed the sky to his descendants in hope that someone might claim the legacy one fine day" (quoted according to [98], p. 31).

It is believed that the possibility of stellar motion was also discussed by Ptolemy. Ptolemy made a special study of this issue, which was crucial to him, and came to the conclusion that the stars were immobile. We know this conclusion to be erroneous.

Therefore, we can by no means credit E. Halley with being the first to raise the issue of stellar motion.

But why didn't any earlier astronomers compare the positions of the stars on their own celestial sphere to those indicated in the Almagest in order to spot proper motions? After all, the very idea of such a calculation can be traced back to Ptolemy, and was hardly a novelty for the mediaeval astronomers. Such attempts would be logical, and may well have resulted in the discovery of proper star motions – for instance, the errata inherent in Ptolemy's star position estimates could easily be mistaken for proper star motions. Early XVII century astronomers could have calculated the proper motion rates of Arcturus and Sirius a century before than Halley, using the catalogue of Tycho Brahe for reference. The latter is believed to have possessed an error margin of 1' and usually dated to 1582-1588 A.D. We have to remark that the error margin of Tycho Brahe's catalogue that we have calculated actually equals 2' – 3', qv above. Therefore, the astronomers of the XVI-XVII century could have easily compared the catalogue of Tycho Brahe with the "ancient" Ptolemy's Almagest – given the correctness of the Scaligerian dating ascribed to the latter.

Let us assume the stance of the XVI-XVII century astronomers. It is a priori clear that they could only have assumed one of the two possible stances on Ptolemy's Almagest as related below.

First let us assume that these astronomers already agreed with the position of Scaliger and Petavius, the XVI-XVII century chronologists, according to whom the reign of Emperor Antoninus Pius began in 138 A.D., which is the observation year as indicated in the Almagest. In this case they must have made an attempt of discovering proper star motions, using this "aged" 1500-2000-year-old catalogue for reference. Arcturus would be a likely choice, since it is the brightest star of the northern sky. However, Scaligerian history of astronomy records no such attempts anywhere in the XV-XVII century A.D., for some reason, although they should have led the astronomers of the XV-XVII century to the same conclusion that was made by Halley in the XVIII century, namely, that Arcturus was mobile, at the very least.

Now let us assume that the astronomers of the XVI-XVII century considered the Almagest to be a comparatively recent document, dating from the XII-XVI century A.D., for instance, or, alternatively, as a document with no known compilation date. In this case, their attitude would be substantially different. If the astronomers believed the document to be of a relatively recent origin, the short period of time elapsed since its creation may have been considered insufficient for the proper stellar motions to be noticed. Furthermore, if the catalogue was considered mediaeval, the low precision of the Almagest scale was no secret for professional astronomers, likewise the resulting impossibility of conducting any useful calculations for individual stars. No calculations could be made for a catalogue without any known compilation date, either.

Let us reiterate that the history of astronomy mentions no attempts of the XVI-XVII century astronomers to discover proper star motions with the aid of the Almagest. Therefore, we can formulate the hypothesis that these astronomers did not deem the Almagest a sufficiently old document with a precise date.

Thus, a serious researcher of the XVI-XVII century A.D., who regarded the Almagest as a mediaeval document must have arrived at the conclusion that the precision of the Almagest coordinates was insufficient for the discovery of proper star motion. On the

other hand, had the Almagest been considered as an ancient document of the II century A.D., for instance, it is utterly improbable that the idea of using it for reference in proper star motion research would wait for Halley to stumble upon it in the XVIII century, taking into account the importance of the issue as seen by the mediaeval astronomers.

Now let us try and explain why it was already possible to make the conclusion concerning the proper motion of certain stars, such as Arcturus and Sirius, in the epoch of Halley, although no rate estimate could yet be made with any degree of precision at all.

Apparently, the first more or less precise star catalogue was compiled by Tycho Brahe, alias "Hipparchus". Arcturus and Sirius had shifted on circa 3' and just over 2', respectively, over the 100-120 years that lay between Tycho Brahe and Halley. Somebody with a precise catalogue of star positions compiled for the epoch of the early XVIII century could already suspect the mobility of Arcturus and Sirius, notwithstanding that the low precision of Tycho Brahe's catalogue didn't permit any motion rate estimates. It turns out that a more reliable catalogue did in fact appear in the early XVIII century – the catalogue of John Flamsteed (1646-1719), which Halley was using de facto even before its publication (some intermediate version that he had procured by proxy of Isaac Newton, who was conducting his chronological research right around that time).

Therefore, we are of the opinion that Halley's conclusion about the proper motion of Arcturus, Sirius and Aldebaran resulted from a comparison of Flamsteed's catalogue to the catalogue of Tycho Brahe.

The "proper motion rate" of Aldebaran that he indicates also receives a natural explanation. Halley was using an intermediate version of Flamsteed's catalogue, which contained certain errata – affecting the position of Aldebaran, for instance. Flamsteed himself opined that his catalogue wasn't ready for publication just then. It is known to us that Halley explicitly enquired about the position of Aldebaran, qv in his letter to A. Sharp written on 13 September 1718 and quoted in F. Bailey's book ([1023]).

Why did Halley refer to Ptolemy's Almagest as the cornerstone of his research, at any rate, and not the catalogue of Tycho Brache, for one? Apparently, in Halley's epoch the Scaligerian dating of the Almagest as "calculated" by Scaliger and Petavius (the alleged year 138 A.D.) was already canonised. Halley's reference to the Almagest and not the catalogue of Tycho Brache was aimed at adding some credibility to his discovery – Almagest data made the shifts of stellar positions look more substantial. The shift of Arcturus as calculated with the aid of Tycho Brache's catalogue would amount to a mere 3', which is next to nothing, given the nominal precision of 1' (actually, 2' – 3') claimed for Brahe's catalogue. But if he used Ptolemy's catalogue in order to calculate the shift of Arcturus (a catalogue compiled in the epoch of circa X-XI century A.D., as we realise now), the value of the shift would be more ostensible. Halley appears to have compared this shift value to the nominal 10' precision of the Almagest, ignoring the issue of the actual precision of star coordinates in the Almagest.

The above considerations once again lead us to the thought that in the XVI-XVII century the Almagest may not have yet been regarded as an ancient document fifteen centuries old. However, in Halley's epoch (the early XVIII century), the erroneous chronology of Scaliger and Petavius was already the official version, with the "amazing antiquity" of the Almagest made canonical.

3. THE IDENTITY OF THE "ANCIENT" EMPEROR PIUS, IN WHOSE REIGN MANY OF PTOLEMY'S ASTRONOMICAL OBSERVATIONS WERE PERFORMED. His geographical and chronological localisation

Let us illustrate how the system of three chronological shifts that was discovered by A.T. Fomenko in Chron1 helps us with the solution of certain chronological problems. We must remind the reader that the "Almagest" mentions the observations to have been conducted in the reign of the Roman emperor Antoninus Pius ([1358], page 328). Modern historians believe this emperor to be "ancient", and date his reign to the alleged II century A.D. However, the astronomical data contained in the Almagest clearly indicate that the book was compiled and brought to completion in the XI-XVII century A.D.

There is no contradiction here. Let us consider the chronological shift map as reproduced in Chron1

Fig. 11.13. A portrait of Maximilian Augustus Pius (1440-1519) done by Albrecht Dürer. Most of the astronomical observations included in the Almagest were performed during his reign. His phantom reflection is the "ancient" emperor Antoninus Pius. Taken from [1234], engraving #318.

and CHRON2. A summary shift of 1053 + 333 = 1386 years the "ancient" emperor Antoninus Pius "travels forward in time" and winds up in the XVI century A.D. (more precisely, his reign falls over the period between 1524 and 1547 A.D.). Let us remind the reader that the Scaligerian dating of his reign is as follows: 138 – 161 A.D. ([797], page 65).

It is most remarkable that the "ancient Antoninus Pius" is transferred to the very epoch of the first editions of the Almagest. The first Latin edition dates from 1537, and the Greek – from 1538. Trebizond's "translation" dates from 1528 – and so on, and so forth. Indeed, all these publications appear to have come out in the reign of "Emperor Pius" as mentioned in the Almagest. The author of the Latin edition must have acted in good faith when he made the reference to the ruler regnant during the epoch of the observations.

We have an excellent opportunity to conduct an in-depth study of this issue. Given the superimposition of the Roman Empire of the I-III century A.D. over the Roman Empire of the X-XIII century A.D. and the Habsburg Empire of the XIV-XVII century, we may attempt to name a Habsburg Emperor named Pius. The epoch that immediately precedes the first editions of the first Almagest editions, or the early XVI century, is "covered" by the reign of the famous emperor Maximilian I (1493-1519). If the publication of the book took place right after its creation, all the astronomical observations in question must have taken place during his reign. The emperor's full name contains the following formula: Maximilian Kaiser Pius Augustus (see Albrecht Dürer's engraving in fig. 11.13). A slightly different version of the same engraving by Dürer is reproduced in [304], Volume 2, page 561. See also CHRON1, Chapter 6.

We are thus led to the thought that many of Ptolemy's astronomical observations were carried out in the reign of the Habsburg Emperor Maximilian Pius Augustus in the late XIV – early XV century.

4. SCALIGERIAN DATINGS OF THE MANUSCRIPTS AND THE PRINTED EDITIONS OF THE ALMAGEST

Let us compare the dating of the Almagest star catalogue that we came up with (VII-XIII century A.D.) to the Scaligerian datings of the surviving Almagest manuscripts. We shall also cite the Scaligerian dates of the first printed editions of the Almagest.

We have used the work of Peters and Knobel for reference ([1339]), which contains a full list of all the oldest Greek, Latin and Arabic manuscripts of the Almagest. We have constructed a chronological diagram, qv in fig. 11.14, and indicated the Scaligerian datings of all these texts on the horizontal time axis. Apart from that, the diagram reflects the interval in the astronomical dating of the Almagest catalogue that we have calculated.

In fig. 11.15 we also cite the Scaligerian lifetimes of certain mediaeval characters associated with astronomy, the findings of the ancient manuscripts, and the establishment of the consensual chronological system.