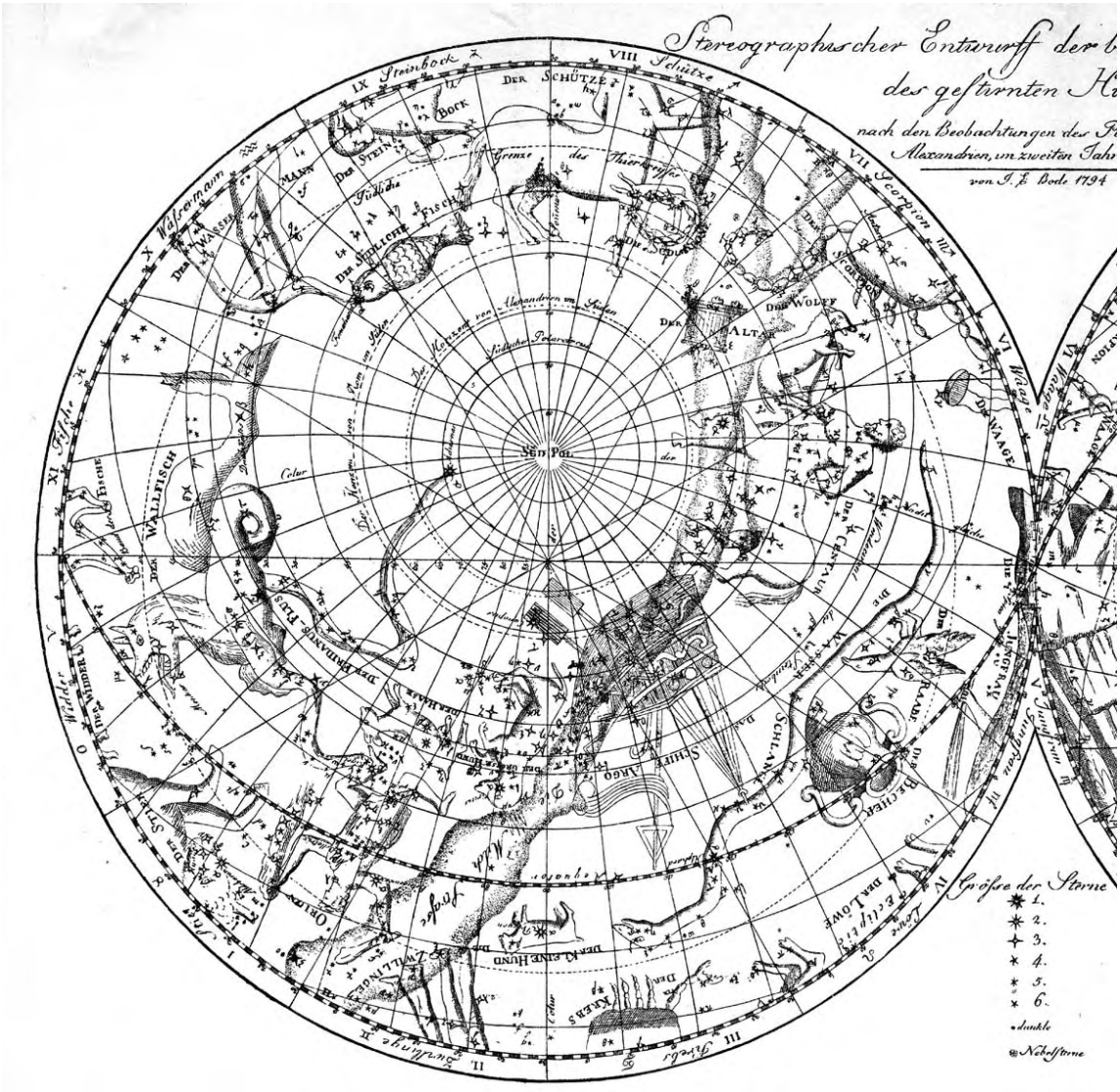
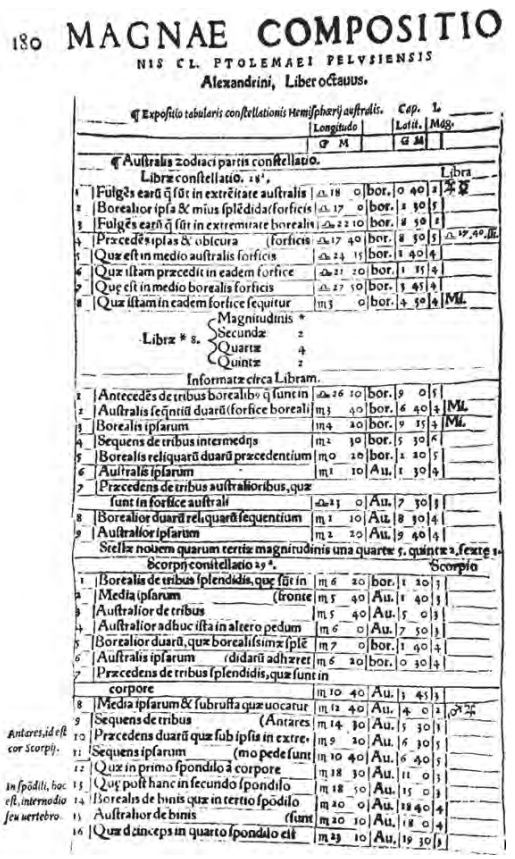



Fig. 2.8. Star chart of the Southern Hemisphere, compiled by the astronomer Bode in the XVIII century according to Ptolemy's Almagest. Published in ***Claudius Ptolemaeus Beobachtung und Beschreibung der Gestirne*** by J. E. Bode, 1795, page 238. Taken from [544], Volume 4, inset between pages 184 and 185.


180 MAGNAE COMPOSITIO

NIS CL. PTOLEMAEI PELVSIENSIS

Alexandrini, Liber octauus.

¶ Expositio tabularis conſtellationis Hemiſpherij auſtralis. Cap. 7.

¶ Auſtralis zodiaci partis conſtellatio.

Libræ conſtellatio. 18.

Fig. 2.9. Fragment of the star catalogue from a 1551 edition of the Almagest.

stellations in this particular way – let us simply point out the naturally occurring regions that the Almagest star atlas can be divided into (see fig. 2.14).

Region *M* is the Milky Way, which divides the sky into two parts. Then we have region *A*, which is the part of the celestial sphere that lays to the right of the Milky Way and goes up unto the very Zodiacal belt, comprising the right part of the latter. Region A contains a part that consists of Zodiacal constellations exclusively; we shall indicate it as *"Zod A"*.

Next we have region *B* – the part of the sky to the left of the Milky Way that reaches up to the zodiacal belt and includes some of the latter's left part – thus, the part of this region that consists of Zodiacal constellations exclusively shall be labelled *"Zod B"*. Finally, region *D* is the southernmost part of the celestial sphere to the left of the Milky Way, which lays to the right of the Zodiac in fig. 2.14.

As we shall see below, such division of the Almagest star atlas is anything but random and possesses several remarkable properties that permit a deeper understanding of the statistical characteristics of the Almagest star catalogue.

Let us point out the specific and rather interesting manner of constellation listing characteristic for the Almagest. For instance, the compiler of the catalogue would be perfectly justified to list the events moving in a spiral and shifting between parts *A* and *B*, making circular periodic movements around the pole. However, Ptolemy opts for a completely different approach. First he lists the constellations that lay to the right of region *M*, then the constellations of that actual region, followed by the ones found on its left, the Zodiacal constellations, and, finally, the southern stars. Ptolemy must have had some motives of his own that have led to this particular choice; the nature of his motivation is however of little importance to us. We are interested in the result – namely, the actual method of listing stars as chosen above.

It is very important (and nowhere near obvious) that the division of the Almagest star atlas into regions is very closely linked to different "precision characteristics" of said regions.

As we have already pointed out, specialists adhere to different opinions in re the identification of some Almagest stars. The table reproduced in [1339] contains a list of all discrepancies between the opinions of the five most prominent researchers and commentators of the Almagest. But what does the very fact of there being such discrepancies between the identifications of different Almagest stars tell us?

It tells us that the coordinates of the star with several different identifications were not measured with sufficient precision by Ptolemy. Since the stars of the first and second magnitude constitute a minority, the rest can only be identified by the coordinates indicated in the Almagest. They need to be compared to the coordinates of the modern stars in order to find a fitting equivalent on the celestial sphere. Obviously enough, this method, which is often the only one available for the identification of an unnamed and relatively dim star, works well only in cases where Ptolemy had measured the coordinates of the star in ques-

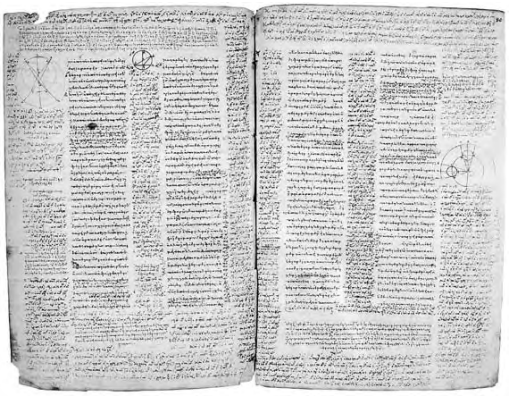


Fig. 2.10. Greek version of Ptolemy's Almagest, allegedly manufactured in the IX century. Taken from [1374], page 143.

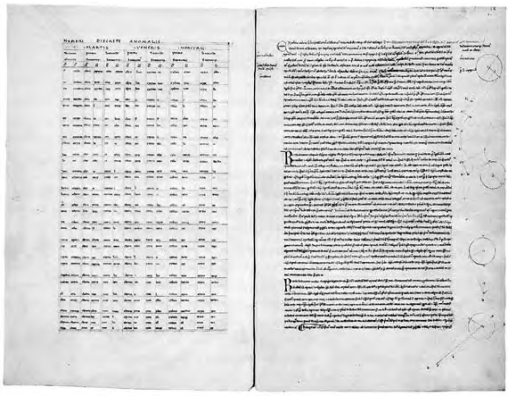


Fig. 2.11. Latin version of the Almagest, allegedly dating from the XIII-XIV century. Taken from [1374], page 146.

tion with sufficient precision. If there were serious errata in the process of taking measurements, there may be several identification options.

The situation becomes particularly complex when the star under study is part of an agglomeration of stars whose brightness is more or less uniform. There may be many different identifications of a single Almagest star; the choice between them shall be hard to make.

This is the reason for the controversial identification of certain Almagest stars.

The "final" version of identifications as cited in the catalogue of Peters and Knobel ([1339]) may have a greater or a lesser priority as compared to the opinions of other researchers. We shall so far refrain from discussing this issue in greater detail, since it is quite beyond the scope of our research. One finds the scientific accuracy of Peters and Knobel most laudable – they have diligently listed all the discrepancies between different identifications in a single table. We shall use this table in order to perform a few simple yet extremely useful calculations. They give us the opportunity to make important corollaries concerning the precision of Ptolemy's stellar coordinate measurements for different parts of the celestial sphere.

The above permits the acceptance of the hypothesis that if some Almagest star cannot be identified unequivocally, its coordinates in the Almagest must contain errors. We can refer to such stars as "dubiously identifiable" or "poorly identifiable". Thus, if we consider some fixed constellation, the proportion of "dubiously identifiable" stars that it contains shall demonstrate how many stars in this constellation weren't measured with sufficient precision. The calculation of these proportions makes it possible to estimate just how precisely Ptolemy measured the coordinates of the star in question.

Thus, we can select the percentage of dubiously identifiable stars as the precision criterion of Ptolemy's observations for a given constellation. In other words, we need to calculate the value of $(X/T) \times 100\%$ for every constellation, where $T$ stands for the sum total of stars and $X$ – for the number of dubiously

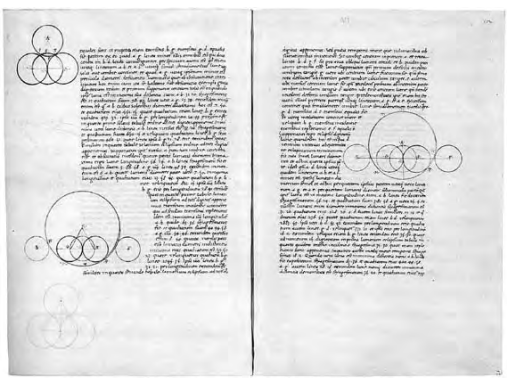


Fig. 2.12. Another Latin version of the Almagest, translated into Latin by George Trebizond around 1481. Taken from [1374], page 147.

identifiable stars contained by the constellation in question.

The end result shall accumulate a great deal of preliminary work conducted by the previous researchers of the Almagest. There was a great deal of such research, therefore one has every reason to assume that the average result of their activities may be considered to represent a more or less veracious picture unaffected by the subjectivism of certain specialists.

We have researched this issue and compiled our results into table 2.2. This table contains eight columns.

In the *first column* one finds the number of the constellation as listed in the Almagest.

The *second column* contains a reference to the part of the celestial sphere where the Almagest constellation in question is located. Let us remind the reader that there are seven such regions (we dubbed them *A, Zod A, B, Zod B, C, D* and *M*, qv in fig. 2.14).

The *third column* contains the name of the constellation (in Latin).

The *fourth column* informs us of the percentage of poorly identifiable stars in the "pure" constellation (sans *informata*).

In the *fifth column* the above percentage is calculated for all the stars in a constellation, the *informata* included.

The *sixth column* contains the percentage of poorly identifiable stars in the actual *informata*.

The *seventh column* contains the number of stars in a constellation.

The *eighth column* contains the number of stars in the respective *informata*. Columns 5 and 6 are blank in cases where there are no *informata* in a constellation, with zero in column 8. Table 2.2. lists all 48 constellations mentioned in the Almagest.

## 3. SEVEN REGIONS OF THE ALMAGEST STAR ATLAS SIGNIFICANTLY DIFFER FROM EACH OTHER BY THE NUMBER OF RELIABLY IDENTIFIABLE STARS

Our analysis of table 2.2 implies the following:

**Corollary 1.** The seven regions that we mention in section 2 contain the following Almagest constellations:

- region *A*: constellations 1-8 and 24-29;

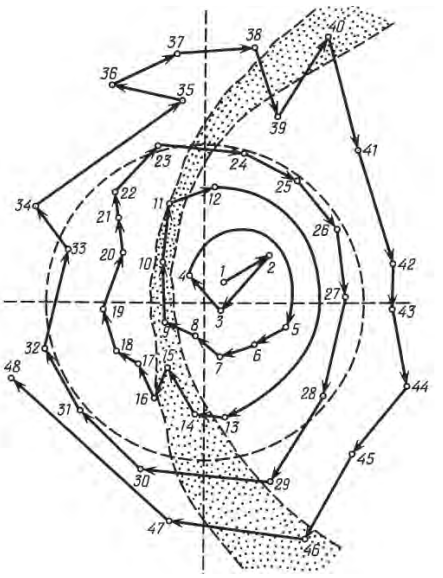


Fig. 2.13. An illustrative presentation of the order in which Ptolemy lists the constellations in the Almagest. Constellation centres are marked by white points in our scheme.

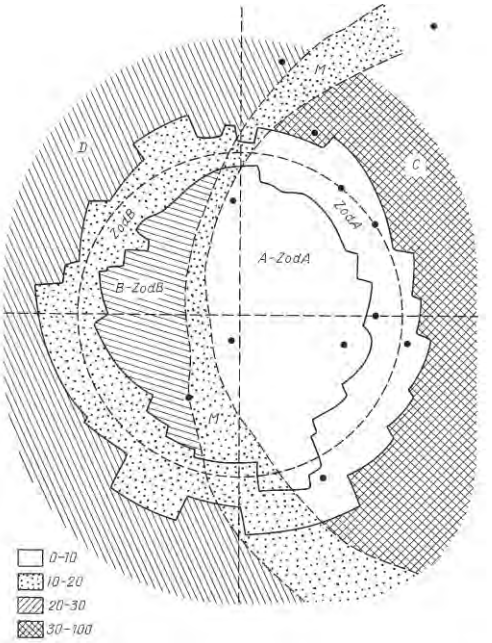



Fig. 2.14. Approximated scheme of the well-measured and badly-measured celestial areas from the Almagest. One can plainly see that only some of the areas are characterised by accurate measurements and therefore stand out. The white area was measured best in the Almagest.