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# Stars, Manuscripts, and Astrolabes–The Stellar Constellations in a Group of Medieval Manuscripts between Latin Literature and a New Science of the Stars

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**Abstract.** The European Middle Ages inherited star names and constellations from Roman antiquity, mostly via Latin literary texts. When, from the 11th century onwards, Arabic texts and instruments became available, figures and vocabulary at first where not compatible with this tradition. The example of an excerpt from Pseudo-Hyginus *De Astronomia* shows, how a Roman text on the constellations was revised and supplemented with the names of the astrolabe-stars to combine the two different traditions.

## 1. Introduction

The figures of the stellar constellations belong to the classic tradition from Greek antiquity inherited by the middle ages of Europe and the Near East. Whereas the early middle ages depended heavily on late Roman manuscripts still extant in the Carolingian centres of learning[1], from the 11th century onwards also Arabic authors became available in Europe with more advanced texts and a different kind of illustrations. One of the most important codices of this kind is the *Al-Sufi latinus* in Paris (Bibliothèque de l'Arsenal, ms. 1036), produced in Bologna not very long after 1231 but based on earlier manuscripts[2]. Parallel to this development, instruments like astrolabes, quadrants, celestial globes etc. with texts, explaining their construction and use, spread throughout the scientific community.

The star-atlas called *Al-Sufi latinus* is a Latin version of the *Kitāb Ṣuwar al-Kawākib al-Thamāniya wa 'l-Arba'īn* a book on stars and constellations by Abū al-Ḥusayn 'Abd al-Raḥmān b. 'Umar al-Ṣūfī, based mostly on the star tables of Ptolemy's *Almagest*. This book has rather precise coordinates and illustrations of the 48 constellations described by Ptolemy. Whereas the Arabic al-Sufi has two drawings of each constellation, one according to the picture in the sky and a second, mirrored as it would appear on a celestial globe, the Latin version has only one depiction of either the sky-version or the inverted globe-version mixed up in a rather irregular way. From the high middle ages until the advent of early modern astronomy several efforts where taken

[1]For example the so called *Leiden Aratea* (Leiden, Universiteitsbibliotheek, Voss. lat. Q 79) a Carolingian manuscript of the Germanicus-translation of Aratus with paintings of the constellations remodelling traditions of later antiquity (facsimile: Lucerne 1987, images are also available on the website of the library).

[2]M.-T. Gousset, *Le Liber de locis stellarum fixarum d'Al-Sufi, ms. 1036 de la Bibliothèque de l'Arsenal à Paris: une réattribution*, "Arte medievale", 2, 1985, pp. 93-108.

to bring the different traditions and information together and present them in an intelligible form. The paper concentrates on one of those newly revised sets of text and illustration on the stellar constellations that was not, up to the present, the subject of closer study.

The *Verzeichnis astrologischer und mythologischer illustrierter Handschriften des lateinischen Mittelalters*, begun by Fritz Saxl, only knew one manuscript of this work (Berlin, Staatsbibliothek Preußischer Kulturbesitz, Ms. lat. oct. 44). The research for the new corpus of medieval manuscripts containing depictions of the stellar constellations now brought up a whole group of codices written from around 1300 until the middle of the 15th century[3]. Those manuscripts show a characteristic combination of an extract from *De Astronomia* attributed to the Roman author Gaius Julius Hyginus with information about the astrolabe stars and a revised illustration cycle. Most of the manuscripts contain additional material on astronomy– texts on the astrolabe, the cylindrical sundial, the quadrant, astronomical tables, astrological texts–that show the intellectual context. The example of this text and its quite extraordinary illustrations can demonstrate quite clearly how intellectual traditions and current concerns worked together in this time of new developments and perspectives.

## 2. Pictures and Manuscripts

Let me first give you an impression of the manuscripts (Figure 1). These are two examples for the constellation pictures that will be–together with the accompanying text–the main subject of this paper. They both show the constellation "Boetes", also known as "Arctophylax" the "Bear Driver", that lies in the northern hemisphere close to the Great Bear. It is one of the constellations mentioned already by Homer in the *Odyssey* (5, 269-275) as well as in the Bible (Job 9:9 and 38:31, Amos 5:8). The two pictures belong to two different manuscripts, both of which today are–accidentally–kept at the municipal library of Lyon, France. To the left is the older one, written and decorated in the first half of the 14th century, probably in southern Germany. The right manuscript is certainly of German origin and was written in the beginning of the 15th century, probably in the region of the upper Rhine valley. The text, naming and describing the stellar constellations, is an excerpt of *De Astronomia* by the Roman author known today as Pseudo-Hyginus[4], with other, additional information. So, what I want to show is, how the tradition of Latin literature from the Roman empire was transformed and supplemented to fulfill new requirements. Requirements that were astronomical in the first place and had little to do with poetry or literary learning.

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[3]This paper is based on research I did in the project on *Picture and Science. Corpus of pictures of the stellar constellations in medieval manuscripts* under the direction of Prof. Dieter Blume, University of Jena, Germany. D. Blume-M. Haffner-W. Metzger, *Bild und Wissenschaft–Corpus der Sternbilderdarstellungen in mittelalterlichen Handschriften, Vol. 2: 1200-1500*, in preparation.

[4]The work is probably not by Gaius Julius Hyginus but by an anonymous author of the 2nd century CE. Its sources are the *Aratea* (texts translated from the Greek *Phainomena* by Aratus of Soloi) and *Katasterismoi*–probably an epitome of a lost work by the Greek astronomer Eratosthenes.

Figure 1. *Boetes* in the two Lyon manuscripts. Left panel: PA ms. 45, f. 72v, Bibliothèque municipale, Lyon. Right panel: ms. 172, f. 41r, Bibliothèque municipale, Lyon.

## 3. Classical Literature and Arabic Science

The text accompanying the picture of Boetes was taken primarily from *De Astronomia* of Pseudo-Hyginus, so let us first have a look at this book[5].

It was written in Rome in the 2nd century of the Christian era. We have four books of it today: the first about the heaven, the celestial motion, the circles and poles and the Earth. The second book gives the mythological tales about the constellations and the figures to be seen in them. The third book describes the constellations according to their position in the sky, their stars and also the planets and the milky way. The fourth book tells us about the heavenly circles, the seasons, the rise and setting of the constellations, the so called *paranatellonta*, eclipses and so on. Presumably there had been a fifth book, that is now lost.

*De Astronomia* is written in a clear, rather simple, prose, easy to understand for a non-Roman reader. Much easier than the Latin translation of the famous poetic description of heavenly phenomena by the Greek poet Aratus–that was one of its sources. The other source of information were the *Katasterismoi* of the end of the 1st century, probably an epitome of a lost work by the Greek astronomer Eratosthenes. Because it

[5]There are several modern editions, the most recent are Hyginus, *De Astronomia*, G. Viré (ed.), Bibliotheca Teubneriana, Stuttgart/Leipzig, Teubner, 1992; Caio Giulio Igino, *L'Astronomia*, M. F. Vitobello (ed.), Bari, Adriatica Editrice, 1988; Hygin, *L'astronomie*, A. Le Boeuffle (ed.), Paris, Les Belles Lettres, 1983.

Table 1. Description of Boetes in a modern edition of *De Astronomia* and in one of the Lyon manuscripts.

| De Astronomia | Lyon BM, PA 45, f. 72v |
|---|---|
| Arctophylax. Huius manum sinistram circulus arcticus includit *ita, ut neque occidere neque exoriri videatur; ipse autem positus ab arctico circulo ad aestivum definitur*, inclinatus in longitudinem, dextro pede aestivo circulo nixus. *Huius humeros et pectus a reliquo corpore dividit circulus, qui per utrosque polos* transiens tangit Arietem et *Chelas*. Hic quod cum Tauro et Geminis *orientibus* et Cancro et Leone occidit, *ideo sero occidere dicitur. Qui magis erectus a pedibus pervenit ad terram, at plagius exoriens citius quam Chelae videtur*. Habet autem in manu dextra stellas quattuor, quae numquam occidere dicuntur; in capite stellam I, in utroque humero singulas, in utraque mamma singulas, sed clariorem dextram et sub ea alteram obscuram, et in cubito dextro claram I, in zona unam *clarius ceteris* lucentem (*haec stella Arcturus appellatur*), in *utrisque* pedibus singulas. Quae omnino sunt *XIII*. | Artophylax *sive Boetes*, huius manum sinistram circulus arcticus includit que nunquam occidit. Ipse autem inter arcticum et aestivum circulum in longitudinem inclinatus, dextro pede aestivo circulo nixus videtur. Huius pectus *transit colurus*, qui per Arietem et Libram ducitur. Hic cum Tauro et Geminis, Cancro et Leone occidit a pedibus. Oriens autem ut iacens ante Libram. Hic habet in manu dextra stellas quattuor, quae numquam occidunt. in capite stellam 1, in utroque humero singulas, in utraque mamma singulas, sed clariorem dextram et sub ea alteram obscuram, et in cubito dextro claram 1, in zona dependente claram 1 lucentem *que Alramech dicitur*. In pedibus singulas. Omnis 14. |

gathered a great part of the astronomical knowledge common in late Roman antiquity, *De Astronomia* could be used in the 11$^{th}$ and 12$^{th}$ century as a kind of textbook for students. In this period also a cycle of illustrations was composed for this text, that took its iconography mostly from the illustrated manuscripts of the *Aratea* and probably also of the smaller and simplified pictures painted on celestial globes.

The manuscripts I am presenting here, contain only a part of the third book of *De Astronomia*, and the illustrations. Obviously, the editor was only interested in the information on star positions and constellations, not in mythology. But he did not just copy what seemed useful but changed it here and there and added some further information.

When you look at the paragraphs on Boetes in a modern edition and in the Lyon manuscript of the 14$^{th}$ century (Table 1), it is easily recognizable, that the medieval version is a bit shorter. Some phrases have been further simplified and parts that seemed unnecessary eliminated. The passages in italics in the edition (left column) have been changed or eliminated in the manuscript. On the right side, in the text transcribed from the manuscript, the italics parts are additions, that are not part of the Roman text. Although on the first glance the medieval text looks very much like Hyginus, the changes are quite substantial.

The numerals have been changed from the Roman system to the so called “Arabic numerals”, that are much easier to use in calculations and therefore common in astronomical tables. The most significant change however is the inclusion of the astrolabe

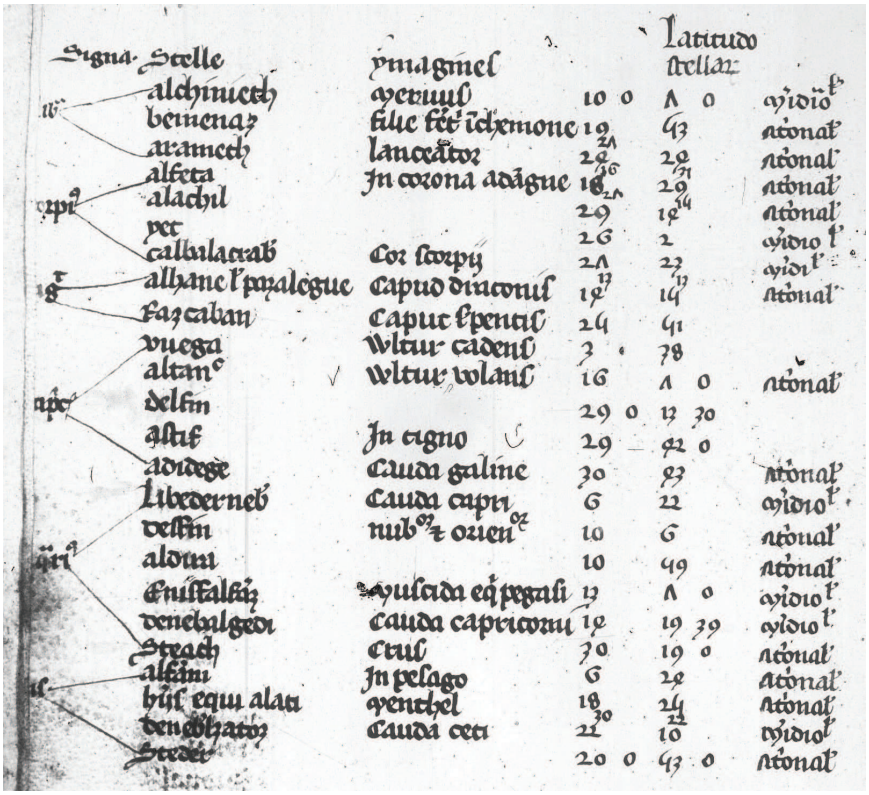

Figure 2. Table of astrolabe stars, PA ms. 45, f. 89v, Bibliothèque municipale, Lyon.

stars. That is: the stars marked by pointers on the *rete* of the astrolabe and listed in tables, we find in astronomical manuscripts.

If you look at an astrolabe of the time, for example Inv. 39540 of the Museum for the History of Science at Oxford[6], you can see the names of a number of stars on the pointers of the *rete*[7]. Those specific names are also to be found in the revised text of Pseudo-Hyginus accompanying the constellation pictures and in tables of astrolabe stars. Also the Lyon manuscript contains such tables (Figure 2). The name "Alramech" for example, $\alpha$-Boötis or Arcturus, can be found in the table as "Aramech".

The table however says, that it belongs to the constellation "Lanceator"–the soldier wielding a lance. Further, the coordinates are given and the information, that it belongs to the northern hemisphere (*septentrionalis*). "Lanceator" of course is an alternative name for the constellation "Boetes" or, as Hyginus calls him "Arctophylax". The *rete*

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[6]France, c. 1400. The website of the museum is http://www.mhs.ox.ac.uk/.

[7]See http://emu.mhs.ox.ac.uk/emuweb/objects/common/webmedia.php?irn=36272 for an excellent image.

of an astrolabe with its star-pointers is in fact a concise star-map, that can be adjusted to a certain time to give the positions in the sky. On the *rete* however the names are often abbreviated for lack of space.

There where several names for Boetes current in the later Middle Ages, for example: Arcas, Arcturus, Arctophylax, Teguius (Tegnius, Teginus), Ullulans, Vociferans, Plorans, Canis latrans, Lanceator. This multitude of names for stars and constellations made it quite confusing for the medieval student. Therefore the integration of the astrolabe star in the text that goes with the illustration was a valuable information for the intended reader.

Now let me summarize this reworking of the text of Hyginus:

1. the paragraphs have been cut down in size and the sentences further simplified;
2. the unwieldy Roman numerals have been superseded by the modern and more practical Hindu-Arabic numerals;
3. the often unfamiliar and changing names of stars and constellations have been adapted to the use and conventions of the contemporary astronomical teaching and writing;
4. the pictures of the constellations have been revised and the number and position of stars coordinated with the text.

## 4. The Constellation Pictures

Let me come to the illustrations. The pictures of the constellations show the traditional figures inherited from Greco-Roman antiquity.

Whereas the form of the depictions in the different medieval lines of tradition depended on more or less the same ancient models, the nature of the mythological figures was seen differently by medieval authors. Some, like Michael Scot, for example, thought, they had some kind of real existence beyond the bright spots in the sky[8]. The poet Baudri de Bourgeuil on the other side wrote in the 11$^{th}$ century, that they do not exist in reality but were invented as a mnemonic device, that would make it easier to learn and recognize the irregular stars-patterns in the sky[9].

I show here Andromeda and Perseus of the earlier Lyon manuscript (Figure 3). Perseus, on the right side, carries the head of the monstrous "Medusa" he had killed. The bright star in it is known as "Algol", derived from the Arabic "al-ghul" a female demon. Here the head has male features and is bald, according to the mythological story, told by Pseudo-Hyginus and others, it should have snakes as hair.

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[8]Michael Scot, *De signis et imaginibus celi*: "Nota quod non est aliqua pars harum figurarum que non sit significatrix eorum que sunt inferius et principaliter in corporibus hominum, et ideo astrologum opus esse multum ingeniosum, ut suo ingenio possit veraciter has figuras transsumere in nascentes homines quousque vivunt in hoc mundo, nam omnis iste figure sunt in stellis fixis", Wien, Österreichische Nationalbibliothek, Cod. Vindob. 2352, f. 12v. See W. Metzger, *Im Anfang war das Bild–die Sternbilder in der Astrologie des Michael Scotus*, in S. Dörr-R. Wilhelm (eds.), *Transfert des savoirs au moyen âge/Wissenstransfer im Mittelalter*, Heidelberg, Universitätsverlag Winter, 2009, pp. 149-161.

[9]Baldricus Burgulianus, *Carmina*, K. Hilbert (ed.), Heidelberg, Winter Verlag, 1979, n. 134, *Adelae comitissae*, pp. 149-187, vv. 1073-1078.

Figure 3. *Andromeda and Perseus*, PA ms. 45, f. 75v/76r, Bibliothèque municipale, Lyon.

In mythology, Andromeda is the daughter of king Cepheus and his wife Cassiopeia. The parents were forced to immolate her to a sea-monster terrorizing their country as a punishment for Cassiopeia's hybris. Perseus freed her and killed the monster. The whole personnel of this story including the sea-monster ("Cetus")–was projected into the sky as a group of neighbouring constellations in the northern hemisphere. In the manuscripts, the figures are shown without surrounding, with only a minimum of paraphernalia characterizing them. In the earlier Lyon manuscript Andromeda, on the left side, for example is drawn with her hands bound with rope to the rocks–that have been left out in the pictures.

We see here, that while the redaction and context of this early example of the group points towards a reader with very good knowledge in the field of natural sciences, there was also a strong interest in fine illustration and obviously the means to pay for them.

The later manuscript has a beautiful picture of Perseus. He looks like a young nobleman of the early 15$^{th}$ century, dressed in the exuberant fashion of the day (Figure 4). He seems to have jumped out of one of the splendid court-festivities current at the time. This manuscript is the most elaborate of the group with the illustrated Hyginus-epitome (Table 2). It has a great number of colourful images on scientific subjects, taught in the so-called *quadrivium*.

There is the treatise of Sacrobosco on the *Sphaera* with commentary and a lengthy introduction, a tract on the quadrant and on practical geometry, a table of astrolabe-stars and a so-called *Volkskalender* in German. An example for the elaborate illustrations on the scientific subjects is the picture explaining an eclipse of the Sun (Figure 5). The illustrations on more technical subjects have also been executed in full colour and with much care. The whole book looks as if it were produced for the teaching of a young

Figure 4. *Perseus*, ms. 172, f. 43v, Bibliothèque municipale, Lyon.

prince of some importance. Unfortunately, we can not identify him up to now. It still remains an unsolved question, who the intended reader of this manuscript may have been. It is not unlikely however, that he belonged to one of the Wittelsbach courts of southern Germany.

## 5. Conclusion

Not all manuscripts with illustrations according to this tradition are beautifully decorated of course. Most of them are executed in a much simpler way. The later examples sometimes have even lost their text, they are not more than sketches of the constellation figures with stars, that go with other astronomical material. At a certain moment in history however, between the 13th and the early 15th century, the illustrated texts I discussed here, played an important role in the transmission of knowledge and information. They combined a text, taken from Roman antiquity and reworked for improved accessibility, with information that made it compatible with the scientific texts and instruments of the present.

The constellation pictures of these manuscripts are not didactic insofar as they reproduced the star patterns in the sky with reasonable exactitude. In fact, there are very

Table 2. Contents of the two manuscripts in Bibliothèque municipale, Lyon.

| PA ms. 45 (only part of the original volume, preserved in a miscellany) | ms. 172 (selection) ... |
|---|---|
| f. 71r-72r: Petrus Philomena de Dacia, *Tabula lunaris*.<br>f. 72v-88v: Excerpt from Pseudo-Hyginus, book III, with pictures of the constellations.<br>f. 89rv: Table of 49 astrolabe-stars.<br>f. 90r: Table of 31 astrolabe-stars. | f. 1va-21v: Johannes de Sacrobosco, *Tractatus de sphaera*.<br>f. 41r-50r: Extract from Hyginus, book III with pictures.<br>f. 55v: Table of 26 astrolabe-stars.<br>f. 56r-58v: Tract on the planets (with tables).<br>f. 69v-81r: Robertus Anglicus, *Tractatus quadrantis*.<br>f. 83r-92v: Computus.<br>f. 93r-103r: Calendar; 30 *dies periculosi*.<br>f. 104v-119v: German *Volkskalender*. |

few medieval manuscripts that give more or less precise "star maps"[10]. The majority is to be seen more as a visualization of the texts they illustrate. If the text says, that a certain star is "in the foot" of the figure, this is what the image shows in the first place. The geometrical position in relation to the other stars of the constellation obviously was not seen as that important. We even have a manuscript of the 12th century, where an explicit explanation for this is given: the drawings of the constellations in their guise as figures of ancient mythology are included here to make it easier for the students to memorize those protagonists they encountered, while reading the classical poets (that where now read with a new and intensified interest)[11]. In the 15th century, the majority of the manuscripts referring to the constellations are of astrological character. They contain mostly the illustrations according to Michael Scot[12]. These are even farther from the astronomical reality. But they show the details that where supposed to be important for their astrological interpretation. Of course there are exceptions as the singular star map of the manuscript Cod. Pal. lat. 1368 in the Vatican of the 1420s[13]. Of

[10]The *Leiden Aratea* and the *Al-Sufi latinus* mentioned above are two examples.

[11]Munich, Bayerische Staatsbibliothek, clm 10270, f. 9r "Signa xii vel a causis annalibus vel a gentilium fabulis nomina sumpserunt, / quas ideo strictim ac breviter hic annotare curavimus, / non quo eorum ineptissimis opinionibus assensum prebeamus, / sed ut lectoris animus his cognitis melius carmina poetarum intelligant / que plerumque his sunt compaginata mendaciis. / Idcirco igitur et figuris ea depingere studuimus, / ut stellarum ordo vel numerus quasi quibusdam membris infixus / evidentius a discente cernatur".

[12]U. Bauer, *Der Liber introductorius des Michael Scotus in der Abschrift Clm 10268 der Bayerischen Staatsbibliothek München. Ein illustrierter astronomisch-astrologischer Codex aus Padua 14 Jahrhundert*, München, Tuduv-Verlagsgesellschaft, 1983; M. Haffner, *Ein antiker Sternbilderzyklus und seine Tradierung in Handschriften vom Frühen Mittelalter bis zum Humanismus. Untersuchungen zu den Illustrationen der "Aratea" des Germanicus*, Hildesheim, Olms, 1997; Metzger, *Astrologie des Michael Scotus* (cit. note 8).

[13]Vatican, Biblioteca Apostolica Vaticana, Cod. Pal. lat. 1368, part III, f. 63r-64v. The origin is probably Heidelberg. The exceptional map-drawings are innovative and show the use of different methods of projection.

Figure 5. *Eclipse of the Sun*, ms. 172, f. 29v, Bibliothèque municipale, Lyon.

the stellar globes of the later middle ages only the one from the possession of Nicolaus Cusanus with constellation drawings of the early 14th century is still extant. There are good reasons to belief, that globes of European origin had existed from the 11th century onwards. Schematic but clearly recognizable depictions of smaller star-groups are also to be found in the literature accompanying the astrolabe.

The numerous constellation-pictures in the medieval manuscripts of Europe are certainly witnesses of a strong and very lively interest in the stars and the star-lore of antiquity. Even greater however was the fascination with those strange and sometimes even threatening creatures that figured in the poems of Ovid, the tragedies of Seneca and all the other works that where so admirably written and so hard to understand. The revised extract from Hyginus in the two Lyon manuscripts and their relatives however belong to the rather few examples that show the effort to bring together the stories of Orion and Hercules, the stars that could be seen at night and the stars that where marked on scientific instruments and used for measurement.