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## Astronomy in Medieval Prague

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Astronomy ranked among the *septem artes liberales* which achieved high level at the University of Prague already soon after its foundation by the Emperor Charles IV in 1348. Astronomy was taught at the artistic faculty and was thus an obligatory introduction to later study either at faculty of medicine, laws or theology. There were studied treatises by ancient authors (Ptolemy, Euclid, Aristotle, Boëthius, Macrobius), by Arabic authors and commentators (Alkabicus, Albategnius, Alfraganus, Hally, Masha'allah, Thabit ibn Qurra), as well as by Christian authors and translators (Gerard of Cremona, Iohannes Campanus of Novara, Iohannes de Sacrobosco, Iohannes de Lineriis and others). The treatises were devoted to different aspects of astrology, mathematics and geometry, theoretical astronomy, but also to the construction and use of astronomical instruments. Especially the understanding of quadrant (see *Fig. 1*) and astrolabe (see *Fig. 2*) belonged to general education and these instruments were also widely used in practice.

Emperor Charles IV used a subtle cosmological symbolics to point out and to justify the uniqueness and exceptional position of the royal majesty, as it can be seen in his architecture. The best known example is the Old Town Tower of Charles's Bridge with its four storeys corresponding to the earthy sphere of ordinary people, the lunar sphere of dukes, the solar sphere of kings and heavenly (stellar) sphere of saints.<sup>1</sup> Charles IV also highly esteemed scholars like Master Claretus de Solentia (Bartholomaeus of Chlumec, c. 1320–1370), who composed – among

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<sup>1</sup>Horský, Zdeněk: *Založení Karlova mostu a kosmologická symbolika Staroměstské mostecké věže*. In: „Staletá Praha“. Ed. Z. Buřival. Praha. Panorama 1979, pp. 197–212.

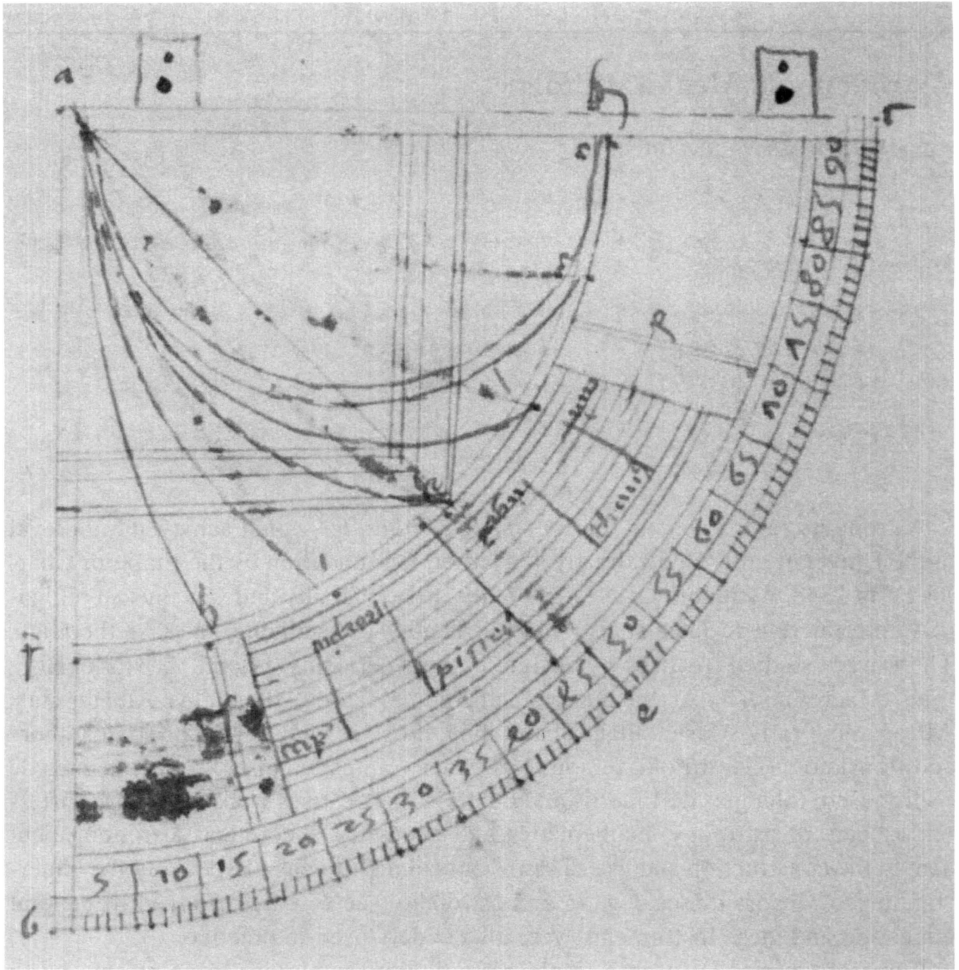


Fig. 1

*Quadrant*. Ms. Brno, Státní vědecká knihovna, A 64  
(IV.Z.e.9), fol. 406r. Pseudo-Masha'allah, *Use of the astrolabe*.

other works – a didactic poem *Astronomicus* in the form of leonine hexameter on Charles' order in about 1350.<sup>2</sup>

The Czech King Wenceslas IV inherited from his father Charles IV a deep interest in sciences, especially in the astronomy: his collection of astronomical manuscripts<sup>3</sup> is well known (cf. so called 'astronomical codices of Wenceslas IV',

<sup>2</sup>*Bartholomaei Clareti Astronomiaris*. Ed. V. Flajšhans. In: „Klaret a jeho družina“. II. Praha 1928, pp. 96–152.

<sup>3</sup>Krása, Josef: *České iluminované rukopisy 13. až 16. století*. Praha, Odeon 1990.

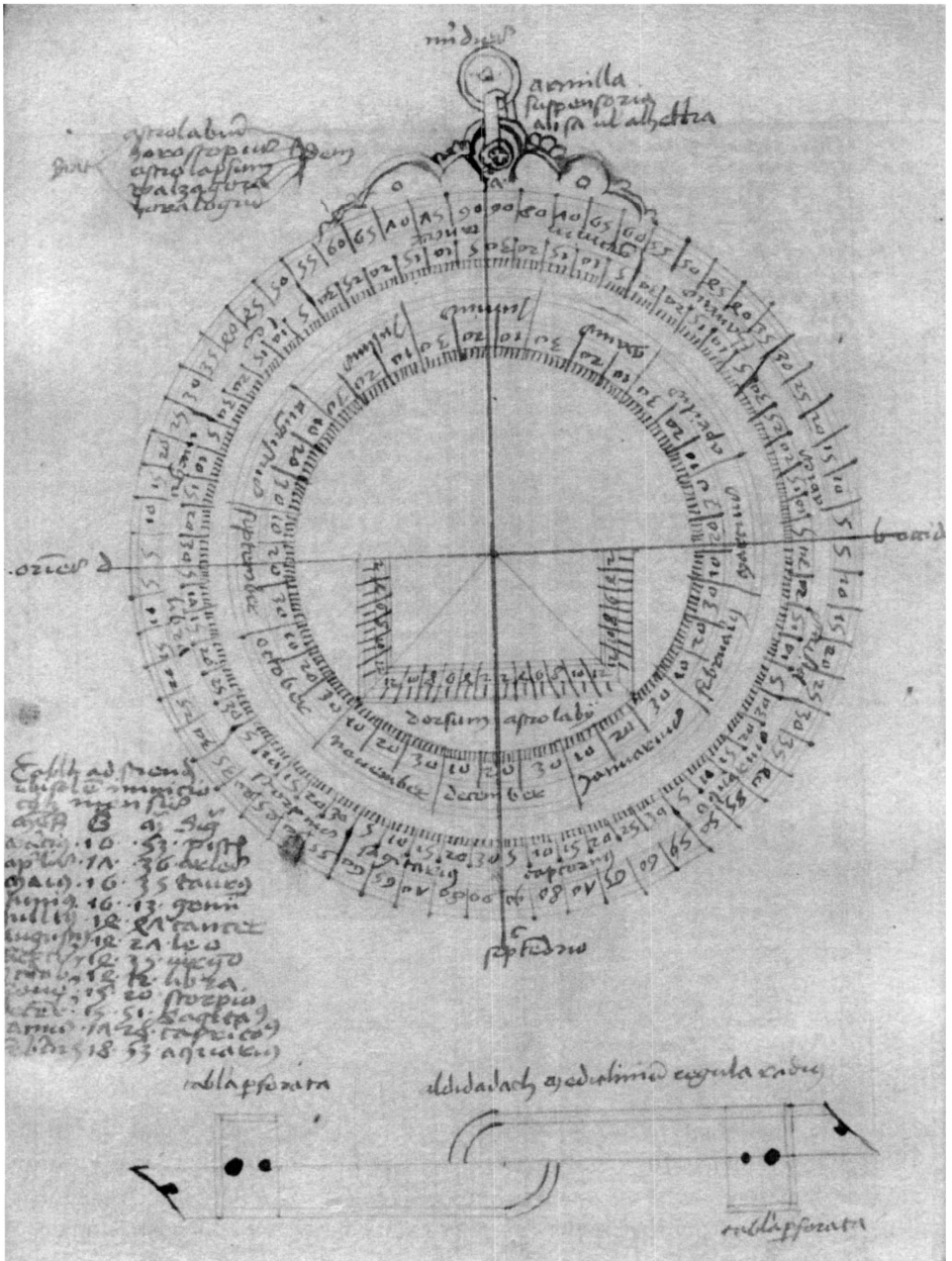


Fig. 2  
 Back of the astrolabe (*dorsum*). Ms. Brno, Státní vědecká knihovna, A 64 (IV.Z.e.9), fol. 412v.  
 Pseudo-Masha'allah, *Use of the astrolabe*.





Fig. 3

Czech astronomer of the 15<sup>th</sup> century, called Těříško.

Ms. Munich, Bayerische Staatsbibliothek, Clm 826. Around 1390–1400.

preserved in Viennese Österreichisches National Bibliothek /ÖNB/<sup>4</sup> and in National Library in Munich<sup>5</sup>). In one of them we can see also the first known portrait of some Czech astronomer – his name is Těříško (see Fig. 3) in Old Czech language and he is otherwise poorly known (most probably he was a court astronomer of the King Wenceslas IV).

<sup>4</sup>Vienna, ÖNB, Cod. lat. 2352 and 2217.

<sup>5</sup>Munich, Bayerische Staatsbibliothek, Clm 826.

Most of the medieval literature was written in Latin. However, the development of astronomical terminology in Old Czech language can be documented as well. For instance the collection *King John's Astronomy* is preserved in the Old Czech manuscript written at the beginning of the 15th century which is located in the Library of the National Museum in Prague (ms. II F 14).<sup>6</sup> The origin of this Old Czech text coincides with the period of the development of national languages as languages of sciences. Vocabulary contained in the manuscript is rich. It yields evidence about the formation of terminological systems in various fields involved in the collection. The Old Czech language of this literary monument exhibits unexpectedly archaic features. The collection consists of several separate parts – first of all it contains astronomical and astrological treatises referring to Ptolemy's works. Explanations on the impact of the seven planets and twelve zodiacal signs on the fate of man, who was born under their influence, prevail in the texts. The manuscript also contains calendar tools for the calculation of Easter and other feasts during the year.

At the beginning of the 15th century, Masters Cristannus of Prachatic<sup>7</sup> and Johannes Andreae called Šindel<sup>8</sup> were very influential astronomers in Prague University. It is proved in the recently published Cristannus' treatises *Construction and Use of the astrolabe*<sup>9</sup> that just these Cristannus' texts written for his lectures in Prague University in 1407 on the basis of Pseudo-Masha'allah's treatises (cf. Fig. 2) were published as the first famous incunabulum on astrolabe in Perugia 1478. Owing to their didactical qualities, the treatises were spread throughout the Europe in many manuscripts (there are known about 80 mss.) and later in the form of incunabulae and old prints. However, Cristannus as a prominent Hussite was a 'persona non grata' for the catholic Europe. It explains why his authorship of both treatises was mostly concealed, forgotten and later wrongly attributed either to Robertus Anglicus or Prosdocius de Beldomandi, despite the Prague origin is obvious from the texts. A redaction of the Cristannus' treatises was written by Magister Johannes von Gmunden in Vienna, the predecessor of the Viennese astronomical school.<sup>10</sup>

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<sup>6</sup>Recently the critical edition of this text was published: *Hvězdářství krále Jana (King John's Astronomy)*. Ze staročeského rukopisu vydali Alena M. Černá, Petr Hadrava, Alena Hadravová, Martin Stluka, Ústav pro jazyk český AV ČR, VCDV AV ČR a UK, AsÚ AV ČR. *Práce z dějin vědy 12, Scripta astronomica 11*. Praha 2004.

<sup>7</sup>Hadravová, Alena – Hadrava, Petr: *Cristannus of Prachatic*. In: "Biographical Encyclopedia of Astronomers". Ed. Thomas Hockey, Dordrecht, Kluwer Academic Publishers, in print.

<sup>8</sup>Hadravová, Aleny – Hadrava, Petr: *John Andrew's called Sindel*. In: "Biographical Encyclopedia of Astronomers". Ed. Thomas Hockey, Dordrecht, Kluwer Academic Publishers, in print.

<sup>9</sup>Křišťan z Prachatic, *Stavba a Užití astrolábu – Cristannus de Prachaticz, Composition and Use of the Astrolabe*. Edd. A. Hadravová and P. Hadrava. Praha, Filosofia 2001. – With English summary.

<sup>10</sup>Ibidem pp. 323–373.

It was scarcely a mere chance that only three years later, in 1410 (as it was established by Czech historian of astronomy Zdeněk Horský)<sup>11</sup> the other fellow of the Charles University, Master Iohannes Šindel, together with the clockmaker Nicolaus of Kadaň finished the famous Astronomical Clock of Prague, which is in fact a clock-driven astrolabe. Iohannes Šindel worked not only in Prague, but also in Germany, in Nuremberg, and especially in Vienna and Klosterneuburg near Vienna, together with Johannes von Gmunden, with whom he is sometimes confused.<sup>12</sup> Šindel wrote a treatise on an eclipse instrument,<sup>13</sup> based on *Albion* by Richard of Wallingford.<sup>14</sup> At present, we are preparing for publication critical edition of Šindel's treatise with computer reconstruction of his instrument. Practically the same figure we can find in the treatise *Opera mathematica* by Johannes Schöner,<sup>15</sup> the well known publisher of the works of many astronomers, like Regiomontanus, Walther and others. Schöner's treatise *Opera mathematica* was published at Nuremberg in 1551 and 1561, this is more that a century after Šindel, and its description is obviously developed from Šindel's words.

An interesting evidence about another presently unknown Šindel's work yields a short treatise by Tycho Brahe *On the obliquity of the ecliptic*.<sup>16</sup> In this text Tycho compared Šindel's measurements of altitude of the Sun in Prague University in summer solstice and autumn equinox 1416. We do not have the original Šindel's manuscript and we do not know technical details about Šindel's instruments. Anyway, the observational results show, that Šindel was probably equipped with quite

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<sup>11</sup>Horský, Zdeněk – Procházka, Emanuel: *Pražský orloj*. Sborník pro dějiny přírodních věd a techniky (Acta historiae rerum naturalium necnon technicarum) IX, Praha, Nakl. ČSAV 1964, pp. 83–146; Horský, Zdeněk: *Pražský orloj*, Praha, Panorama 1988.

<sup>12</sup>To the biography of Johannes von Gmunden cf. e.g. Vogel, Kurt: *John of Gmunden*. Dictionary of Scientific Biography VII, 1963, pp. 117–122; Uiblein, Paul: *Zur Biographie des Johannes von Gmunden*. In: "Beiträge zur Kopernikus-Forschung", Linz 1973, pp. 29–36; Grössing, Helmut: *Johannes von Gmunden – Georg von Peuerbach – Johannes Regiomontanus*. In: Wilfried Seipel, *Mensch und Kosmos*, I–II. OÖ. Landesausstellung. Linz 1990, pp. 71–77; Samhaber, Friedrich: *Die Zeitzither. Georg von Peuerbach und das Helle Mittelalter*. Peuerbach – Vienna 2000.

<sup>13</sup>The title of this treatise is *Canones pro eclipsibus Solis et Lune per instrumentum ad hoc factum inveniendis Magistri Iohannis Schindel* and it is preserved in three manuscripts only: Vienna, ÖNB, Cod. 5415, fol. 133r-146r; Vienna, ÖNB, Cod. 5412, fol. 161r-174r; Nuremberg, Stadtbibliothek, Cent. V. 58., fol. 116vb-121va. – Cf. Hadravová, Alena: *Jan Šindel a jeho traktát „Pravidla pro výpočet zatmění Slunce a Měsíce“*. In: „Astronomie ve středověké vzdělanosti“. Edd. A. and P. Hadravovi. Scripta astronomica 10 – Práce z dějin vědy 10. Praha, VCDV 2003, pp. 46–55.

<sup>14</sup>*Richard of Wallingford*. An edition of his writings with introductions, English translation and commentary by J. D. North. I–III, Oxford, Clarendon Press 1976. (I: Texts and translations. *Tractatus albionis – Treatise on the albion* is on pp. 245–401.)

<sup>15</sup>*Opera mathematica Ioannis Schoneri Carolostadii in unum volumen congesta et publicae utilitati studiosorum omnium ac celebri famae Norici nominis dicata*. Norinbergae, in officina Ioannis Montani et Ulrici Neuberi 1551, fol. 26r ff.

<sup>16</sup>*Tychonis Brahe Dani Opera omnia I–XV*. Ed. I.L.E. Dreyer, Hauniae 1913–1929. (Cf. vol. V, p. 228, and vol. XIII, p. 161.)

capable instruments, because already Tycho found that Šindel's measurements were more precise than his own.<sup>17</sup>

In the middle of the 15th century Magister Paulerinus (Pavel Žídek) composed his extensive encyclopaedia for the king George of Poděbrady, called *Liber viginti arcium* (*The Book of Twenty Arts*).<sup>18</sup> Some parts of the encyclopaedia are not preserved up to now, however, the work has nevertheless nearly 400 very spacious folios. The folios 131ra-142vb contains the explanations devoted to astronomy, the folios 143r-152v the astronomical tables. It is clear that Paulerinus knew the work of Bartholomaeus de Solentia, Iohannes de Erfordia, Eberhardus Bethuniensis, Cristannus' *Astrolabe*, *Alfonsine Tables*, *canons* on this tables written by Iohannes de Lineriis and other works.

We would like to point out that development of astronomy at Prague University was not limited to a national context. Medieval universities were universal not only by the extension of the field of teaching, but also by the international origin of students, lecturers and texts which were read. E.g. the *Alfonsine Tables* (*Tabulae Alfoncii*), completed around the year 1272, became the most widely used astronomical tables in all late medieval Europe. (They were developed from the *Toledan Tables* from the eleventh century.<sup>19</sup> The *Toledan tables* were based on the geocentric model of the planetary system as described in Ptolemy's *Almagest*.) Many copies of *Alfonsine Tables* are hidden in Czech libraries. There were known also the *canons*, i.e. explanations and rules for the use of the tables, in Prague. They were written first of all by Iohannes de Lineriis (Jean de Lignères), Iohannes de Saxonia (John of Saxony),<sup>20</sup> and Iohannes de Muris (Jean

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<sup>17</sup>A. Hadravová – P. Hadrava: *Tycho Brahe and Iohannes Šindel*. In: „Tycho Brahe and Prague: Crossroads of European Science“. Edd. J. R. Christianson, A. Hadravová, P. Hadrava, and M. Šolc. *Acta Historica Astronomiae*, vol. 16. Frankfurt am Main, Harri Deutsch Verlag 2002, pp. 237–247.

<sup>18</sup>Unique manuscript is located in the Jagellonian Library in Cracow under the signature BJ 257. For the detailed description of the manuscript see Muczowski, J.: *Pauli Paulirini olim Paulus de Praga vocitati Viginti artium manuscriptum librum, cuius codex membranaceus in bibliotheca universitatis Jagellonicae Cracoviae asservatus Twardovio vulgo tribuitur*. Cracoviae 1835; *Catalogus codicum manuscriptorum medii aevi Latinorum qui in bibliotheca Jagellonica Cracoviae asservantur*. Vol. I. Composuerunt Sophia Włodek, Georgius Zathay, Marianus Zwiercan. Wratislaviae – Varsoviae – Cracoviae – Gedani, Institutum Ossolinianum 1980. – One part of the encyclopaedia (i.e. the bilingual passages of Žídek's encyclopaedia containing Latin exposition of various artisans with Old Czech glosses and with some German translations) was edited: Paulerinus (Pavel Žídek): *Liber viginti arcium* (ff. 185ra-190rb). K vydání připravila, úvodem, poznámkami a rejstříky opatřila Alena Hadravová. *Staročeské glosy zrevidoval Jiří Cejnar*. *Clavis monumentorum litterarum* (Regnum Bohemiae) 3, Fontes 2. Praha, KLP 1997.

<sup>19</sup>Cf. *The Toledan Tables. A review of the manuscripts and textual versions, with an edition*. I–IV. Ed. Fritz Saaby Pedersen. Copenhagen, Reitzel 2002.

<sup>20</sup>Cf. the critical edition *Les tables alphonsines, avec les canons de Jean de Saxe*. Édition, traduction et commentaire par Emmanuel Poulle. *Sources d'Histoire Médiévale*. Paris, Éditions du Centre national de la Recherche 1984.

de Murs).<sup>21</sup> Texts of Prague scholars influenced their followers in other universities abroad. Our aim is to contribute by editions of such texts to reconstruction of the picture of the medieval astronomy as a whole.

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<sup>21</sup>To the dissemination of the *Alfonsine tables* and their canons see the works by Bernard R. Goldstein, Beatriz Porres and José Chabás. (E.g. Porres, Beatriz – Chabás, José: *John of Murs's „Tabulae permanentes“ for finding true syzygies*. *Journal for the History of Astronomy*, 32, 2001, pp. 63–72; Porres de Mateo, Beatriz: *Astronomy between Prague and Vienna in the 15th Century: the Case of John Šindel and John of Gmunden*. In: „Tycho Brahe and Prague: Crossroads of European Science“. Edd. John Robert Christianson, Alena Hadravová, Petr Hadrava, and Martin Šolc. *Acta Historica Astronomiae*, vol. 16. Frankfurt am Main, Harri Deutsch Verlag 2002, pp. 248–255; Chabás, José: *The Diffusion of the Alfonsine Tables: The Case of the Tabulae Resolutae*. *Perspectives on Science*. Vol. 10, no. 2, 2002, pp. 168–178; Porres, Beatriz: *Šíření středověkých astronomických tabulek ve střední Evropě v 15. století (The Dissemination of Medieval Astronomical Tables in Central Europe in the 15 Century)*. In: „Astronomie ve středověké vzdělanosti. (Astronomy in Medieval Learning.)“ Edited by A. Hadravová and P. Hadrava. *Studies in the History of Sciences and Humanities 10, Scripta astronomica 10*. Prague: Výzkumné centrum pro dějiny vědy 2003, pp. 39–51; Chabás, José – Goldstein, Bernard R.: *The Alfonsine Tables of Toledo*. Dordrecht, Kluwer Academic Publishers 2003.)