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Manuscripts of Latin Translations of Scientific Texts from Arabic

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Abstract

Manuscripts of translations give one the opportunity not only to compare texts in two different languages but also to compare the formats of those texts and to consider whether any features of the source manuscript have passed over into the target manuscript. Though it is very rare to find the very manuscript that a translator used when making his translation, there are translations in which, in one way or another, the Arabic Vorlage has influenced the way the translator has set out his material. By examining the manuscript evidence from scientific texts, this paper explores various ways in which translators dealt with certain formal challenges posed by the translation from Arabic into Latin.

Keywords

Latin translation, Arabic scientific literature, palaeography, medieval manuscripts

Manuscripts of Latin Translations of Scientific Texts from Arabic

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Manuscripts of translations give one the opportunity not only to compare texts in two different languages but also to compare the formats of those texts and to consider whether any features of the source manuscript have passed over into the target manuscript. In the Middle Ages, it is very rare to find the very manuscript that a translator used when making his translation. There are exceptions in the case of Greek-Latin translations. A group of Greek manuscripts written by Ioanikios and his colleagues provided the original texts of translations made by Burgundio of Pisa in the second half of the twelfth century.¹ A manuscript of Euclid's *Elements* written in Southern Italy could be the original of the Greek-Latin version of the *Elements* composed in Sicily ca. 1160.² Greek manuscripts used by Bartholomew of Messina and William Moerbeke have been identified.³ In Arabic, however, we are not so lucky.

There is the case of an Arabic manuscript of Ptolemy's *Almagest* that was written in 1085 in al-Andalus. It has exactly the same combination of one Greco-Arabic translation as the main text and excerpts from another Greco-Arabic translation in the margin as the revised version of Gerard of Cremona's translation of the *Almagest*, made shortly before 1175.⁴ In another instance, an Arabic manuscript is a copy of a dated

¹ Gudrun Vuillemin-Diem and Marwan Rashed, "Burgundio de Pise et ses manuscrits grecs d'Aristote: Laur. 87.7 et Laur. 81.18," *Recherches de theologie et philosophie médiévales* 64 (1997), 136-98.

² That Oxford, Bodleian Library, MS D'Orville 301, was the manuscript used by the anonymous translator is argued by John Murdoch in "Euclides Graeco-Latinus: A Hitherto Unknown Medieval Latin Translation of the *Elements* Made Directly from the Greek," *Harvard Studies in Classical Philology* 71 (1966), 249-302 (see pp. 260-3), but has been questioned by Hubert Busard in *The Mediaeval Latin Translation of Euclid's Elements Made Directly from the Greek* (Stuttgart, 1987), pp. 8-9.

³ Vatican City, Biblioteca Apostolica Vaticana, MS Gr. 276 (Hippocrates) was used by both translators; Vienna, Österreichische Nationalbibliothek, MS gr. phil. 100 was the source for many of Moerbeke's translations of Aristotle. For these and other Greek manuscripts which possibly passed through the hands of Bartholomew and William, and ended up in the Papal library, see Gudrun Vuillemin-Diem, "La liste des oeuvres d'Hippocrate dans le *Vindobensis Phil. Gr.* 100: un autographe de Guillaume de Moerbeke," in *Guillaume de Moerbeke: Recueil d'Études à l'occasion du 700e anniversaire de sa mort (1286)*, eds. Jozef Brams and Willy Vanhamel (Leuven, 1989), pp. 135-83, and Pieter Deleemans, "Manfred's Greek Manuscripts and William of Moerbeke," in the proceedings of the conference *Bartholomew of Messina and the Cultural Life at the Court of King Manfred of Sicily*, held in Leuven, 8-10 January, 2009.

⁴ P. Kunitzsch, "The Role of Al-Andalus in the Transmission of Ptolemy's *Planisphaerium* and *Almagest*," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 10 (1995-6), 147-55 (see p. 149), referring to Tunis, National Library, no. 07116.

manuscript that was probably used by the translator.⁵ In a third case we have an even closer match between an Arabic manuscript and a Latin translation. Peter Pormann has come to the conclusion that Leiden, Universiteitsbibliotheek, MS Or. 2070, which contains the seventh book of Ibn Sarābiyūn's *Small Compendium* (a pharmaceutical work), is the very manuscript, or an extraordinarily close copy of the manuscript that Gerard of Cremona translated, on the evidence both of its text (including the omission or retention of *wa*—'and') and of its glosses (*fī nuskha ukhra*, 'in alia descriptione/littera'). Since the manuscript ended up in the hands of the Jewish family of ha-Me'ati (active in Cento and Rome), it might have been one of the volumes owned by Gerard and brought back to Cremona with his books after his death.⁶

These three Arabic manuscripts would repay closer attention.⁷ What I would like to consider here, however, are translations in which, in one way or another, the Arabic Vorlage has influenced the way the translator has set out his material. Direct copying from an Arabic manuscript is rare. In a mid-twelfth-century manuscript of Plato of Tivoli's translation of al-Battani's *Opus astronomicum*, the master scribe has drawn a schematic illustration of the world in which he has written in Arabic the four cardinal points of the world and the word 'Europe', presumably copying a diagram in his original (see figure 1).⁸ Contemporary with Plato, Hugo of Santalla retains Arabic letters when describing how to divine the name of the thief, translating a text by 'Umar ibn al-Farrukhan which is incorporated into the *Book of the Nine Judges* (figure 2). Adelard of Bath, when translating Euclid's *Elements* from Arabic, in his geometrical diagrams substitutes the nearest equivalent in Latin letters for Arabic letters. Nevertheless, the equivalent Arabic letters appear in the margins of his earliest manuscripts (figure 3), just as the equivalent Arabic terms (this time in transliteration) appear in the margins of the text. In an early thirteenth-century manuscript of the version of Euclid's *Elements* known as 'Adelard II', we have a much more competent rendering of the Arabic letters (figure 4).⁹

⁵ Balinus, *Sirr al-khalīqa*; Madrid, Biblioteca nacional, MS Gg 153, a fifteenth-century copy of a manuscript dated 1092, including the letter of the Byzantine Emperor to the Court of the Spanish Umayyad Caliph al-Hakam: see S. M. Stern, "A Letter of the Byzantine Emperor to the Court of the Spanish Umayyad Caliph al-Hakam," *Al-Andalus* 26 (1961), 37-42, and Ursula Weisser, *Das 'Buch über das Geheimnis der Schöpfung' von Pseudo-Apollonios von Tyana* (Berlin and New York, 1980), p. 55.

⁶ For the transmission of Ibn Sarābiyūn's *Large* and *Small Compendia* (originally written in Syriac), see Peter E. Pormann, "Yuhannā Ibn Sarābiyūn: Further Studies into the Transmission of his Works," *Arabic Sciences and Philosophy* 14 (2004), 233-62 (see pp. 241-4 for the Leiden manuscript). Pormann pointed out the striking similarities to Gerard of Cremona's translation to the Leiden manuscript in a seminar at the Warburg Institute, London, but has not yet published these findings.

⁷ Another possible candidate is Lawrence J. Schoenberg MS 446, a manuscript of Ibn Sina's *Canon of Medicine*, written in Córdoba or Toledo in the first half of the twelfth-century; the same text was translated by Gerard of Cremona in Toledo later in the same century.

⁸ The contents and context of this manuscript are described in Tony Lévy and Charles Burnett, "Sefer ha-Middot: A Mid-Twelfth-Century Text on Arithmetic and Geometry Attributed to Abraham Ibn Ezra," *Aleph* 6 (2006), 57-238 (see pp. 69-74).

⁹ I am grateful to Paul Kunitzsch for alerting me to this manuscript.

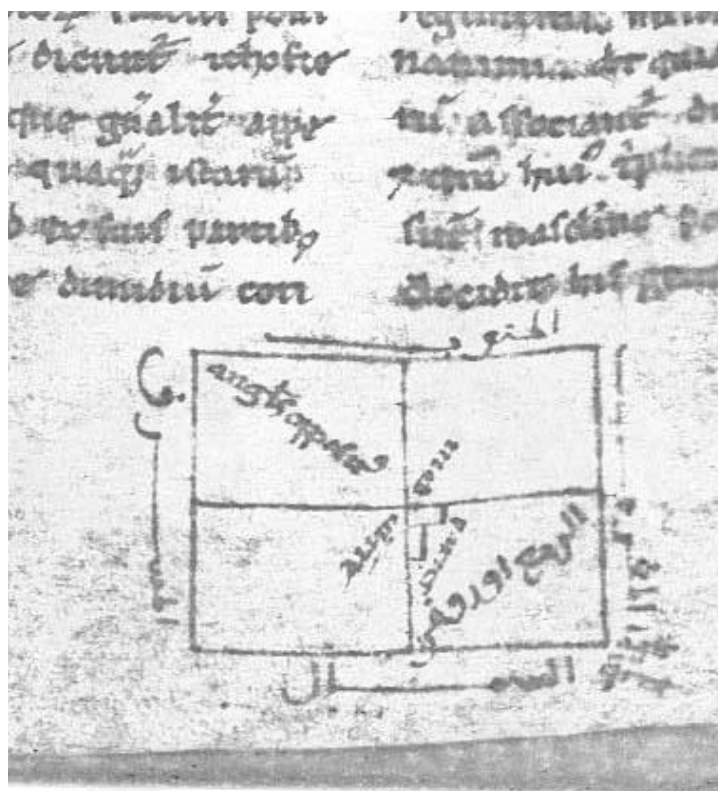


Figure 1: A schematic diagram of the world, with Europe marked in the northwest quadrant (lower right-hand corner; Oxford, Bodleian Library, MS Digby 51, fol. 88v).

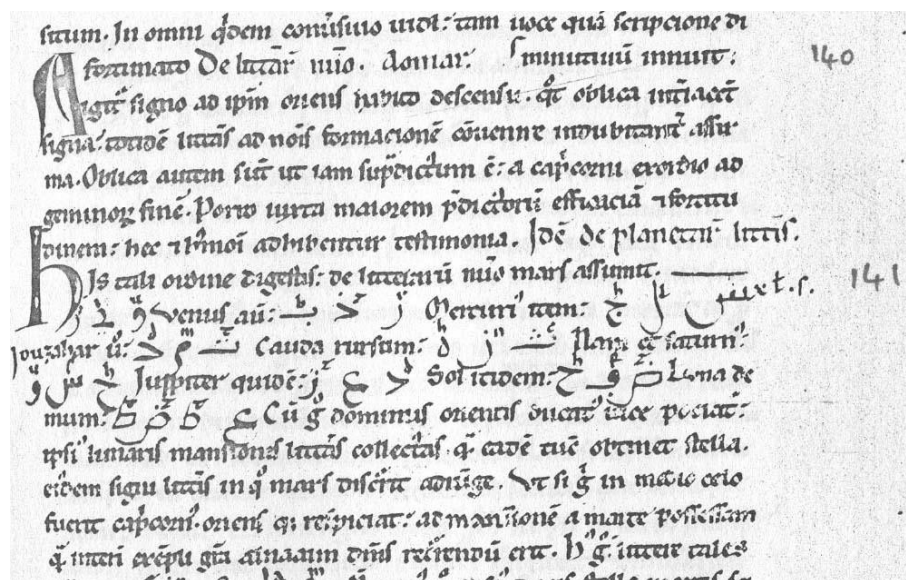


Figure 2: Maghrebi forms of Arabic letters (ÖNB/Wien, cvp 2428, fol. 90r).

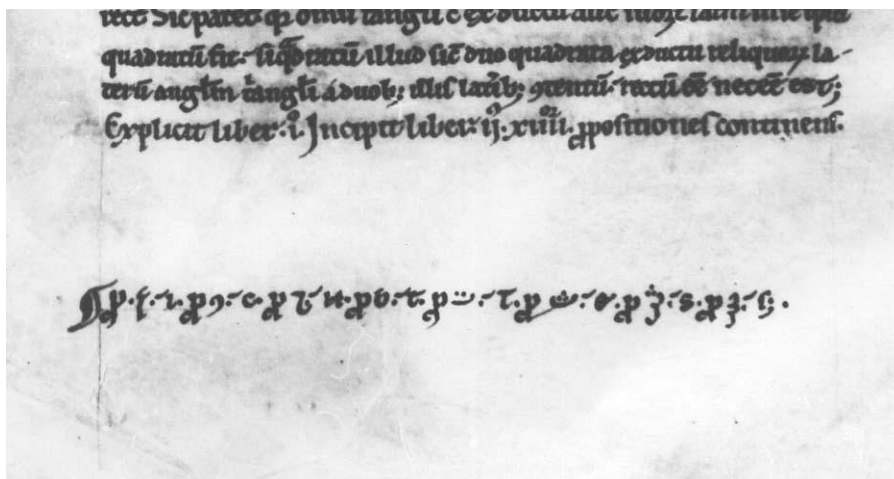


Figure 3: Collation of Arabic and Latin letters for marking geometrical diagrams in Adelard of Bath's translation of Euclid's *Elements* (Bruges, Stadsbibliotheek, MS 529, fol. 9v).

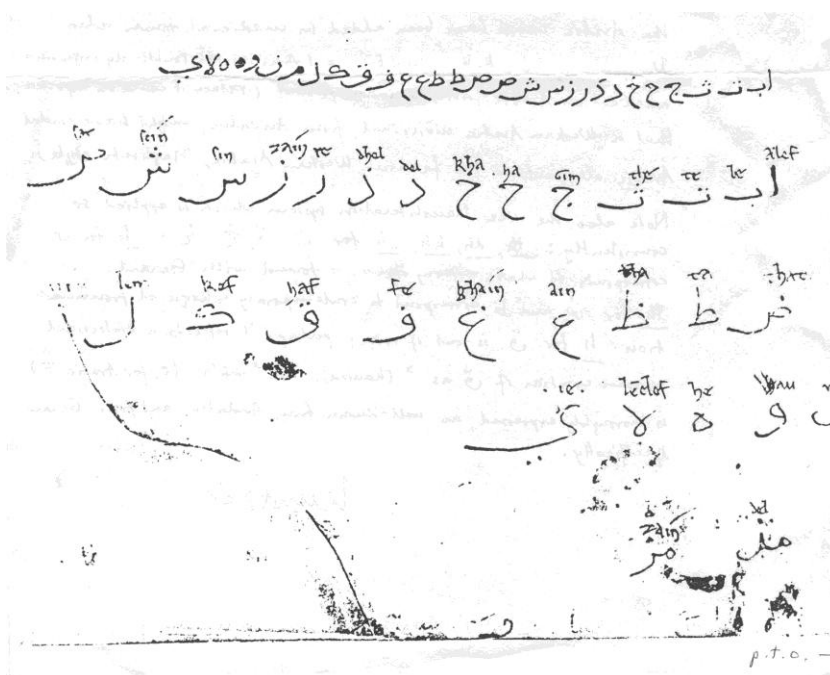


Figure 4: Last page of an early thirteenth-century manuscript of Euclid's *Elements* ('Adelard II' version), showing well-drawn Eastern forms of the Arabic letters (Universitätsbibliothek Leipzig (Depositum der Stadt Leipzig), Rep. I 68c, fol).

Illustrations pass over from Arabic manuscripts into Latin ones in the depiction of the heavenly constellations as well as in surgical and anatomical depictions. In the case of astronomy, we have the example of Abu'l-Husayn al-Sufi, who showed the positions of the stars in the constellations by drawing the zoomorphic (and other) shapes of the constellations (*suwar*), as seen from both within and without the celestial sphere. This is reflected in manuscripts of the Latin Sufi tradition.¹⁰ In the case of surgery, we have the fine example of Gerard of Cremona's Latin translation of the *Book of Surgery* of Abu'l-Qasim az-Zahrawi, in which numerous surgical instruments (forceps for extracting dead embryos, racks for stretching bodies and so on) are faithfully copied from the detailed depictions of the Arabic original.¹¹

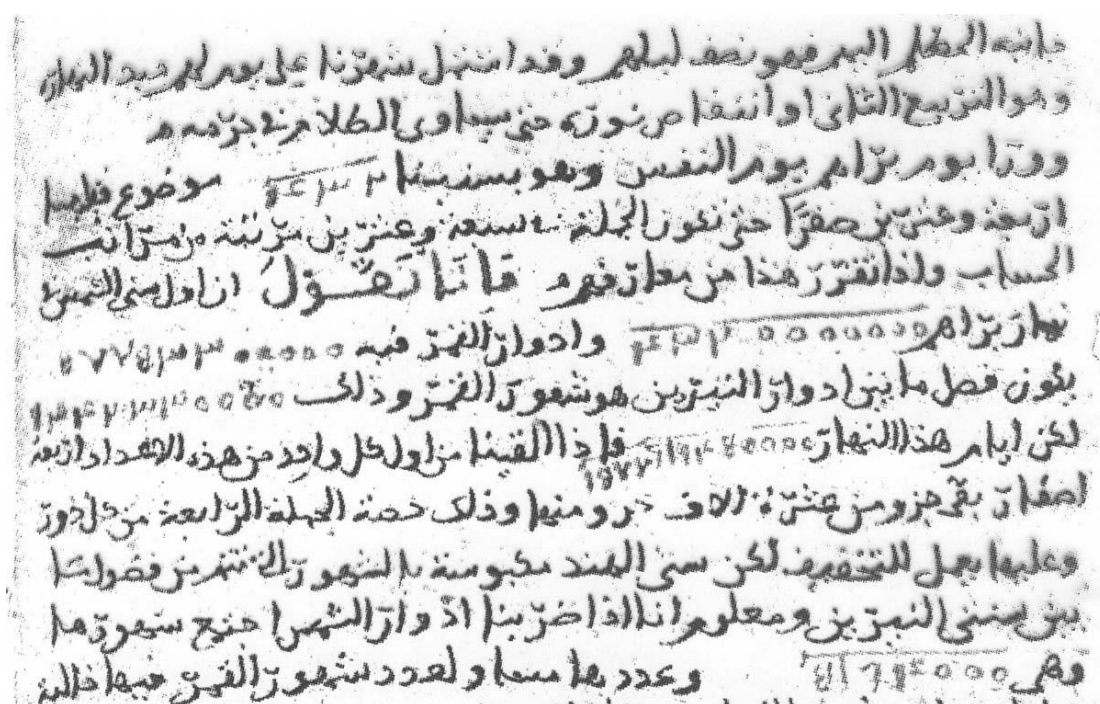


Figure 5: Hindu-Arabic numerals in al-Biruni's *Qanun al-Mas'udi* (Oxford, Bodleian Library, MS Or. 516, fol. 27v).

But what is meant by a faithful copy? I should like to draw attention to just one problem facing the translators, namely, that of directionality. The Arabic language is written from right to left. The Latin text runs from left to right. There is a reversal of the direction of the script. Consequently, sometimes one sees a reversal in the 'direction' of the illustrations. In an *Almagest* translated from Arabic, probably in Antioch in the mid-twelfth century, we find mirror images of the diagrams in the

¹⁰ E.g. Paris, Bibliothèque de l'Arsenal, MS 1036 and its derivatives: see Paul Kunitzsch, "The Astronomer Abu'l-Husayn al-Sufi, and his Book of the Constellations," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 3 (1986), 56-81 (see pp. 68-9).

¹¹ E. Irblich, "Einfluss von Vorlage und Text im Hinblick auf kodikologische Erscheinungsformen am Beispiel der "Chirurgie" des Abu'l-Qasim Halaf Ibn 'Abbas al-Zahraui vom 13. Jahrhundert bis 1500", in *Paläographie 1981. Colloquium des Comité Internationale de Paléographie, München, 15.-18. September 1981*, ed. G. Silagi, (Munich, 1982), pp. 209-31 (with 8 illustrations).

Arabic text (Dresden, Landesbibliothek, Db. 87).¹² The problem of directionality becomes particularly acute in the case of Arabic (or rather Hindu-Arabic) numerals. Arabic works on Indian arithmetic presuppose that the composite numbers are written from right to left, just as the Arabic script is written from right to left (figure 5). So one begins by writing the lowest number numeral and ends by writing the highest. What happens when such an Arabic text is translated into Latin? The numerals retain the same order. One may compare the rows of numbers in the arithmetical work of the twelfth-century Moroccan scholar, Ibn Yasamin (figure 6), and those in the *Liber Abbaci* of Fibonacci (figure 7): the surrounding script may be different, but both the shapes and the order of the numerals are recognizably the same.

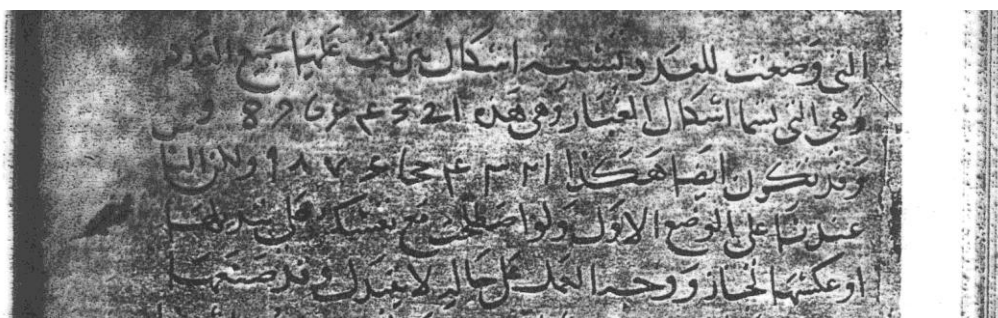


Figure 6: The Eastern and Western forms of the Hindu-Arabic numerals in the algorithm of Ibn al-Yasamin (Rabat, Maktaba al-‘amma, MS k 222, fol. 5a.)

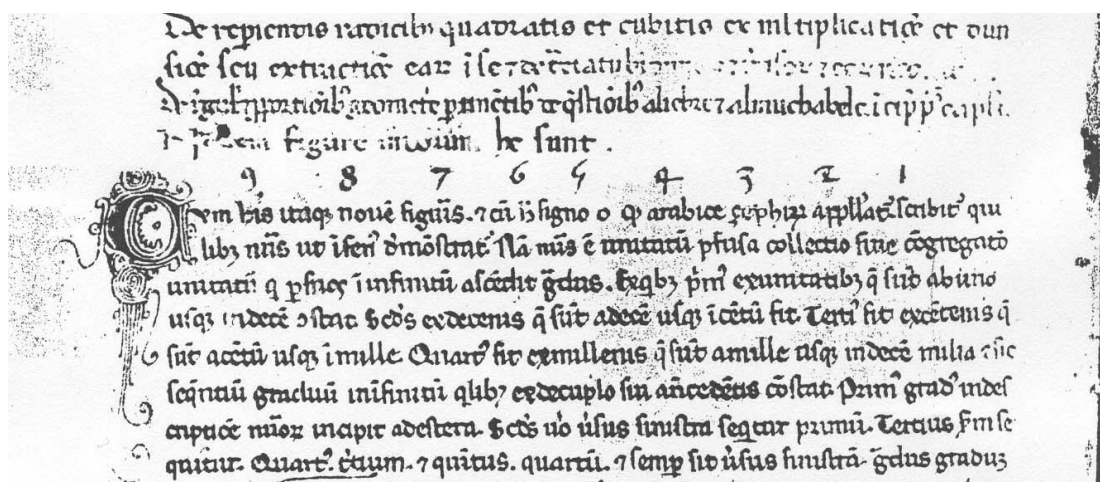


Figure 7: Fibonacci, *Liber Abbaci* (Florence, Biblioteca Nazionale Centrale, MS Magliabech.C.1.2616, fol.1v)

¹² For this translation, see Charles Burnett, “The Transmission of Arabic Astronomy via Antioch and Pisa in the Second Quarter of the Twelfth Century,” in *The Enterprise of Science in Islam: New Perspectives*, eds Jan P. Hogendijk and Abdelhamid I. Sabra (Cambridge, MA. 2003), 23-51 (see pp. 23-7).

In Latin, the texts describing the Hindu-Arabic numerals and the method of calculating with them were called *algorismi* ('algorism') after the ninth-century Arabic author, al-Khwarizmi, whose text had introduced this method to the Latins. In the earliest Latin algorism (*Dixi Algorizmi*), which we may presume to follow the Arabic original quite closely, we are told that every numeral 'one' that is 'in an earlier decimal place' (*in priori differentia*) is 'one', but every numeral 'one' that is 'in a later decimal place' (*in posteriori differentia*) is 'ten' and that 'the beginning of the decimal places is on the right of the reader' (*initium differentiarum in dextera scriptoris*).¹³ The same text instructs us that when there are tens but no units, mathematicians have "placed before [the ten] a small circle like the letter *o*" (*Preposuerunt...circulum parvum in similitudine o littere*).¹⁴

To talk about priority starting from the right suggests that one writes the numeral from the right. This is confirmed in the clear statement in the *Algorismus Vulgaris* of John of Sacrobosco (written before 1244) that 'in this art we write towards the left following the custom of the Arabs, for they are the inventors of this science' (*Sinistrorsum autem scribimus in hac arte more Arabum hujus scientiae inventorum*).¹⁵ And when John gives examples of composite numbers, he mentions the numeral on the right as being 'in the first position' (*primo loco*) and each numeral to its left as being 'in the second, third, fourth, etc. position'.¹⁶ So, in writing 230, one would put the 'zero' in the first position, the 3 in the second position, and the 2 in the third position. That one has to write from right to left is confirmed by the equally popular versified algorism, the *Carmen de Algorismo* of Alexander of Villa Dei of the mid-thirteenth century:

Primo scribe loco digitum, post articulum; atque
Si sit articulus, in primo limite cifram.
(‘In the first place write the digit, after it, the ten, and
if there is a ten [without a digit], write a zero in the first position.’)¹⁷

John of Sacrobosco goes on to give another completely different (and, in his view, better) reason for writing the lower numbers on the right and the higher ones on the left, saying: "in following the usual order in reading, we place a greater number before a smaller number" (*vel hac ratione ut in legendo consuetum ordinem observantes numerum majorem proponamus*).¹⁸ Using the same example, one says, usually, "two hundred and thirty" and not "zero and thirty and two hundred". The implication, then, from the algorisms is that one writes composite numbers from right to left, but reads them from left to right. It would strike any graphologist as being odd, and certainly inconvenient, if in a text involving numbers one was constantly having to shift from

¹³ *Dixit Algorizmi* has most recently been published in *Die älteste lateinische Schrift über das indische Rechnen nach al-Hwarizmi*, ed. Menso Folkerts, with the help of Paul Kunitzsch (Munich, 1997); see p. 32, lines 106-10.

¹⁴ *Ibid.*, lines 116-8.

¹⁵ John of Sacrobosco, *Algorismus Vulgaris*, ed. James Orchard Halliwell in *Rara Mathematica: A Collection of Treatises on the Mathematics* (London, 1841), pp. 1-26, and by Maximilian Curtze, in *Petri Philomeni de Dacia in Algorismum vulgarem Johannis de Sacrobosco Commentarius una cum Algorismo ipso* (Copenhagen, 1897). An annotated partial English translation of the latter, by Edward Grant, is given in *A Source Book in Medieval Science*, ed. Edward Grant (Cambridge, MA, 1974), pp. 94-101. For the quotation see ed. Halliwell, p. 5, trans. Grant, p. 96 (adding 'and Hebrews' after 'Arabs').

¹⁶ *Ibid.*, ed. Halliwell, p. 4.

¹⁷ Alexander of Villa Dei, *Carmen de Algorismo*, ed. Halliwell, *Rara Mathematica*, pp. 73-83; see p. 74.

¹⁸ John of Sacrobosco, *Algorismus vulgaris*, ed. Halliwell, p. 5.

writing from left to right to writing from right to left. Do we see evidence that composite numbers were in fact written from right to left in Latin manuscripts?

One example suggests that we do. A translation by Hugo of Santalla of Ibn al-Muthanna's commentary on the tables of al-Khwarizmi includes tables which contain numerical values. We have two early manuscripts of the text, which manifest different scribal decisions in respect to these numerals. In one manuscript, Cambridge, Gonville and Caius College, MS 456/394 (figure 8), the scribe reverses the numerals, under the assumption, presumably, that, since the script is reversed when one translates from Arabic into Latin, the numerals too must be reversed (i.e., should be a mirror image of the Arabic; taking the previous example, this would mean writing 032 for 230). Here it is quite clear that he is writing his numerals from left to right. They start off flush with the left-hand sides of the boxes and fail to fill the boxes. Moreover, the numeral '3' has been reversed in respect to the usual Arabic form, so that it flows naturally from left to right, and the more complex '4' has, for some odd reason, been entirely changed into a nonsense roman equivalent. This reversal of numerals is unusual but not unique.¹⁹ In a second manuscript of Hugo's translation, Oxford, Bodleian Library, MS Arch. Seld. B.34, the same numerical values appear in the more usual order (figure 9). But here we clearly see the scribe beginning to write the numerals flush with the right hand sides of the boxes, and stretching them out towards the left in order to fill the boxes. The forms of the numerals too (which are identical with 'Eastern' Arabic forms) have evidently been written from right to left. This is particularly obvious in the case of the '4' (occurring three times) which ends with a flourish and the '3', which ends with a decisive downwards stroke. So, in both manuscripts, the scribe has written the numerals starting with the smallest values, but the scribe of the Oxford manuscript, being faithful to the instructions in the algorisms has reversed the direction of his handwriting.

One could say that these numerals are written within boxes and are not part of the text, so it would not be problematic to insert them from right to left, especially since they are not joined up to each other. The numbers written in the text are roman numerals. The boxing of Arabic numerals is commonly seen in the algorism texts (figure 10). The Arabic numerals should, perhaps, be regarded as symbols rather than letters, and as such are not fully integrated into the script. Eventually, the numerals became naturalised, and scribes must have begun to write composite numbers starting with the highest numeral, rather than lowest, so that the order in which the numerals were written corresponded to the order in which they were pronounced.²⁰

¹⁹ We find it also (1) in a horoscope for 1178 associated with the *Microcosmographia* of a certain 'William' dedicated to William of the White Hands, archbishop of Reims, in Trier, Stadtbibliothek, MS 1041, (2) in a brief algorism written in British Library, MS Arundel 206 (shortly before 1250 A.D.), and (3) in the foliation of a late thirteenth-century manuscript, Bruxelles, Bibliothèque royale, MS 9251-2. For the last two items see Charles Burnett, 'Why We Read Arabic Numerals Backwards', in *Ancient and Medieval Traditions in the Exact Sciences. Essays in Memory of Wilbur Knorr*, eds. Patrick Suppes, Julius M. Moravcsik and Henry Mendell (Stanford, Ca., 2000), pp. 197-202.

²⁰ Thus, in Oxford, Bodleian Library, MS Digby 40 (a manuscript of Abraham Ibn Ezra's *Foundations of the Astronomical Tables*), fols 83r-v have the same tables as MS Arch. Seld. B.34, fol. 33r, but in this case it is obvious that the numerals have been written from left to right (but not as mirror images as in MS Gonville and Caius College 456/394).

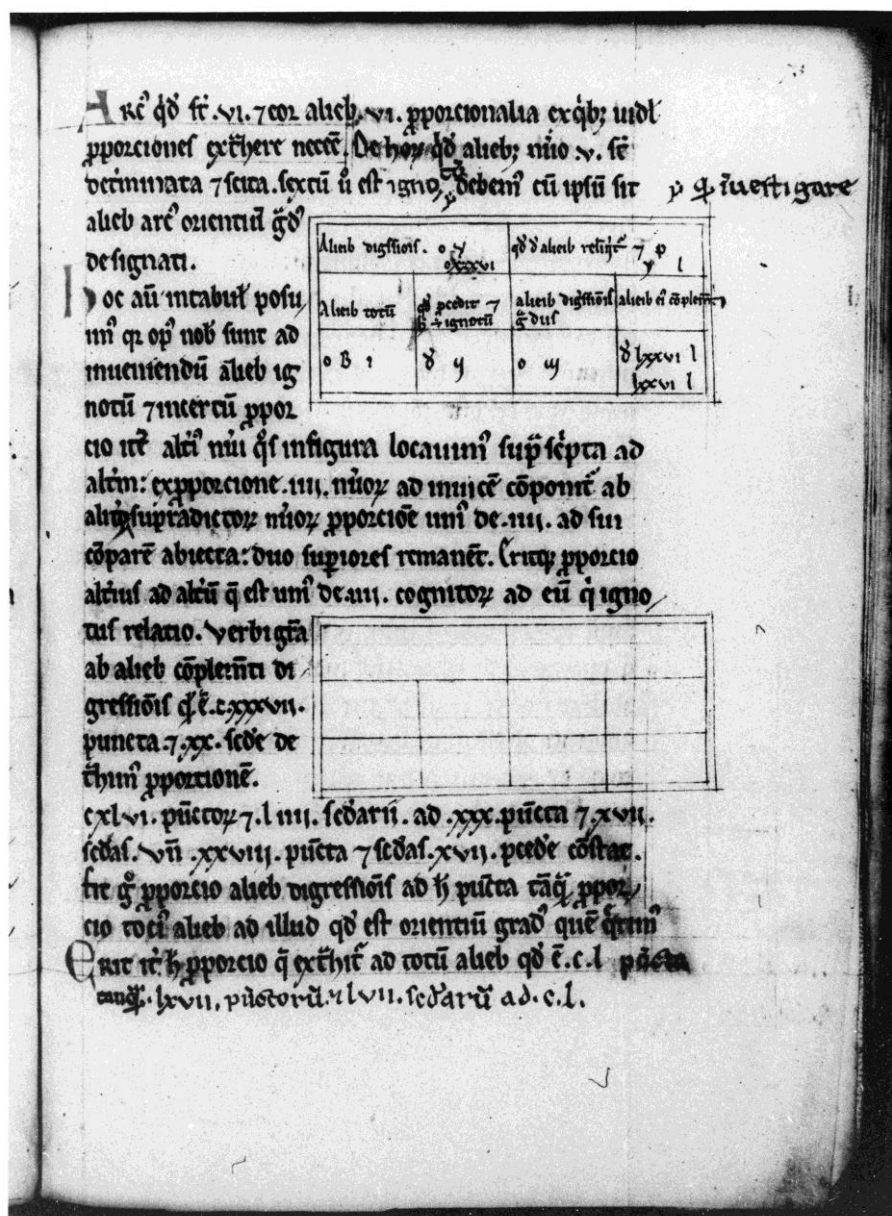


Figure 8: Cambridge, Gonville and Caius College, MS 456/394, fol. 73r (reproduced by the permission of the Master and Fellows of Gonville and Gaius College).

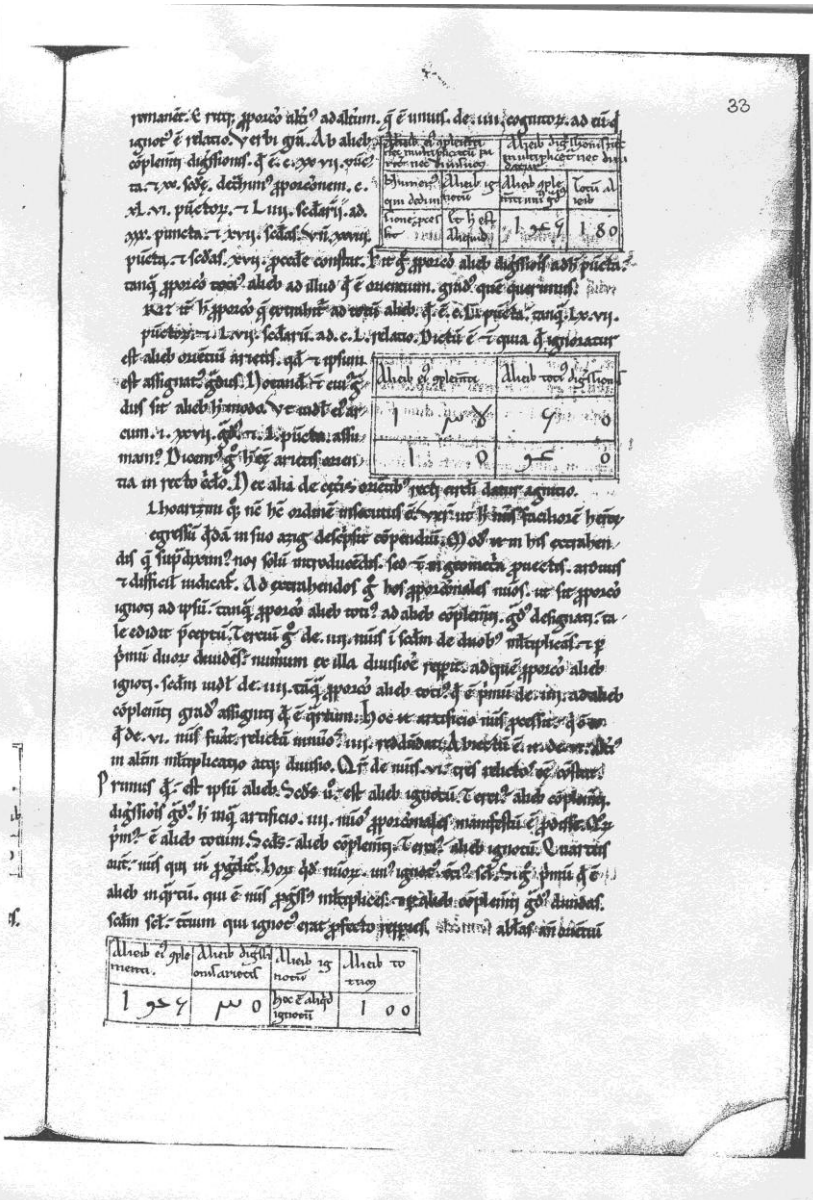


Figure 9: Oxford, Bodleian Library, MS Arch. Seld. B 34, fol. 33r.



11