

Notes on Anonymous Twelfth-Century Translations of Philosophical Texts from Arabic into Latin on the Iberian Peninsula

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It is well known that the translators Dominicus Gundisalvi, Avendauth, Johannes Hispanus and Alfred of Shareshill were responsible for a good number of Avicenna translations from Arabic into Latin in twelfth-century Spain. Some Avicenna translations, however, are anonymous, notably the *Isagoge* and *Physics* parts of the summa *al-Šifāʾ* (*The Cure*). The *Physics* part, in fact, was translated into Latin in two steps. The first two books and the beginning of the third book were translated in the twelfth century by an unknown translator. About a century later, in the 1270s, the remainder of book three and book four were translated by Juan Gonzalves de Burgos and a companion translator named Salomon. In addition to the two anonymous Avicenna translations of *Isagoge* and *Physics*, there are at least seventeen further anonymous translations of Arabic philosophical texts in twelfth-century Spain. The present paper makes an attempt to lift the anonymity of these translations.

Earlier studies have shown that anonymous medieval translations from Greek or Arabic can be attributed to known translators by studying the usage of non-technical, non-disciplinary vocabulary, that is, everyday words, particles and short phrases. Stylistic analysis made it possible, for instance, to attribute anonymous Greek-Latin translations of Aristotle to James of Venice and Arabic-Latin translations of Averroes to Michael Scot, William of Luna and Her-

1 This paper started as a study on the anonymous translator of Avicenna's *Physics* and then grew into a more comprehensive study. It was written by Dag Nikolaus Hasse. Andreas Büttner contributed significantly by creating a digitized and fully searchable corpus of the translations, by developing an interface to improve the workflow of the computational analysis with Cosine Delta, and by programming a search tool for analysing the corpus manually. We are grateful for having received very helpful advice, especially from Stefan Georges, Jonathan Maier, Katrin Fischer, Amos Bertolacci, Nicola Polloni, Charles Burnett, Fotis Jannidis and Christof Schöch, and for the transcription work of Monika Isépy and Eva Sahr. Research for this paper was funded by the German Federal Ministry of Education and Research as part of *Kallimachos: Zentrum für digitale Edition und quantitative Analyse* at the University of Würzburg.

mannus Alemannus.² The great translation movement in Spain in the twelfth century is a deserving but difficult target for such an analysis. Here, too, we have many anonymous translations, but the textual situation is complicated. The translation movement in Spain is large, and the number of anonymous translations is considerable. Also, texts by many different Arabic and Greek authors are involved, not only by one, such as Aristotle or Averroes, so that the stylistic differences between the authors may obscure the stylistic differences between the translators. Some anonymous translations, for instance those of Alkindi, are very short, which makes them a difficult target for stylistic analysis. In order to keep the size manageable and the corpus coherent, I decided to concentrate on philosophical texts, as exhibited on the table below, and to exclude, for the purpose of the present study, other disciplines such as medicine, mathematics or the occult sciences. In a paper focusing on the translator John of Seville which was written in parallel with the present one, I discuss first results of a stylistic analysis of anonymous twelfth-century translations in the field of astronomy and astrology.³

Twelfth-Century Latin Translations of Arabic Philosophical Texts
on the Iberian Peninsula

anonymous	01-Aristotle, <i>Metaphysica A</i> , fragm.	ed. Martini
	02-Alexander of Aphrodisias, <i>De intellectu et intellecto</i>	ed. Théry, pp. 74–82
	03-Anonymous, <i>Turba philosophorum</i>	ed. Ruska
	04-Alkindi, <i>De intellectu et intellecto</i>	ed. Nagy, pp. 1–11
	05-Alkindi, <i>De mutatione temporum</i>	ed. Bos/Burnett
	06-Alkindi, <i>De radiis</i>	ed. d’Alverny/Hudry
	07-Alfarabi, <i>De intellectu et intellecto</i>	ed. Gilson, pp. 115–26
	08-Alfarabi, <i>Liber excitationis ad viam felicitatis</i>	ed. Salman
	09-Alfarabi, <i>De scientiis</i> (or: <i>De divisione scientiarum</i>)	ed. Alonso, repr. Schneider
	10-Ps.-Alfarabi, <i>Flos</i> (or: <i>Fontes quaestionum</i>) (<i>‘Uyūn al-masā’il</i>)	ed. Cruz Hernández
	11-Alfarabi, <i>Quintus liber</i> (Comm. on Euclid’s <i>Elements V</i>)	ed. Burnett
	12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	ed. Baeumker

2 Minio-Paluello, Iacobus Veneticus Grecus, and Hasse, *Latin Averroes Translations*. Cf. also McVaugh, *Towards a Stylistic Grouping*.

3 Hasse, *Stylistic Evidence*.

	13-Iḥwān al-Šafāʿ, <i>Liber introductorius in artem logicae demonstrationis</i> 14-Iḥwān al-Šafāʿ, <i>Cosmographia</i> 15-Anonymous, <i>Liber de quatuor confectioibus</i> 16-Isaac Israeli, <i>De definitionibus</i> 17-Avicenna, <i>Logica, Isagoge (al-Šifāʿ)</i> 18-Avicenna, <i>Physica I–III (al-Šifāʿ)</i> 19-Avicenna, <i>De diluviis (al-Šifāʿ: Meteora II.6)</i> 20-Algazel, Prologue to <i>De philosophorum intentionibus (Maqāšid)</i>	ed. Nagy, pp. 41–64 ed. Gautier Dalché ed. Sannino ed. Muckle ed. 1508, transcr. Isépy/Sahr ed. Van Riet ed. Alonso ed. Salman, pp. 125–7
John of Seville	21-Ps.-Aristotle, <i>Secretum secretorum</i> 22-Costa ben Luca, <i>De differentia spiritus et animae</i> 23-Albumasar, <i>Liber introductorii maioris</i>	ed. Suchier, pp. 473–80 ed. Wilcox ed. Lemay
Hugo of Santalla	24-Ps.-Apollonius, <i>De secretis naturae</i> 25-Messahalāh, <i>Liber Aristotilis de 255 Indorum voluminibus</i>	ed. Hudry ed. Burnett/Pingree
Gerard of Cremona	26-Aristotle, <i>Analytica posteriora</i> 27-Aristotle, <i>Physica</i> 28-Aristotle, <i>De caelo</i> 29-Aristotle, <i>De generatione et corruptione</i> 30-Aristotle / Ibn al-Bitrīq, <i>Meteora I–III</i> 31-Ps.-Aristotle, <i>Liber de causis</i> 32-Alexander of Aphrodisias, <i>De tempore, De sensu, De eo quod augmentum</i> 33-Themistius, Comm. on <i>Analytica posteriora</i> 34-Alkindi, <i>De quinque essentiis</i> 35-Alkindi, <i>De somno et visione</i> 36-Alkindi, <i>De ratione</i> 37-Alfarabi, <i>De scientiis</i> 38-Isaac Israeli, <i>De elementis</i> 39-Isaac Israeli, <i>De definitionibus</i>	ed. Minio-Paluello mss. ed. Hossfeld mss. ed. Schoonheim ed. Pattin ed. Théry, pp. 86–100 ed. O’Donnell ed. Nagy, pp. 28–40 ed. Nagy, pp. 12–27 ed. Nagy, pp. 1–10 ed. Schupp ed. 1515 ed. Muckle
Avendauth and ?	40-Avicenna, <i>Prologus + Logica, Isagoge I.1 + I.12 (al-Šifāʿ)</i>	ed. Birkenmajer
Gundisalvi and Avendauth	41-Avicenna, <i>De anima (al-Šifāʿ)</i> 42-Avicenna, <i>De medicinis cordialibus</i>	ed. Van Riet ed. Van Riet 1968, pp. 187–210

Gundisalvi and Johannes Hispanus	43-Ibn Gabirol, <i>Fons vitae</i> 44-Algazel, <i>Summa theoriae philosophiae</i> (or: <i>De scientiis philosophorum</i>) (<i>Maqāṣid</i>)	ed. Baeumker ed. Lohr/Muckle
Gundisalvi	45-Avicenna, <i>Philosophia prima</i> (<i>al-Šifā'</i>) ⁴ 46-Avicenna, <i>De convenientia et differentia scientiarum</i> (<i>al-Šifā'</i> : <i>Analytica posteriora</i> II.7) 47-Ps.-Avicenna, <i>Liber celi et mundi</i>	ed. Van Riet ed. Baur, pp. 124–33 ed. Gutman
Alfred of Shareshill	48-Nicolaus Damascenus, <i>De vegetabilibus et plantis</i> 49-Avicenna, <i>De mineralibus</i> (<i>al-Šifā'</i> : <i>Meteora</i> I.1 + I.5)	ed. Drossaart Lulofs/ Poortman ed. Holmyard/Mandeville
Michael Scot (early thirteenth century)	50-Aristotle, <i>De animalibus</i> 11–19 51-Averroes, Long Commentary on <i>De caelo</i> 52-Avicenna, <i>Abbreuiatio de animalibus</i> (<i>al-Šifā'</i>)	ed. van Oppenraaij ed. Carmody/Arnzen ed. ca. 1500

The table lists 20 anonymous translations and 29 translations by translators known to us, plus three translations explicitly attributed to Michael Scot, which were produced in the early thirteenth century. It is likely that in the future some texts will be added to this list, when titles such as the enigmatic *Distinctio Alfarabii super librum Aristotelis de naturali auditu*, which Gerard of Cremona's *socii* list among his translations, are properly identified with extant texts in Latin and Arabic. That the 20 anonymous translations were produced in the twelfth century and on the Iberian Peninsula, is not certain, but a surmise based on the observation that these translations became available in about the same period and in the same context as the 29 translations by known Iberian translators. Michael Scot is an exception, since he moved to southern Italy around 1220 after having been active in Spain. Hence, anonymous translations attributed to him would not be correctly described as being produced 'in twelfth-century Spain'.

For some texts in the list, which exist in manuscript and early prints only, I did not have access to electronic versions: Gerard of Cremona's translations of Isaac Israeli's *De elementis* and of Aristotle's *Physica* and *De generatione et corruptione*, as well as Michael Scot's translation of Avicenna's *Abbreuiatio de animalibus*. These texts are therefore not part of the stylistic analysis below. It may surprise readers that I have included two works of predominantly astrolog-

4 Four of the 25 manuscripts attribute the translation of Avicenna's *Philosophia prima* to Dominicus Gundisalvi, one to Gerard of Cremona. See Bertolacci, *A Community of Translators*, p. 41, n. 8.

ical character: Messahalāh's *Liber Aristotelis de 255 Indorum voluminibus* and Albumasar's well-known *Liber introductorii maioris* (*The Great Introduction to Astrology*), which has a very philosophical first book. These texts were added in order to increase the statistical material for Hugo of Santalla and John of Seville, whose philosophical translations are few and rather short.

The shortness of texts is one problem for stylistic analysis. Revision and double translation is another. For example, John of Seville's translation of Albumasar's *Liber introductorii maioris* was systematically revised by one or several other translators, who have not yet been identified. Moreover, there are three double translations in our corpus. Alfarabi's *Enumeration of the Sciences* (*De scientiis*), texts 9 and 37, was translated by Gerard of Cremona and by an anonymous translator, whom many modern scholars identify with Dominicus Gundisalvi, on the grounds that Gundisalvi amply draws on this translation in his own treatise *De divisione philosophiae*. Isaac Israeli's *On Definitions*, texts 16 and 39, was also translated twice, by Gerard of Cremona and by an anonymous translator. The same is true of Alkindi's *On the Intellect*, texts 4 and 36. As I have shown elsewhere, Gerard's translation was the earlier one in all three cases.⁵ Even if we stay away from these double translations and focus on the rest, there remain enough problems for stylistic analysis. One problem is that further translations may be revised translations too, without us being aware of it. Another troubling question is whether the stylistic signal of the author, i.e. of Alkindi, Alfarabi or Avicenna, may turn out to be stronger than the stylistic signal of the translator—so that, for instance, Alfarabi translations will group together in Latin, even if the Latin versions stem from different translators. A stylistic identification of the translator would then be impossible.

The *status quaestionis* on anonymous translations in Toledo owes much to Manuel Alonso Alonso, who has analysed Dominicus Gundisalvi's translation style in several papers. In an impressive article of 1955, Alonso compared, on 59 densely written pages, the 'coincidencias verbales típicas' in the works and translations by Gundisalvi, comparing the Arabic and the Latin.⁶ This article is full of interesting material. For the present purpose it is most relevant that Alonso bases his ascriptions on 34 typical words and phrases:

aequidistantia, anitas, appendiciae, assolare, astrologia / astronomia, caelatura, comitari, credulitas / credere, dapsilis, designare / designatus / designatio, diversificare, elongatio, enim, et omnino, fortassis, habens, hylearis, imaginatio, in sensibilibus, intellectus, intentio, maneria, materiare, mediante, minus commune, multivocum,

5 In a paper read on 13 February 2016 at the Paris conference on *The Book of Causes and the Elements of Theology from the 5th to the 17th Century* organized by Dragos Calma and Marc Geoffroy. The paper will appear in the proceedings.

6 Alonso, *Coincidencias verbales típicas*, pp. 129–52 and 345–79.

numerus surdus, parificare, propalare, quadrivialia, si ... aut, solet, transumere / transumptive, vicissitudinantur.

On this basis, Alonso ascribes nine anonymous translations to Gundisalvi. The other anonymous translations in the present corpus are not discussed by Alonso:

Manuel Alonso: Anonymous Translations Ascribed to Gundisalvi

anonymous translation	Manuel Alonso
01-Aristotle, <i>Metaphysica</i> A, fragm.	
02-Alexander of Aphrodisias, <i>De intellectu</i>	Gundisalvi
03-Anonymous, <i>Turba philosophorum</i>	
04-Alkindi, <i>De intellectu</i>	Gundisalvi
05-Alkindi, <i>De mutatione temporum</i>	
06-Alkindi, <i>De radiis</i>	
07-Alfarabi, <i>De intellectu</i>	Gundisalvi
08-Alfarabi, <i>Liber excitationis ad viam felicitatis</i>	Gundisalvi
09-Alfarabi, <i>De scientiis</i>	Gundisalvi
10-Ps.-Alfarabi, <i>Flos</i>	Gundisalvi
11-Alfarabi, <i>Quintus liber</i>	
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	Gundisalvi
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	
15-Anonymous, <i>Liber de quatuor confectionibus</i>	
16-Isaac Israeli, <i>De definitionibus</i>	Gundisalvi
17-Avicenna, <i>Logica, Isagoge</i>	Gundisalvi
18-Avicenna, <i>Physica</i> I–III	Gundisalvi
19-Avicenna, <i>De diluviis</i>	
20-Algazel, Prologue to <i>De intentionibus</i>	

The evidence collected by Alonso is substantial. The degree to which we are convinced by it depends on the standards we demand from stylistic analysis. One drawback of Alonso's studies is that he does not compare Gundisalvi's style with that of any other translator on the Iberian Peninsula. Once you start comparing, the result is disillusioning. The rare Latin term *parificare*, for instance, one of the words picked out by Alonso, is used by Gundisalvi, but also by Gerard of Cremona and Hugo of Santalla, as the following table shows (which lists only those texts of the corpus in which the word appears):

parific-

anonymous	Alfarabi, <i>Quintus liber</i>	2
	Alfarabi, <i>De scientiis</i>	2
	Avicenna, <i>Physica</i> I–III	3
Hugo of Santalla	Ps.-Apollonius, <i>De secretis</i>	1
Gerard of Cremona	Ps.-Aristotle, <i>Liber de causis</i>	1
	Themistius, Comm. on <i>Analytica posteriora</i>	1
Gundisalvi and Avendauth	Avicenna, <i>De anima</i>	2
Gundisalvi and Johannes Hispanus	Ibn Gabirol, <i>Fons vitae</i>	1
Gundisalvi	Avicenna, <i>Philosophia prima</i>	13

To give further examples: *credulitas* appears eleven times in Gerard's translation of the *Analytica posteriora*; *designare* and its cognates is used by John of Seville and Hugo of Santalla; *fortassis* appears in John, Hugo and Alfred; *aequidistare* is used by Gerard in his Themistius translation; *mediante* appears in John, Hugo and Gerard; *elongatio* is used by Alfred and Gerard; *imaginatio* is used in various writings by Gerard; *et omnino*—which is a wonderfully stylistic term that appears often in Gundisalvi's writings—unfortunately is also used by John, Hugo and Gerard. And, a final example, which is exhibited in the table below: *diversificare* is a term that regularly appears in Gerard's translations.

diversifica-

anonymous	Alkindi, <i>De radiis</i>	1
	Avicenna, <i>Physica</i>	25
Gerard of Cremona	Aristotle, <i>Analytica posteriora</i>	7
	Aristotle, <i>De caelo</i>	45
	Aristotle, <i>Meteora</i>	5
	Ps.-Aristotle, <i>Liber de causis</i>	7
	Themistius, Comm. on <i>Analytica posteriora</i>	9
	Alkindi, <i>De somno</i>	2
	Alfarabi, <i>De scientiis</i>	2
Avendauth	Prologue to <i>De intentionibus</i>	1
Gundisalvi and Avendauth	Avicenna, <i>De anima</i>	2
Gundisalvi and Johannes Hispanus	Ibn Gabirol, <i>Fons vitae</i>	24
	Algazel, <i>Summa</i>	3
Gundisalvi	Avicenna, <i>Philosophia prima</i>	4
	Ps.-Avicenna, <i>Liber celi et mundi</i>	1

What these tables show, is that Alonso has successfully unearthed terms *preferred* by Gundisalvi, but not necessarily terms *typical* of Gundisalvi. Hence, Alonso made a great advance, because he was able to offer many indications buttressing his hypothesis that Gundisalvi was in fact responsible for a greater set of translations than we knew before. But these indications are of limited validity. Alonso's evidence for author attribution is not conclusive.

Charles Burnett has contributed many important studies on the translation movement in Spain: on the coherence of the translation programme and on many individual translators.⁷ The starting-point for the present study was Burnett's list of Arabic-Latin philosophical translations, which was published in 2005.⁸ These are his careful comments on the presumed translators:

Charles Burnett: Presumed Translators

anonymous translation	Charles Burnett
01-Aristotle, <i>Metaphysica</i> A, fragm.	perhaps the same translator as 06
02-Alexander of Aphrodisias, <i>De intellectu</i>	Gundisalvi (?)
03-Anonymous, <i>Turba philosophorum</i>	anonymous
04-Alkindi, <i>De intellectu</i>	Gundisalvi (?)
05-Alkindi, <i>De mutatione temporum</i>	anonymous
06-Alkindi, <i>De radiis</i>	perhaps the same translator as 01
07-Alfarabi, <i>De intellectu</i>	Gundisalvi (?)
08-Alfarabi, <i>Liber excitationis ad viam felicitatis</i>	Gundisalvi (?)
09-Alfarabi, <i>De scientiis</i>	Gundisalvi
10-Ps.-Alfarabi, <i>Flos</i>	anonymous
11-Alfarabi, <i>Quintus liber</i>	Gundisalvi (?)
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	Gundisalvi (?)
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	anonymous
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	anonymous
15-Anonymous, <i>Liber de quatuor confectionibus</i>	anonymous
16-Isaac Israeli, <i>De definitionibus</i>	Gundisalvi (?)
17-Avicenna, <i>Logica, Isagoge</i>	unknown, not Gundisalvi
18-Avicenna, <i>Physica</i> I–III	unknown, Toledan (?)
19-Avicenna, <i>De diluviis</i>	Alfred of Sharesill (?)
20-Algazel, Prologue to <i>De intentionibus</i>	anonymous

7 The most important articles are easily accessible in Burnett, *Arabic into Latin in the Middle Ages*.

8 Burnett, *Arabic into Latin: the Reception of Arabic Philosophy*, pp. 391–400.

Burnett follows Alonso's suggestions on Gundisalvi being responsible for the translations of treatises on the intellect by Alexander of Aphrodisias, Alkindi and Alfarabi, of Alfarabi's *Liber excitationis* and *De scientiis*, of the Iḥwān al-Ṣafā's *In artem logicae demonstrationis* and of Isaac Israeli's *De definitionibus*, but he adds cautious question marks.

Who were the translators of these twenty treatises? Most of these texts are pieces of Arabic philosophy proper; that is, they are mainly written by Arabic philosophers, such as Alkindi, Alfarabi and Avicenna, rather than by ancient Greek philosophers transmitted in Arabic. Hence, the identification of the translators is important also for determining who transported Arabic philosophy into Europe. Moreover, the anonymity of the translations prevents us from knowing more about the historical circumstances of the translation movement on the Iberian Peninsula.⁹ John of Seville was mainly active in the region of the Limia valley in northern Portugal. Hugo of Santalla, in all likelihood, was a canon of the cathedral of Tarazona. Gerard of Cremona, Dominic Gundisalvi and Michael Scot were canons of the cathedral of Toledo, and Alfred of Shareshill was probably active in Toledo towards the end of the twelfth century. Hence, the importance of Toledo, and possibly other Iberian cities, as a centre for Arabic-Latin translations depends upon whether we can make advances in identifying anonymous translators.

I shall approach this task in two steps. First, I provide philological evidence, based on a stylistic analysis of the usage of particles and short phrases. Second, I try to demonstrate that a good part of the results receives confirmation through a computational analysis of the most frequent words statistics of the texts.

1 Philological Analysis

The first hurdle to clear was to create a digital corpus of texts which allowed for the comparison of stylistic features. The texts had to be transcribed or scanned, and the Latin spelling had to be standardized in a way that would not seriously distort the stylistic preferences of the translators. In order to extinguish scanning mistakes and to standardize the Latin spelling, the texts were checked automatically against Morpheus, the Perseus Project's morphology parser, and against our own list of Latin words specific to the translation literature. To reduce the amount of errors, we gradually developed a set of substitution rules to smoothen the sometimes idiosyncratic orthography. After many of such

9 On this translation movement see Burnett, *The Coherence*, pp. 249–88, and Hasse, *The Social Conditions*, pp. 68–86; specifically on Avicenna translations see Bertolacci, *A Community of Translators*, pp. 37–54, and Hasse, *Die Überlieferung arabischer Philosophie*, pp. 377–400.

checking routines, the two datasets together recognized a high percentage of the text as correct Latin.

From previous studies, for instance on the Greek-Latin translations of Aristotle, it is known that the analysis of small words and phrases is a promising way towards identifying the translators. It has proved fruitful, in particular, to concentrate on words that are regular and specific at the same time, that is, words or small phrases which appear often in texts by one translator, but hardly ever in those of the other translators. The philological analysis of this paper is based on such a search for stylistic and specific terms. It was accomplished in two steps. First, with the help of a search programme written by Andreas Büttner, we generated six lists of words and phrases that appear only in one of the six known translators: John of Seville, Hugo of Santalla, Gerard of Cremona, Dominicus Gundisalvi, Alfred of Sharesill and Michael Scot respectively (Avendauth was omitted because his text is too short to be of any statistical relevance). The second step was to sieve out from these lists all content words like *substantia composita*, which are not stylistic, but specific to certain topics or sub-disciplines of medieval philosophy: logic, meteorology, zoology etc. ‘Stylistic words’ is understood in a broad sense and includes terms such as *comparatio*, *fingere* or *absurdus*, which are stylistic only in the sense that they could in principle appear in any scientific Latin text of the twelfth century. The focus on stylistic words is important because experience shows that content words have a tendency to travel from one translator to the other, while stylistic words are much more stable.

Some stylistic words are even highly characteristic of a translator. An example, at least on first sight, is the phrase *et deinde*:

et deinde (translating: *tumma*)

The other translators use: *deinde*, *et post*, *postea*, *et postea*, *post istud*, *post hoc*, *consequenter*, *ergo*, *et ideo*

anonymous	01-Aristotle, <i>Metaphysica</i> A, fragm.	0
	02-Alexander of Aphrodisias, <i>De intellectu</i>	1
	03-Anonymous, <i>Turba philosophorum</i>	0
	04-Alkindi, <i>De intellectu</i>	0
	05-Alkindi, <i>De mutatione temporum</i>	0
	06-Alkindi, <i>De radiis</i>	0
	07-Alfarabi, <i>De intellectu</i>	5
	08-Alfarabi, <i>Liber excitationis</i>	0
	09-Alfarabi, <i>De scientiis</i>	1
	10-Ps.-Alfarabi, <i>Flos</i>	0
	11-Alfarabi, <i>Quintus liber</i>	0

	12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	0
	13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	2
	14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	10
	15-Anonymous, <i>De 4 confectionibus</i>	0
	16-Isaac Israeli, <i>De definitionibus</i>	4
	17-Avicenna, <i>Logica, Isagoge</i>	21
	18-Avicenna, <i>Physica I–III</i>	6
	19-Avicenna, <i>De diluviis</i>	0
	20-Algazel, Prologue to <i>De intentionibus</i>	0
John of Seville	21-Ps.-Aristotle, <i>Secretum secretorum</i>	0
	22-Costa ben Luca, <i>De differentia</i>	0
	23-Albumasar, <i>Liber introductorii maioris</i>	0
Hugo of Santalla	24-Ps.-Apollonius, <i>De secretis naturae</i>	0
	25-Messahalāh, <i>Liber Aristotilis</i>	0
Gerard of Cremona	26-Aristotle, <i>Analytica posteriora</i>	0
	28-Aristotle, <i>De caelo</i>	0
	30-Aristotle / Ibn al-Biṭrīq, <i>Meteora I–III</i>	0
	31-Ps.-Aristotle, <i>Liber de causis</i>	0
	32-Alexander of Aphrodisias, <i>De tempore etc.</i>	0
	33-Themistius, Comm. on <i>Analytica posteriora</i>	0
	34-Alkindi, <i>De quinque essentiis</i>	0
	35-Alkindi, <i>De somno et visione</i>	0
	36-Alkindi, <i>De ratione</i>	0
	37-Alfarabi, <i>De scientiis</i>	0
	39-Isaac Israeli, <i>De definitionibus</i>	0
Avendauth (and ?)	40-Avicenna, <i>Prologus</i>	0
Gundisalvi + Avendauth	41-Avicenna, <i>De anima</i>	25
	42-Avicenna, <i>De medicinis cordialibus</i>	0
Gundisalvi + Johannes Hispanus	43-Ibn Gabirol, <i>Fons vitae</i>	3
	44-Algazel, <i>Summa</i>	23
Gundisalvi	45-Avicenna, <i>Philosophia prima</i>	54
	46-Avicenna, <i>De convenientia scientiarum</i>	1
	47-Ps.-Avicenna, <i>Liber celi et mundi</i>	2
Alfred of Sharesill	48-Nicolaus Damascenus, <i>De vegetabilibus</i>	0
	49-Avicenna, <i>De mineralibus</i>	0
Michael Scot	50-Aristotle, <i>De animalibus</i> 11–19	3
	51-Averroes, Long Comm. on <i>De caelo</i>	7

This phrase appears in almost all translations by Dominicus Gundisalvi (except for the very short *De medicinis cordialibus*)—regardless, in fact, of whether Gundisalvi was translating with another person or by himself. *Et deinde* never appears in the philosophical translations by John, Hugo, Gerard, Avendauth and Alfred.

In earlier versions of the present paper, the phrase *et deinde* was taken to be very indicative evidence. In the meantime, however, I realized that this evidence is not entirely reliable when the analysis is refined in two ways: by checking it against the corresponding corpus of astronomical/astrological translations and by including the translator Michael Scot. (1) The above-mentioned 2016 paper focusing on John of Seville is based on the corpus of twelfth-century astronomical and astrological translations, which not only contains very long texts, such as Gerard of Cremona's translation of Ptolemy's *Almagest*, but also covers the translators Adelard of Bath, Hermann of Carinthia and Plato of Tivoli, who are potential translators also of the philosophical texts discussed here. (2) As the above table for *et deinde* illustrates, it is sensible to include Michael Scot's translations in the analysis, even though his translations date from the early thirteenth century. As a Toledan translator, who left Spain for Italy around 1220, he prolonged the Spanish translation movement into the thirteenth century. Also, it was revealing that one text of the astronomical and astrological corpus of twelfth-century translations in fact turned out to be the product of Michael Scot, namely Alhazen's *Liber Aboali*.

The problem with the phrase *et deinde* is not the astronomical and astrological corpus: Adelard, Hermann and Plato do not employ the phrase either. But *et deinde* is used several times by the translator Michael Scot, as the above table exhibits: the phrase appears seven times in his translation of Aristotle's *De animalibus* 11–19 and five times in his translation of Averroes' Long Commentary on *De caelo*. Hence, *et deinde* remains a phrase typical of Gundisalvi, but not of him only. Gundisalvi shares this stylistic predilection with Michael Scot. As a consequence, this paper is now based on firmer evidence. It makes sure that the vocabulary identified as highly indicative of a translator is not, by chance, typical of Michael Scot or of the astronomical/astrological translators Adelard of Bath, Hermann of Carinthia, and Plato of Tivoli.

When I had arrived at the six lists of purely stylistic terms, I further shortened these lists by concentrating on terms that appear *regularly* in the texts of a known translator. This I did by selecting all those terms that appear more than 10 times and in at least 50% of the translations of a person. This rule had to be modified for John of Seville and Alfred of Shareshill, whose corpus of philosophical translations is very small. In their case, I also included terms that appear only 5 to 10 times or that appear in only 40% of the translations. I shall now present, in chronological sequence, the six translators and the tables with

words and phrases specific to them, showing which of these appear also in the anonymous translations.

1.1 John of Seville

The first translator is John of Seville, who is well known especially for his many astrological and astronomical translations produced in the 1120s and 1130s. The table below contains words and phrases specific to John of Seville which appear in at least 1 of his 3 translations and more than 4 times.¹⁰ Note that I have added the catchwords, i.e. the stylistically characteristic words, isolated in the 2016 study on the astronomical/astrological corpus; these words are marked with underlining. Terms marked with italics appear once (or more often, as indicated in brackets) in texts by other translators in this corpus.

words and phrases specific to John of Seville
repente, iussu, invenient, dicamusque, significaverit, participatur, nutu dei, eorum atque, opera autem, oporteret eum, dixerunt philosophi, a semet ipso, fuerit cum hoc, et quicquid in, accidunt/accidit in hoc, secundum quod putaverunt, in contradictione eorum, nunc autem narremus, eorum in quibusdam, ut dicerent quod, et quicquid accidit, quicquid accidit in, quoque et in, narravimus in praecedentibus, dixerunt philosophi quod
<u>catchwords of the astronomical/astrological corpus:</u>
aspicies, nominabis, et scito, boni esse, quoque eius, sint inter, et volueris, quam volueris, cumque volueris, accipe a, finitus fuerit, nutu dei, quamdiu duraverit, qua fuerit, plus erit, serva eum, quod fuerit inter, et volueris scire, cum volueris hoc, qui si fuerit, in quo fuerit et, et cetera similia, post hoc aspice, <i>annullare, et aspice, et pones, quoque ac</i> (3)

anonymous translation	words and phrases shared with John of Seville
01-Aristotle, <i>Metaphysica A</i> , fragm.	
02-Alexander of Aphrodisias, <i>De intellectu</i>	
03-Anonymous, <i>Turba philosophorum</i>	nutu dei (5), dixerunt philosophi (1), invenient (1)
04-Alkindi, <i>De intellectu</i>	
05-Alkindi, <i>De mutatione temporum</i>	sint inter (1), accipe a (4), plus erit (1)
06-Alkindi, <i>De radiis</i>	
07-Alfarabi, <i>De intellectu</i>	

¹⁰ The words and phrases are listed according to frequency: *repente* is the most frequent characteristic single word, *nutu dei* the most frequent two-word phrase etc.

08-Alfarabi, <i>Liber excitationis</i>	
09-Alfarabi, <i>De scientiis</i>	
10-Ps.-Alfarabi, <i>Flos</i>	
11-Alfarabi, <i>Quintus liber</i>	
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	<u>et volueris scire (1)</u>
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	
15-Anonymous, <i>De 4 confectionibus</i>	<u>nominabis (1), cumque volueris (3), serva eum (1), et pones (3), quoque ac (1)</u>
16-Isaac Israeli, <i>De definitionibus</i>	
17-Avicenna, <i>Logica, Isagoge</i>	<u>significaverit (2), participatur (1), plus erit (1)</u>
18-Avicenna, <i>Physica I–III</i>	<u>participatur (1), sint inter (3), et quic- quid accidit (2), accidit in hoc (1), et cetera similia (1)</u>
19-Avicenna, <i>De diluviis</i>	
20-Algazel, Prologue to <i>De intentionibus</i>	

The evidence presented in this table is not substantial enough to allow for the safe attribution of any of these anonymous translations to John of Seville. Some terms specific to John of Seville appear in the translations of Avicenna's *Logica* and *Physica*, but, as we will see below, there is overwhelming stylistic evidence that Dominicus Gundisalvi was the translator of these two Avicennian texts. This is a reminder that a few stylistic predilections shared with a known translator are not enough to justify an attribution, especially not in the case of long texts such as these, which comprise 24.673 words (*Logica*) and 59.724 words (*Physica*) respectively. It is much more significant that the rather short treatise *De quatuor confectionibus*, which is 1.891 words long, contains five John of Seville catchwords. *De quatuor confectionibus* is a treatise on magic and natural philosophy by an anonymous Arabic author, who discusses, among other things, how to catch animals without hunting. It served as a source for the final letter of *The Epistles* of the so-called 'Brethren of Purity' (Iḥwān al-Ṣafā'). There is an interesting fact about this treatise which helps to identify its translator: Its field is blank in the other five translator tables of this study, as we shall see. There are no catchwords of Hugo of Santalla, Gerard of Cremona, Dominicus Gundisalvi, Alfred of Sharesill or Michael Scot in *De quatuor confectionibus*. The negative evidence squares well with the positive evidence of the five catchwords of the above table.

Because *De quatuor confectionibus* is short, it is difficult to isolate a sufficient number of catchwords that are both regular and exclusive to a translator

in the philosophical corpus. I have therefore started to search systematically for rarer terms that appear exclusively in one translator, but less than 10 (and more than 2) times, counting also occurrences in the astronomical/astrological corpus.¹¹ This is the resulting table, in which I list also the translators Adelard of Bath, Plato of Tivoli and Hermann of Carinthia, who are part of the astronomical/astrological corpus¹² (the first figure in brackets gives the occurrences in the combined two corpora, the second figure in *De quatuor confectioibus*):

	Anonymous, <i>De quatuor confectioibus</i>: rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	accipiesque (3 occ. in translations by John / 1 occ. in this text), proicies (3/7), cumque volueris (9/3), et nominabis (9/1), quod volueris (9/2), cumque fuerint (8/1), voluerit ex (6/1), serva eum (6/1), eum super (6/1), pones super (4/1), eo cumque (3/1), et operare (3/1), magisteriorum et (3/1), aliquod ingenium (3/1), post haec accipe (5/2)
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	nihilque (6/1), adhibere (4/1)
Gerard of Cremona	et dicatur (9/1), scientiam non (3/1)

11 Also, I have added the Latin translation of Averroes' Long Commentary on *De anima* to the two corpora, a translation which can safely be attributed to Michael Scot, with the purpose of broadening the textual material for Michael Scot. This I have done for all tables on 'stylistic, but rare terms' of this study.

12 To be precise, the following translations are considered in addition to the philosophical corpus: Adelard of Bath, Albumasar's *Ysagoga minor*; Adelard of Bath, Algorismi's *Tabulae*; John of Seville, Alcabitius' *Introductorius*; John of Seville, Thebit's *De imaginibus* (versions I and J); John of Seville, anonymous *Astrologicae speculationis exercitium*; John of Seville, Ibn al-Šaffār's *De opere astrolabii*; Plato of Tivoli, Ptolemy's *Tetrabiblos* I–II; Plato of Tivoli, Haly Embrani's *De electionibus horarum*; Plato of Tivoli, Archimedes' *De mensura circuli*; Plato of Tivoli, Savasorda's *Liber embadorum*; Hugo of Santalla, Jafar's *Liber imbrium*; Hugo of Santalla, Ps.-Aristotle's *De ducentis quinquaginta quinque Indorum voluminibus*; Hugo of Santalla, Hermes' *De spatula*; Hugo of Santalla, Ibn al-Muṭannā's Commentary on al-Ḥwārizmī's *Tables*; Hermann of Carinthia, Ptolemy's *Planisphaerium*; Hermann of Carinthia, Albumasar's *Liber introductorius in astrologiam*; Gerard of Cremona, Ptolemy's *Almagest*; Gerard of Cremona, Theodosius' *De habitationibus*; Gerard of Cremona, Thebit's *De his que indigent*; Gerard of Cremona, Ps.-Thebit's *De motu octavae sphaerae*; Gerard of Cremona, Archimedes' *De mensura circuli*; Gerard of Cremona, Banu Musa's *Verba*; Michael Scot, Averroes' Long Commentary on *De anima*. Note that this additional corpus includes astronomical and astrological translations for the most part, but also some that border on mathematics or magic. The corpus does not include the various translations of Ps.-Ptolemy's *Centiloquium*, in order to avoid the problem of identical content.

Dominicus Gundisalvi	numquid (6/2), interroga (5/1), cadendi (3/1), nec sicut (7/1), formatum et (3/1)
Alfred of Shareshill	–
Michael Scot	dixit ita (9/1), dixit erunt (3/1), apud me est (3/1)

It is indicative that when we turn to rarer stylistic terms exclusive to the known translators, the evidence clearly speaks in favour of John of Seville as the translator. In sum, the combined positive and negative evidence of the translator tables together with the evidence of the rarer stylistic terms makes it probable that John of Seville was the translator of the anonymous treatise *De quatuor confectioibus*. This is only ‘probable’ and not yet certain because the text has many similarities in content and style with texts of magic, so that the final word on this issue has to wait until a comparison is made with other Arabic-Latin translations of magic.

1.2 Hugo of Santalla

The next translator in chronological sequence is Hugo of Santalla, who is known as the translator of about seven texts in astrology, astronomy and the divinatory sciences. Hugo, in principle, would have been a good candidate for the translation of *De quatuor confectioibus*. But the translator was not Hugo of Santalla, as the following table shows, which contains words and phrases that appear in both translations by Hugo and more than 10 times:

words and phrases specific to Hugo of Santalla ¹³
tandemque, agnitio, licebit, arbitror, ulterius, deinceps quoque, nihilominus quoque, ut videlicet, sive potius, dum videlicet, cuiusmodi sunt, plerumque etiam, vel medio, aliter quoque, rursus in, nam sub, vel potius, eo item, quae videlicet, praecipue dum, videlicet aut, ad hunc quoque modum, <i>potissimum</i> , <i>denuo</i> , <i>atque huiusmodi</i> catchwords of the astronomical/astrological corpus; agnitio, digressio, ut videlicet, deinceps quoque, nihilominus quoque, sive potius, dum videlicet, plerumque etiam, cuiusmodi sunt, rursus in, nisi inquam, dum tamen, quia item, vel potius, aliter quoque, ut inde, ut tandem, ubi videlicet, prout videlicet, si videlicet, praecipue dum, ante cetera, que quidem omnia, ad hunc quoque modum

13 In earlier versions of this paper (before the inclusion of the astronomical/astrological corpus and of Michael Scot), the following terms and phrases now omitted were listed as specific to Hugo of Santalla: *pariter* (61 occurrences in Hermann, 4 in Plato, 1 in Adelard), *aut saltem* (2 Hermann, 1 Adelard, 1 Michael Scot), *itidem* (3 Plato, 1 Hermann, 1 Adelard).

anonymous translation	words and phrases shared with Hugo of Santalla
01-Aristotle, <i>Metaphysica</i> A, fragm.	
02-Alexander of Aphrodisias, <i>De intellectu</i>	
03-Anonymous, <i>Turba philosophorum</i>	
04-Alkindi, <i>De intellectu</i>	
05-Alkindi, <i>De mutatione temporum</i>	
06-Alkindi, <i>De radiis</i>	
07-Alfarabi, <i>De intellectu</i>	
08-Alfarabi, <i>Liber excitationis</i>	vel medio (1)
09-Alfarabi, <i>De scientiis</i>	
10-Ps.-Alfarabi, <i>Flos</i>	
11-Alfarabi, <i>Quintus liber</i>	
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	ut inde (1)
15-Anonymous, <i>De 4 confectionibus</i>	
16-Isaac Israeli, <i>De definitionibus</i>	
17-Avicenna, <i>Logica, Isagoge</i>	agnitio (1), ulterius (1), nam sub (1)
18-Avicenna, <i>Physica</i> I–III	ulterius (2)
19-Avicenna, <i>De diluviis</i>	
20-Algazel, Prologue to <i>De intentionibus</i>	

Hugo of Santalla has long been known as an idiosyncratic stylist, whose style is easy to recognize. This is confirmed by the present analysis of stylistic particles and phrases. Hugo has many and obvious stylistic preferences which are not shared by any of the anonymous texts discussed here.

1.3 Gerard of Cremona

The third translator in our corpus is Gerard of Cremona (1114–87), the canon of Toledo cathedral and most productive Arabic-Latin translator of the Middle Ages. From the list of translations produced by his *socii*, i.e., his students and colleagues, after his death, we know that he was the translator of at least 70 Arabic texts in philosophy, astronomy, mathematics, medicine, alchemy and divination. The following list contains those words and phrases that appear in at least 4 of the 11 translations by Gerard and more than 10 times:

words and phrases specific to Gerard of Cremona ¹⁴
significo, imprimis, reliquarum, sufficiente, iterum quia, absque medio, nos quidem, significo per, verumtamen non, et ipsorum, propterea quia, rem aliam, illud iterum, quo fuimus, reliquis rebus, nam quando, quare fit, modum unum, planum quod, similiter iterum, iterum super, secundum semitam, ¹⁵ et dico iterum, quod est quoniam, ut sit res, et nos quidem, et illud quidem, eius et ipsius, quando non est, in quo fuimus, est secundum duos, illud est quoniam, propter illud ergo, propterea quod est, iterum quod est, sunt res una, et planum quod, propterea quod non, et scientia quidem, et de eis, et dico iterum quod, est secundum duos modos, illud in quo fuimus, et causa in illo, dico ergo quod si, <i>et neque, nisi quoniam, similiter quando, quod est quia, secundum duos modos</i>
<u>catchwords of the astronomical/astrological corpus:</u> describam, ponam ut, demonstrare voluimus, vero fuit, quod voluimus, ponam autem, et neque, illud est quoniam, iam vero fuit, tunc propter illud, in eo quod sequitur ¹⁶

anonymous translation	words and phrases shared with Gerard of Cremona
01-Aristotle, <i>Metaphysica</i> A, fragm.	
02-Alexander of Aphrodisias, <i>De intellectu</i>	
03-Anonymous, <i>Turba philosophorum</i>	significo (10), <u>describam</u> (1)
04-Alkindi, <i>De intellectu</i>	sunt res una (3)
05-Alkindi, <i>De mutatione temporum</i>	<u>in eo quod sequitur</u> (1), <i>similiter quando</i> (2)
06-Alkindi, <i>De radiis</i>	
07-Alfarabi, <i>De intellectu</i>	ut sit res (1)
08-Alfarabi, <i>Liber excitationis</i>	nos quidem (1), et de eis (1)
09-Alfarabi, <i>De scientiis</i>	
10-Ps.-Alfarabi, <i>Flos</i>	et scientia quidem (1), secundum semitam (2), <i>secundum duos modos</i> (1)
11-Alfarabi, <i>Quintus liber</i>	

14 In earlier versions of the paper, the following terms and phrases now omitted were listed as specific to Gerard of Cremona: *praeter quod* (11 Plato, 3 Hermann, 1 Michael Scot); *et propter illud* (3 Michael Scot); *per sermonem* (5 Michael Scot); *demonstratio super* (10 Michael Scot, 1 Plato); *quoniam quando* (53 Michael Scot); *neque est* (69 Michael Scot, 1 Gundisalvi). The figures count the occurrences in both corpora: philosophical and astronomical/astrological.

15 The phrase *secundum semitam* appears only in 3 of the 11 translations by Gerard.

16 In Hasse, *Stylistic Evidence*, p. 37, further phrases are listed as specific to Gerard of Cremona, which are excluded here because they also appear in Michael Scot's translations of the long commentaries on *De caelo* and *De anima* and of *De animalibus* 11–19 with the following frequencies: *declaratur quod* (9), *neque est* (69), *quod narrabo* (7), *illud est quod* (1), *qui est inter* (2), *propter hoc erit* (31), *et propter illud* (3), *et propter hoc erit* (30).

12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	sufficiente (1)
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	nam quando (1)
15-Anonymous, <i>De 4 confectionibus</i>	
16-Isaac Israeli, <i>De definitionibus</i>	reliquarum (1), absque medio (1), eius et ipsius (1)
17-Avicenna, <i>Logica, Isagoge</i>	vero fuit (1)
18-Avicenna, <i>Physica I–III</i>	iterum quia (1), ut sit res (5)
19-Avicenna, <i>De diluviis</i>	
20-Algazel, Prologue to <i>De intentionibus</i>	ipsorum (1)

It is possible to isolate many words and phrases as specific to Gerard of Cremona, but only few of them are used in our anonymous translations. Three Gerardian phrases can be found in the anonymous translation of Isaac Israeli's *De definitionibus*, which is not surprising given that the three passages are identical in wording with Gerard of Cremona's own translation of Isaac Israeli's *De definitionibus*, of which the anonymous text here is a revision, as has been shown elsewhere.¹⁷

The second interesting item on the table is Ps.-Alfarabi's *Flos*, which is also titled *Fontes quaestionum* in Latin. This brief text of only 822 words is a translation of the first part of the Arabic text 'Uyūn al-masā'il (*The Principal Questions*), a succinct summa of Avicennian philosophy, which treats first concepts, the necessary and possible being, emanation, the active intellect, the physics of the sublunar world, the human intellect and the soul's afterlife. Among the three catchwords in this translation which are specific to Gerard of Cremona, the phrase *secundum semitam* is particularly interesting. It translates the ordinary Arabic phrase 'alā sabīl, which means 'in the way of', 'according to'. I have not found this Latin phrase in any other translation of the corpus outside Gerard's translations:

secundum semitam (translating: 'alā sabīl)

The other translators use *ad modum*, *secundum*, *secundum quod*, *secundum viam*.

anonymous	...	0
	10-Ps.-Alfarabi, <i>Flos</i>	2
	...	0
John of Seville	...	0
Hugo of Santalla	...	0

¹⁷ See n. 5 above.

Gerard of Cremona	26-Aristotle, <i>Analytica posteriora</i>	31
	...	0
	33-Themistius, Comm. on <i>Analytica posteriora</i>	25
	...	0
	35-Alkindi, <i>De somno et visione</i>	1
	...	0
Avendauth (and ?)	...	0
Gundisalvi + Avendauth	...	0
Gundisalvi + Johannes Hispanus	...	0
Gundisalvi	...	0
Alfred of Shareshill	...	0
Michael Scot	...	0

This picture is completed by the astronomical/astrological corpus, where again the phrase *secundum semitam* appears only in translations by Gerard: twice in Ptolemy's *Almagest* and once in Ps.-Thebit ben Corat's *De motu octavae sphaerae*. Related phrases like *per semitam* and *secundum hanc semitam* also appear exclusively in Gerard's translations (4 and 6 times), while the term *semita* as such is also used by other translators such as Adelard (10), Hugo (2) and John of Seville (2).

A closer textual study of Ps.-Alfarabi's *Flos* reveals further evidence that this is a translation by Gerard of Cremona. The text contains phrases like *per sermonem*, *neque est* and *secundum quod oportet* which are very typical of Gerard of Cremona and shared by only one translator (namely Michael Scot).¹⁸ More significantly, the text contains rarer stylistic phrases that appear exclusively in translations by Gerard of Cremona, but less often. I shall again present a table, as above for *De quatuor confectionibus*, with the results of a systematic search for rarer stylistic terms in Ps.-Alfarabi's *Flos* which are exclusive to the translators, but which appear less than 10 times, counting both the philosophical and the astronomical/astrological corpus:

	Ps.-Alfarabi, <i>Flos</i>: rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	–
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	–

¹⁸ See n. 14 above.

Gerard of Cremona	modos unus (7 occ. in translations by Gerard / 1 occ. in this text), dialecticae et (7/1), res quidem (6/1), scientia dialecticae (6/1), quando invenitur (4/1), non tollitur (4/1), cuius comprehensio (3/1), ex esse eius (6/1), et res quidem (5/1), est demonstratio et (4/1), in primis ut (3/1), super ipsum ex (3/1), eius intentio est (3/1), non licet ut (3/1), aliud et est (3/1), secundum duos modos unus (6/1), non est ex rebus (4/1), sunt secundum duos modos (4/1), modos unus eorum est (3/1)
Dominicus Gundisalvi	et dominantem (3/1), non formatur (3/1), sunt secundum ordinem (4/1), genere et differentia (4/1), ipsum est necesse (3/1), et ea quae sunt (4/1)
Alfred of Shareshill	–
Michael Scot	possibile aut (4/1), opinioni et (4/1), quod veritas (4/1), facere eas (3/1), iste enim non (3/1), et hoc possibile (3/1)

As this table shows, the translator of Ps.-Alfarabi's *Flos* shares some of these rarer stylistic phrases with Gundisalvi and Michael Scot, but many more phrases with Gerard of Cremona. When we add the negative evidence of the other five translator tables of this study, where the field with Ps.-Alfarabi's *Flos* is always blank, it is safe to conclude that Gerard of Cremona was the translator of Ps.-Alfarabi's *Flos*. We will see below that the computational analysis of the most frequent words underlines this philological conclusion.

1.4 Dominicus Gundisalvi

The fourth translator in sequence is Dominicus Gundisalvi, who was also a canon of the cathedral of Toledo, contemporary with Gerard of Cremona. Gerard died in 1187, while Gundisalvi was still alive in 1190. Gundisalvi's focus, as far as we can see today, was on philosophical translations, which is why the table does not contain any catchwords from the astronomical/astrological corpus. The table lists specific words and phrases that appear in at least 3 of the 7 translations by Gundisalvi (including the translations produced together with Avendauth or Johannes Hispanus) and more than 10 times.

words and phrases specific to Dominicus Gundisalvi ¹⁹
nosci, quandoquidem, nonne, ipsamet, quomodocumque, sic ut, facit debere, debere esse, vel est, sicut postea, est absurdum, restat ergo, interim dum, per differentiam, verbum de, in plerisque, nec esset, sed adhuc, posset esse, aliquando vero, cuius comparatio, fuerit ibi, opus fuit, tractat de, eo nec, quam id, alio a se, unde oportet ut, ex his quae, non potest autem, non si autem, ullo modo sed, id per quod, haec est scilicet, id autem quod, est scilicet quia, ullo modo si, ideo oportet ut, haec est quia, causa autem huius, modo si autem, habet comparisonem ad, sine dubio est, esse nisi propter, omnis quod est, si quis autem dixerit, ut id quod est, <i>ullo modo, modo si, sequitur post, hoc fieri, quis dixerit, dictio de, est quiddam quod, sine dubio et</i> , ²⁰ <i>id quod habet, esse nisi cum, in tantum quod, hoc est scilicet, si quis autem, si autem non fuerit</i>

anonymous translation	words and phrases shared with Dominicus Gundisalvi
01-Aristotle, <i>Metaphysica</i> A, fragm.	
02-Alexander of Aphrodisias, <i>De intellectu</i>	sic ut (1), vel est (2), cuius comparatio (1), opus fuit (1), id per quod (1), id autem quod (1), omnis quod est (1), <i>est quiddam quod</i> (1)
03-Anonymous, <i>Turba philosophorum</i>	nonne (16)
04-Alkindi, <i>De intellectu</i>	vel est (2), interim dum (1), alio a se (1)
05-Alkindi, <i>De mutatione temporum</i>	quandoquidem (3), <i>in tantum quod</i> (2)
06-Alkindi, <i>De radiis</i>	sic ut (1), in plerisque (1)
07-Alfarabi, <i>De intellectu</i>	vel est (2), cuius comparatio (2), opus fuit (1), eo nec (1), alio a se (1), id per quod (1)

19 In earlier versions of the paper, the following terms and phrases now omitted were listed as specific to Dominicus Gundisalvi: *et deinde* (Gerard 3, Michael Scot 10), *postquam autem* (Plato 1, Gerard 1), *inter se* (3 Adelard, 1 John, 2 Plato, 3 Gerard, 4 Michael Scot), *idcirco* (1 Plato, 2 Hermann), *cur non* (2 Hermann, 1 Gerard), *probatum* (6 Plato, 1 Michael Scot), *tunc esset* (17 Michael Scot), *est hoc quod* (19 Michael Scot), *non est necesse* (4 Gerard, 28 Michael Scot), *id cuius* (6 Gerard), *potest autem* (5 Gerard), *et etiam quia* (64 Gerard, 6 Michael Scot), *praedictum est* (1 Adelard, 5 John, 1 Plato, 7 Michael Scot), *habet esse* (1 Gerard, 9 Michael Scot), *nullo modo* (1 Hugo, 3 Gerard, 9 Michael Scot), *est eo quod* (7 Plato, 2 Gerard, 1 Michael Scot), *secundum hoc quod* (2 Adelard, 1 John, 2 Plato, 8 Gerard, 5 Michael Scot), *non est autem* (3 Gerard), *sine dubio* (1 Hugo, 1 Gerard, 4 Michael Scot), *in actu* (1 Gerard, 516 Michael Scot), *opus est* (3 John, 3 Plato, 1 Hermann, 1 Gerard), *id in quo* (6 Plato, 1 Hugo, 2 Gerard).

20 The phrases *modo si*, *est quiddam quod* and *sine dubio et* do not appear elsewhere in the present corpus, but one time each in Michael Scot's translation of Averroes' Long Commentary on *De anima*.

08-Alfarabi, <i>Liber excit. ad viam felicitatis</i>	quomodocumque (1), id per quod (1)
09-Alfarabi, <i>De scientiis</i>	cuius comparatio (1), <i>hoc fieri</i> (1)
10-Ps.-Alfarabi, <i>Flos</i>	
11-Alfarabi, <i>Quintus liber</i>	vel est (1), <i>ullo modo</i> (1)
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	opus fuit (4), haec est quia (1), <i>dictio de</i> (6)
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	sic ut (1), vel est (5), sicut postea (1), ex his quae (3), id per quod (2), haec est scilicet (2), <i>hoc est scilicet</i> (1)
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	
15-Anonymous, <i>De 4 confectionibus</i>	
16-Isaac Israeli, <i>De definitionibus</i>	<i>in tantum quod</i> (1), <i>si quis autem</i> (1)
17-Avicenna, <i>Logica, Isagoge</i>	nosci (13), quandoquidem (2), sic ut (3), sicut postea (10), per differentiam (1), in plerisque (1), fuerit ibi (1), aliquando vero (2), cuius comparatio (4), non si autem (1), id per quod (2), id autem quod (3), ullo modo si (1), haec est quia (1), modo si autem (1), habet comparisonem ad (2), sine dubio est (1), si quis autem dixerit (2), ut id quod est (1), <i>ullo modo</i> (15), <i>modo si</i> (3), <i>hoc fieri</i> (1), <i>quis dixerit</i> (1), <i>id quod habet</i> (2), <i>esse nisi cum</i> (1), <i>hoc est scilicet</i> (3), <i>si quis autem</i> (4), <i>si autem non fuerit</i> (1)
18-Avicenna, <i>Physica I–III</i>	nosci (2), quandoquidem (23), nonne (6), ipsamet (4), sic ut (9), facit debere (2), debere esse (2), sicut postea (16), restat ergo (6), interim dum (2), per differentiam (1), verbum de (2), nec esset (1), posset esse (1), fuerit ibi (5), aliquando vero (2), cuius comparatio (1), opus fuit (1), eo nec (3), alio a se (1), unde oportet ut (2), ex his quae (2), non si autem (4), ullo modo sed (8), haec est scilicet (5), id autem quod (1), est scilicet quia (1), ullo modo si (3), ideo oportet ut (2), haec est quia (4), modo si autem (3), habet comparisonem ad (2), sine dubio est (5), si quis autem dixerit (1), <i>ullo modo</i> (45), <i>modo si</i> (5), <i>sequitur post</i> (2), <i>hoc fieri</i> (1), <i>dictio de</i> (7), <i>est quiddam quod</i> (1), <i>sine dubio et</i> (2), <i>id quod habet</i> (3), <i>in tantum quod</i> (1), <i>hoc est scilicet</i> (16), <i>si autem non fuerit</i> (2)

19-Avicenna, <i>De diluviis</i>	<i>quis dixerit</i> (1, Michael Scot), <i>in tantum quod</i> (2, Michael Scot)
20-Algazel, Prologue to <i>De intentionibus</i>	<i>hoc est scilicet</i> (1)

This is the richest table of this article. Remember that the words in upright never appear in any other translator of the corpus and that those in italics appear only once outside Gundisalvi's translations. Together the terms pile up much evidence. The evidence for Avicenna's *Isagoge* and Avicenna's *Physica* is overwhelming. It has been a long-standing surmise that Dominicus Gundisalvi was the translator not only of Avicenna's *De anima*, *Philosophia prima* and *De convenientia et differentia scientiarum*, but also of two other major parts of Avicenna's summa *al-Šifā'*: the *Isagoge* and the *Physica*. The stylistic analysis of small words does not leave any doubt that this is indeed the case.

The evidence of the above table is also convincing for three other texts that are considerably shorter (as compared with the 24.673 words of Avicenna's *Isagoge* and the 59.724 words of his *Physica*): Alexander of Aphrodisias' *De intellectu* (3.345 words), Alfarabi's *De intellectu* (4.074 words) and the Iḥwān al-Šafā' 's *Liber introductorius in artem logicae demonstrationis* (6.008 words). It is true that the lists of Gundisalvian catchwords in these three shorter texts are not particularly long: The Alexander translation contains 8 such terms, the Alfarabi translation 5 and the Iḥwān al-Šafā' translation 7. But one should keep in mind that these terms do not appear outside Gundisalvi's translations, neither in the present corpus, which includes Michael Scot, nor in the astronomical/astrological corpus. There may always be some stray appearances of unusual stylistic terms in a translation, such as Hugo of Santalla's and John of Seville's terms in Gundisalvi's long translations of *Isagoge* and *Physica*. But in the case of these three shorter texts, sets of 6–8 Gundisalvian phrases are a significant indication of Gundisalvi's involvement, especially since the negative evidence for the other translators is very stable: There are blank fields for these three texts in the tables for the other translators John, Hugo, Gerard, Alfred and Michael Scot, except for four single terms.²¹ The stylistic analysis of small words therefore points clearly to Dominicus Gundisalvi as the translator of Alexander's *De intellectu*, Alfarabi's *De intellectu* and the Iḥwān al-Šafā' 's *Liber introductorius in artem logicae demonstrationis*.

To underline the above attributions to Gundisalvi, it is worthwhile to have a look at an occurrences table for a phrase specific to Gundisalvi: *opus fuit*. This term translates forms of the verbs *aḥwaġa* and *iḥtāġa* ('to need'):

21 Michael's phrase *quoniam si ita esset* appears once in Alexander; Gerard's phrase *ut sit res* once in Alfarabi's *De intellectu*; Gerard's phrase *sufficiente* once in the Iḥwān al-Šafā' 's *Liber*; and John's phrase *et volueris scire* also once in the Iḥwān al-Šafā' 's *Liber*.

opus fuit (translating: *aḥwaḡa*, *iḥtāḡa*)

The other translators use: *indiget*, *necessarius est*, *oportet*, *necesse est*

anonymous	...	0
	02-Alexander of Aphrodisias, <i>De intellectu</i>	1
	...	0
	07-Alfarabi, <i>De intellectu</i>	1
	...	0
	12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	4
	...	0
	18-Avicenna, <i>Physica</i> I–III	1
	...	0
John of Seville	...	0
Hugo of Santalla	...	0
Gerard of Cremona	...	0
Gundisalvi + Avendauth	41-Avicenna, <i>De anima</i>	1
	...	0
Gundisalvi + Johannes Hispanus	...	0
	44-Algazel, <i>Summa</i>	2
Gundisalvi	45-Avicenna, <i>Philosophia prima</i>	2
	...	0
	47-Ps.-Avicenna, <i>Liber celi et mundi</i>	6
Alfred of Shareshill	...	0
Michael Scot	...	0

Opus fuit is a good example of a phrase which is regular and specific at the same time. In addition, it also illustrates why the present study does not differentiate between translations attributed to Gundisalvi, to Gundisalvi and Avendauth, and to Gundisalvi and Johannes Hispanus: the Latin style remains very similar, at least when studied with regard to catchwords. In the future, however, with a finer-grained stylistic analysis, it may well be possible to isolate the stylistic input of Gundisalvi's companion translators. In sum, then, on the basis of the evidence provided by *opus fuit* and by the other Gundisalvian catchwords listed at the beginning of this section, five translations can be firmly attributed to Gundisalvi: Avicenna's *Logica* and *Physica*, Alexander's and Alfarabi's *De intellectu* and the Iḥwān al-Ṣafā's *Liber introductorius*.

Can anything be said about other texts that bear traces of Gundisalvi's style, as exhibited on the table with Gundisalvi catchwords? This is possible if we turn our attention to rarer stylistic terms, as we did above with the translations of *De quatuor confectionibus* and *Flos*. A systematic analysis of such terms in

both the philosophical and the astronomical/astrological corpus makes it probable that Gundisalvi was the translator also of the following four texts, as we shall see: Alkindi's *De intellectu* (805 words), Alfarabi's *De scientiis* (6.900 words), Isaac Israeli's *De definitionibus* (4.452 words) and Ps.-Alfarabi's *De ortu scientiarum* (2.207 words). The first three of these have in common that there also exists a translation by Gerard of Cremona of the same text. As was mentioned above, Gerard's translation was produced first and then substantially revised by an anonymous translator, in all three cases. It has long been assumed that Dominic Gundisalvi was this anonymous reviser, since he draws on the three anonymous translations in his own works. The tables below buttress this assumption with stylistic evidence.

The first of these texts, Alkindi's *De intellectu*, which Gerard had translated as *De ratione*, has very few resonances in the translator tables, which exhibit two Gundisalvian and one Gerardian phrase and nothing with the other translators. Here comes the table with rarer stylistic terms, which appear only 10 times or less in a known translator:

	Alkindi, <i>De intellectu</i>: rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	–
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	–
Gerard of Cremona (without considering Gerard's translation of <i>Alkindi's De ratione</i>)	est apparens (6 occ. in translations by Gerard / 1 occ. in this text), species prima (3/1)
Dominicus Gundisalvi	attribuens (7/1), aliud vel (10/1), nec sicut (7/1), quae praecedit (4/1), quae non erat (9/1), in alio a (5/2), ut cum voluerit (5/1), a se sicut (4/1), esset per se (4/1), quantum vero ad (3/1), hae igitur sunt (3/1)
Alfred of Shareshill	–
Michael Scot	assimilavit (4/1), actu quoniam (7/1), secundum igitur quod (6/1), in actu quoniam (5/1)

This table points to Gundisalvi as a translator, as do the many phrases with the content term *effectus*, such as *exit ad effectum* (6/3), which are exclusive to

Gundisalvi.²² The two Gerardian phrases *est apparens* and *species prima* appear in those passages of Gerard's translation that Gundisalvi has left untouched.

The second text is Alfarabi's famous *Enumeration of the Sciences* (*Iḥṣā' al-ʿulūm*). The anonymous revision of Gerard's translation was edited by Manuel Alonso and Jakob Schneider under the translator name of Dominicus Gundisalvi, but in fact the manuscripts of the translation do not contain any attribution to Gundisalvi. The regular translator tables offer hardly any catch-words for this text: only two for Gundisalvi. The rarer stylistic terms table, however, provides more evidence:

	Alfarabi, <i>De scientiis</i>: rare stylistic terms shared with known translators
Adelard of Bath	ducendum (5 occ. in translations by Adelard / 1 occ. in this text)
John of Seville	scientiae esse (3/1), unumquodque istorum per (3/1)
Plato of Tivoli	observemus (5/1), esse dicuntur (6/1)
Hermann of Carinthia	–
Hugo of Santalla	credatur (9/1), plenissime (4/1), qui omnium (5/1)
Gerard of Cremona (without considering Gerard's translation of Alfarabi's <i>De scientiis</i>)	experiendi (4/1), redeutes (3/1), verumtamen in (6/1), in summa (5/3), inveniuntur res (4/2), fixi in (4/1), hae ergo (4/1), minore ad (4/1), declaratur per (3/1), egent ut (3/1), sunt auctores (3/1), qualiter oportet (3/2), libri huius (3/1), supra omnia (3/1), alia sunt quae (9/2), et primum et (4/1), absolute et secundum (4/1), est in mente (3/1), in mente et (3/1), quia demonstratio non (3/1), et medium quidem (3/1), est summa quam (3/1), est in unaquaque (3/1), super illud quod est (7/1), et alia sunt quae (7/1), in libro qui dicitur (5/2), eo quod futurum est (4/1), quae sunt inter utraque (3/1)

22 In addition, Alkindi's *De intellectu* contains many exclusively Gundisalvian phrases with the content term *effectus*: *effectu sed* (30/1), *effectu non* (20/1), *effectu est* (14/1), *effectum nisi* (9/1), *effectu quae* (4/1), *est in effectu* (45/1), *in effectu sed* (30/1), *in effectu non* (20/1), *in effectu est* (14/1), *exit ad effectum* (6/3), *ad effectum nisi* (5/1), *effectu sed in* (4/1), *effectu non est* (4/1), *in effectu quae* (4/1), *effectum nisi per* (3/1), *non in effectu* (3/1).

Dominicus Gundisalvi	separatas (8/1), practicae (4/2), putativa (4/1), activae (3/2), perveniri (3/1), actiones quae (8/1), vel quae (8/3), quocumque autem (7/1), unaquaeque istarum (6/1), illa esse (5/1), provenit esse (5/1), ipsum vel (5/1), in promptu (4/1), eius qua (4/1), nec provenit (4/1), quia vel (4/1), quod aliae (3/1), partes unam (3/1), quamvis id (3/1), sumpta est (3/1), earum habet (3/1), comparatione quae (3/1), esse separatas (3/1), positae in (3/1), probatione non (3/1), appareat et (3/1), aliis huiusmodi (3/1), autem modo (3/1), quae est una (8/1), cuius comparatio ad (7/1), vel quod est (6/1), cum aliis et (6/1), aliquo modo in (6/1), et multa alia (5/3), ea quae fiunt (4/1), per hoc etiam (4/1), quae dicitur de (4/1), ea quae accidunt (3/2), ea inter se (3/1), de his est (3/2), quae accidunt eis (3/5), secundum hoc quod sunt (5/1), sunt ea quae sunt (5/1), et ex his est (4/1), quae est una ex (3/1), et per hoc etiam (3/1)
Alfred of Shareshill	–
Michael Scot	non omnia (10/1), quasi instrumentum (7/1), est activa (5/1), rectius est (5/1), istud quod (4/1), quia propositio (3/1), pluribus eorum (3/2), quousque compleat (3/1), probando quod (3/1), errorem et (3/1), sicut ea (3/1), eo aliquod (3/1), sunt positae (3/1), non est eadem (5/1), et ex iis (4/2), non et hoc (4/1), eorum nisi secundum (3/1), partium et hoc (3/2), eorum in actu (3/1), ergo sunt causae (3/1), in eo secundum quod (5/1)

The anonymous translation of Alfarabi's *De scientiis* is replete with Gundisalvian terms. Again, most of the Gerardian catchwords appear in that part of Gerard's translation which the anonymous translator had left unchanged in his own version. Michael Scot, in turn, cannot be the translator for chronological reasons: since large parts of the anonymous version of *De scientiis* are adopted by Gundisalvi, who flourished 1162–90, into his own treatise *De divisione philosophiae*, the translation predates the lifetime of Michael Scot, who is attested 1215–28. As I observed above, Michael Scot's vocabulary bears many similarities with Gerard's and Gundisalvi's, which may explain the resonances with Michael Scot's style in the above table. In view of all this, it is probable that Dominicus Gundisalvi was the anonymous translator and reviser of Alfarabi's *De scientiis*.

The third text, Isaac Israeli's *De definitionibus*, again is a revision of a translation by Gerard. The translator tables do not yield conclusive results: there are three phrases by Gerard, two by Gundisalvi and one by Michael Scot in this text. The below table for rarer stylistic terms provides better evidence:

	Isaac Israeli, <i>De definitionibus</i> : rare stylistic terms shared with known translators
Adelard of Bath	sic a (3 occ. in translations by Adelard / 1 occ. in this text)
John of Seville	qua diximus (8/1), ex receptione (3/1), qua diximus quod (4/1), est ex proprietate (4/2)
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	–
Gerard of Cremona (without considering Gerard's translation of Isaac Israeli's <i>De definitionibus</i>)	incederent (5/1), utens (3/2), rebus ut (6/1), et reliquae (4/1), quid ipsa (4/1), rerum una (3/1), ostendamus quid (3/1), sursum ad (3/1), ipso de (3/1), scit eas (3/1), et demonstratio non (7/1), de esse rei (5/1), est res secundum (4/1), cognitione eius quod (3/1), et cadit sub (3/1), est in ipso de (3/1), sit an non sit (3/1)
Dominicus Gundisalvi	manifestetur (8/1), discit (4/1), revera (3/1), nullus autem (9/1), est certa (8/1), perfectior est (7/1), eget aliquo (6/1), naturalibus quae (5/1), differentia vel (5/1), sua quae (5/1), dubio sed (5/1), mediante et (4/1), non afficitur (4/1), discedit a (4/1), eius qua (5/1), variatur nec (3/1), causatum secundum (3/1), discedens ab (3/1), et profundum (3/2), propter amissionem (3/1), ad seipsam (3/1), tunc ipsae (3/1), sumpta est (4/3), imperfecta est (3/1), postea non (3/1), id enim quod (9/1), et alia huiusmodi (9/1), si autem esset (6/1), constat autem quod (5/1), vel non est (5/2), sine dubio sed (5/1), ut non egeat (5/1), ut cum voluerit (5/1), a se sed (4/1), sic est ut (4/1), est vel non (3/2), sine medio quod (3/1), et deinde ab (3/1), non esse sicut (3/1), si autem quis (3/1), non variatur nec (3/1), esse et postea (3/1), scilicet an sit (3/1)
Alfred of Shareshill	–
Michael Scot	attributas (6/1), carentes (4/1), declaraverit (3/1), sed faciunt (4/1), perscrutari et (3/1), ita quod cum (7/1), dicitur enim de (7/1), et falsum in (4/1), cum nihil sit (3/1), enim agit in (3/1), in hoc quod dicunt (3/1)

Again, the overwhelming majority of Gerard's terms comes from Gerard's earlier translation, that is, from passages that have been left untouched in the revision. It is probable therefore that Gundisalvi was the reviser.

The fourth text is Ps.-Alfarabi's *De ortu scientiarum*, which does not resonate with any regular terms specific to the known translators, with the import-

ant exception of the Gundisalvian phrases *opus fuit*, *haec est quia* and *dictio de*. This evidence is supported by the table with rarer stylistic terms:

	Ps.-Alfarabi, <i>De ortu scientiarum</i> : rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	scilicet eorum (5 occ. in translations by John / 2 occ. in this text)
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	ascribit (5/1), multiplicatus (5/1), multiplicem (4/1), praeter quem non est (4/1)
Gerard of Cremona	abbreviatur (3/1), non pervenimus (8/1), dictionum et (5/1), pervenerunt ad (4/1), scimus eam (4/1), quae cadit sub (6/1), non pervenimus ad (6/1), eorum est praeter (3/1), eorum qui sunt in (3/2)
Dominicus Gundisalvi	comparationibus (6/1), praecipuis (3/1), esse hanc (8/1), probatio autem (8/1), tantum nec (7/1), non restat (7/1), illam non (7/1), et comparisonem (5/2), sed quantum (5/1), eam quae (4/1), probatio haec (3/1), est ordinatio (3/1), quae postea (3/1), possibile eam (3/1), comparisonem eorum (3/1), ergo opus (3/1), hoc probatur (3/1), quae hoc (3/1), probatio in (3/1), quibus quaedam (3/1), vocatur scientia (3/1), constat ergo quod (6/1), est ab hoc (5/1), et ad sciendum (4/1), sed quantum ad (4/1), est dictio de (4/1), eius est praeter (3/1), probatio haec est (3/1), in illa non (3/1), quia quicquid est (3/1), ex quibus quaedam (3/1), probatio autem quod (3/1), et de eius (3/1), hoc et illud (3/1), id quod vocatur (3/1), illarum non est (3/1) ²³
Alfred of Shareshill	–
Michael Scot	illorum quae (3/1), enim est finis (6/1), induxit nos ad (4/1), in multas partes (3/1), et huiusmodi et (3/1)

Hence, for these four texts by Alkindi, Alfarabi, Isaac Israeli and Ps.-Alfarabi it is not certain, but probable that Gundisalvi was the translator—or, in three cases, the reviser.

23 To these Gundisalvian phrases in Ps.-Alfarabi's *De ortu* one can add three phrases which appear regularly, but in less than 3 of the 7 translations by Gundisalvi, which is why they are not listed in the translator table above: *subsistit in* (16/1), *sed quomodo* (14/1), *ergo quomodo* (12/1).

A peculiar case is the very short text *De diluviis* (838 words) by Avicenna. The two Gundisalvian phrases that appear in this treatise are set in italics on Gundisalvi's translator table, because they appear once outside Gundisalvi's corpus, namely in translations by Michael Scot. It is therefore necessary to check whether Michael Scot may have been the translator. Another possible candidate, as suggested by Charles Burnett, is Alfred of Shareshill, who was active as a translator in Toledo at the end of the twelfth century. Alfred's meteorological, mineralogical and botanical interests fit well with the content of *De diluviis* (*On Floods*), which is chapter II.6 of the meteorological part of *al-Šifā'* on *Great Events which Happen in this World*, in which Avicenna discusses spontaneous generation after catastrophic floods. Let us then turn to the last two translator tables of this study, those for Alfred of Shareshill and Michael Scot.

1.5 Alfred of Shareshill

It proved very difficult to extract stylistic terms specific to Alfred of Shareshill from the two translations that are explicitly attributed to him: Nicolaus Damascenus' *De vegetabilibus* and Avicenna's *De mineralibus*. The following table contains those words and phrases that appear in one of the two translations by Alfred (but nowhere else) and more often than three times:

words and phrases specific to Alfred of Shareshill ²⁴
ut plurimum, <i>fietque</i> (1 Plato, 1 Hugo), <i>ceterum</i> (1 Hugo), <i>huius signum</i> (3 Gundisalvi), <i>ut multum</i> (4 Gerard, 1 Gundisalvi, 1 Michael Scot)

anonymous translation	words and phrases shared with Alfred of Shareshill
01-Aristotle, <i>Metaphysica</i> A, fragm.	
02-Alexander of Aphrodisias, <i>De intellectu</i>	
03-Anonymous, <i>Turba philosophorum</i>	<i>ceterum</i> (1)
04-Alkindi, <i>De intellectu</i>	
05-Alkindi, <i>De mutatione temporum</i>	
06-Alkindi, <i>De radiis</i>	
07-Alfarabi, <i>De intellectu</i>	
08-Alfarabi, <i>Liber excitationis</i>	

24 The following terms which had been listed in earlier versions of the present study are now excluded: *simulque* (13 Hermann, only 1 Alfred), *aliquotiens* (only 3 Alfred, 1 Gerard), *per multa* (only 2 Alfred, 1 Gundisalvi, 1 Michael Scot).

09-Alfarabi, <i>De scientiis</i>	
10-Ps.-Alfarabi, <i>Flos</i>	
11-Alfarabi, <i>Quintus liber</i>	
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	ut plurimum (6)
15-Anonymous, <i>De 4 confectionibus</i>	
16-Isaac Israeli, <i>De definitionibus</i>	
17-Avicenna, <i>Logica, Isagoge</i>	
18-Avicenna, <i>Physica I–III</i>	
19-Avicenna, <i>De diluviis</i>	
20-Algazel, Prologue to <i>De intentionibus</i>	

The tableau of stylistic phrases specific to Alfred of Shareshill is too small to be informative. Unfortunately, since the two translations of Nicolaus Damascenus and Avicenna are the only translations of Alfred extant, it is unlikely that the set of stylistic terms can be broadened in the future.

1.6 Michael Scot

The final translator table concerns Michael Scot. Michael Scot was responsible not only for the four translations explicitly attributed to him in the manuscripts—Alpetragius' *De motibus caelorum*, Aristotle's *De animalibus*, Averroes' Long Commentary on *De caelo* and Avicenna's *Abbreviatio de animalibus*—but also for several other commentaries by Averroes, as particle analysis of the corpus of medieval Latin Averroes translations shows.²⁵ It is possible to isolate a significant number of stylistic terms and phrases specific to Michael Scot, if studied with respect to our two corpora. The following table lists all those words that appear in both of the two translations by Michael Scot which are in our corpus

25 Hasse, *Latin Averroes Translations*. Note that the catchwords isolated for Michael Scot in this 2010 study (*quapropter, facere rememorationem, declaratum est, ex hoc sermone, et forte, sed tamen, cum ita sit, si ita esset, cum declaratum est*) are exclusive of Michael Scot only if compared to the other Averroes translators of the thirteenth century: William of Luna and Hermannus Alemannus. Remarkably enough, the phrases *facere rememorationem* and *cum declaratum est* are specific to Michael Scot also when compared to the 12th-century translators of our present corpus.

(Aristotle's *De animalibus* 11–19 and the Long Commentary on *De caelo*)²⁶ and more than 10 times:

words and phrases specific to Michael Scot ²⁷
diversatur, fingere, carentibus, ingeniata, inopinabile, semper fuit, diximus superius, dare causam, fingere quod, dicendo quod, dignum est, hoc apparet, hanc opinionem, talis dispositionis, simpliciter aut, diversantur in, diversantur secundum, quod quodlibet, quod recte, sibi similibus, sit eadem, non diversantur, ideo si, communicationem cum, multi homines, perscrutari utrum, inter alia, quoniam forte, istius sermonis, causa istius, sunt eadem, locutus fuit, quaedam istorum, habet communicationem, dedit eis, non indiget, quodlibet istorum, iam diximus superius, super hoc est, est idem cum, nos videmus quod, et est dicere, quod est impossibile et, quoniam si ita esset, quod impossibile est quod, hoc manifestum est ex, manifestum ergo est quod, <i>non est rectum</i>

anonymous translation	words and phrases shared with Michael Scot
01-Aristotle, <i>Metaphysica</i> A, fragm.	ideo si (1), manifestum ergo est quod (1)
02-Alexander of Aphrodisias, <i>De intellectu</i>	quoniam si ita esset (1)
03-Anonymous, <i>Turba philosophorum</i>	
04-Alkindi, <i>De intellectu</i>	
05-Alkindi, <i>De mutatione temporum</i>	carentibus (1)
06-Alkindi, <i>De radiis</i>	
07-Alfarabi, <i>De intellectu</i>	
08-Alfarabi, <i>Liber excitationis</i>	hoc apparet (1), multi homines (1)
09-Alfarabi, <i>De scientiis</i>	
10-Ps.-Alfarabi, <i>Flos</i>	
11-Alfarabi, <i>Quintus liber</i>	
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>	
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>	quodlibet istorum (2)
15-Anonymous, <i>De 4 confectionibus</i>	
16-Isaac Israeli, <i>De definitionibus</i>	

26 With the exception of the words and phrases *inopinabile*, *semper fuit* and *manifestum ergo est quod*, which appear only in one of the two translations by Michael Scot.

27 See Hasse, *Stylistic Evidence*, pp. 36–9, for the attribution of the translation of Alhazen's *Liber Aboali* to Michael Scot. This attribution finds further support in the Michael Scot catchwords of the philosophical corpus, of which the *Liber Aboali* contains the following: *diversatur* (7), *diximus superius* (1), *non diversantur* (2), *et est dicere* (1).

17-Avicenna, <i>Logica, Isagoge</i>	dicendo quod (1), inter alia (1), est idem cum (2)
18-Avicenna, <i>Physica</i> I–III	dignum est (2), hanc opinionem (1), simpliciter aut (2), multi homines (2)
19-Avicenna, <i>De diluviis</i>	inopinabile (2), semper fuit (1), <i>non est rectum</i> (1)
20-Algazel, Prologue to <i>De intentionibus</i>	

As was shown in the paper on the astronomical/astrological corpus, Michael Scot's technical and non-technical vocabulary is to a certain degree similar to that of Gerard of Cremona, and perhaps influenced by him. This is confirmed in the present paper by the fact that some Gerardian catchwords had to be sorted out because they turned out to be stylistic preferences also of Michael Scot: *et propter illud, per sermonem, demonstratio super, quoniam quando* and *neque est*.²⁸ Moreover, I found that the same holds for some Gundisalvian catchwords that could not be used for the analysis because they are typical also of Michael Scot: *et deinde, tunc esset, est hoc quod, non est necesse* and *in actu*.²⁹ It seems that Michael Scot knew the vocabulary of Gerard and Gundisalvi very well, who were his predecessors not only as Arabic-Latin translators, but also as canons of Toledo cathedral. This may help to explain the occasional 'Michael Scotian' terms in the translations of Avicenna's *Isagoge* and *Physica*, two texts which are otherwise replete with truly Gundisalvian catchwords.

Let us return to *De diluviis*. It is remarkable that the term *inopinabile* appears twice in this text, since it is never used by any other translator in the two corpora and since it is a very regular term of Michael Scot's Averroes translations: *inopinabile* or *inopinabilitas* appear 17 times in the Long Commentary on *De caelo*, 18 times in the Long Commentary on *De anima*, 80 times in the Long Commentary on the *Physics*, 24 times in the Long Commentary on the *Metaphysics*, and once in the Compendium on the *Parva naturalia*. Michael Scot here renders the Arabic adjectives *šani* 'or *mustašna* ('absurd', 'nonsensical'), or the noun *šanā'a* ('absurdity'), or the adjective *nakīr* ('reprehensible'). In *De diluviis*, the Arabic term in both passages is *mustankar* ('objectionable'). Other translators of these Arabic phrases prefer other terms like *absurdus*, *absurditas*, *abominabilis* (Gundisalvi) or *repugnans* (William of Luna) instead.³⁰

There is more evidence that Michael Scot was the translator of *De diluviis* when we turn to rarer stylistic phrases of known translators that appear less

28 See n. 14 above.

29 See n. 19 above.

30 See the *Arabic and Latin Glossary*, s.v.

than 10 times, counting both corpora. To increase the textual basis, I have added Michael Scot's translation of the Long Commentary on *De anima* to the corpus:

	Avicenna, <i>De diluviis</i>: rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	–
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	et omnia huiusmodi (3 occ. in translations by Hugo / 1 occ. in this text)
Gerard of Cremona	particulare et (3/1), ut eveniat (3/1), fuit in primis (4/1)
Dominicus Gundisalvi	retinente (3/1), illa proprietates (6/2), sunt tales (4/1), quod omnes sunt (7/2), si quis dixerit (7/1), quis dixerit quod (6/1), est fortius et (4/1), si quis dixerit quod (5/1)
Alfred of Shareshill	–
Michael Scot	quoniam multa (4/1), ista igitur (8/1), cum causis (3/1), et congregatio (3/1), quoniam quemadmodum ³¹ (11/1), rectum dicere (6/1), forte igitur (5/1), aut duo (4/1), semper fuit in (7/1), bene scimus quod (6/1), et si quis (6/1), et maxime quia (5/1), non est inopinabile (8/2), est rectum dicere (4/1), enim est necesse (4/1), et si verum (3/1), quod dicunt de (4/1), omnia enim ista (3/1), dixerit quod est (3/1), si igitur est (4/1), et non est rectum (5/1), non est rectum dicere (4/1), non enim est necesse (3/1), in hoc quod dicunt (3/1), hoc quod dicunt de (3/1), et non est inopinabile (4/1), et nos bene scimus quod (3/1)

The usage of rarer stylistic terms again points clearly to Michael Scot as translator of *De diluviis*. Note that I was not able to isolate textual parallels with Alfred of Shareshill's two translations even with this fine-grained method of analysis. If we put all the evidence together, including the negative evidence from the other translator tables, it can safely be concluded that *De diluviis* was a translation by Michael Scot.

A related case is the first anonymous text on the list: the anonymous translation of the beginning of Aristotle's *Metaphysics*, book Alpha Meizon, a very brief text of 562 words (which is also called *Metaphysica Vaticana* by modern scholars, because it survives in a single manuscript which is now in the Vatican

31 The phrase *quoniam quemadmodum* does not appear in Michael Scot's translator table above because 9 of its 11 occurrences come from the Long Commentary on *De anima*, which is considered only in tables on rare terms.

library). Perhaps because of its brevity, it has left blank fields in all translator tables discussed in this paper, save for the one phrase *manifestum ergo est quod*, which only appears in Michael Scot. A systematic search for rare stylistic terms in both corpora yields the following result:

	Aristotle, <i>Metaphysica A</i>: rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	–
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	–
Gerard of Cremona	nam ipse (7 occ. in translations by Gerard / 1 occ. in this text), quando volumus (5/1), tunc dicimus (4/1), experimentum et (4/3), et per causam (3/1), est quod ille (3/1)
Dominicus Gundisalvi	est ordinatio (3/1), significatio huius (3/1)
Alfred of Shareshill	–
Michael Scot	experimentatur (3/1), bene dixit (9/1), est innatum ³² (14/1), accidit quia (3/1), et ideo si ³³ (16/1), sed tantum in (5/1), tantum et causa (4/1)

At first sight, it may seem as if both Gerard of Cremona and Michael Scot are likely candidates for being translators of *Metaphysics Alpha Meizon*. At closer inspection, the evidence favours Michael Scot. For there are three phrases in this very short text that are exclusive to Michael Scot and that appear very often in his translations (counting his translations of Aristotle's *De animalibus* 11–19 and of Averroes' four long commentaries): *manifestum ergo est quod* (12 occurrences), *est innatum* (54) and *et ideo si* (45).³⁴ I have not been able to isolate such very regular, typical and exclusive terms of Gerard of Cremona in *Metaphysics Alpha Meizon*, in spite of the fact that there is extensive Gerardian

32 Just as the phrase *quoniam quemadmodum* in *De diluviis*, the phrase *est innatum* does not appear in the translator table for Michael Scot because 9 of these 14 occurrences come from the Long Commentary on *De anima*, which is not considered in the translators' tables. The same applies to *et ideo si* (6 times in the Long Commentary on *De anima*).

33 See preceding note.

34 It is true that *innatum* once appears also in *De radiis* ('innatum sciendi desiderium') and in a passage with similar content as in *Metaphysics Alpha Meizon* ('desiderium sciendi est innatum'), as C. Martini has pointed out (Martini, *The Arabic Version*, p. 189), but *innatus* as such is not exclusive to *De radiis*, but also appears in translations by Hugo of Santalla and Michael Scot. The same is true of another term shared by *De radiis* and *Metaphysics Alpha Meizon*: *ex defectu*, which is also found in translations by Hugo of Santalla and Dominicus Gundisalvi.

material in the two corpora. The most regular Gerardian phrase in *Metaphysics* Alpha Meizon is *nam ipse* with 7 occurrences in Gerard's translations.

It is more probable, therefore, that Michael Scot was the translator of *Metaphysics* Alpha Meizon. Note that Michael Scot was the translator also of Averroes' Long Commentary of the *Metaphysics*, which includes Aristotle's text. But the *Metaphysics* text of Averroes' commentary misses out most of book Alpha Meizon, which is badly transmitted in Arabic. It is probable that Michael Scot was aware of this lacuna, that he looked out for an Arabic manuscript with Alpha Meizon and started to produce a translation when he got access to it.

1.7 Uncertain Translators

At the end of this philological analysis let us turn to those anonymous texts for which no translator has as yet been suggested in this study: Anonymous, *Turba philosophorum* (18.681 words), Alkindi's *De mutatione temporum* (9.988), Alkindi's *De radiis* (9.150), Alfarabi's *Liber excitationis ad viam felicitatis* (6.567), Alfarabi's *Quintus liber* (2.257), Iḥwān al-Ṣafā's *Cosmographia* (4.720) and Algazel's Prologue to *De philosophorum intentionibus* (414). In all these cases the regular terms specific to the translators do not yield conclusive results. Nor do the rarer stylistic terms, as the following tables show:

	Anonymous, <i>Turba philosophorum</i>: rare stylistic terms shared with known translators
Adelard of Bath	tabulae (9 occ. in translations by Adelard / 1 occ. in this text)
John of Seville	in perfectionem (10/1), dixerunt philosophi (6/1), hoc pone (6/1), omnes sapientes (5/2), propior quam (4/1), deinde fiunt (3/1), quousque non (3/1), non iungitur (3/1), residuum quod (3/1), his esse (3/1), quod ascendit ab (3/1)
Plato of Tivoli	coadunati (3/1), hoc igitur in (3/1)
Hermann of Carinthia	resque (4/1)
Hugo of Santalla	nuncupant (9/1), introduxit (7/2), easque (6/1), protulit (6/2), obviante (5/1), introducit (5/1), praescriptam (5/1), largiuntur (4/2), describe (4/1), ablato (3/1), extrahi (3/1), agnoscatur (3/1), imminet (3/2), reduxit (3/1), multiplicat et (6/1), ad unius (5/1), proprio in (4/1), hac enim (3/1), ea namque (3/2), his namque (3/1)

Gerard of Cremona	reiterabo (3/2), partem unam (45/4), operatus est (8/2), qualiter fit (6/1), rei unius (5/1), in ratione (4/1), age et (4/2), non moritur (4/1), dicam in (4/3), sursum ad (4/2), ipsum semper (3/1), inquit philosophus (3/1), quod vos (3/1), nostrum in (3/1), multiplicatur illud (3/1), non ingreditur (3/1), partem unam et (31/3), est et facta (3/1), hoc autem est quod (7/1), quid est quod est (3/1)
Dominicus Gundisalvi	occupatur (10/1), prosunt (8/1), miror (7/2), numquid (6/4), consecutus (5/1), intendi (4/1), tuis (4/3), praedixisti (3/1), dicam igitur (10/3), non coniunguntur (9/1), sed id (8/1), enim una (7/1), cur ergo (6/2), fiat hoc (6/4), autem ipsum (5/1), non video (5/2), fiunt unum (5/1), quae omnia (5/1), cum tamen (5/2), est ego (4/1), ipsum totum (4/2), quod dicis (4/1), non prodest (4/1), omnibus praemissis (3/1), eo tantum (3/1), dixisti et (3/4), ideo dico (3/1), dictis quod (3/1), ponatur illa (3/1), perficiuntur nisi (3/1), hoc te (3/1), putat se (3/1), coniuncta sunt (3/1), iam aliquid (3/1), ipso si (3/1), quod non erat (10/1), et inter se (4/1), eo quod id (4/2), est quam quod (4/2), quod una res (4/1), non enim oportet (4/1), omnia et in (3/1), unum sunt et (3/1), ex quibus quaedam (3/1), se eo quod (3/1), autem haec omnia (3/1), his quae diximus (3/1), non variatur nec (3/1), et fit hoc (3/1), eo est et (3/1), est a se (3/1)
Alfred of Sharehill	–
Michael Scot	congregavit (4/1), carentes (4/2), perpetuam (3/1), in hac dispositione (7/2), non exit ex (6/1), cum dixit in (6/1), et quemadmodum in (4/1), et quod nullum (4/1), non fit absque (3/2)

The translator of *Turba philosophorum* may be Gundisalvi, but it is also possible that the translator is not identical with any known translator of the corpus. The rather long text of the *Turba* (18.681 words) shares terms and phrases with many known translators. Since the *Turba* is a treatise on alchemy in the first place, which incorporates much philosophical material, it is to be expected that more can be said on the translator by way of a comparison with a corpus of alchemical translations.

	Alkindi, <i>De mutatione temporum</i>: rare stylistic terms shared with known translators
Adelard of Bath	adde supra (3 occ. in translations by Adelard / 2 occ. in this text)

John of Seville	duraverint (4/1), minuentur (4/1), duratio (3/1), dirigantur (3/1), accipe a (9/4), plus erit (7/1), iunctus fuerit (6/1), et aspexerit (6/1), quantum plus (5/1), non ceciderit (5/1), deinde aspice (5/1), et divide (5/1), accipe in (4/1), succedit in (4/1), proice ab (4/1), praecedentibus et (3/1), suo erit (3/1), pone eum (3/1), fuerint directi (3/4), et operare (3/2), voluerit de (3/1), fuerint in uno (8/1), in hac differentia (4/1), et proice ab (4/1), et quantum plus (4/1), suo et in (3/1), ibi erit pars (3/1), si fuerit de (3/4), quando erit in (3/1), et cum volueris scire (5/2), et si fuerit haec (3/1), et si fuerit cum (3/1)
Plato of Tivoli	in istarum (3/1), cum multiplicatione (3/1)
Hermann of Carinthia	–
Hugo of Santalla	quoslibet (4/1), consummationis (3/1), enim sub (6/1), terminabitur numerus (4/3), si itaque (3/2), ubi terminabitur (3/4), applicans aut (3/1), applicet et (3/1), cui applicat (3/1)
Gerard of Cremona	praemittam (7/1), expansi (7/1), approximatus (6/1), credulitatis (6/1), antecedentibus (4/1), perscrutabor (3/1), sermone aggregato (10/1), scit eam (9/1), ante nos (7/1), praecessit scientia (6/1), addens in (5/3), perscrutationis et (5/1), suam a (5/1), secundum communitatem (5/1), indigemus in (4/1), quo indigemus (3/1), suas ex (3/1), deinde ponam (3/1), dixi in (3/1), sua tunc (3/1), si inveniimus (3/1), et applicetur (3/1), plus quam sit (8/1), in qua erit (5/1), et quando erit (3/4), est quando sunt (3/1), iam praecessit scientia (3/1), ordine suo et (3/1), plus quam sit in (3/1)
Dominicus Gundisalvi	inspice (5/17), imposuerunt (3/1), generalitate (3/1), variabilis (3/1), sicut dixisti (9/1), et constat (7/1), scias etiam (5/2), illa nec (4/1), et debilius (4/1), illi simile (3/1), quandoquidem ita (3/1), sciatur quod (3/1), erit sibi (3/1), dixi de (3/1), quo posuerunt (3/1), ab illa et (8/1), in illis et (8/1), est quam quod (4/1), scias etiam quod (4/2), fuerit in se (3/1), et quandoquidem ita est (3/1)
Alfred of Shareshill	–
Michael Scot	figurantes (3/1), apparentiam (3/1), et quilibet (8/1), aut ambo (7/2), istius partis (6/1), poneretur in (5/1), secundum istam (5/1), dico in (4/3), manet in (4/1), ista parte (4/1), alia via (3/1), istam naturam (3/1), simplicibus non (3/1), multitudo et paucitas (7/1), etiam et si (4/1), sed in aliis (3/1), in rei veritate et (4/1), in se et cum (3/1)

Alkindi's *De mutatione temporum* is a text on weather forecasting with much meteorological and astrological vocabulary. It contains many astrological content terms and phrases (that do not appear in this table with stylistic phrases), most of which are highly specific to John of Seville. This is noteworthy since with Adelard of Bath, Plato of Tivoli, Hermann of Carinthia and Hugo of Santalla there are other translators of astrology in the corpus. Apart from this link to John of Seville, however, there is not much that can be said about the translator, since both the regular and the rare stylistic terms show similarities with John of Seville's, Gerard's, Gundisalvi's and Michael Scot's translations.

	Alkindi, <i>De radiis</i>: rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	scrutati (5 occ. in translations by John / 2 occ. in this text), inventas (5/1), significat quoque (6/1), concordant cum (5/4), ratione usi (4/1), significacione et (4/1), sapientibus et (3/1), per opus (3/2), ut fiat et (3/1)
Plato of Tivoli	in se continet (9/1)
Hermann of Carinthia	adicit (7/1), indagine (5/1), crebris (4/2), causas existere (3/1), ut nunc (3/1), omnes alias (3/1)
Hugo of Santalla	expressius (10/2), carebit (8/1), efficaciae (6/4), proferatur (6/1), evidenter (6/3), deficiente (6/1), produci (5/1), mundanam (4/1), quoque de (10/1), supra de (9/2), ex propria (6/1), de ipsius (6/1), alia item (4/1), unde quaedam (4/1), hac enim (3/1), et ubique (3/1), omni aspectu (3/1), necesse est ad (3/1)
Gerard of Cremona	per artem (8/2), in ratione (4/1), nunc existens (4/1), rebus pluribus (3/1), reperiuntur per (3/1), factum est quod (5/1), in rebus aliis (4/2), quare non est (4/1), possibile ut fiat (4/1), ad res alias (3/1), in virtute sua (3/1)
Dominicus Gundisalvi	prosunt (8/1), manifestetur (8/1), causalitas (6/1), putativa (5/1), distans (4/1), audiuntur (4/1), habilior (4/2), aliud vel (10/1), praeter naturam (9/1), ad habendum (8/1), sciendum quod (7/1), est condicio (7/1), fuerunt autem (6/1), coniungi in (6/1), tali conditione (6/1), aliquibus et (6/1), recipit quam (6/1), naturale vel (5/1), est impressa (5/1), una species (5/1), respectum ad (5/1), cum tamen (5/4), singularibus non (4/2), speciei sed (4/1), apta est (4/1), sunt adeo (4/1), probatur in (3/1), non impeditur (3/1), putant esse (3/1), alio item (3/2), vel utrumque (3/1), respectus autem (3/1), intenditur non (3/1), provenit necessario (3/1), causatum per (3/1), quem intendit (3/2), quibus quaedam (3/1), sit exemplum

	quem intendit (3/2), quibus quaedam (3/1), sit exemplum (3/2), non quicquid (3/1), id quod intenditur (11/2), et alia huiusmodi (9/1), alia a se (6/1), differt ab alia (5/1), in aliquibus et (4/1), quod una res (4/2), non est impressa (3/1), est quod per (3/2), non per causam (3/1), illud cum autem (3/1), habilior est ad (3/1), in aliquo alio (3/1), non est autem hoc (4/1)
Alfred of Shareshill	–
Michael Scot	perscrutantes (5/1), iuvans (4/1), vulgariter (3/1), diversimode (3/2), generaretur (3/1), ista igitur (8/1), sicut habet (7/2), tota sua (6/2), sunt naturaliter (6/1), haec opinio (6/1), per exercitium (5/1), naturaliter scilicet (4/1), sic sit (4/1), sic universaliter (4/1), sic contingit (4/1), habent quaedam (4/1), suam opinionem (3/1), ex tali (3/1), ratione quia (3/1), de talibus (3/1), a tali (3/2), de possibili (3/1), hoc ratione (3/1), per suos (3/2), quod contingit ex (5/1), quandoque non et (4/1), in diversis locis (4/5), quibusdam et in (4/1), et ex iis (4/1), illud quod possibile (3/1), in aliquo modo (3/1), per quas fit (3/1)

Alkindi's *De radiis*, which does not seem to be extant in Arabic, is a treatise on the physics of the cosmos as constituted by rays issuing from the stars and the elements, and on the magic which can be based on these physics. This text contains regular stylistic phrases of only one translator, Gundisalvi: *sic ut* and *in plerisque*. As to the above table with rare stylistic terms, there is a tendency towards Gundisalvian vocabulary, which is underlined by the fact that the text contains many exclusively Gundisalvian phrases with the content term *effectus*.³⁵ There is, however, so much vocabulary shared with other translators in this text, especially with Michael Scot, that the translator cannot be determined with certainty. It is likely that more can be said on this issue if the text is compared to a corpus of magical translations from Arabic into Latin.

	Alfarabi, <i>Liber excitationis ad viam felicitatis</i> : rare stylistic terms shared with known translators
Adelard of Bath	habebitur (4 occ. in translations by Adelard / 8 occ. in this text)
John of Seville	facilitatis (3/1), prima facie (12/1), vocata est (7/1), uno ex (4/1), fuerit post ipsam (3/1)

35 The phrases are the following: *in effectum* (27/1), *effectu non* (20/1), *effectum non* (11/1), *effectu igitur* (8/1), *effectu cum* (6/1), *effectu secundum* (4/1), *effectum sicut* (4/2), *in effectum et* (6/1), *sunt in effectum* (6/1), *in effectum secundum* (4/1).

Plato of Tivoli	constituamus (6/1), periti (3/1), cavendum est (4/1)
Hermann of Carinthia	–
Hugo of Santalla	incurrerit (7/1), procedentis (5/1), asseruit (4/1), vitandum (3/1), alia item (4/1), in quo agitur (3/1)
Gerard of Cremona	necessitate quod (8/1), per artem (8/2), et ars (7/1), intendit ad (7/1), verumtamen in (6/2), ab extremitate (4/1), mente et (4/1), erunt apud (3/1), in eis per (7/1), inter duas extremitates (5/1), sit ex illis (3/2), est ut consideremus (3/1)
Dominicus Gundisalvi	acquiretur (8/1), negaverit (5/1), instituat (5/2), accedamus (3/1), immediate (3/1), divulgatum (3/1), omne id (10/1), nulla autem (9/1), actiones suas (9/1), multa sunt (5/1), nomen vero (5/1), unamquamque istarum (4/1), quod faciat (4/3), et acquiritur (3/1), quod has (3/1), quae intelliguntur (3/1), autem modo (4/1), agit non (3/1), est procedens (3/1), ars vero (3/4), intentio cum (3/1), non debeat (3/1), illarum sit (3/1), accidit sibi (3/1), aliquibus non (3/1), id per quod (17/1), hoc quod de (6/1), est id per (4/1), est et ad (4/1), quod dicimus de (4/1), omne id quod (4/1), et in aliquibus (3/2), est sed quod (3/1), est similiter et (3/1)
Alfred of Shaftesbury	–
Michael Scot	consimilitudo (7/2), a pluribus (8/1), per istam (6/1), multipliciter et (5/1), cum voluerint (4/1), modo possumus (4/2), amobus et (4/1), quod ars (4/1), cum contraria (4/1), per dispositiones (3/3), casu in (3/1), et istum (3/2), opinatur esse (3/1), cum habeat (3/1), et propter quid (10/1), oportet nos cum (3/1), et quod simile (3/1), istorum modorum habet (3/1), propter quid est (3/1), hoc non indiget (3/1), in quibusdam et in (4/1)

The translation of Alfarabi's *Liber excitationis ad viam felicitatis*, a propaedeutic introduction to ethics, contains regular stylistic terms by Hugo, Gerard, Gundisalvi and Michael Scot, as well as rare stylistic terms in greater number by Gerard, Gundisalvi and Michael Scot. The translator cannot be determined on these grounds.

	Alfarabi, <i>Quintus liber</i>: rare stylistic terms shared with known translators
Adelard of Bath	non dissimiliter (3 occ. in translations by Adelard / 1 occ. in this text)
John of Seville	universarum (6/2)
Plato of Tivoli	metiendi (6/1)

Hermann of Carinthia	minoris cum (5/1)
Hugo of Santalla	expressam (4/1), recurrendum (4/1), interserens (3/1), tali ordine (4/1), ea siquidem (3/1), cuius rei exemplum (6/1)
Gerard of Cremona	notiora (5/1), ad utrasque (5/1), sint species (4/1), ut utraeque (4/1), quid ipsa (4/1), inveniuntur enim (3/1)
Dominicus Gundisalvi	communioris (8/1), assignata (4/1), est certa (8/1), oppositum est (6/1), totum habet (4/1), etiam fiet (4/1), se intelligere (4/1), ad assignandum (3/1), et alia huiusmodi (9/2), in illis et (8/1), idem est quod (7/2), sub eodem genere (5/1)
Alfred of Shareshill	–
Michael Scot	terminamus (3/1), dicens hoc (7/1), apparet hic (5/1), innuit quod (3/1), sit consimilis (3/1), aliquod genus (3/1), est possibile nisi in (3/1)

Alfarabi's *Quintus liber* is a commentary on the postulates of the fifth book of Euclid's *Elements* (2.257 words). Of the regular terms specific to the translators, this text only contains Gundisalvian material, the phrases *vel est* (1) and *ullo modo* (1). The above table with rarer stylistic phrases, however, is ambiguous. The translator of this text therefore remains uncertain.

	Ḥwān al-Ṣafāʾ, <i>Cosmographia</i>: rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	minuentur (4 occ. in translations by John / 1 occ. in this text)
Plato of Tivoli	–
Hermann of Carinthia	prosequi (3/1)
Hugo of Santalla	–
Gerard of Cremona	et partibus eius (7/1), et quot sint (3/1), quod sit necessarium (3/1), et ex ea est (3/1), fuerunt qui dixerunt quod (11/1)
Dominicus Gundisalvi	distans (4/1), amodo (4/1), sciendum quod (7/1), sic ad (3/1), appareat et (4/1), et loqui (3/1)
Alfred of Shareshill	ut plurimum (5/6)
Michael Scot	operationibus et (7/1), sunt naturaliter (6/1), modus secundum (5/1), incipiamus modo (3/1), iuvandum et (3/1), positi in (3/1), est intelligenda (3/1), nos loqui (3/1), et propter multitudinem (6/1), et quodlibet istorum (6/1), et sic oportet (4/1), inter ista duo (3/1), ista duo scilicet (3/1), et principium eorum (3/1)

The *Epistola fratrum sincerorum in cosmographia* is a translation of a treatise on geography, which forms the fourth letter of the encyclopedia of the Iḥwān al-Ṣafā'. The above tables on regular phrases have unearthed some faint resonance of vocabulary with Hugo of Santalla (*ut inde*), Gerard of Cremona (*nam quando*) and Michael Scot (*quodlibet istorum*), while the rare stylistic phrases have a tendency towards Michael Scot.³⁶ This evidence does not allow the identification of the translator.

	Algazel, Prologue to <i>De intentionibus</i> : rare stylistic terms shared with known translators
Adelard of Bath	–
John of Seville	–
Plato of Tivoli	–
Hermann of Carinthia	–
Hugo of Santalla	controversiam (3 occ. in translations by Hugo / 1 occ. in this text)
Gerard of Cremona	ponam itaque (6/1), speculatio in (6/1), plurimum vero (4/1), deus gloriosus (3/1)
Dominicus Gundisalvi	ostendam tibi (4/1), et naturalibus (3/1)
Alfred of Sharehill	–
Michael Scot	opinionum (4/1), corruptum in (9/1)

This extremely short text of 414 words, a translation of Algazel's prologue to the *Maqāṣid al-falāsifa* (*Intentions of the Philosophers*), does not yield enough stylistic evidence for any of the translators of the corpus. Hence, for these six texts, the translator cannot be determined with certainty or with some probability. There is hope that the extension of the textual corpus towards magic and alchemy as well as towards other centuries and areas will offer more evidence eventually.

The overall result of the philological analysis presented so far can be summed up as follows:

anonymous translation	Alonso	translator based on analysis of particle usage
01-Aristotle, <i>Metaphysica</i> A, fragm.		probably Michael Scot
02-Alexander of Aphrodisias, <i>De intellectu et intellecto</i>	Gundisalvi	Gundisalvi

³⁶ On the unknown translator and date of this translation see also Gautier Dalché, *Epistola*, 146–8.

03-Anonymous, <i>Turba philosophorum</i>		?
04-Alkindi, <i>De intellectu et intellecto</i>	Gundisalvi	probably Gundisalvi
05-Alkindi, <i>De mutatione temporum</i>		?
06-Alkindi, <i>De radiis</i>		?
07-Alfarabi, <i>De intellectu et intellecto</i>	Gundisalvi	Gundisalvi
08-Alfarabi, <i>Liber excitationis</i>	Gundisalvi	?
09-Alfarabi, <i>De scientiis</i>	Gundisalvi	probably Gundisalvi
10-Ps.-Alfarabi, <i>Flos</i>	Gundisalvi	Gerard of Cremona
11-Alfarabi, <i>Quintus liber</i>		?
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>		probably Gundisalvi
13-Iḥwān al-Ṣafā', <i>In artem logicae demon.</i>	Gundisalvi	Gundisalvi
14-Iḥwān al-Ṣafā', <i>Cosmographia</i>		?
15-Anonymous, <i>De 4 confectionibus</i>		very probably John of Seville
16-Isaac Israeli, <i>De definitionibus</i>	Gundisalvi	probably Gundisalvi
17-Avicenna, <i>Logica, Isagoge</i>	Gundisalvi	Gundisalvi
18-Avicenna, <i>Physica I–III</i>	Gundisalvi	Gundisalvi
19-Avicenna, <i>De diluviis</i>		Michael Scot
20-Algazel, Prologue to <i>De intentionibus</i>		

Upon the evidence of particles and stylistic terms, Dominicus Gundisalvi was clearly the translator of five anonymous translations, probably of nine. One translation, that of Ps.-Alfarabi's *Uyūn al-masā'il*, comes from Gerard of Cremona. One translation, that of *De quatuor confectionibus*, in all likelihood comes from John of Seville. One translation, that of Avicenna's *De diluviis*, comes from Michael Scot, as probably also does the translation of *Metaphysics Alpha Meizon*. Note that Manuel Alonso is proved right on several cases, but that he did not detect Gerard of Cremona's hand in Ps.-Alfarabi's *Flos*, since he concentrated on Gundisalvi's vocabulary only.

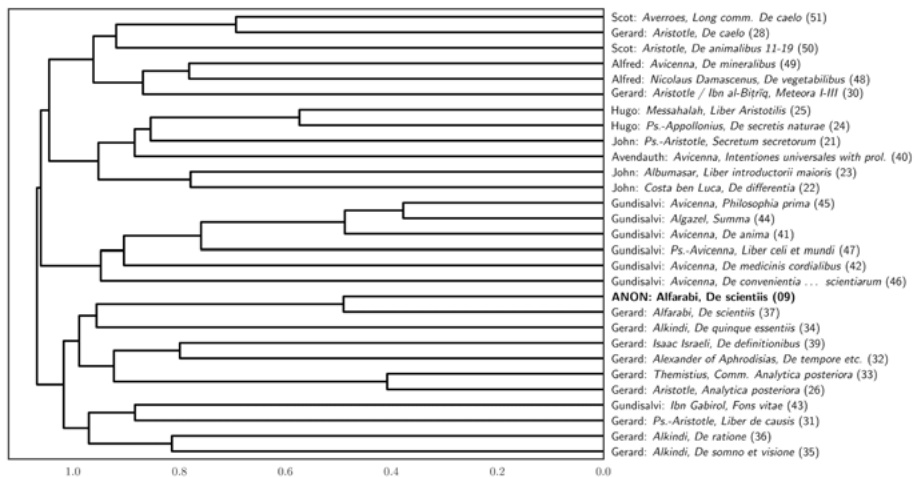
2 Computational Stylometry

The above results can be confirmed to a significant degree by a computational analysis of the authorship of our texts. Our analysis follows, in principle, the idea of John Burrows that authorship can be determined computationally by comparing the standardized relative frequencies of the most frequent words of individual texts.³⁷ By now, there are several implementations of the method

³⁷ Burrows, 'Delta': a Measure of Stylistic Difference, pp. 267–87.

available: A very user-friendly graphical interface is included in the ‘Stylo’ R-package by Maciej Eder and Jan Rybicki,³⁸ whereas our own implementation in Python owes much to Fotis Jannidis’ ‘pydelta’. When we began to analyse the text corpus computationally, we were not entirely optimistic that we would achieve results, because it was unclear whether the author signal would over-trump the translator signal. In an earlier study, Rybicki had tried to identify English-Polish, French-Polish, French-English and English-French translators by comparing the usage of the most frequent words.³⁹ But his disappointing conclusion was that translators are condemned to stylometric invisibility. Multivariate analysis of most frequent words cannot tell translator from translator, because the texts usually cluster around the author rather than the translator. Fortunately, however, this does not seem to be true for translations from Arabic into Latin—possibly because the linguistic differences between the Semitic and Indo-European languages block author signals, or perhaps because the scientific translations do not restrict the style of the translator to the same degree as the literary translations Rybicki was working with.

Plot 1



In a first step, we analysed only that part of our corpus for which the translators are known, that is, texts 21 to 51. The computational analysis of the stylistic similarities between these texts, as based on the frequency of occurrence of

38 The script was published in 2011 in a Stanford paper and is since freely available on the net. See Eder and Rybicki, *Stylometry with R*, pp. 308–11. I am grateful to Fotis Jannidis for directing my attention to ‘Stylo’ and for introducing me to computational stylistics in general.

39 Rybicki, *The Great Mystery*, pp. 231–48.

the 500 most frequent words, delivered the above dendrogram (Plot 1). The dendrogram is a graphic expression of the grouping of the texts in the corpus according to the distance measured between them. It turns out that the clustering represented in Plot 1 is affected by two serious problems, one of which we illustrate by including text 9, the anonymous translation of Alfarabi's *De scientiis*. This translation groups together with text 37, which is Gerard of Cremona's translation of the same text. As was mentioned above, the anonymous translation very likely is a revision of Gerard's. For stylometry, this has the detrimental effect that the common content covers up the stylistic differences. The same problem applies to texts 36 (Alkindi's *De ratione*) and 39 (Isaac's *De definitionibus*), which can be expected to show a similar stylometric affinity with their anonymous revisions, texts 4 and 16 respectively. To avoid the disturbing influence of common content in two texts, we decided to remove all these texts from our corpus for the purpose of stylometric analysis.

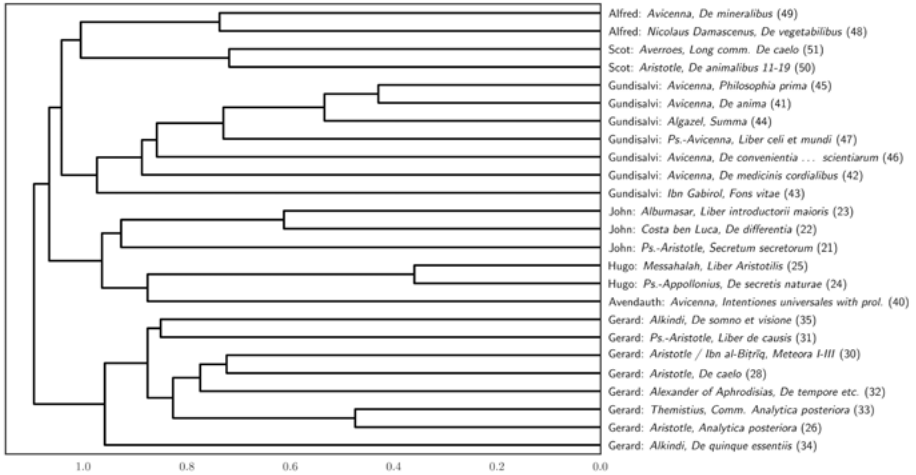
The second problem is the influence of scientific subdisciplines. Text 21 (Ps.-Aristotle's *Secretum secretorum*), for example, does not group with the other translations of John of Seville, but is situated in vicinity to text 24 (Ps.-Apollonius' *De secretis naturae*), obviously because both texts border on philosophy and the occult sciences. A quick glance at the wordlist that produced the clustering of Plot 1 reveals the reason for this: Even among the 100 most frequent words of the corpus are words like *anima, corpus, causa, forma, potentia, substantia, materia, tempus, aqua, natura*. The only way to eliminate the influence of these content words was to remove them from the wordlist. Since we did not want to select the features by hand, our aim was to develop an automatic procedure.⁴⁰ The procedure chosen is based on the idea that nouns and adjectives carry more content information than conjunctions or pronouns and that content words and non-content words can be differentiated by the part of speech they represent. By using the parts of speech classification of a Latin-English dictionary⁴¹ we were able to tag each Latin word with its most probable part of speech. Even if this procedure was far from a rigorous morphological and grammatical analysis, it produced sufficiently accurate results for improving the classification of the texts. Based on an evaluation of all possible combinations of parts of speech and different lengths of the wordlist, we decided to take the 2000 most frequent words and keep only those words that were classified as 'adverb', 'conjunction', 'packon' (*quidam, unaquaeque, ...*), or 'pronoun', and those words that were in the dictionary but without any parts of speech classification (*qui, se, aliquid, ...*).

40 If the corpus is large enough, this can be achieved by machine learning, as shown by A. Büttner and T. Proisl in Büttner et al., 'Delta' in der stilometrischen Autorschaftsattribu-tion, section 4.

41 William Whitaker's Words (<http://mk270.github.io/whitakers-words>).

As soon as we took out the double translations and constrained the wordlist to the aforementioned parts of speech, the analysis delivered the following satisfactory dendrogram (Plot 2):

Plot 2



In principle, this method is able to differentiate between the translators Gundisalvi, Gerard, Alfred, Michael Scot and one group consisting of John of Seville, Hugo and Avendauth, if we cut the branches at the 1.0 mark. It is encouraging that Alfred's translation of the section *On Stones and Minerals* of Avicenna's *al-Šifā'* does *not* group together with the many other translations of Avicenna's *al-Šifā'*, which were produced by Gundisalvi. The author signal in this case is weaker than the translator signal. The strongest similarity in the corpus exists between the two translations by Hugo of Santalla, which is not surprising given that Hugo is a very idiosyncratic stylist, as we have seen above.

Some brief comments on the statistical parameters which produce this dendrogram are necessary. The translator attribution rests on an analysis of the most frequent 2000 words, from which the words belonging to the aforementioned parts of speech are selected, thereby producing a list of 273 words.⁴² In the

42 In order of descending frequency: et, quod, non, quae, ut, hoc, autem, eius, quia, ergo, si, sed, sicut, aut, enim, nisi, eo, qui, vero, illud, uel, quoniam, tunc, etiam, eorum, scilicet, quam, eis, ei, ipsum, super, ea, haec, quo, iam, nec, quaedam, se, ipsa, igitur, quando, id, quidem, neque, eam, similiter, aliquid, nos, ita, deinde, eorum, quibus, iterum, quoque, illa, qua, atque, cuius, unde, sic, tamen, modo, illius, quare, ideo, huius, nam, ipsius, quasi, nobis, quamvis, ipse, quid, eum, his, omnino, eas, dum, sui, quidam, illo, ipso, magis, aliquo, nunc, sibi, aliqua, hunc, hic, item, siue, quem, semper, ac, huiusmodi, hanc, illis, postquam, illi,

computation, each text in the corpus is mathematically represented as a vector containing the standardized relative frequencies of these words (z-scores). The distance between the vectors is then calculated using Cosine Delta. This distance measure has recently been shown to yield the best attribution results of all current Deltas,⁴³ and we too gained much better results with Cosine Delta than with other distance measures tested. The distances are then used to construct hierarchical clusters by iteratively combining the two texts with the smallest distance between each other into a cluster, which is then compared to the remaining texts (or clusters of texts) until all texts and clusters are connected.⁴⁴ These clusters are visualized in the dendrogram by representing the distances between text and text, text and cluster, or cluster and cluster as vertical connections. The position of these connections in relation to the x-axis indicates the values of the distances.⁴⁵

We chose this selection of texts and this set of words as our calibrated standard. Once we had this standard, we could add anonymous translations.

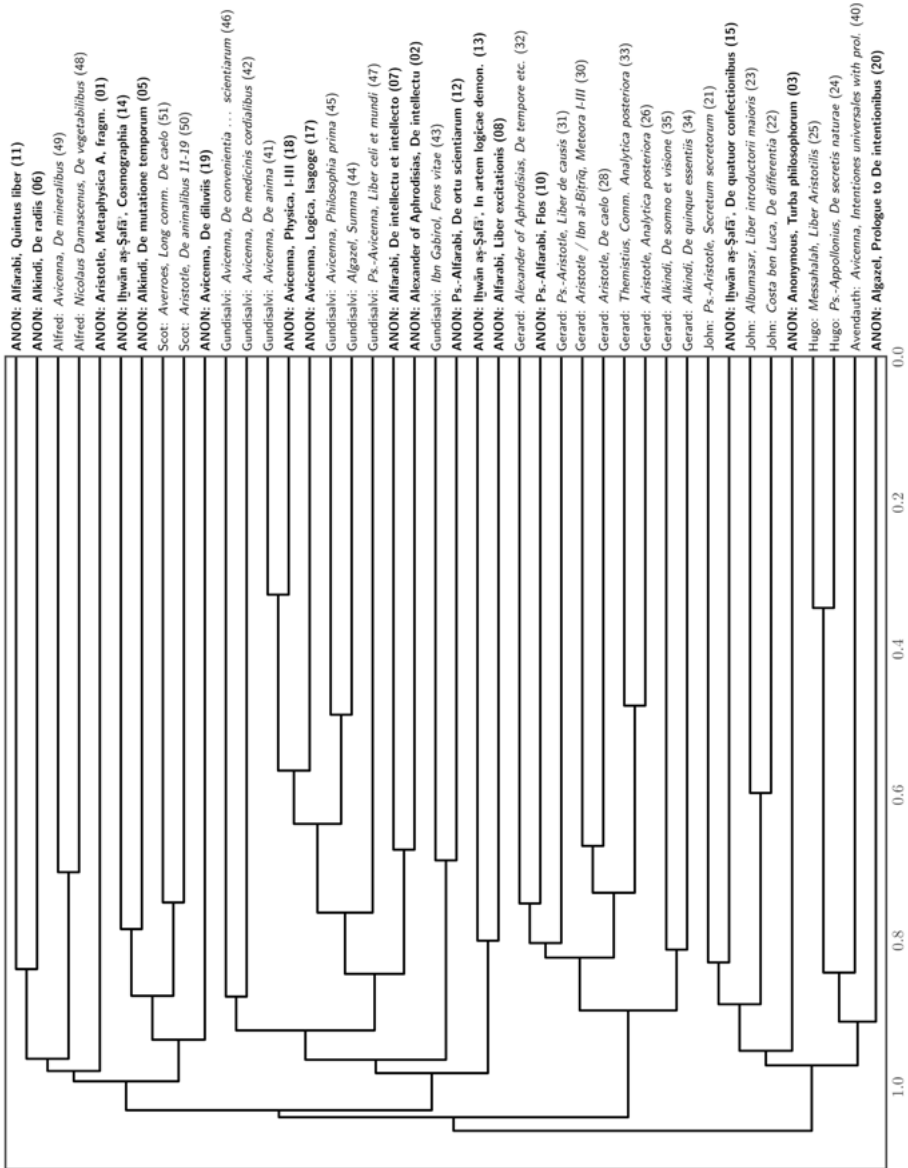
quibusdam, idest, ipsam, an, quarum, quomodo, propterea, mihi, hac, cui, quas, quorum, ille, quicquid, postea, usque, invicem, donec, simul, videlicet, namque, aliquando, eos, illum, verumtamen, immo, inde, quandoque, huic, aliquis, iste, eodem, ista, eadem, horum, ipsi, eiusdem, vis, illam, ubi, itaque, me, aliquod, bene, sursum, valde, idem, ne, quos, tibi, quis, ibi, naturaliter, alicuius, ipsis, antequam, quemadmodum, amplius, qualiter, vult, proculdubio, harum, ipsae, quin, hae, quinque, istae, aliquam, rursus, deorsum, istorum, inquantum, istius, alicui, aequaliter, illic, has, te, aliquem, licet, tandem, illorum, iis, uniuscuiusque, tu, ipsorum, illas, quousque, consequenter, etenim, unumquodque, fortassis, ipsas, istud, ultimum, quapropter, illarum, fortasse, quadam, sicque, quarundam, aliter, unicuique, nondum, adhuc, tam, illae, statim, paulatim, unaquaeque, ibidem, aliquibus, mediante, pariter, ego, nimis, deinceps, istarum, at, eiusque, subito, unusquisque, quotiens, saepe, universaliter, quaelibet, quiddam, fere, etsi, quoddam, quorundam, siquidem, ipsarum, nostri, adeo, cuiusque, seipsam, intus, praeterea, cuiusdam, quasdam, numquam, saltem, simpliciter, quolibet, illos, qualibet, ideoque, cuidam, nuper, istum, nihilominus, tamquam, diligenter, eundem, uti, interim, vix, idcirco, essentialiter, quicquam, eidem, cur, eorumque, potissimum, indubitanter, seipso, prout, unamquamque, quodlibet, ipsos, seipsum, hos, vobis.

43 Evert et al., *Towards a Better Understanding*, pp. 79-88. The authors show that normalizing the word frequency vectors improves the accuracy of the method of authorship attribution.

44 The clusters are built according to the WPGMA-Algorithm: The distance between any element and a cluster is simply the arithmetic mean of the distances between the element and each of the constituents of the cluster.

45 Two very similar texts with z-score vectors pointing in the same direction would have a cosine distance of 0 and therefore be connected at 0. Two quite different texts with orthogonal z-score vectors would have a cosine distance of 1 and therefore be connected at 1.

Plot 3



In this dendrogram (Plot 3) the groups of texts of the calibrated standard remain largely intact. When studying the dendrogram from left to right, one can distinguish four different groups of texts: by Gerard, Gundisalvi, Alfred/Scot, and John/Hugo/Avendauth. The two groups with several translators nicely branch

out towards the right into subgroups for each of the translators: Alfred, Scot, John, Hugo, Avendauth.

Text 10 (Ps.-Alfarabi's *Flos*) can unambiguously be interpreted as Gerard of Cremona's translation, thus confirming the philological analysis of the present paper. Texts 2 (Alexander's *De intellectu*), 7 (Alfarabi's *De intellectu*), 17 (Avicenna's *Logica*) and 18 (Avicenna's *Physica*) can be ascribed to Gundisalvi with great certainty, again just as in the philological analysis above. Text 12 (Ps.-Alfarabi's *De ortu*) groups closely with Gundisalvi's translation of Ibn Gabirol. There are two translations which are only loosely associated with Gundisalvi: texts 8 (Alfarabi, *Liber excitationis*) and 13 (Iḥwān, *In artem logicae demonstrationis*).

Text 15 (Iḥwān, *De quatuor confectionibus*) is clustered together with John of Seville's texts, just as in the philological analysis above. Text 3 (Anonymous, *Turba philosophorum*) is vaguely associated with John's translations. Text 20 (Algazel's Prologue) is grouped with Avendauth, but this grouping is to be treated with much caution since both texts 40 and 20 are extremely short. Texts 5 (Alkindi's *De mutatione temporum*) and 14 (Iḥwān, *Cosmographia*) are loosely associated with Michael Scot's translations, as is text 19 (Avicenna, *De diluviis*), albeit with less certainty. Texts 1 (Aristotle, *Metaphysics Alpha Meizon*), 6 (Alkindi, *De radiis*) and 11 (Alfarabi, *Quintus liber*) are placed in the vicinity of Alfred of Shareshill, but much too loosely to allow for a translator attribution. All texts which are associated only vaguely with known translators may well be the translations of persons not known to us or not considered in this study.

Hence, in 6 of the 20 cases, we arrive at unambiguous results when analysing the texts computationally with the Delta method. The computer analysis of the distances between the most frequent word vectors results in the ascription of four anonymous translations to Dominicus Gundisalvi (texts 2, 7, 17, and 18), of one anonymous translation to John of Seville (text 15), and of one anonymous translation to Gerard of Cremona (text 10).

It is a very good sign that, whenever the computational analysis of most frequent words groups a text unambiguously with one translator, the result agrees with the philological analysis. In many cases, the details of the dendrogram—such as the weaker attributions to Alfred or Michael Scot, or the subgroups within Gundisalvi's and Gerard's translations—should be an occasion for further philological and stylometric studies. Finally, it is important not to take the results of the statistical analysis at face value just because of its apparent mathematical precision. There are many factors in the production and analysis of the corpus of translations that are dependent on decisions, starting with the compilation of the texts, the quality of the editions, the scans, the text recognition, the normalization of the orthography, and ending with selecting statistical methods and stylistic features for the analysis. Therefore, the results of a computational stylometric analysis are only valuable in an interplay with philological scrutiny.

3 Conclusion

The overall result of this study is summarized in the following table. Note that the conclusion, as presented in the column on the right, is more cautious and conservative than in earlier versions of this paper, as we have decided to present only those results of which we are fully convinced. The number of question marks indicates the degree of uncertainty.

anonymous translation	Alonso	statistical analysis (Cosine Delta)	conclusion based on analysis of particle usage
01-Aristotle, <i>Metaphysica</i> A, fragm.		Alfred???	probably Michael Scot
02-Alexander of Aphrodisias, <i>De intellectu et intellecto</i>	Gundisalvi	Gundisalvi	Gundisalvi
03-Anonymous, <i>Turba philosophorum</i>		John of Seville??	?
04-Alkindi, <i>De intellectu et intellecto</i>	Gundisalvi	—	probably Gundisalvi
05-Alkindi, <i>De mutatione temporum</i>		Michael Scot?	?
06-Alkindi, <i>De radiis</i>		Alfred??, similarities with 11	?
07-Alfarabi, <i>De intellectu et intellecto</i>	Gundisalvi	Gundisalvi	Gundisalvi
08-Alfarabi, <i>Liber excitationis</i>	Gundisalvi	Gundisalvi???, similarities with 13	?
09-Alfarabi, <i>De scientiis</i>	Gundisalvi	—	probably Gundisalvi
10-Ps.-Alfarabi, <i>Flos</i>	Gundisalvi	Gerard of Cremona	Gerard of Cremona
11-Alfarabi, <i>Quintus liber</i>		Alfred??, similarities with 06	?
12-Ps.-Alfarabi, <i>De ortu scientiarum</i>		Gundisalvi??, similarities with 42 (<i>Fons vitae</i> , transl. by Gundisalvi)	probably Gundisalvi
13-Iḥwān al-Şafā', <i>In artem logicae demon.</i>	Gundisalvi	Gundisalvi???, similarities with 08	Gundisalvi
14-Iḥwān al-Şafā', <i>Cosmographia</i>		Michael Scot?	?

15-Iḥwān al-Ṣafā', <i>De 4 confectionibus</i>		John of Seville	very probably John of Seville
16-Isaac Israeli, <i>De definitionibus</i>	Gundisalvi	—	probably Gundisalvi
17-Avicenna, <i>Logica, Isagoge</i>	Gundisalvi	Gundisalvi	Gundisalvi
18-Avicenna, <i>Physica</i> I–III	Gundisalvi	Gundisalvi	Gundisalvi
19-Avicenna, <i>De diluviis</i>		Michael Scot?	Michael Scot
20-Algazel, Prologue to <i>De intentionibus</i>		Avendauth/Hugo?	

The evidence for the translator ascriptions proposed in this paper is clearly much stronger than Alonso's evidence had been. Some of the evidence, such as for Dominicus Gundisalvi as the translator of Avicenna's *Physics*, is so overwhelming that we may safely call it conclusive. But it is not without reason that this study is called 'Notes'. It is impossible to provide full documentation of all the statistical material relevant for these attributions in one paper. Also, we believe that there is room for improvement both with the philological and the computational analysis.

The results are interesting in many historical and philological respects. It has turned out that Gerard of Cremona was responsible for the translation of Ps.-Alfarabi's *Flos* ('*Uyūn al-masā'il*'). This ascription is noteworthy because it demonstrates that Gerard of Cremona had translated more texts than those listed by his *socii* in the famous list of his translations, which they drew up after Gerard's death in 1187.⁴⁶ The result shows that we should be prepared to attribute more translations to Gerard of Cremona than previously known. The same is true of Michael Scot, whose translation of *De diluviis* (and probably also of *Metaphysics* Alpha Meizon) reminds us that Michael Scot may have been responsible for more translations, also outside the Averroes corpus.

Dominicus Gundisalvi's list of translations is now increased by five clear cases: Alexander's *De intellectu*, Alfarabi's *De intellectu*, the Iḥwān's *In artem logicae demonstrationis*, Avicenna's *Logica* and Avicenna's *Physica*. Four further translations are probably also by Gundisalvi. Dominicus Gundisalvi emerges from this study as one of the major Arabic-Latin translators of the Middle Ages, alongside other great names such as John of Seville, Gerard of Cremona and Michael Scot. Gundisalvi much contributed to the transport of Alkindi, Alfarabi and Avicenna into Latin culture. We know that, for some translations, Gundisalvi worked together with Arabic-speaking scholars, the Jew Avendauth and the Mozarab Johannes Hispanus. This may also have been the case for the anonymous translations that are attributed to Gundisalvi in this

46 Burnett, *The Coherence*, pp. 249–88.

paper. But in view of the great experience that he must have collected over the years and in view of the fact that his Latin style remains recognizable, one may surmise that he produced some translations by himself.

Dominicus Gundisalvi signs several Latin and Mozarabic charters between 1162 and 1190. He was archdeacon of Cuellar north of Segovia, but was resident in Toledo, where he was a canon of the cathedral. Gerard of Cremona was canon of this cathedral too, in the very same decades. The attribution of anonymous translations to Gundisalvi adds to the importance of Toledo, and in particular of the cathedral of Toledo, in the translation movement. Gerard of Cremona, of course, the translator of at least 70 texts from Arabic, among them great works of Greek and Arabic astronomy and medicine, remains the towering figure. But his fellow canon Gundisalvi also translated at least 12 texts—7 with explicit attribution and 5 that are firmly assigned to him in this paper. In contrast to Gerard, Gundisalvi was a philosophical and theological author in his own right. He was the translator and first reader of the translations at the same time. And in contrast to Gerard, Gundisalvi, when translating, was less interested in Greek authors transmitted in Arabic, but predominantly in Arabic philosophy proper. In this particular respect, he was very important for the history of philosophy of the Latin West.

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