Vettius Valens' Longitudes (1.18), Balbillus, and the Illusion of Astrology's Self-sufficiency

Cristian Tolsa

THE PLANETARY LONGITUDES, that is, the positions of the planets (including the sun and moon) on the path of the sun—the ecliptic, or the zodiac, if conceived as divided into twelve equal sections starting with the vernal equinox—calculated for a client's date of birth, are probably the most fundamental given with which astrologers operated (and operate) to derive the effects of the planets on that person's life. Thus, the overwhelming majority of horoscope reports found in papyri, the main direct witnesses of the spread of astrology in the Graeco-Roman world apart from the theoretical astrological manuals, consist solely of lists with these longitudes for each of the planets, usually just giving the sign (e.g. Saturn in Aries, and so on).

It might then come as a surprise that ancient astrological manuals, both Greek and Roman, say nothing of the astronomical methods by which such longitudes should be computed. There is however one exception in the work of the second-century astrologer Vettius Valens (1.18), whose mechanism and underlying theory were reviewed in the Roman-era section of O. Neugebauer's monumental study of ancient astronomy.[1] The computation described by Valens is surprisingly simple, as can be seen in the first method, for Saturn (1.18.6–9):

[1] O. Neugebauer, *A History of Ancient Mathematical Astronomy* (Berlin/Heidelberg 1975: *HAMA*) 793–801. Valens: D. Pingree, *Vetti Valentis Antiocheni Anthologiarum libri novem* (Leipzig 1986).

Greek, Roman, and Byzantine Studies 59 (2019) 397–414

τὸν μὲν οὖν Κρόνον οὕτως ψηφιστέον. τὰ ἀπὸ Αὐγούστου ἔτη πλήρη ἀναλαβὼν, ἔκκρουε ὁσάκις δύνῃ ἀνὰ λ′, τὰ δὲ περιλειπόμενα πολυπλασίασον ἐπὶ τὸν ιβ′· καὶ ὁσάκις εἶ ἐκκεκρουκὼς τριακοντάδας, ἑκάστου κύκλου ἀναλάμβανε ε′ καὶ ἀπὸ Θὼθ ἑκάστου μηνὸς ἀνὰ α′, ἑκάστης δὲ ἡμέρας ἀνὰ λ<επτὰ> β′, καὶ συγκεφαλαιώσας ἀπόλυε ἀπὸ Καρκίνου κατὰ τὸ ἑξῆς ἀνὰ λ′· καὶ ὅπου δ' ἂν καταλήξῃ, ἐκεῖ ἔσται ὁ ἀστήρ.

Saturn is to be computed as follows: take the completed years since Augustus and divide by 30 as far as possible. Multiply the remainder by 12. Multiply the result of the division by 30 times 5. For each month from Thoth add 1°, and for each day 2′. Having totaled all this, count forward from Cancer, giving 30° to each sign. The star will be where the count stops.

As Neugebauer shows, the results are at most approximations. Far from using the well-attested Greek adaptation of the arithmetical systems from the Babylonian theory,[2] or the Babylonian Goal-Year period of 59 years in which Saturn returns to roughly the same longitude and stage in the synodic cycle—the cycle of planetary phenomena in relation to the sun, such as stations, opposition, conjunction—the method works with a sidereal period of 30 years in which the planet returns, after one revolution, to approximately the same point in relation to the fixed stars, adding 5 additional degrees as a correction.[3] The daily position of the planet is then found by assuming constant velocity throughout the whole 30-year period. If in 30 years the motion is of 365 degrees, in one year it moves ca. 12 degrees, in one month 1 degree, and in one day 2 minutes. This is obviously not

[2] See A. Jones, "Studies in the Astronomy of the Roman Period III. Planetary Epoch Tables," *Centaurus* 40 (1998) 1–41.

[3] For the use of Babylonian Goal-Year periods in Greek astronomy see Ptol. *Alm.* 9.2, as well as the astronomical papyri edited and commented in A. Jones, *Astronomical Papyri from Oxyrhynchus* (Philadelphia 1999) (where they are used in conjunction with the arithmetical methods). For the Babylonian theory of the Goal-Year periods see J. M. K. Gray and J. M. Steele, "Studies in Babylonian Goal-Year Astronomy I: A Comparison between Planetary Data in Goal-Year Texts, Almanacs, and Normal Star Almanacs," *Archive for History of Exact Sciences* 62 (2008) 553–600.

the true longitude, since the planet does not appear to move at constant speed throughout the zodiac, actually experiencing retrogradation around opposition. However, because of Saturn's small change in velocity (it moves more slowly in comparison with the other planets) the discrepancy is of just a few degrees.[4]

The procedures for Jupiter and Mars are analogous to the one for Saturn, but they attain lower degrees of accuracy, especially in the case of Mars. For Jupiter, the 12-year sidereal period is used (in which Jupiter completes approximately one revolution), with an algorithm involving an intermediate step designed to make the formula for the longitude appear very similar to that of Saturn (*HAMA* 795), probably for the sake of memorization, but at the cost of some extra inaccuracy. In the case of Mars, a crude period of 2 years in which the planet supposedly completes one exact revolution is used, giving a result involving an error of more than one quadrant for the mean longitude (the longitude of the epicycle's center), but which in Valens' example is suspiciously made to agree with the true longitude by way of a couple of apparent mistakes in the application of the rules (*HAMA* 796).

The approach for the inner planets is different. Venus completes 5 synodic periods (i.e. solar cycles) in 8 years, and the method correspondingly divides 8 years into 5 roughly equal periods of time (360 x 8/5=576°), each starting with a maximum elongation as evening star (the phase when the inner planets are at maximum distance from the sun) taking place at the beginning of different zodiacal signs (*HAMA* 798). Neugebauer interprets that the dates in Valens are garbled, but it seems possible that

[4] In comparison with the epoch value here (i.e. the departing point of the method), that is, Augustus 1 Thoth 1 = 0° Cancer, the mean longitude (i.e. of the center of the epicycle) was 13° Gemini, and the true longitude 21°30′ (*HAMA* 795), but these are tropical longitudes calculated from Ptolemy's methods (i.e. counting from the vernal point, whose slow motion through the stars is called precession); the sidereal longitude normally used by ancient astrologers including Valens would yield by the second century some 5 degrees higher, amounting in this case to approximately 27° Gemini, only 3 degrees from 0° Cancer.

they were modified so that the longitudes were close to the first degrees of the signs (see the computed longitudes in Neugebauer's table). Then, instead of using an auxiliary table with a template to track the position of the planet along one synodic period, there follows a procedure apparently designed *ad hoc* for the given examples, since it subtracts 120 days to skip to another phase of the planet (station as morning star) and then compute the rest of days using a mean velocity valid for the period between this phase and the next maximum elongation. Nothing is said for the case in which the date falls before that period of 120 days in the synodic period. The case of Mercury is perhaps even more striking. Not only does the method assume an exact number of synodic periods in a year (three), which with time produces impossible results (viz. placing Mercury too far from the sun), but again no template is used, just making the planet advance with the mean velocity of the sun (one degree per day) (*HAMA* 800). The procedure involves an addition of 162 days that take the planet back to an initial position close to its phase of maximum elongation as evening star, the same as Venus before: a possible conclusion is that the inventor of the method drew inspiration from practice with auxiliary templates that gave the advancement in longitude along the synodic cycle.

The question is, then, to what purpose were such methods invented and used? It is obvious that Valens does not use them for his horoscopes, which are all well computed using auxiliary astronomical tables. Furthermore, as Neugebauer shows, Valens in some cases manipulates the data exemplifying the methods, so that they approximately agree with the real, computed longitudes.[5] He is then fully conscious that the methods were of little practical use, and probably records them in part because they appeared in the work of some predecessor. The epoch dates at the beginning of the Augustan era mark a *terminus post quem* at least for the version in Valens, and by that time arithmetical schemes were already in circulation in the Graeco-Roman world, as shown by the approximately correct longitudes of the

[5] *HAMA* 796 (Mars), 799 (Venus).

first horoscopes on record (cf. n.11 below for the horoscopes from Balbillus' manual). It could however be the case that astronomical tables were not then as widespread as in the following centuries. Maybe astrologers of that period would be more prone to devising methods for the computations of planetary longitudes that did not make use of auxiliary astronomical tables, even if in the case of Mars and the inner planets such methods were doomed to fail.

From the number of surviving papyri, it is possible to speculate that an astrological boom in the first century A.D. in the Graeco-Roman world, combined with a relatively low familiarity with the technical needs of astrological practice, favored the invention of these methods. Of course, the numbers can be skewed both by non-uniformity in the publication of papyri for different periods and by non-uniform preservation contexts, hence A. Jones' caution when suggesting that the low quantity of astronomical/astrological papyri in the first centuries B.C. and A.D. is caused by the lower general survival rates of papyri.[6] However, it is likely that the practice of astrology was not yet widespread in the first century B.C., given that Hypsicles adapted the Babylonian ascensional times for the zodiacal signs to the latitude of Alexandria around the middle of the second century B.C. The first century A.D. is by far the most fruitful in the number of astrological authorities,[7] which corresponds quite well with a surge in astrological interest among the imperial elite (Tiberius, Nero)[8] and with the high relative frequency of astronomical and astronomical papyri charted below. The fact that the high number of such papyri in the third century is not paired with that of astrological authorities is perhaps due to the use of astrological manuals from the preceding centuries.

[6] Jones, *Astronomical Papyri from Oxyrhynchus* 6–7.

[7] Dorotheus, Manilius, Anubio, Thrasyllus, Balbillus, Teucer.

[8] For a classic analysis of the political and intellectual context of this period in relation to astrology see F. Cramer, *Astrology in Roman Law and Politics* (Philadelphia 1954).

Century	Number of astronomical papyri + horoscopes	Number of documentary papyri[9]	Relative frequency	Relative frequency with 30-year factor[10]
I B.C.	7	6370	0.11%	0.07%
I A.D.	30	10951	0.27%	0.21%
II A.D.	46	26522	0.17%	0.16%
III A.D.	74	23427	0.32%	0.28%
IV A.D.	29	16556	0.18%	0.26%

By sheer coincidence, among the first surviving Graeco-Roman horoscopes are two from an excerpt of Ti. Claudius Balbillus, active towards the middle of the first century A.D., and who, as I will claim, was plausibly linked to the invention of these methods.[11] The dates of the horoscopes (72 B.C. and 43 B.C.) are exceptionally early for an astrologer active under Claudius and Nero. Neugebauer and van Hoesen argue, probably rightly, that they were likely taken from the archives of his father Thrasyllus, the famous astrologer friend of Tiberius, but this does not explain why Balbillus did not use horoscopes of his own as was normally the case with practicing astrologers. My hypothesis is that he was aware of the enormous deviations of his rules of thumb for some of the planets in comparison with the true longitudes, and, not willing to manipulate the data in the way that Valens did, picked horoscopes from before the time of Augustus, so that those methods could not be directly applied.

We are fortunate enough to have an early summary of Balbillus' astrological work, which ends with the following remark

[9] Source: papyri.info, retrieved 2018/12/20.

[10] In this column I take into account the fact that astronomical/astrological papyri are dated by the astronomical data from several decades before (the client's birth date), redistributing the number of horoscopes so that in average 30% in each century are passed to the next, i.e. I assume that charts were on average cast 30 years after the date of birth. Thus, e.g. for I A.D. 30% of the 30 go to II A.D., while 30% of the 7 from I B.C. are added here, giving 23.1.

[11] Analysis and translation of these horoscopes in O. Neugebauer and H. B. van Hoesen, *Greek Horoscopes* (Philadelphia 1987) 76–78. Cf. M. Gansten, "Balbillus and the Method of *aphesis*," *GRBS* 52 (2012) 587–602. On the figures of Balbillus and his father Thrasyllus in relation to Roman politics see again Cramer, *Astrology in Roman Law and Politics*.

(*CCAG* VIII.3, 103–4):

> παραδίδωσι δὲ καὶ διαφόρους μεθόδους εὑρέσεως ὡροσκόπου καὶ μὴν καὶ καταλήψεως τῶν ἀστέρων ἀναλύσεως ἄνευ.
>
> And he gives different methods for finding the ascendant, as well as for apprehending the [longitudes of the] planets, without retrogression.

There are several reasons to believe that the latter is a reference to the methods copied by Valens. First, no other ancient astrological work that I know of teaches the reader how to use astronomical tables to find the longitudes of the planets. It was understood that this was the domain of astronomy. The same is true for the methods to find the ascendant: there is the normal astronomical procedure, employing the astronomical table of ascensions, but as the text refers to "different methods" (διαφόρους μεθόδους), it almost certainly means the so-called natural methods, through which astrologers adjusted the ascending point. Ptolemy justifies the use of these methods, arguing that sundials were notoriously inaccurate,[12] a circumstance related to the fact that the time of birth was customarily reported to the precision of whole seasonal hours (which theoretically give much room to place the ascendant, namely one-half zodiacal sign on average).[13] Likewise, the summary likely refers to methods for finding the longitude of the planets such as the above, which do not use auxiliary astronomical tables, and since we do not know of other such methods, there is a fair probability that these were the ones copied by Valens. Also, the fact that the epoch dates are Augustan fits Balbillus' chronology excellently. If that were not enough, there is still the intriguing phrase ἀναλύσεως ἄνευ, "without ἀνάλυσις," which qualifies the methods in the summary. The concept of ἀνάλυσις covered a variety of meanings, all of them technical and almost exclusively applied to (1)

[12] Ptol. *Tetr.* 3.3.1–2 (ed. W. Hübner, *Claudi Ptolemaei Opera* III.1 [Leipzig 1998]). R. Hannah, *Time in Antiquity* (London/New York 2009) 106, estimates an average error of 15 minutes.

[13] On this matter see C. Tolsa, "Time of Birth and Ascendant in the Papyrus Horoscopes," *ZPE* 204 (2017) 209–220.

mathematical methods for the solution of problems or theorems going backwards to already known facts in reversible steps, or (2) the reduction of philosophical propositions to already-established first principles. Neither of them seems to be directly applicable to methods for the determination of the planetary longitudes, but the general sense of going backwards could have evolved here (and perhaps in other, non-attested instances) to signify the planetary retrogradation, which is as a norm called ἀφαίρεσις ("subtraction") on account of the decreasing longitude of the retrogradating planet. As demonstrated above, among other inaccuracies, our methods do not allow for retrogradations, perhaps the most striking of their deviations. Supporting the possibility of this meaning for ἀνάλυσις I can adduce the evidence from second- and third-century writers on theology who use the term as a substitute for ἀφαίρεσις to refer to the definition method for the divine entity that proceeds by subtraction of negative attributes, the so-called negative theology practiced by Middle Platonic thinkers and Christian theologians.[14]

Secondly, among the natural methods for determining the ascendant called "gnomon" by Valens, one is attributed to Thrasyllus, who, as Valens suggests, only recorded it privately (Vett. Val. 9.11.1–4):

> καὶ ἑτέραν ἀγωγὴν ὑπό τινων αἰνιγματωδῶς ἀναγεγραμμένην ὑποτάξω … δύσκολον μὲν οὖν καὶ ἐργῶδες ἀλλοτρίας δόξας ἐλέγχειν, καὶ ταῦτα μηδὲ διὰ γεγραμμένων βιβλίων μηδὲ διὰ λόγων ἐνεργητικῶν παρειληφότα, καθάπερ ὁ Πετόσιρις τῷ βασιλεῖ περὶ πολλῶν μυστικῶς ἐκτίθεται … πολλὰς οὖν αἱρέσεις ἐκτίθεται ἐξεπίτηδες διά τε τοὺς μεμυσταγωγημένους καὶ ἀπαιδεύτους, ὧν τὴν δύναμιν οἵ γε νοῦν ἔχοντες εὐκατάληπτον ἕξουσι, καὶ ἃς μὲν ἰδίας ἃς δὲ λεληθότως ἀναγεγραμμένας.
>
> I will also append a method recorded mysteriously by some astrologers … It is difficult and laborious to prove a doctrine from elsewhere, especially if it has not been received through written

[14] Clem. *Strom.* 5.11.71.2–3; Celsus ap. Origen *C.Cels.* 7.42.9–11. Cf. D. Jugrin, "The Way of ἀνάλυσις: Clement of Alexandria and the Platonic Tradition," *Studia Philosophiae Christianae* 52.2 (2016) 71–94, at 73 and 77.

> books or powerful dialogues, in the way that Petosiris mystically exposes many theories to the King … [The compiler] purposefully exposes many methods for both the initiates and the ignorant, whose utility will be grasped by the intelligent, and some of them are written privately, others secretly.

Then he explains the method and finally reveals that Thrasyllus used it. It turns out that we also have a summary of Thrasyllus' work, which, in contrast to that of Balbillus, appears to be exhaustive; and in fact, as Valens implies, Thrasyllus does not seem to have written on the topic of the natural determination of the horoscope.[15] If he recorded it privately, then a plausible scenario is that his son Balbillus knew the method and copied it in his work, in the section devoted to such doctrines in the summary, citing his father as the inventor. Hence, Valens may well have used Balbillus' work.

Third, the method of the gnomon ascribed to Thrasyllus by Valens bears an interesting resemblance to the methods for the longitudes of the planets, in that its most distinctive feature is the use of divisions and their remainders. Basically, it instructs to measure the elongation (the distance along the zodiac) in degrees

[15] *CCAG* VIII.3 99–101. It is the common view that Thrasyllus' work was named *Pinax*, from this witness alone—the title of the excerpt reads συγκεφαλαίωσις τοῦ πρὸς Ἱεροκλέα Θρασύλλου πίνακος, and a very similar statement closes it. I suspect however that πίναξ, meaning "astrological board," was also a generic name for an astrological treatise. The evidence is in the fourth-century compiler Hephaestion, who on only two occasions seems to give the title of an astrological work. Since most astrological writers had written only one book, their names were sufficient and titles were entirely forgotten if they ever existed; Hephaestion's own treatise bears no title. One of his apparent titles corresponds to the *Synagogai* of Protagoras of Nicaea (*Apotel.* 3.47.52), which suspiciously has the same title that Hephaestion (3.pr.1) once applies to his own work. The other is Critodemus' *Pinax* (*Apotel.* 2.10.42), but, as we know from Valens (3.9.3, 9.1.5), Critodemus' work was entitled *Horasis*, a much more specific and thus credible title. The author of the summary must have felt compelled to choose a descriptive term (yet not necessarily the exact title) because he wanted to include the name of the dedicatee. The same would be true of Balbillus' ἀστρολογούμενα (*CCAG* VIII.3 103–104).

from the sun to the moon, and to compare this with the remainder of dividing by 360 the multiplication of the length of the day by the hour of birth. The distance from the sun to the moon is also used in a method by Balbillus' contemporary Anubion to find the ascendant naturally (ap. Heph. *Apotel.* 2.2.11–18); the fact that this number appears independently in two roughly contemporary sources could imply that it was derived from an older source.[16] The second number—the remainder of dividing by 360 the multiplication of the length of the day by the hour of birth—is much weirder. The length of the current day runs from 170 to 210 time-degrees in the latitude of Alexandria, and the multiplication by the hour of birth can reach a very large number, which is then reduced *modulo* 360. Methods of this kind only survive recorded in Valens.

Fourth, in the chapters in Valens' text preceding the exposition of the rules of thumb for the longitudes of the planets, we find a series of methods for the natural determination of the ascendant containing variations of the one by Thrasyllus (1.4), as well as a chapter on the calculation of the longitude of the moon (1.17), both of which could have been taken from the last part of Balbillus' astrological work. The method for the moon, which gives good approximations, uses the fact that 19 years contain an almost exact number of lunations (i.e. synodic periods

[16] Valens specifies that the distance must be taken in time-degrees, that is, in equatorial degrees, which recalls the standard procedure of "primary directions" for measuring the client's lifespan from the distance between the starting-point (ἀφέτης) and the destroyer (ἀναιρέτης), actually the first doctrine recorded in Balbillus' summary. Astrologers chose these two points along the ecliptic and then computed the equatorial degrees in which this stretch of the zodiac rose above the horizon, using a table of ascensions that divided the whole rising time of a sign equally among all ecliptic degrees. Thus, if Scorpio rises in 35 time-degrees, any degree of Scorpio was assumed to rise in 35/30 time-degrees (this is, of course, a simplification based on the mathematical average; in the astronomical reality even the single degrees have slightly different rising times). Then these degrees were counted as years of life. The procedure was refined with Ptolemy's table of ascensions in his *Handy Tables*, which uses spherical trigonometry, but this was not widespread until the middle of the third century.

of the moon), so that from the date and longitude of an initial conjunction, one deduces the day since the last conjunction and the longitude with respect to the sun (applying the rule of 12°/day) by counting the years, months, and days within the present 19-year cycle. However, as Neugebauer explains, instead of simply reducing the latter number *modulo* 29.5 (the days of a complete lunation), Valens employs an apparently unnecessary complication by dividing the number of completed years within the present cycle by 3, and instructing the reader to look at the remainder. I will not repeat Neugebauer's exposition, but it is important to keep in mind that if the remainder is 1, one is then asked to use the number 10, and if it is 2, the number 20; and nothing if it divides evenly.[17]

If we now go back to the summary of Balbillus' treatise, we see that he recorded a doctrine called ἐξάλματα ("leaps") (*CCAG* VIII.3 104):

> μεθοδεύει δὲ καὶ περὶ ἐξαλμάτων λέγων οὕτως· τὰς ἀναφορὰς ἑκάστου ζῳδίου δίπλωσον καὶ ποίησον παρὰ τὸν πέμπτον. καὶ ἐὰν μὲν καταλείπῃ α΄ ἡμέρα, θὲς ἀντὶ μιᾶς ι΄· ἐὰν δὲ β΄, κ΄· οἷον <εἰ> Διδύμοι ἀνατέλλουσι κη΄, δὶς δὲ κη΄, νς΄· ταῦτα παρὰ τῶν ε΄ μέριζε ἑνδεκάκις πέντε, γίνεται νε΄, λοιπὸν α΄, ἥ ἐστιν τῶν ι΄· εἰ δὲ β΄ ὑπελείποντο, κ᾽ ἂν ἦσαν καὶ ἑξῆς ὁμοίως.
>
> Then he deals with the leaps, saying the following: double the ascending degrees of the sign and divide by 5. If the remainder is 1 day, instead of 1 use 10; if it is 2, 20. Thus if Gemini ascends in 28, the double of 28 is 56; divide this by 5, 11 times 5 makes 55, the remainder is 1, this is the 10. If the remainder is 2, it would be 20, and similarly with the rest.

From the summary, we cannot know what this was used for. All we know is that for each sign, one picks the rising times (the equatorial degrees it takes to rise), doubles them, divides the resulting number by 5, and uses the result of 10 times the remainder. We immediately see the striking similarity with the counterintuitive reckoning of the moon's longitude in the above method. It is very specific that the wording in the final step, the

[17] Vett. Val. 1.17.1: ἐὰν μὲν γὰρ περισσεύῃ α΄, πρόσθες ι΄ τῷ ἀριθμῷ· ἐὰν δὲ β΄, κ΄· ἐὰν δὲ γ΄, μηδέν.

multiplication by 10 of the reminder, is the same, for it would have been more natural to say "multiply the remainder by 10" than "if it is 1, take 10," and so on.

We can go a bit further to understand the doctrine presented here by Balbillus. The word ἐξάλματα recurs in an astrological context only in Paulus' *Elem.* (92.10–22 Boer) and its commentary attributed to Heliodorus (131.1–10 Boer). Paulus explains a doctrine he names "circumambulation" (περίπατος) of the sun, moon, and ascendant, which is analogous to the computation of the years of life. Using the sun (supposedly if it is a nocturnal nativity one uses the moon), he measures the time-degrees from its position (in the direction of the signs) to all hostile points on the zodiac (in his example a point square with Mars) to find the dates of life's crises. The only difference with the usual calculation of the length of life is that here we take any hostile point, whereas, in the calculation of the length of life, the so-called destroyer (ἀναιρέτης), which naturally marks the ultimate crisis, needs to meet more conditions.

Paulus adds that attaining the limit of a new zodiacal sign, what he calls a leap, also indicates a crisis. So, if the sun is at 15° Scorpio, the 15° remaining until Sagittarius are counted as 35 (the time-degrees in which Scorpio ascends) divided by 30, multiplied by 15 = 17.5, meaning that in 17 years 6 months there will be a crisis. Now the commentator explains another method for the leaps, "resulting in the same" (τὸ αὐτὸ πάλιν ἀνάγουσα), which consists in multiplying the rising time by 2, then by 6, and counting the result as days. These are then divided by 30, and the resulting number of months is assigned to each degree of the sign. It is clear that Heliodorus here modifies Balbillus' leaps to make them compatible with the standard method of counting time-degrees, as used by Paulus. This is revealed by the fact that he first doubles the ascensional times (like Balbillus) instead of multiplying directly by 12, and by the contradiction of naming the result of this operation "days." If the rising time of Scorpio is 35, that means 35 years, which multiplied by 12 should yield 420 months, not days. This is because Balbillus' procedure gives directly the days corresponding to each degree.

It thus seems that Balbillus was keen on playing with multiplications, divisions, and residues to build periodical distributions of numbers, making of this a kind of trademark, unless this was also typical of other astrologers who have left no traces in the extant record. By doubling the ascensional times of the signs, then dividing by 5 and multiplying the remainder by 10, he attained a qualitatively different result than if he had not first doubled:[18]

Signs	*With doubling*	*Without doubling*
Aries, Pisces	50	50
Taurus, Aquarius	30	40
Gemini, Capricorn	10	30
Cancer, Sagittarius	40	20
Leo, Scorpio	20	10
Virgo, Libra	50	50

From the numbers in the chart, we should probably interpret that for Balbillus the term "leaps" referred to the leaps between the quantities in the sequence of the signs, not the leap to the end of the signs in the computation of the crises as in Paulus. Paulus thus substituted Balbillus' weird assignment of times for the usual one, transferring the concept of leap to the assignment of a crisis at the end of each sign. The end of a sign then probably did not mark a crisis for Balbillus, who, if I am right here, was very conscious of the numerical distribution resulting from his procedure, naming the doctrine accordingly.

In any case, a similar kind of creativity is attested in the invention of the label "gnomon" for each of the numbers that need to be compared in order to astrologically determine the ascending degree. Since the ascending point resulting from the table of rising times is interpreted to be correct in the case when the numbers coincide, it is clear that the name alludes to the pointer

[18] I am using the latitude of Alexandria, and assume that when the division was exact the remainder was understood to be 5, not 0. In the method for the longitude of the moon, the remainder of division by 3 of the number of years in the present cycle of 19 years can likewise be 3 (Vett. Val. 1.17.1–3).

of a sundial, which actually gave the hour of birth. Some sundials like the Tower of the Winds in Athens, but also the more typical, portable kind, were formed of multiple dials and pointers, so a usual procedure to check the accuracy of the time is likely to have consisted in comparing more than one dial. If they agreed, there was a good chance that the hour was correct. The astrological gnomon seems to be based on the same principle.

It is worth emphasizing that these two labels (leaps and gnomon) share something quite specific. Whereas most astrological doctrines bear more general names—houses, terms (ὅρια), method of *aphesis*, etc.—leaps and gnomons refer to concrete, intrinsic features of the numerical method employed. This adds plausibility to the thesis that we are dealing with astrological creations from the same specific milieu (Thrasyllus/Balbillus), the same milieu in which the similarly-working algorithms for the planets and the moon were likely devised.

Conclusions

Returning to our initial problem, it is worth noting that the attempt to find simple numerical algorithms for determining the planetary longitudes represents an instance of two general trends in Hellenistic astrology. One is the idea of simplification, the other a certain kind of mystification. The doctrine of the terms is a case in point, where we find both things. Each sign was divided into unequal sections, each ruled by a different heavenly body. Hellenistic-Egyptian astrologers inherited from Babylonian sources a system for this which cannot be derived from a small set of rules, that is, it can only be given term by term in a table,[19] in contrast to systems attested only in Greek sources, generated from different kinds of periodical rotations. It is telling that Ptolemy (*Tetr.* 1.21) struggles with the so-called Egyptian system, the one derived from Babylonian texts, and presents another system, based on a simple rotation of the ruling planets, which he confusingly calls Chaldean but which is most probably

[19] A. Jones and J. Steele, "A New Discovery of a Component of Greek Astrology in Babylonian Tablets: The Terms," *ISAW Papers* 1 (2011), http://doi.org/2333.1/k98sf96r.

Hellenistic. Finally, he proposes a "rational" modification of the Egyptian system purportedly encountered in a damaged old manuscript. This one is probably a hoax, since no actual division of the signs can be attained with the rules he proposes, and the table in the manuscripts has been incorporated from later commentaries.[20] Consequently, Ptolemy's preferred terms were not used until later commentators established a concrete system which only approximately corresponded with Ptolemy's rules.[21]

We can also qualify some of the present methods for the discovery of the planetary longitudes as a hoax, since they do not even remotely give the correct longitudes. If my analysis is correct, Balbillus provides us with easy, "rational" methods based on his usual astrological procedures, which supposedly serve to determine longitudes which every trained astrologer knows must be discovered with complex astronomical tables using Babylonian numerical methods. The method for the moon seems unnecessarily complicated, but the astrologer probably sought to find an algorithm that looked similar to the procedure for the leaps. Likewise, the rule for Jupiter contains an apparent complication in fact aimed at giving it the same appearance as the one for Saturn. The fact that the computation of the moon's longitude, also using these periods, is effective, suggests that Balbillus could have tried to derive the astronomical data naively with these procedures. After all, astrologers were in general not very good astronomers. Seeing that these methods approximately worked for Saturn and Jupiter, he would have silenced the complete lack of agreement for the rest of the planets. The same seems to be the case with Ptolemy and his terms. A real effort on his part is seen in the confection of the rules for his desired system, but not reaching a satisfactory result apparently did not stop him from giving the directions for the derivation of his terms. The inclusion of a hoax could then form part of the

[20] C. Tolsa, "The Table of Ptolemy's Terms," *Philologus* 162 (2018) 247–264.

[21] S. Heilen, "Ptolemy's Doctrine of Terms and its Reception," in A. Jones (ed.), *Ptolemy in Perspective. Use and Criticism of his Work from Antiquity to the Nineteenth Century* (New York 2010) 45–94.

generic characteristics of astrological writing: perhaps it was a game readers were used to and even expected and enjoyed.

Valens can be useful for understanding this context. He often describes astrological texts (both his own and others') as having two kinds of readers in mind, beginners and initiates. Speaking of Critodemus' *Horasis*, he claims that its opening, with a reference to the astrologer's voyage (supposedly in a search for knowledge), sounds fantastical and marvellous to learners,[22] and also notes that some of Critodemus' readers "have discarded his empty words and tracked down the relevant chapters with great toil."[23] Valens also frequently mentions that his predecessors spoke in riddles (μυστικῶς), at one point acknowledging that he is also writing in this guise in some parts of his text in order to generate interest among his students.[24] One facet of the writing-style aimed at beginners may have been to pretend that astrology was self-sufficient with respect to astronomy. Ptolemy is the only astrological author who assumes right away that astrology is secondary with respect to mathematical astronomy (*Tetr.* 1.1), but precisely because he was first and foremost a great astronomer he can be the exception that confirms the rule. We have already seen that the fact that the ascending point could not be attained with precision led to the invention of astrological methods for its adjustment.

These widespread techniques—to judge from the many methods preserved in the treatises, but also from some documentary horoscopes[25]—could have convinced some that astrology was not subordinated to astronomy, or even was more precise. For example, Valens warns against astrologers who criticize the makers of astronomical tables "either from jealousy or crooked-

[22] Vett. Val. 3.9.3: ἐντυχέτω δέ τις τῇ λεγομένῃ ὁράσει Κριτοδήμου, πῶς μὲν τὴν ἀρχὴν εὐφαντασίωτον ἔχει καὶ τὰ λοιπὰ τετερατολογημένα πρὸς τοὺς ἀμαθεῖς.

[23] Vett. Val. 3.9.5: οἱ μὲν τὰς ματαιολογίας παραπεμψάμενοι καὶ διεξιχνεύσαντες τὰ δοκοῦντα κεφάλαια μετὰ παντὸς πόνου.

[24] Vett. Val. 2.3.1 (Nechepsos); 2.41.2 (Petosiris); 7.6.2 (Nechepsos and Petosiris); 9.4.3 (Zoroaster). See 3.10.19, speaking of himself.

[25] Cf. Tolsa, *ZPE* 204 (2017) 209–220.

ness" (διὰ φθόνον ἢ διὰ τὸ σκολιὸν τῆς εἰσόδου), demanding that his readers "stick to exactness" (τὸ ἀκριβὲς προσέχειν); but, at the same time, he seems just thereafter to fall into the same mistake when he mentions his attempt at correcting small errors in Apollinarius' tables by looking at the natural effects of the stars (6.4.8–9). In another passage, he remarks on the variations among astronomical tables of his time and the lack of consensus over the length of the years among astronomers, which, he says, led him to attempt the confection of his own tables for the sun and the moon (9.12.8–9):

> ἐπειράθην μὲν οὖν καὶ αὐτὸς κανόνα συμπῆξαι Ἡλίου τε καὶ Σελήνης πρὸς τὰς ἐκλείψεις· ἐπεὶ δέ με ὁ χρόνος περιέκλειε τὸ τέλος ἐπάγων…
>
> I tried myself to calculate an astronomical table of the sun and the moon using eclipses, but since the time was too limited to bring this to completion…

Then he provides the names of the astronomers responsible for the tables he used. It would be naive to think that he is speaking frankly here: Valens clearly had not the astronomical acumen needed to produce good astronomical tables. He rather wants to impress the reader by posing as an even better astronomer than the best astronomers of his time. For this reason I am inclined to believe that the methods for the planetary longitudes are not just a *pia fraus* intended not to deter beginners from the study of astrology and designed as a substitute for using proper astronomical tables which would come later in the training process. My claim is that they rather aim at presenting astrology as superior to astronomy in every aspect.

The circumstance that Valens offers Balbillus' methods, which, as we have seen, he knows do not work, should then not be surprising, for it would be part of the same game. It should not bother us that he also recommends using astronomical tables and sticking to astronomical exactness, since contradiction is not a problem if one operates at two levels; Valens actually represents one of the most extreme cases of tolerance for contradiction in antiquity. For example, he harshly criticizes Critodemus' voyage-description, big tables, and astrological oaths as arrogant

tricks to attract readers, but he ends up incorporating his own variations of these three devices in his text.[26] His reason to do so: as he has expressed in his criticisms, he thinks that these devices impress beginners. And what an impression would it make to reveal that planetary longitudes could be obtained with those simple rules, which only astrologers know![27]

May, 2019

Universität Osnabrück
ctolsa@gmail.com

[26] The description of the voyage, the oaths, and the tables are criticized at 3.9.3–5; the voyage and the tables again at 9.1.5–7. Valens mentions his own arrival in Egypt, echoing Critodemus' words, at 4.11.4; he exacts an oath at 4.11.12 and 7.1.1–3; and he draws two big tables at the end of Book 8, the first of which we know (from the title of 3.6) is from Critodemus.

[27] I wish to thank the two *GRBS* reviewers for their many insightful comments contributing to the improvement of this article.