

On the Dimension of the Astral Bodies in Zoroastrian Literature: between tradition and scientific astronomy

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Although Pahlavi Zoroastrian literature directly preserves only a few remnants of a larger astrological and astronomical production, we can still find therein some scattered information and a lot of traditional astral beliefs, frequently mixed (not without contradictions) with up-to-date astronomical data. This peculiar aspect of the Sasanian astral culture reflects the ambiguous and contradictory attempts of a priestly and intellectual class trying to make use of Greek and Indian astronomical and astrological sciences without any open and radical refusal of the standard theological doctrines concerning the sky and celestial phenomena. Thus, as has already been noted by Henning,¹ we can find in Pahlavi texts a number of ‘modern’ astronomical data intermingled, for instance, with the traditional idea that the heaven of the stars was closer to the earth than those of the moon and the sun [Panaino 1995]. I do not doubt that in this as in some other cases the writers (or at least some of them) knew the truth, but we can imagine that they tried to avoid a direct confutation of the Avestan doctrines. We have also to recall that the still-extant Pahlavi texts do not belong to professional astronomers/astrologers (who, as we know also from later Arabic, Byzantine and Latin sources, not only existed but were very active and productive). Rather, they represented a sort of religious commentary where astral problems were treated by means of a *mélange* of theology and current scientific (or pseudo-scientific) doctrines, some of them foreign in origin, as David Pingree (starting with a very seminal contribution in 1963) has pointed out in a number of works which have substantially defined the complex role of Sasanian Iran in the

¹ [Henning 1942], in particular p. 230.

transmission of astral sciences in antiquity.²

The survival of an ancient astral lore is in any case very important because it contributes to our understanding of the remotest picture of the heavenly bodies and phenomena developed in ancient Iran, apparently before the impact of Mesopotamian, Greek and Indian sciences. We are still able, at least in some cases, to trace for some Pahlavi texts their direct Avestan literary prototypes (or in any case the textual models derived from the same *Vorlage*), as for instance in the current description of the *Axis mundi*,³ which appears in the *Bundahišn*. In fact it is very difficult to deny a direct parallel between *Yašt* 12, 25 (the Avestan hymn to the god Rašnu)⁴ and a very similar passage from *Great Bundahišn* (or *Iranian Bundahišn*) VB, 1, which was rightly proposed by Bailey and MacKenzie;⁵ nonetheless, we can say a little more about it.

The Av. text runs as follows [Geldner 1889, 166]:

<i>yaṭciṭ ahi rašnuuō ašāum</i>	‘When you are, O pious Rašnu,
<i>upa taērəm haraiθiiā barəzō</i>	over the Peak (Taēra) of Mount
	Haraitī (Haraitī Bərəz) ⁶

² See in particular the chapter ‘The Recovery of Sasanian Astrology’ in [Pingree 1997, 39–50], summarizing the main points of the research on this field.

³ [Panaino 1994–5], [Panaino 1996].

⁴ The Avestan hymn to Rašnu (*Rašn Yašt*, the XIIth of the Av. Corpus) probably is, in its attested version, a later composition, where the god is invoked (starting from stanza 12) with a quite repetitive litany in every part of the earthly, atmospheric and celestial worlds in which he is assumed to be present. The sequence of these invocations, however, clearly represents a sort of ascension made by the Iranian divinity from the earth—starting from the seven Karšvar-s (Pahl. Kišwar-s), i.e. the seven parts of the earth—up to the paradise of the supreme creator, Ahura Mazdā, by following a particular path which deserves attention, because it conforms to (and at the same time confirms) a number of astral patterns attested in Old Iranian culture. Such a strictly religious document presents us in fact with a number of cosmographic and uranographic conceptions that, on one hand, reflect an Indo-Iranian background and, on the other hand, had an enormous impact on the later Zoroastrian conception of the world, in particular in Pahlavi astrological and astronomical texts. See also [Windfuhr 1983], [Panaino 1994–5].

⁵ [Bailey 1971, 138–9], [MacKenzie 1964, 517, n. 38].

⁶ This is not the place where we can re-discuss all problems connected with the cosmic geography of the Avesta people; we can simply summarise the data [Gnoli 1980, 146–149] by noting that Mount Harā (or Haraitī) corresponds to

yaṭ mē aiβitō **uruuisinti*⁷ round which my
starasca māśca huuarəca stars, Moon and Sun turn,
zbaiiamahi ... (then) we invoke you ...'

The fact that the corresponding Pahlavi text in *Gr.Bd.* VB 2 contains a passage which can be considered as a direct quotation from an Avestan source is openly supported not only by the content itself, but also by the fact that the Pahlavi translation is introduced with the standard formula used for the quotations (translated) from the sacred scriptures. In fact the passage starts with 'as He says' (*čiyōn gōwēd*);⁸ then we give the text (with transliteration, transcription and translation) of *Gr.Bd.* VB 1-2 (**DH**,⁹ 173v, 13-16; **TD1**,¹⁰ 45, 9-13 [= fol. 22r, 9-13]; **TD2**,¹¹ 55, 3-8; see also the parallel tradition according to the *Ind.Bd.*,

the Harburz system (probably to be identified with the Hindūkuš), which, according to *Gr.Bd.* VB, 1 [MacKenzie 1964, 517], is around the world, while the mountain Tērag (corresponding to the Av. Taēra, and perhaps to be located in the Alburz range) is in the centre of the world, and corresponds to the *Axis Mundi*.

⁷ MSS: °*sənti* F1, E1; *uruuasənti* J10, O3; the emendation in *°*sinti* was already suggested by Geldner in the *apparatus criticus*. We may also note that the Av. verb *uruuis-* 'to turn' (here translated with Pahl. *waštan*, *ward-*) is particularly fitting for the movement of the astral bodies (cf. [Bartholomae 1904, cols. 1533-4], [Kellens 1995, 60]). In addition we may quote the Av. adj. compound *dūraēuruuaēsa-* [Bartholomae 1904, col. 751], actually attested with Av. *pañtā-/paθ-*, m. 'way' (cf. O.P. *paθi-*, f.; Ved. *pánthā-*, *path-*, *pathi-*, m.), e.g. in the expression *dūraēuruuaēsəm paiti pañtam* 'along the far-winding way' (*Yt.* 8, 35; see the commentary in [Panaino 1990, 123-124]) in a context referred to Tištrya (the star Sirius), but also in an elliptical construction with Av. *aδβan-*, m. 'path' (cf. [Bartholomae 1904, col. 62]) in the sentence *āṭ tē nūrəm frauuazənti dūraēuruuaēsəm aδβanō uruuaēsəm nāšəmna* 'thus, these now move forth along the far-winding (way), reaching the turning point of the path' (*Yt.* 13, 57-8) in a context referred to Sun, Moon and stars. It has to be noted that in its turn, O.Av. *aduuān-*, m. 'idem', which occurs with perfect synonymy with *paθ-* (cf. [Kellens & Pirart 1990, 201]) is attested in *Y.* 44, 3, with reference to the course of the Sun and of the stars: *kasnā x' əng strēmācā dāṭ aduuānəm* 'who determined the path of the Sun and of the stars?' (cf. [Kellens & Pirart 1988, 149]; [Insler 1975, 66-7]; [Humbach 1991, I, 157]). In *Yt.* 12, 3 we find also *paitiša hū aδβanəm* 'in front of the course of the sun'.

⁸ On this expression see [Henning 1942, 231, n. 8], who wrote 'When the book cited happens to be the Avesta (...), the subject of *gōwēd* is the author of the Avesta, namely Ohrmazd according to Zoroastrian teachings (cf. Dinkard, pp. 9-10).'

⁹ **DH** = [Codex DH 1971].

¹⁰ **TD1** = [Bondahesh 1970].

¹¹ **TD2** = [Anklesaria 1908].

V 3-4: **M51**,¹² 230r, 12-16; **K20**,¹³ 13, 5-10):

(1) kwp Y hlbwlc pyt'k AYK¹⁴ pyl'mwn¹⁵ Y gyh'n' kwp Y tylk' Y¹⁶ mdy'n' Y gyh'n'.¹⁷ hwlšyt' gltšn'¹⁸ cygwn 'pysl¹⁹ pyl'mwn Y gyh'n' BYN²⁰ 'pyckyh²¹ Y hcpl²² kwp Y hlbwlc²³ pyl'mwn²⁴ Y tylk' LAWHL wltyt'. (2) cygwn YMALLWNyt²⁵ AYK tylk' <Y>²⁶ hlbwlc²⁷ MNW ZK Y²⁸ L hwlšyt' W m'h²⁹ <W> st'lk'n³⁰ MN AHL LAWHL wltyt'.

(1) *kōf ī harburz paydāg kū pērāmōn ī gēhān. kōf ī tērag ī mayān ī gēhān. xwaršēd gardišn čiyōn abesar pērāmōn ī gēhān. andar abēzagīh ī azabar ī kōf ī harburz pērāmōn ī tērag abāz wardēd.*
(2) *čiyōn gōwēd kū tērag <ī> harburz kē ān ī man xwaršēd ud māh ud stāragān az pas abāz wardēd.*

'It is revealed that the mountain Harburz is around the world (and) the mountain Tērag is the middle of the world. The revolution of the sun is like a crown around the world. In (a state of) purity above the mountain Harburz it turns back around Tērag.'
(2) 'As He says: "Tērag of the Harburz, behind which my sun, moon and stars turn back".'³¹

¹² **M51** = Unpublished ms. of the *Indian Bundahišn* from the Munich Library. I have to thank my friend and colleague Dr. Carlo Cereti (University of Rome) who kindly placed at my disposal the readings of M51. Dr. Cereti is now preparing an edition of this very important codex of the Munich Library (see [Bartholomae 1915, 56–72]).

¹³ **K20** = [Westergaard 1851].

¹⁴ pyt'k AYK only in K20; desunt in DH, TD1, TD2.

¹⁵ K20; TD1, DH, TD2: pyl'mw.

¹⁶ Only M51.

¹⁷ DH, TD2, K20; TD1: gytydy.

¹⁸ DH, TD1, TD2; K20: gltyn'.

¹⁹ DH, TD1, TD2; M51; M51; K20: MYAsl.

²⁰ TD1, K20; DH, TD2 omittunt.

²¹ DH, TD1, TD2; M51, K20: 'pyck Y MN wl.

²² DH, TD1, TD2; K20: Y MN wl.

²³ DH, TD2, K20; TD1: hblc.

²⁴ DH, TD2, K20; TD1: pyl'mw.

²⁵ DH, TD2; TD1, K20: YMRRWNYt.

²⁶ DH, K20.

²⁷ DH, TD2, K20; TD1: hblc.

²⁸ DH, K20.

²⁹ DH, TD1, TD2; M51, K20: BYRH.

³⁰ K20; DH, TD1, TD2: st'lk'.

³¹ See [MacKenzie 1964, 517]; [Anklesaria 1956, 64–5]; for the version of the *Indian Bundahišn*, see also [Justi 1868, 7 (translation), XIII, 5–9 (text)]; [West 1880, 22].

The Pahlavi sentence is clearly a *quasi*-word-for-word literary quotation—with only an inversion of the order of stars, moon and sun, which actually is the opposite in the Pahlavi text; very striking appears the presence of Pahl. *man*, which perfectly translates Av. *mē*, and which permits us to identify the subject of the sentence ‘He says. . .’ as Ahura Mazdā himself, being the sole and highest god, in such a source, in order to affirm that the astral bodies are his own belongings. We have to note, on the contrary, that the personal pronoun is omitted in another parallel passage as attested in *Gr.Bd.* IX, 6 (DH 179v, 16–17 [= fol. 40, 16–17]; TD1, 63, 16–17 [= fol. 31r, 16–17]; TD2, 77, 8–10); but here, on the other hand, the astral order is the same as in the Av. passage:

tylk' Y hlbwlc ZK MNW-š st'l W m'h W hwlšyt ptš BYN wltynd
W ptš LAWHL YATWNyt'.

*tērag ī harburz ān kē-š stār ud māh ud xwaršēd padīš andar
wardēnd ud padīš abāz āyēnd.*

‘Tērag of the Harburz is that (mountain) through which stars, moon and sun turn and through which they come back.’³²

Thus, if it is impossible to affirm that any of these texts is the direct translation of the Avestan stanza of *Yt.* 12, 25 (we have to recall that more than two thirds of the original Avesta has disappeared) we can surely state that this very Avestan passage confirms the existence of an Av. *Vorlage* which was accessible to translations, adaptations and eventually changes, already in Avestan and of course also in Pahlavi writings. The identification of Avestan models becomes very significant because we can distinguish and precisely determine the impact and preservation of traditional doctrines in later astronomical documents, notwithstanding that these old Iranian texts were subjected to modifications and reinterpretations.³³

³² Cf. [Anklesaria 1956, 94–5].

³³ As in the case of the idea, attested just in *Gr.Bd.* VB, 3 (see [Panaino 1998, 76–7], with all the additional bibliographical references), that the astral bodies (moon, stars and planets) are bound to the windows which lie (180 in the East and 180 in the West) around the chain of Mount Harburz. This doctrine—as Pingree has first noted ([Pingree 1963], in particular p. 242; [Pingree 1964, 123]; [Pingree 1975, 6])—finds its model in Indian astronomical

Another example which for instance can be placed among the patent contradictions between past and present ‘doctrines’ attested in Pahlavi texts is the one concerning the dimension of the astral bodies. In this case again we will have the opportunity to trace and compare different and concurrent traditions.

Among the Avestan fragments quoted in the Avestan-Pahlavi Dictionary, better known as *Frahang ī Ōīm*, which reference to the contents of the *Nikādūm* Nask,³⁴ we find the following sentence:³⁵

Av. text:

*nitəmaciṭ*³⁶ *auuaēšqm stārqm yaθa nars̥ *maδəmiiehe*³⁷
vaγdanəm.

Pahl. translation:

ZKc Y nytwm MN OLEš’n stl’n’ cnd GBRA 1 Y mdy’nk wγd’n.
ān-iz ī nidom az awēšān starān čand mard ēk ī mayānag waγdān.

literature, where the pole of the world (*dhruva*) is bound to the stars and the planets by wind-bonds [Panaino 1998, 52–57]. In a recent work, where the Pahlavi texts reflecting these Indian concepts have been discussed, I have underlined the importance of a few sources concerning the bonds which link the Moon to some seas; in the discussion of the important passages attested in the *Wizūdagiḥā ī Zātspram*, III, 18–19 [Panaino 1998, 80–1] I have omitted to take into consideration ch. III, 20, where, after the statement that the tides are produced by the bonds tied with the waters, it is stated: *pāymār az pēš mäh dō wād frāz tazēnd andar sadwēs māništ dārēnd ēk ul-āhang ud ēk frōd-āhang pad ān ī ul-āhang bawēd purr ud pad ān ī frōd-āhang bawēd ōgar*. ‘Il est désigné: au-devant de la lune courent deux vents, et ils ont leur demeure dans (le lac) Sadwēs, l’un expirant et l’autre inspirant, par celui qui expire il y a le flux et par celui qui inspire il y a le reflux’ (see [Gignoux & Tafazzoli 1993, 44–5]). The presence of two winds (*wād*), one which breathes out (*uk-āhang*) and the other breathes in (*frōd-āhang*), closely evokes that of the Pravaha wind (i.e. the Provector) that (e.g. in the *Sūryasiddhānta* and some Purāṇas) impels the astral bodies along the diurnal motion; in the *Siddhāntas* are mentioned also other winds producing the anomalies of the Sun, the Moon and the planets (see [Pingree 1990]; cf. [Panaino 1998, 57]). On the cosmological and cosmographical function of Mount Meru in Indian astronomical literature, see, e.g., the *Āryabhaṭīya*, 11–12 [Shukla 1976, 121–3].

³⁴ See also [West 1892, 471–5].

³⁵ [Darmesteter 1893, 16] (as number 9); [Reichelt 1900, 191]; [Reichelt 1901, 176]; [Klingenschmitt 1968, xix, 81] (discussed under number 224).

³⁶ [Darmesteter 1893, 16, n. 3] reads *nitəmaciṭ* (thus as acc. sg.), but suggesting a correction in *nitəmaciṭ*.

³⁷ MSS *maδəmiiehe*; correction suggested by [Reichelt 1901, 176] and [Klingenschmitt 1968, 81].

‘The smallest ones of those stars (are) like the head³⁸ of a middle-sized man.’

The idea that the stars can be small or big, and that their (supposed) dimension can be compared with that of human beings or in other cases with terrestrial things, parts of the body or places, is confirmed by the Pahlavi texts, and it is actually attested in the famous astronomical chapter of the *Great Bundahišn*, II, 16 (DH, 166v, 19–167r, 2; TD1, 25, 17–26, 1–3 [= fol. 12r, 17–12v, 1–3]; TD2, 29, 7–12):

MN OLEš'n' st'lk'n'³⁹ ZK Y ms cnd *KYPA-1⁴⁰ Y htk-ms'd, ZK Y mdy'n'⁴¹ cnd c'hkwn'⁴² *wp[t]šn', ZK Y ks cnd LOYŠE Y TWRA <Y> ktkyk. W m'h cnd 'splys-1 <Y> 2 h'sl,⁴³ cygwn KRA h'sl-1 Y PWN zmyk plsng-1 <Y> ptm'nyk hwm'n'k.⁴⁴ hwlšyt' 'ndcnd 'yl'nwyc.

*az āwēšān stāragān, ān ī mas čand *gōhr-ēw ī kadag-masāy. ān ī mayān čand *čahragwān wafīšn. ān ī keh čand sar ī gāw <ī> kadagīg. ud māh čand asprēs-ē <ī> 2 hāsar; čiyōn harw hāsar-ē ī pad zamīg frasang ī paymānīg homānāg. xwaršēd and-čand ērān-wēz.*

‘Among these stars, the large ones are like a piece of rock the size of a room, the medium-sized ones are like a rolling wheel, the smallest ones like the head of the domesticated ox. The moon is the size of a racecourse of two *hāsars* (*hāθras*), each geographical *hāsar* being about as much as a parasang of average length. The sun is the size of *Ērān-vēz*.’⁴⁵

The present passage clearly reflects a traditional doctrine, as we can deduce from the persistence of the idea that the smallest stars

³⁸ It is peculiar that here the Daēvic stem *vaða-*, n., is used, and not *sara-*, n. (Ahuric), which should be the expected one with reference to the stars, which are positive divine beings in the Zoroastrian tradition.

³⁹ DH, TD1, TD2.

⁴⁰ DH, TD1, TD2: cc'-1. [Anklesaria 1956, 34] reads *dālman ē* ‘an eagle’; for the emendation see [Henning 1942, 233–4, n. 7].

⁴¹ DH, TD2; TD1: mdy'nk.

⁴² DH, TD2; TD1: c'hk' 'n'; [Anklesaria 1956, 34] reads *chehār-kunān patīkh'* ‘a four-sided granary’.

⁴³ TD1; DH: hy'sl.

⁴⁴ DH; TD1: hm'n'k.

⁴⁵ Translation from [Henning 1942, 233–4]; cf. [Bailey 1971, 136–7]; [Anklesaria 1956, 34–5].

can be compared to a head. In the Av. fragment the head was that of a middle-sized man, here that of a domesticated ox, as already noted by [Henning 1942, 234, n. 3]. The concept of 'size' of the stars (expressed by the second element of the compound *-masāy*)⁴⁶ has to be interpreted as referring to their apparent brightness.

In addition we have to note that these popular traditions were current in Iran. For instance, in the *Pahlavi Rewāyat to the Dādestān ī Dēnīg* we find the following proportions:⁴⁷

Ch. 65, 3:

W stl 'ywk' 'ywk' 'nd cnd ktk'-ms'd PWN 22 YATWNd W OZL-
WNd AP-š'n' 22 'sp' 'hncyt ...

*ud star ēk ēk and čand kadag-masāy pad wīst ud dō āyēnd ud
šawēnd u-šān wīst ud dō asp āhanjēd;...*

'And each of the stars individually (is) house-sized, and 22 come and go, and 22 horses draw them;...'

Ch. 65, 8:

W gltk' Y m'h KHDE 2 plsg dlhn'd W 2 plsg p'hn'd...

*ud girdag ī māh hammis dō frasang drahnāy ud dō frasang
pahnāy...*

'And the disk of the moon (is) altogether two parasangs in length and two parasangs in width...'

Ch. 65, 13:

gltk' Y hwlšyt 'nd cnd 'yl'nwyc 'yl'nw<y> c 'nd cnd 7 'ywk' Y
hwnyls...

⁴⁶ It has to be noted that Pahlavi *kadag-masāy* corresponds to an Av. *katō.masah-* (see [Henning 1942, 233, n. 7]; cf. [Bartholomae 1904, col. 434], where *katō*, the first member of the compound, has to be derived from the stem *kata-*, m. 'Kammer, Keller' [Bartholomae 1904, col. 432]; [Duchesne-Guillemin 1936, 153, par. 193]. Pahlavi *kadag-masāy* occurs also in *Dēnkard*, VII, 4, 41 (see [Molé 1967, 48–9]) where it refers to a stone that Zoroaster received from Ohrmazd. It is possible that the celestial origin of such a stone is evoked through the mention of this rare compound.

⁴⁷ [Williams 1990, vol. I, 234–5; vol. II, 113–14].

*girdag ī xwaršēd and čand ērān-wēz ērān-wēz and čand haft ēk ī *xwanirah...*

‘The disk of the sun (is) as great as Ērān-wēz;⁴⁸ Ērān-wēz (is) as great as one seventh part of Xwanirah.’⁴⁹

The stars referred to in the present *Pahlavi Rewāyat* are the ‘biggest’ ones and in fact their dimension (house-sized [*kadag-masāy*]) corresponds to that of the *Bundahišn*’s already quoted passage (like a piece of rock having the size of a room [*kadag-masāy*]). This parallel is very important because thanks to it we can conclude that the 22 stars carried by a corresponding number of horses, mentioned in ch. 65, 3 of the *Pahlavi Rewāyat*, were the brightest ones. Unfortunately this very number of stars, to my knowledge, is not otherwise attested in Pahlavi literature; thus their identification remains quite hypothetical.⁵⁰

The dimension of the moon is also confirmed: the *Bundahišn* in fact established that the moon is the size of two *hāθras* (corresponding to two parasangs)⁵¹ and the same figure (two parasangs) is given in the *Rewāyat*. In the case of the Sun we find again that its disc corresponds to the size⁵² of the Ērān-wēz, and more

⁴⁸ On the Ērān-wēz, the Av. Airyana Vaejah ‘the Iranian space’, i.e., the mythical region of the Aryan peoples, see [Gnoli 1966, 67–75]; [Gnoli 1967, 81–101]; [Gnoli 1980, 88–90]; [Gnoli 1985, 15–30].

⁴⁹ It corresponds to Av. *xʼaniratha-*, the central karšvar; see [Bartholomae 1904, col. 1864]. On the Indo-Iranian (and perhaps Mesopotamian) background of the subdivision of the world in seven parts, see [Kirfel 1920, 30*, 34*]; [Honigmann 1929, 8]; [Panaino 1995, 220–21].

⁵⁰ We could imagine that this very figure comprehended some of the 15 stars of first magnitude in the Ptolemaic catalogue, plus some of second magnitude; as we can see below, it has to be noted that the *Bundahišn* apparently attests to only 3 of the 6 expected magnitudes. In the first chapter of the Zarādušt’s *Kitāb al-Mawālīd*, ([Kunitzsch 1993]; see also [Panaino 1996] for some Sasanian and Iranian aspects of this text) we find only 16 bright stars, only 10 of which are of 1st magnitude.

⁵¹ On these measures see [Henning 1942, 235–8]. Henning suggested (op. cit., p. 243, n. 4) that the original Av. passage should have said: ‘The moon is *cərətu.masah-*’, i.e. ‘having the measure of a complete full round of course’ (= 1400 metres; in fact an Av. *hāθra-* corresponds to 700 metres (and is the length of a racecourse), while a *cərətu-* is double that).

⁵² A primitive and peculiar measure for the Sun has been attributed also to Heraklitos (apud Aëtius, 2, 21 [περὶ μεγέθους ἡλίου]); 14 [A 54] εὖρος ποδὸς ἀνθρώπου. ‘For width (the sun) is like the man’s foot’; 22B3 DK (= [Diels 1956]); Dox. 351 a 11f., b 21 (= [Diels 1969]); see [Colli 1993, 62–3].

precisely to one-seventh of Xwanirah, the central region of the traditional Iranian cosmography. On the other hand, we may recall that the comparison between the Sun's size and that of an earthly region is attested for instance in Greek culture. According to a tradition attributed to Anaxagoras, the sun should have been larger than the Peloponnesus (see Diogenes Laertius, II, 8: Οὗτος ἔλεγε τὸν ἥλιον μύδρον εἶναι διάπυρον καὶ μείζω τῆς Πελοποννήσου· οἱ δὲ φασὶ Τάνταλον. 'He declared the sun to be a mass of red-hot metal and to be larger than the Peloponnesus, though others ascribe this view to Tantalus' [Hicks 1980, I, 137]).

These old Iranian doctrines did not stop the diffusion of absolutely contradictory concepts which, paradoxically, we can find in the same Pahlavi text; in fact, just a few lines before chapter II, 16, in paragraph 5, the *Bundahišn* openly referred to the 'magnitudes' (*wuzurgīh*, *wcwlgyh*) of the stars by following an astronomical pattern, which ultimately goes back (but see below) to Hipparchus (DH, 166r, 17–18; TD1, 25, 6–8 [= fol. 11v, 6–8]; TD2, 27, 6–9):

W 'htl'm'l'n' ZNE st'lk'n KON st'lk' <Y> 'wyd'p'nyk KRY-
TWNd W ms W ks W mdy'nk' l'd YMLLWNd⁵³ AYK wcwlgyh
Y nhwstyn',⁵⁴ wcwlgyh <Y dtykl, wcwlgyh Y> ⁵⁵ stykl.

*ud axtarāmārān ēn stāragān nūn stārag ī awiyābānīg xwanēnd ud
meh ud keh ud mayānag rāy gōwēnd kū wuzurgīh ī narustīn ud
wuzurgīh <ī dudīgar, wuzurgīh ī> sidīgar.*

'The astronomers nowadays call these stars *inerrantes*,⁵⁶ and instead of 'large', 'small', 'medium', they use the expressions 'first magnitude', '<second> magnitude', 'third <magnitude>'.⁵⁷

There is no doubt that Pahl. *wuzurgīh* is a perfect translation of Gr. μέγεθος (in Arabic it will be translated as *al-'uẓm* or *al-*

⁵³ TD2: YMRRWNd.

⁵⁴ DH; TD1: nzdstyn'; TD2: nwstyn'

⁵⁵ A blank space in DH and TD2. In TD1 three points between nzdstyn and stygl.

⁵⁶ On the stars *awiyābānīg* see [Henning 1942, 232, n. 3]; [Kunitzsch 1968]; [Kunitzsch 1970]; [Kunitzsch 1972]; [Kunitzsch 1981]; [Kunitzsch 1993, 244–5]; [Pingree 1989, 227–39]. See also [Burnett & Pingree 1997, 44] (*Liber Aristotilis* III, ii, 1, 10); [Panaino 1996].

⁵⁷ [Henning 1942, 232]; [Anklesaria 1956, 32–3].

qadr).⁵⁸ On the other hand, it is clear, as [Henning 1942, 232, n. 4] noted, by focusing on the philological condition of this sentence, that the scribes (and perhaps the writer himself) did not understand the passage very well. Probably they were not conversant with the astronomical concept of ‘magnitude’ (*wuzurgīh*), while for them that of standard physical and visible greatness was more usual. However, notwithstanding the poor condition of the present passage, I would like to draw the attention of the reader on the fact that here we find only three magnitudes; first, second and third. This very simple distinction finds counterparts in other astronomical traditions, so it is not necessarily the fruit of a textual mistake or of a bold omission and excision suffered by the original Pahlavi text. Actually we know, as [Toomer 1984, 16] has clearly pointed out, that the magnitudes range⁵⁹ from 1 to 6 according to a system which certainly preceded Ptolemy,⁶⁰ but which is ‘only conjecturally attributed to Hipparchus’. In the Commentary to Aratus by Hipparchus, the earliest and ‘almost only source from which we can hope to obtain information about the terminology at his time and before’—as Neugebauer states—‘there is no evidence. . . for numerical classes of stellar magnitudes; only qualitative distinctions are made like “bright” and “small” stars, etc.’ In addition some astrologers used simpler patterns, as in the summary of the *Θησαυροῖ* attributed to Antiochus (but more precisely of Rhetorius),⁶¹ who apparently seems to distinguish only three categories of brightness, as we deduce from the ms. Parisinus Graecus 2425 [CCAG, VIII, III, 105: 36–7]: Περὶ τῶν παρανατελλόντων ἀπλανῶν λαμπρῶν ἀστέρων καὶ ἀμυδρῶν καὶ μέσων καὶ τῆς τούτων δυνάμεως καὶ τί ἀποσημαίνουν (‘On the stars rising simultaneously which are bright, faint and middle, and on their power and what they signify’).⁶² I do not know if

⁵⁸ See [Kunitzsch 1974, 166, n. 111]. Cf. Cf. al-Bīrūnī, *Tafhīm* [Wright 1934, 68].

⁵⁹ [Neugebauer 1975, I, 291] however remarks that ‘the magnitudes themselves are not always integers but occasionally modified “greater” or “less”, indicating a brightness between two magnitudes’. See also *ibid.*, n. 3 with reference to Manilius’ Commentary to Aratus.

⁶⁰ See [Grasshoff 1990, 69–71]; cf. [Boll 1916, 87–8].

⁶¹ See [Gundel 1936, 133, n. 2]; cf. also [Gundel & Gundel 1966, 250, 6]; on this subject see in particular [Pingree 1977].

⁶² See also [Gundel 1936, 133, n. 2], with reference also to [CCAG, I, 151], chapter 11 and to the *Isagoge* of Porphyrius (*ibid.*, p. 200): λαμπροὺς ἀστέρας

the present division in three groups of magnitudes, as attested in the Pahlavi texts, reflects a simplified vulgarisation of a complete Ptolemaic scheme with six magnitudes, or if it is based on a simpler division in three categories according to a primitive and local tradition. On this regard we could recall that al-Bīrūnī in the *Tafhīm* wrote⁶³ that ‘astrologers give the name of glory’ (*šaraf*) to the two first degrees of magnitudes;⁶⁴ in any case, all these sources confirm that different arrangements of the magnitudes were possible, in particular among astrologers.

However, it is interesting to note also that the ‘modern’ conception of ‘magnitude’ was formulated in the *Bundahišn* in a way which did not clash with the traditional astral lore; actually to say ‘first’, ‘second’ or ‘third’ magnitude, or to say ‘large’ (*an ī mas*), ‘medium-sized’ (*ān ī mayān*) or ‘small’ (*ān ī keh*) for a star was a way in which a ‘technical’ language was distinguished from popular and traditional speech, but on the practical side the two definitions closely corresponded. This observation could thus alert us to the fact that—from a strictly linguistic point of view—the Greek representation too of the concept of (increasing or diminishing) brightness of the stars by a word meaning ‘greatness’ [μέγεθος],⁶⁵ which involves a very concrete and physical idea, belongs to an old pattern.

In addition it is very bizarre but also very significant that in later times, in the context of the Persian *Riwāyats*, we find an evident mixture of traditional lore and astronomical sciences with reference to the size of the astral bodies [Unvâlâ 1922, 59, 4–5]:

wa ‘arz <ō> ʔul-e xoršīd čahār šad farsang wa ‘arz <ō> ʔul-e māh do šad farsang wa ‘arz ʔul sitāre-ye bozorg si-o-se gaz wa ‘arz ʔul sitāre-ye xord panj gaz wa asmāni farsang-e yek hazār o do šad gaz ast wa gaz yek dast.

‘The length (and) breadth of the sun is 400 *farsangs*. The length

καὶ ἀμυδροὺς καὶ στυγνοτέρους ‘the bright stars and the faint ones and those more gloomy’. Cf. again [Neugebauer 1975, I, 291, n. 4].

⁶³ Al-Bīrūnī, *Tafhīm*, according to [Wright 1934, 68].

⁶⁴ Corresponding in Lat. texts to *honor*, *exaltatio*. See again [Kunitzsch 1974, 166, n. 111].

⁶⁵ In Homer it means only stature (of men and women); but it can mean also size in general, loudness (of sounds), might, power, extension, length (in metrics). See [Liddell & Scott 1968, 1089].

and breadth of the moon is 200 *farsangs*; the length and breadth of a big star is 33 *gaz*; the length and breadth of a small star is 5 *gaz*. A heavenly *farsang* is equal to 1,200 *gaz*; and one *gaz* is (equal to the length of) a hand.⁶⁶

These figures have to be compared with those attested in the *Rivāyat* of Shapuhr Baruchi [Unvâlâ 1922, II, 59, 9–12]:

*wa 'arz ô ʔul-e xoršîd čahâr sad farsang 'arz ô ʔul-e mâh do sad farsang 'arz wa ʔul-e sitâre-ye bozorg si-o-se *(<gaz>)⁶⁷ wa 'arz ô ʔul-e sitâre-ye miyâne panj gaz; wa 'arz ô ʔul-e sitâre-ye xord ham-kadâr sar-e gâw ast wa šomar-e farsang-e asmâni duwâzda hazâr gaz ast.*

‘The length and breadth of the sun is 400 *farsangs*. The length and breadth of the moon is 200 *farsangs*; the length and breadth of a big star is 33 (*gaz*); the length and breadth of a middle star is 5 *gaz*; the length and breadth of a small star is like the head of a bull. The measure of a heavenly *farsang* is equal to 12,000 *gaz*; and a *gaz* is of the measure of one hand.’⁶⁸

Clearly, in both texts the concepts of magnitude and size are mixed, and it is noteworthy that the big stars here are expressly called *bozorg*, i.e. with an adjective etymologically linked with Pahl. *wuzurgîh* ‘magnitude’, the abstract noun derived from Pahl. *wuzurg* (cf. O.P. *vazrka-* ‘big, great’); in the second Persian *Rivāyat*⁶⁹ we still find a direct echo of the Pahlavi description concerning the three different sizes of the stars (big (*bozorg*), medium

⁶⁶ Cf. [Dhabhar 1932, 427].

⁶⁷ The ms. has *farsang*.

⁶⁸ This explanation differs from the meanings listed by [Steingass 1892, 1087], who mentions a cubit, a length of 24 finger-breadths, or six hands, etc. Cf. [Dhabhar 1932, 427].

⁶⁹ The fact that the *Rivāyat* of Shapuhr Bharuchi is closer to a Pahlavi text is confirmed not only by the complete sequence of three different types of stars, as in *Gr.Bd.* VB and in the *Pahlavi Rewāyat to the Dādēstān ī Dēnīg*, but also because here the distances between the world and the star-station, the star-station and the moon-station, the moon-station and the sun-station are given as 34,000 *frasangs*, as in the *Pahlavi Rewāyat*, ch. 46, 7 (cf. [Williams 1990, I, 162–163; II, 73]; [Zaehner 1972, 361, 365]), while in the preceding *Rewāyat* they are given as 33,000 *frasangs*. On the other hand it has to be noted that the Pahlavi and the Persian Letters present some general problems in the order of the stations, which probably reflect a flaw in the transmission of this doctrine.

(*miyāne*) and small (*xord*), and the comparison of the smallest ones with the head of a bull), with the only difference that in the Persian document we find references to the *gaz* unit of measure.

Notwithstanding the evolution of astronomical sciences, later Parsi doctors and savants still followed (and mixed) old and new patterns, astral lore and sciences; thus they have maintained a properly Iranian tradition. In fact such a distinction (in a sort of scale of greatness) of the stars' brightness is apparently not yet attested, as far as I know, in Mesopotamian sources, nor do I know of any clear attempt at comparison for their brightness.⁷⁰ Also there, for instance, we find a strict link between the idea of brightness and that of the (supposed) dimension of the astral body. Bright meteors are called in fact 'big stars' (*kakkabu rabû*), e.g., in the 'Diaries' [Sachs & Hunger 1988, 27], while in the MUL.APIN compendium [Hunger & Pingree 1989] and in the 'Astrological Reports' [Hunger 1992] the stars (but also the planets) can be defined as *rabû* 'big', *ṣehru/ṣeheru* 'small', *nebû* 'bright', and *unnunu/unnutu* 'faint'. Moreover, as Hunger kindly informs me, 'Venus is sometimes called *nabat kakkabi* "the bright one of the stars" which means the brightest of the stars', while 'the expression "big star" is used sometimes for a meteor, sometimes for Jupiter'. In addition we may note that again in MUL.APIN, e.g. in tabl. I iv 21–22 [Hunger & Pingree 1989, 63], the 'bright star of the Old Man' (*kakkabu nebû ša Šībi*), i.e. α Persei, the brightest star of Perseus (*Šību*), is distinguished by the 'dusky stars of the Old Man' (*kakkabû ummulūtu ša Šībi*), while tabl. II i 26–27, 36–42, 54–59 [Hunger & Pingree 1989, 77–84] concerns the systematic observation of fixed stars and planets with particular attention to their change in 'glow' (*zīmu*) and in colour (*risnu*). On the other hand it is clear that we do not have anything which can be compared to a primitive magnitude scheme and which can be assumed as a prototype for the Greek magnitude order.⁷¹ On this aspect, the Iranian astral culture seems to

⁷⁰ I have to deeply thank for their help and kind information on this subject my dear friends and colleagues Prof. Hermann Hunger (University of Wien) and Prof. Simo Parpola (University of Helsinki).

⁷¹ We have in fact to recall, as [Neugebauer 1975, I, 291] noted, that 'we do not know where and when the concept of six stellar magnitudes originated'. On the other hand I think it is worthy of note that in Ptolemy we find 9 stars which are 'faint', i.e. the same adjective used in Babylonian astronomical

have—independently and in a very primitive form (and without any probable impact on the western system)—foreseen a real astronomical problem by distinguishing the brightness of the stars in three groups of different size (the greatest ones as a piece of rock the size of a room, the medium-sized ones like a rolling wheel, the smallest ones like the head of the domesticated ox or of a middle-sized man), by connecting their visible light with a proportional physical dimension.

Why they did not abandon this pattern is another problem we have tried to explain.

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texts. [Le Boeuffe 1987, 172] suggests a distant link with a 'Chaldaean' pattern of associating the fixed stars with the planets according to their own colour.

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