Star Lists in Hebrew

by

BERNARD R. GOLDSTEIN*

Introduction

In most medieval sets of astronomical tables there are star lists that usually derive from the star catalogue in Ptolemy's *Almagest*. In addition, a substantial number of shorter star lists occur in manuscripts that are often associated with treatises on the astrolabe. The star names as well as the coordinates in these lists are notoriously subject to textual corruption and this fact can help to demonstrate literary dependence. Professor Kunitzsch has written a great number of studies on Arabic and Latin star lists that illustrate both the problems and the rewards of detailed analysis of such lists. It is the aim of this paper to extend that kind of analysis to star lists in Hebrew manuscripts, concentrating on lists that are extant in multiple copies and that derive from Arabic, rather than from Latin, sources. We shall only be concerned with the lists of Abraham Bar Ḥiyya and Abraham Ibn Ezra that were composed in the 12th century (though the copies I consulted were certainly written much later), and an anonymous list for epoch 1392 A.D. In some manuscripts (e.g., MS J) the anonymous list comes after the planetary tables of Immanuel Bonfils of Tarascon (fl. ca. 1360), but I see no reason to identify him as the author of this list.

It will be argued here that the anonymous list was derived from the lists of Bar Ḥiyya through an intermediate list compiled by Levi ben Gerson for the year 1325 with suitable allowances for the precession in longitude. Bar Ḥiyya's two lists depend on the star catalogue of al-Battānī (d. 929), and those of Ibn Ezra are closely related to a list ascribed to al-Zarqāllu (11th century). In all three cases, the lists are

* University of Pittsburgh, JS/2604 CL, Pittsburgh, Pennsylvania 15260, U.S.A.

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Star List of Abraham Bar Ḥiyya
for the beginning of 4865 A.M. = Sept. 1104 A.D.[1]

Positions for fixed stars of 1st magnitude at the beginning of cycle 257

[No.]	[Mod.]	Names of Stars of 1st Magnitude Hebrew	Arabic
1	α Tau	ᶜeyn ha-shor	al-dabarān
2	β Ori	regel te'omim	rijl jawzā
3	θ Eri	aḥarit ha-nahar	akhir al-nahr
4	α Ori	ṣad te'omim yemini	mankib al-jawzā ayman
5	α CMi	ha-kelev ha-qaṭan	shiᶜrā ghumayṣā
6	α CMa	kelev gadol	shiᶜrā ᶜabūr
7	α Aur	moshekh ha-resen	al-ᶜayyūq
8	α Boo	ha-nitmakh ha-romeᵃḥ	simāk al-rāmiḥ
9	α Vir	nitmakh lo' mezuyyan	simāk aᶜzal
10	α Lyr	nesher nofel	nasr wāqiᶜ
11	ζ Sgr	sof zenav ha-sus	aṣl dhanab al-faras
12	α Leo	lev ha-aryeh	qalb al-asad
13	α Cen	regel ha-sus ha-mequddam	rijl al-faras muqaddama
14	α PsA	pi ha-dag ha-deromi	fūm al-ḥūt al-janūbī

short and were intended for use in making the rete of an astrolabe. Ibn Ezra's list appears in a text on the astrolabe and the others include mediations and declinations to aid an astrolabe maker. Extant astrolabes inscribed in Hebrew have star names that do not occur in our texts (see Goldstein, 1976; and Goldstein and Saliba, 1983), and this suggests that the astrolabe makers had access to other lists. However, in MS B that includes the Star List for 1392 A.D. (fol. 1b) we also find an illustration of the rete for an astrolabe (fol. 17a) with 1 Arabic and 8 Hebrew star names on it (all in Hebrew characters), all of which are to be found in that list (stars 4 (*al-dabaran*), 8, 10, 11, 15, 18, 19, 21, 24). Although it is not yet possible to identify the texts used by the instrument makers, it remains an ultimate goal.

The trigonometric techniques needed to convert celestial longitude and latitude to mediation (i.e., the point on the ecliptic that crosses the meridian at the same moment the star does) and declination were certainly known to medieval astronomers, but the details of each cal-

Star list of Abraham Bar Ḥiyya
for the beginning of 4865 A.M. = Sept. 1104 A.D.[1]

Positions for fixed stars of 1st magnitude at the beginning of cycle 257

[No.]	Ecliptic Coordinates Longitude	Lat. & Dir.	Equatorial Coordinates Dec. & Dir.	Mediation
1	57;10°	5;10° S	13;19° N	58;24°
2	64;20	31;20 S	10;22 S	69;52
3	14;40	53;30 S	42;27 S	41;42
4	81;30	17; 0 S	5;20 N	82;22
5	103;40	16;10 S	6;28 N	102; 8
6	92;10	39;10 S	15;14 S	91;40
7	69;30	22;30 N	44; 6 N	60; 4
8	191;30	31;30 N	24;30 N	205;24
9	191;14	2; 0 S	6; 2 S	190;12
10	271;50	62; 0 N	38; 9 N	271;28
11	277;18	6;30 S	30; 3 S	278;30
12	137;20	0;10 N	15;16 N	137;24
13	202;40	41;10 S	45;18 S	185; 9
14	321;30	20;20 S	33; 6 S	330;20

culation and the tables used for that purpose are not available to us and are impossible to reconstruct. Hence we can only compare the results of their calculations with modern recomputation, and this means that the comparison has limited usefulness in editing the texts concerned. It is particularly helpful when there is a problem of misalignment of the columns (as in Kunitzsch, 1966, Type I, p. 16), and sometimes in choosing between manuscript variants (which I have done).

The sigla are identified at the beginning of the list of variant readings for each text (in the notes). No attempt has been made to locate all copies of each star list: for this purpose manuscript catalogues are inadequate guides. Arabic names have been transliterated here according to the way they appear in the Hebrew manuscripts; for the standard forms, see Kunitzsch, 1966. Hebrew alphabetic numerals have been transcribed using modern Hindu numerals (i.e., 0, 1, ..., 9).

We begin with the two earliest lists, those of Abraham Bar Ḥiyya.

Star List of Abraham Bar Ḥiyya
for the beginning of 4865 A.M. = Sept. 1104 A.D.[2]

Positions for fixed stars of 2nd magnitude at the beginning of cycle 257

[No.]	[Mod.]	Names of Stars of 2nd Magnitude Hebrew	Arabic
1	α And	ha-yad ha-ṣevuᶜa	al-kaff al-khaḍīb
2	γ Ori	ṣad semol te'omim	mankib al-jawzā
3	β Per	rosh ha-shed	ra's al-ghūl
4	β Leo	zenav ha-ari	dhanab al-asad al ṣarfā
5	α CrB	nezer ṣefoni	al-fakka
6	α Sco	lev ha-ᶜaqrav	qalb al-ᶜaqrab
7	η UMa	ha-me'ir mi-benot ᶜayish asher be-sof ha-zenav	
8	α Aql	ha-nesher ha-meᶜofef	al-nasr al-ṭā'ir
9	α Cyg	zenav ha-tarnegolet	al-ridf
10	ζ Cyg	arkovet ha-tarnegolet	rukbat al-dajāja
11	β Peg	ṣad ha-sus ha-yemini	mankib al-faras
12	δ Leo	shidrat ha-ari	faqār al-asad
13	15(c) Com	me'ir beyn zenav ha-ari veha-nitmakh kokhav	al-dhu'āba
14	α Car	kesil vehu' meha-ᶜerekh ha-rishon	suhayl

Comments on Bar Ḥiyya's Star Lists

Bar Ḥiyya's Star Lists, like most of his astronomical tables, depend on the tables of al-Battānī (d. 929: ed. and trans. C. A. Nallino, 1899, 1903, 1907). Unless otherwise noted, all longitudes here agree with those of al-Battānī with a precession of 3;20°, and with those of Ptolemy with a precession of 14;30°. The longitude of star 1.12 derives from the value in al-Battānī's text and deviates from that of Ptolemy, indicating that Bar Ḥiyya depended on al-Battānī and not directly on Ptolemy (see below). It is also worth noting that Bar Ḥiyya's star magnitudes do not always agree with those of Ptolemy, see below: 1.11, 2.4, 2.10 (3rd magnitude for Ptolemy), 2.13 (nebulous for Ptolemy), 2.14.

All columns appear in the manuscripts except those labelled: No. and Mod.

Star List of Abraham Bar Ḥiyya
for the beginning of 4865 A.M. = Sept. 1104 A.D.[2]

Positions for fixed stars of 2nd magnitude at the beginning of cycle 257

[No.]	Ecliptic Coordinates Longitude	Lat. & Dir.	Equatorial Coordinates Dec. & Dir.	Mediation
1	2; 0°	26; 0° N	24;24° N	349;40°
2	68;30	17;30 S	4; 6 N	71;10
3	44;10	23; 0 N	39;12 N	35;14
4	159; 0	11;50 N	18;34 N	163;55
5	209;10	44;30 N	30;28 N	254;12
6	237;10	4; 0 S	24; 2 S	236; 7
7	164;18	54; 0 N	53; 0 N	199; 0
8	287;20	29;10 N	6;36 N	283;56
9	323;40	60; 0 N	42;11 N	300;38
10	321;30	44; 0 N	27;35 N	306;35
11	345;40	31; 0 N	22;48 N	331;31
12	117;40	13;40 N	14;20 N	120;28
13	158;47	30; 0 N	35;27 N	173;40
14	91;40	75; 0 S	51;25 S	90;30

1st Magnitude Stars

ad 4. Longitude: All manuscripts agree on 81;30° (instead of the expected 76;30°). In al-Battānī's text, the longitude is given as 73;10° that could easily be misread as 78;10° which, with the addition of 3:20° for precession, yields the entry here.

ad. 9. Longitude: The value 191;14° is textually secure (cf. the Star List of 1392 A.D., below, star 17). From al-Battānī's value we would expect 191;10°. Hence there must have been a copyist's error in the list used by Bar Ḥiyya.

ad 11. The text of al-Battānī (16th star of Sgr: ed. Nallino, vol. 2: 163) presents a number of difficulties: (1) two expressions are used to describe this star of which *aṣl dhanab al-faras* refers to Ptolemy's 28th star of Sgr (ω Sgr) while *ʿurqūb al-rāmī* is the name of Ptolemy's 23rd star of Sgr (β Sgr); (2) the coordinates ascribed to this star by

al-Battānī refer to Ptolemy's 14th star of Sgr (υ Sgr) that, according to Ptolemy, is a 4th magnitude star. Ibn al-Ṣalāḥ (12th century) reported that the "old" Arabic translation of the *Almagest* had 1st magnitude (instead of 4th magnitude: a simple misreading of Greek *delta* as *alpha*), and so we can say that al-Battānī followed the "old" Arabic *Almagest* in designating this star as 1st magnitude (cf. Ibn al-Ṣalāḥ, ed. Kunitzsch, no. 56). Bar Ḥiyya's longitude, based on al-Battānī's 16th star of Sgr, ought to be 277;20° whereas our text reads 277;18°. Finally, the latitude of Ptolemy's 14th star of Sgr is 6;30° N, whereas the latitude of al-Battānī's 16th star of Sgr is 6;30° S in agreement with our text.

ad 12. The longitude 137;20° agrees with the text of al-Battānī with a precession of 3;20°. In this instance al-Battānī cited an observation he made himself to justify his departure from Ptolemy's value (cf. ed. Nallino, vol. 1: 124; vol. 2: 159). Here we have additional evidence for Bar Ḥiyya's reliance on al-Battānī and not directly on Ptolemy.

ad 13. al-Battānī's longitude together with a precession of 3;20° yields 202;50° (Bar Ḥiyya: 202;40°). In this case al-Battānī's value is 30° (i.e., one zodiacal sign) below that expected from the *Almagest,* an error found in the Arabic versions of the *Almagest* (see Ibn al-Ṣalāḥ, ed. Kunitzsch, no. 83).

2nd Magnitude Stars

ad 1. Arabic: This expression usually refers to β Cassiopeiae (Kunitzsch, 1959, p. 66), but in al-Battānī's text it refers to α And, for we read: *al-mar'a wa-hiya al-kaff al-khaḍīb* (ed. Nallino, vol. 2: 188, no. 44 [where this star is identified as α Oph]; and vol. 3: 277); *ra's al-mar'a* is the usual name for α And (Kunitzsch, 1966, p. 83, no. 13). Longitude: Al-Battānī's value for α And is 358;30° (ed. Nallino, vol. 2: 153) which, with a precession of 3;20°, yields a longitude of 1;50° (Bar Ḥiyya: 2°). Latitude: Al-Battānī and Bar Ḥiyya both have 26° N.

ad 3. In Millás's edition of this table, this star name is incorrectly translated as "head of Draco" (1959, p. 125).

ad 4. This star is of 1st magnitude and belongs in Bar Ḥiyya's other list.

ad 7. Longitude: With al-Battānī's value and a precession of 3;20° we arrive at 164;20° (Bar Ḥiyya: 164;18°); cf. Notes to the Star List for 1392 A.D., star 15.

ad 8. Longitude: Al-Battānī's text reads 285;0° which, with a precession of 3;20°, yields 288;20° (Bar Ḥiyya: 287;20°). It is possible that the copy before Bar Ḥiyya had 284;0° (instead of 285;0°) due to a confusion of the Arabic numerals for 84 (*fd*) and 85 (*fh*) in the maghribi style.

ad 10. Arabic: This name refers to ξ Cyg in al-Battānī's list. However, the longitude here refers to ζ Cyg (a star that is missing from al-Battānī's list: I do not know what source Bar Ḥiyya used). With the longitude of ζ Cyg in the *Almagest* of 306;40° and a precession of 14;30° we arrive at 321;10° (Bar Ḥiyya: 321;30°). Latitude: Bar Ḥiyya's value agrees with that of Ptolemy for ζ Cyg. For an earlier discussion of the identification of this star, see Goldstein, 1976, p. 257.

ad 11. Longitude: With Ptolemy's value and a precession of 14;30° we arrive at 346;40° (Bar Ḥiyya: 345;40°): the reason for this discrepancy is unclear. According to al-Battānī, the longitude of this star is 333;20° (ed. Nallino, vol. 3: 253) instead of the expected 343;20°. Since "3" and "8" can easily be confused in Arabic alphabetic numerals, Bar Ḥiyya (or his source) may have read this longitude as 338;20°, in which case he would arrive at a longitude of 341;40° as in P1 and P4 (suggested by Professor Kunitzsch). This would imply that 345;40° is a corruption of 341;40° rather than the other way around. However, Levi's list of 1325 and the anonymous list of 1392 (star 24) depend on the reading 345;40° to arrive at their longitudes for this star, and so I am inclined to leave open the question of Bar Ḥiyya's intended reading.

ad 12. Longitude: Al-Battānī's text reads: 144;20°. If this was misread as 114;20° (medial *mīm* mistakenly read as a *yā'*) and we add 3;20° for precession, we arrive at 117;40° as in our text (suggested by Professor Kunitzsch).

ad 13. Arabic: This term appears in al-Battānī's text (ed. Nallino, vol. 2: 183, no. 52; and vol. 3: 278). There is also a star called: *awwaluhā l.ṭ.r.qānush wa-huwa al-kawkab alladhī bayna dhanab al-asad wal-simāk al-rāmiḥ* (ed. Nallino, vol. 3: 258) and this corresponds to the Hebrew name here (reading *ha-rome^{a}ḥ* instead of *kokhav*). The first word in the Hebrew star name, *ha-me'ir* (i.e., the luminary),

Ibn Ezra's Star List[3]

[No.]	[K]	[Mod.]	Star Name Hebrew	Arabic
1	1	α Tau	ʿeyn ha-shor ha-semoli	al-dabarān
2	2	β Ori	regel te'omim	rijl al-jawzā
3	3	α Aur	ha-nilḥam	al-ʿayyūq
4	4	α Ori	shekhem ha-gibbor	mankib al-jabbār
5	5	α CMa	ʿover ha-afudda	al-shiʿrā al-ʿabūr
6	6	α CMi	ha-soger ʿeyno	al-shiʿrā al-ghumayṣā
7	7	α Leo	lev ha-aryeh	galb al-asad
8	8	β Leo	zenav ha-aryeh	al-ṣarfa
9	9	α Vir	ha-gibbor belo' romaḥ	al-simāk al-ʿazāl
10	10	α Boo	ha-gibbor baʿal romaḥ	al-simāk al-rāmiḥ
11	11	α Lyr	ha-nesher ha-nofel	al-nasr al-wāqiʿ
12	12	α PsA	pi ha-dag	fam al-ḥūt
13	13	α And	rosh ha-ishsha	ra's al-mar'a
14	14	β Per	rosh ha-saṭan	ra's al-ghūl
15	15	α Per	nose' rosh ha-saṭan	ḥāmil ra's al-ghūl
16	16	γ Ori	shekhem ha-gibbor ha-semoli	mankib al-jabbār al-aysar
17	17	β Aur	ketef ʿoṣer ha-resen	katif mumsik al-ʿinān
18	18	α Gem	rosh he-te'om ha-niqdam	ra's al-taw'am al-muqaddam
19	19	β Gem	rosh he-te'om ha-me'uḥḥar	ra's al-taw'am al-mu'akhkhar
20	20	γ Leo	ha-me'ir be-ṣavar ha-aryeh	al-munīr alladhī fī ʿunq al-asad

Ibn Ezra's Star List[3]

	Ibn Ezra				Ptolemy			
[No.]	M	Longitude	Lat. & Dir.		M	Longitude[4]	Lat. & Dir.	
1	1	Tau 27;48°	5;10°	S	1	Tau 27;48°	5;10°	S
2	1	Gem 4;58	31;50	S	1	Gem 4;58	31;30	S[6]
3	1	Gem 10;21	22	N	1	Gem 10; 8[6]	22;30	N[6]
4		Gem 17; 8	17	S	<1	Gem 17; 8	17	S
5	1	Cnc 2;48	39;10	S	1	CnC 2;48	39;10	S
6	1	Cnc 14;18°	16;10°	S	1	Cnc 14;18°	16;10°	S
7	1	Leo 17;38	0	N	1	Leo 17;38	0;10	N[6]
8	1	Vir 9;38	11;50	N	<1	Vir 9;38	11;50	N
9	1	Lib 11;48	6	S	1	Lib 11;48	2	S[6]
10	1	Lib 27;20	31;30	N	1	Lib 12; 8[6]	31;30	N
11	1	Cap 2;28°	60 °	N	1	Cap 2;28°	62 °	N[6]
12	2	Aqu 22; 8	23	S	1[6]	Aqu 22; 8	20;20	S[6]
13	2	Ari 2;38	26	N	<2	Ari 2;58[6]	26	N
14	2	Tau 14;48	23	N	2	Tau 14;48	23	N
15	2	Tau 2;39	30	N	2	Tau 19;58[6]	30	N
16	2	Gem 5;28°	17;30°	S	2	Gem 9; 8[06]	17;30°	S
17	2	Gem 17;38	20	N	2	Gem 17;58[6]	20	N
18	2	Cnc 8;28[5]	9;40	N	2	Cnc 8;28	9;30	S[6]
19	2	Cnc 11;48	30;15	N	2	Cnc 11;48	6;15	N[6]
20	2	Leo 17;18	8;30	N	2	Leo 17;18	8;30	N

Ibn Ezra's Star List[3]

[No.]	[K]	[Mod.]	Star Name Hebrew	Arabic
21	21	α Hya	ha-adom she-hu' be-ṣavar ha-menaṣṣe^{a}ḥ	al-ward alladhī fī ^{c}unq al-shujā^{c}
22	24	α Sco	lev ha-^{c}aqrav	qalb al-^{c}aqrab
23	25	α Sgr	berekh ha-qeshet ha-semoli	rukbat al-rāmī al-yusrā
24	26	β Sgr	qarsol ha-qeshet ha-semoli	^{c}urqūb al-rāmī
25	27	α Aql	ha-nesher ha-me^{c}ofef	al-nasr al-ṭā'ir
26	28	α Cyg	zenav ha-tarnegolet	dhanab al-dajāja
27	30	β And	lev ha-dag	qalb al-ḥūt
28	29	β Peg	shekhem ha-sus	mankib al-faras
29	31	β Ari	ha-qeren ha-semoli meha-menagge^{a}ḥ	al-shamālī min al-naṭḥ
30	32	γ And	regel ha-ishsha ha-semolit	rijl al-mar'a al-yusrā
31	33	β Tau	qarsol ha-te'om ha-yemini	al-^{c}urqūb al-ayman min al-jawzā
32	22	α Lib	ha-niqdam mi-shtei ha-ṣurot	
33	23	β Lib	ha-me'uḥḥar	
34	35	α Oph	rosh mi she-eyn lo ko^{c}aḥ	ra's al-ḥāwī[5]
35	36	ε Peg	ṣavar ha-sus	
36	37	β Cet	qaṣe zenav kokhav qayṭus	

may reflect the Arabic *muḍi'* that appears in the magnitude column for this star in al-Ḥajjāj's translation of the *Almagest* (cf. star 14 in the list for 1392, below). Longitude: with al-Battānī's value and a precession of 3;20° we arrive at 159;20 (Bar Ḥiyya: 158;47°): the

Ibn Ezra's Star List[3]

[No.]	Ibn Ezra M	Longitude	Lat. & Dir.		Ptolemy M	Longitude[4]	Lat. & Dir.	
21	2	Leo 15; 8°[5]	20 °	S	2	Leo 15; 8°	20;30°	S[6]
22	2	Sco 27;48	3	S	2	Sco 27;48	4	S[6]
23	2	Cap 2; 8[5]	18	S	<2	Cap 2; 8	18	S
24	2	Cap 2;53	23	S	2	Cap 2;48[6]	23	S
25	2	Cap 18; 1	29	N	>2	Cap 18;58[6]	29;10	N[6]
26	2	Aqu 24;18°	60 °	N	2	Aqu 24;18°	60 °	N
27	2	Ari 9	26;20	N	3	Ari 18;58[6]	26;20	N
28	2	Psc 17;18	31	N	<2	Psc 17;18	31	N
29	2	Ari 22;48	8;20	N	3	Ari 22;48	8;20	N
30	2	Tau 2; 3[5]	28	N	3	Tau 1;58[6]	28	N
31	2	Gem 10;48°	5 °	N[5]	3	Gem 10;48°	5 °	N
32	2	Sco 3; 8[5]	0;40	N[5]	2	Sco 3; 8	0;40	N
33	2	Sco 7;18[5]	8;30	N[5]	2	Sco 7;18	8;50	N[6]
34	2	Sgr 9;38	36	N	>3	Sgr 9;58[6]	36	N
35	2	Aqu 20;21	22;30	N[5]	>3	Aqu 20;28[6]	22;30	N
36	2	Psc 20;48°[5]	20;20°	S[5]	3	Psc 20;48°	20;20°	S

reason for this discrepancy is not clear, but the entry for star 14 in the list for 1392 A.D. supports the reading here.

ad 14. Hebrew: "*kesil,* and it is of 1st magnitude". Hence this star belongs in the previous list.

Comments on Ibn Ezra's Star List

This list appears as part of Ibn Ezra's *Keli neḥoshet* (ed. Edelmann, pp. 31–35), a work on the astrolabe. In the manuscripts there is no star table, rather the list is in the form of a paragraph in which the coordinates are given in Hebrew alphabetic numerals and the Arabic names are transliterated into Hebrew characters (in Edelmann's edition the coordinates are written out in words). In studying the manuscripts I noticed that there are two versions, one dated 4906 A.M. (1146 A.D.) which I designate Ea (this is the version in Edelmann's edition), and another dated 4908 A.M. (1148 A.D.) which I designate Eb. Version Eb has only 23 stars whereas Ea has 36 stars: Eb omits stars 15, 17, 18, 19, 20, 21, 23, 27, 32, 33, 34, 35, 36. Moreover, the order of the data for each star in the two versions differs: Ea lists the Hebrew name first, followed by the Arabic name, the magnitude, longitude, and latitude; Eb lists the Arabic name first, followed by the Hebrew name, longitude, and latitude (no magnitudes are indicated). In Ea, following star no. 4, we are told: "If the magnitude (*kavod*) of a star is not recorded (here), it is of second magnitude"; I have followed this instruction in listing the magnitudes, except for star no. 4 where it seemed better to omit the magnitude. Only one table is presented because all the stars in Eb are also found in Ea and the coordinates, but for textual corruption, are the same in both versions. Because of the great number of errors in Edelmann's edition, I have not used it, nor have I listed variants from it. In fact, there are a large number of surviving copies of this text, and to consult them would increase the reporting of erroneous readings without much benefit unless an accurate early copy were to be identified.

As Kunitzsch (1966, pp. 74, 78, 83 ff) has noted, Ibn Ezra's star list is closely related to one ascribed to al-Zarqāllu (11th century) preserved in Paris, arab. 4824, fol. 4b (37 entries). I have listed the corresponding star that appears in Table XIIA (Kunitzsch, 1966, p. 83) in the column labelled "K" ("K" star names that differ from those of Ibn Ezra are noted below). From this table, and other works of Kunitzsch, the corresponding modern designations have been established, and they are shown in the column labelled "Mod.". I have recently been informed by Professor Kunitzsch that another Arabic copy of star list

"K" has been identified in MS Istanbul, Aya Sofya 2671, fol. 148b. In a number of cases Ibn Ezra's Arabic star names show closer agreement with the Istanbul copy than with the Paris copy, but I await publication of the new text before drawing any conclusions.

All columns in our table appear in the manuscripts except those labelled: No., K, and Mod., as well as those that fall under the heading, Ptolemy, that are displayed for purposes of comparison (based on the new translation of the *Almagest* by G. J. Toomer [1984]). The longitudes in the table are 15;8° greater than those in the *Almagest* to account for the precession from 138 A.D. (Ptolemy's epoch) to 1146 A.D. (Ibn Ezra's epoch), or about 1° in 66⅔ years (despite Ibn Ezra's text which states a value for precession of 1° in 70 years [ed. Edelmann, p. 31]).

Many of the discrepancies between Ibn Ezra's star positions and those in the Greek text of the *Almagest* can be ascribed to the Arabic versions of the *Almagest,* and I am grateful to Professor P. Kunitzsch for communicating to me the results of his recent studies based on the relevant Arabic manuscripts (see below).

ad 1. Hebrew: In the *Almagest* this star is called the southern eye but here it is called the northern eye.

ad 2. Hebrew: This expression agrees with al-Battānī's designation for this star: *rijl al-jawzā* (ed. Nallino, vol. 2: 169) and Ibn Ezra's Arabic, but K reads: *al-jabbār*. The variant in EA, *ha-kelev* (i.e., the dog), seems to be related to a Latin miscopying of *orionis* as *canis* (see, e.g., Kunitzsch, 1966, p. 36, no. 2): this is the only case in Ibn Ezra's Star List where there seems to be contamination from a Latin source. Latitude: In Arabic manuscripts 30 (*lām*) and 50 (*nūn*) are often confused, and so the discrepancy here probably goes back to a mistake in the Arabic text tradition.

ad 3. Longitude: In Hebrew alphabetic numerals 1 (*alef*) and 8 (*ḥet*) are easily confused. Thus, if Gem 10;21° was originally Gem 10;28°, the difference of 0;20° might be due to a confusion in Arabic between *lām* and *nūn* (as in no. 2, above). Latitude: The minutes have been dropped.

ad 4. Magnitude: See the introduction to these comments, above.

ad 5. Hebrew: "The one who crosses the belt"; in Arabic lore this star

is said to have crossed the Milky Way. Though *afudda* in an astronomical context usually refers to the zodiac (cf. Klatzkin, 1968, vol. 1: 64), it might refer to the Milky Way here.

ad 6. Hebrew: "Who closes his eye"; cf. Comments on the Star List of 1392 A.D., star 10.

ad 7. Latitude: The minutes have been dropped.

ad 9. Latitude: I cannot explain this discrepancy.

ad 10. Longitude: I cannot explain this discrepancy.

ad 11. Latitude: The "2" has been dropped.

ad 12. Arabic: *al-ḥūt]* K: *al-ḥūt al-janūbī.* Latitude: Both versions of the Arabic *Almagest* (those of al-Ḥajjāj and Isḥāq b. Hunayn) have 23°: therefore, for Ibn Ezra this is an authentic value: it is based on misreading 20⅓ as 23, an error found in the Arabic translations of the *Almagest* (cf. Ibn al-Ṣalāḥ, ed. Kunitzsch, no. 63).

ad 13. Longitude: Again the difference of 0;20° may be due to confusion in the Arabic text tradition. Indeed, three (of the four) MSS of the Ḥajjāj version of the *Almagest* read Psc 17;30° (instead of 17;50°) and, with a precession of 15;8°, we arrive at Ibn Ezra's entry.

ad 15. Arabic: *ḥāmil]* K: *janb al-ḥāmil.* Longitude: I cannot explain this discrepancy. To be sure, 2 (*bet*) and 20 (*kaf*) are easily confused in Hebrew manuscripts, but this does not resolve the problem here.

ad 16. Longitude: The same three MSS of the Ḥajjāj version of the *Almagest* (noted in no. 13, above) read Tau 20;20° (instead of 24°). Hence, adding 15;8° for precession, we arrive at Ibn Ezra's entry.

ad 17. Longitude: The discrepancy of 0;20° again may be due to a confusion of *lām* (30) and *nūn* (50) in Arabic.

ad 18. Latitude: Ibn Ezra's entry agrees with the Arabic versions of the *Almagest.*

ad 19. Latitude: This entry seems to be due to a corruption in the transmission of the Hebrew text.

ad 20. Arabic: *al-munīr]* K: *al-nayyir.*

ad 21. Hebrew: "The red (*ha-adom*) that is in the neck of the victor". Note that "red" translates the Arabic of Ibn Ezra: *al-ward* (i.e., rose), a corrupsion of *al-fard* (i.e., the solitary) in K. The Hebrew *menaṣṣe^{a}ḥ* (i.e., victor) translates the Arabic *shujā^{c}* (i.e., courageous) which here designates Hydra. Edelmann's *ha-arus* (i.e., the be-

trothed) is a further corruption of *ha-adom* (cf. Goldstein, 1976, p. 258). Latitude: The minutes have been dropped.

ad 22. Latitude: The three manuscripts of the Ḥajjāj version of the *Almagest* (noted in no. 13, above) read 3° (instead of 4°).

ad 24. Arabic: *al-rāmī]* K: *al-rāmī al-aysar*. Longitude: The three manuscripts of the Ḥajjāj version of the *Almagest* (noted in no. 13, above) have the incorrect reading: Sgr 17;45° (instead of 17;40°). Hence, adding 15;8° for precession, we arrive at Ibn Ezra's entry.

ad 25. Longitude: Perhaps the copy of the *Almagest* underlying this list had Cap 3° (instead of 3;50°). In that case, we would expect Cap 18;8°: 1 (*alef*) and 8 (*ḥet*) are easily confused in Hebrew manuscripts. Latitude: The minutes have been dropped.

ad 27. Arabic: *qalb]* K: *dhanab*.

ad 29. Arabic: *al-shamālī]* K: *al-thānī*.

ad 31. Arabic: *al-ayman min al-jawzā]* K: *al-aysar min mumsik al-ᶜinān*.

ad 33. Arabic om.; K: *al-mu'akhkhar minhumā*. Latitude: The three MSS of the Ḥajjāj version of the *Almagest* (noted in no. 13, above) read 8;30° as in Ibn Ezra's text.

ad 34. Arabic: *al-ḥāwīʾ]* K: *al-ḥawwā'*. Longitude: Again the discrepancy may be due to the confusion of *lām* (30) and *nūn* (50) in the Arabic text tradition.

ad 35. Arabic om.; K: *jaḥfalat al-faras*. Longitude: Again, *alef* (1) and *ḥet* (8) are easily confused in Hebrew manuscripts.

ad 36. Arabic om.; K: *ṭaraf dhanab qayṭus*.

Comments on the Star List for 1392 A.D.

This list depends on those of Bar Ḥiyya: all 24 stars appear in the two lists of Bar Ḥiyya and, in almost all cases, the names are the same. Unless otherwise noted, the longitudes here are those of Bar Ḥiyya increased by 4;20° to account for the precession in the 288 years from 1104 A.D. to 1392 A.D., or 1° in about 66⅔ years. The latitudes are identical with those in Bar Ḥiyya's lists but for stars 1, 15, 21 (see below). The magnitudes are also the same as those of Bar Ḥiyya but for star 21.

It therefore comes as a surprise to find that this anonymous list does

Star List for 1392 A.D.: Anonymous[7]

Table for the positions of the stars in longitude, latitude, mediation, and declination at the beginning of the year 1392[8] according to their reckoning.

[No.]	[Mod.]	M.	Arabic Name	Hebrew Name
1	θ Eri	1	akhir al-nahr	aḥarit ha-nahar
2	α And	2	kaff al-naṣīr	ha-yad ha-ṣevuᶜa
3	β Per	2	ra's al-ghūl	rosh ha-shed
4	α Tau	1	al-dabaran	ᶜeyn ha-shor
5	β Ori	1	rijl al-jawzā	regel te'omim
6	γ Ori	2	mankib al-jawzā	semol te'omim
7	α Aur	1	al-ᶜayyūq	moshekh ha-resen
8	α Ori	1	mankib al-yamīn	yemin te'omim
9	α CMa	1	al-ᶜabūr kalb	kelev gadol
10	α CMi	1	al-ghumayṣā	kelev qaṭan
11	α Leo	1	qalb al-asad	lev ha-aryeh
12	δ Leo	2	faqār al-asad	shidrat ha-aryeh
13	β Leo	2	al-ṣarfa	zenav ha-aryeh
14	15 (c) Com	2	al-munīr	ha-me'ir
15	η UMa	2	al-thurayyā	zenav benot ᶜayish
16	α Boo	1	simak al-rawmiḥ	nismakh ha-romaḥ
17	α Vir	1	simak al-aᶜzal	nismakh lo' mezuyyan
18	α CrB	2	iklīl shamālī	nezer ṣefoni
19	α Sco	2	qālb al-ᶜaqrab	lev ha-ᶜaqrav
20	α Lyr	1	nasr wāqiᶜ	nesher nofel
21	α Aql	1	nasīr al-ṭā'ir	nesher meᶜofef
22	ζ Cyg	2	rukbat al-dajāja	arkovet tarnegolet
23	α Cyg	2	al-rādf	zenav tarnegolet
24	β Peg	2	mankib al-faras	yemin ha-sus

not depend directly on Bar Ḥiyya's lists, but on a list compiled by Levi ben Gerson for the year 1325 A.D. than in turn derives from Bar Ḥiyya's lists. Levi's text is preserved in two copies: MS Mantua heb. 10, folios 12a–13a, as part of his treatise entitled *ḥug shamayim* (inc.: "Levi

Star List for 1392 A.D.: Anonymous[7]

Table for the positions of the stars in longitude, latitude, mediation, and declination at the beginning of the year 1392[8] according to their reckoning.

[No.]	[B.H.]	Longitude		Lat. & Dir.		Mediation		Dec. & Dir.	
1	1.3	0^s	19; 0°	13;30°	S	0^s	21;30°	5;34°	S
2	2.1	0	6;20	26; 0	N	1	23; 1	26; 4	N
3	2.3	1	18;30	23; 0	N	1	4;17	38;30	N
4	1.1	2	1;30	5;10	S	2	4;46	15; 4	N
5	1.2	2	8;40	31;30	S	2	12;34	9;32	S
6	2.2	2^s	12;50°	17;30°	S	2^s	13;32°	4;55°	N
7	1.7	2	13;50	22;30	N	2	6;44	44;40	N
8	1.4	2	25;50	17; 0	S	2	28; 2	6;29	N
9	1.6	3	6;30	39;10	S	3	5;42	15;46	S
10	1.5	3	18; 0	16;10	S	3	16;51	6;39	N
11	1.12	4^s	21;40°	0;10°	N	4^s	21;40°	14;27°	N
12	2.12	4	2; 0	13;40	N	4	4;55	32;54	N
13	2.4	5	13;20	11;50	N	5	27;20	16;58	N
14	2.13	5	13; 7	30; 0	N	6	2;35	33;26	N
15	2.7	5	18;38	53; 0	N	6	24;49	32;30	N
16	1.8	6^s	15;50°	31;30°	N	6^s	27;21°	23;10°	N
17	1.9	6	15;34	2; 0	S	6	11;56	7;32	S
18	2.5	7	3;30	44;30	N	7	17; 3	29;40	N
19	2.6	8	0;30	4; 0	S	7	25;56	23;56	S
20	1.10	9	6;10	62; 0	N	9	4; 1	38;33	N
21	2.8	9^s	21;52°	29; 0°	N	9^s	20;12°	7; 4°	N
22	2.10	10	25;50	44; 0	N	10	13;44	29; 0	N
23	2.9	10	28; 0	60; 0	N	10	6;11	43;59	N
24	2.11	11	20; 0	31; 0	N	11	7;37	24;40	N

ben Gerson said" [fol. 1a:1]), a description of the armillary sphere (I am grateful to Dr. Y. T. Langermann, Hebrew University, for bringing this text to my attention; cf. his "An Unknown Astronomical Treatise by Levi ben Gerson", to appear in *Kiryat Sefer* [in Hebrew]); and

MS London, Montefiore Library 425, fol. 8a, where this list is explicitly ascribed to Levi ben Gerson (fol. 8a:1). On folios 8b and 9a of the London copy we find Bar Ḥiyya's star lists with the notable variant that *suhayl* (B.H. 2.14) appears in the list of first magnitude stars after B.H. 1.11, and not in the list of second magnitude stars as in the other copies cited above.

The heading for Levi's star list in the London copy refers to the epoch 1325 A.D. and adds that the positions are based on those of al-Battānī (the same information appears in a somewhat different form in MS Mantua f. 12a). The Mantua copy notes that the precession used was about 1° in about 66 years (f. 12a:13); the London copy adds a remark after the star list: "I found that he [i.e., Levi] added 3⅓° to their positions at the beginning of cycle 257 ...". Levi's value for the precession in his *Astronomy* is 1° in about 67 years based explicitly on observations as late as 1335 (cf. Goldstein, 1975, p. 36); here he may be using the value he ascribed to al-Battānī of 1° in about 66 years (Goldstein, 1975, p. 35; cf. ed. Nallino, vol. 1: 124). It should be noted that in his *Astronomy* Levi's references to al-Battānī seem, in general, to depend on Bar Ḥiyya who paraphrased the Arabic text of al-Battānī in Hebrew. The text of Levi's star table is in paragraph form arranged by zodiacal sign with the Hebrew and Arabic names followed by the longitude, latitude, and magnitude of each star; mediations and declinations are not found in it.

All 28 stars in Bar Ḥiyya's lists appear in Levi's list in the same order as the 24 stars that are found in the 1392 list with the following exceptions: (1) in Levi's list B.H. 1.7 precedes B.H. 2.2 (corresponding to stars 7 and 6 in the 1392 list); in Levi's list B.H. 2.14 follows B.H. 1.9 (B.H. 2.14 is missing in the 1392 list); (3) in Levi's list B.H. 2.7 precedes B.H. 2.13 (corresponding to stars 15 and 14 in the 1392 list); (4) in Levi's list B.H. 1.13 follows B.H. 1.9 (B.H. 1.13 is missing in the 1392 list); (5) in Levi's list B.H. 1.11 follows B.H. 1.10 (B.H. 1.11 is missing in the 1392 list); (6) in Levi's list B.H. 1.14 follows B.H. 2.8 (B.H. 1.14 is missing in the 1392 list). Despite some minor textual problems in the copies of Levi's list, it is clear that the longitudes in the 1392 list are all exactly 1° greater than those in Levi's list, and that the latitudes are the same. It is worth noting that Levi's epoch, 1325 A.D., is 67 years earlier than 1392 A.D. which corresponds to 1° of precession according to Levi (as cited above).

The following discrepancies indicate that the 1392 text was not based on either one of the available manuscripts of Levi's star list: (1) for star 6 (1392), Levi has Gem 11;57° instead of the expected Gem 11;50°; (2) for star 22 (1392), Levi has Aqu 26;50° instead of the expected Aqu 24;50° (based on B.H. 2.10 plus 3;20° for precession).

All columns in our table appear in the manuscripts except those labelled: No., Mod., and B.H. (i.e., the corresponding star in Bar Ḥiyya's lists). Recomputed values of mediation and declination have been used to choose between manuscript variants, but this has been done cautiously because there are often significant discrepancies between text and computation (see below).

ad 1. Latitude: 13;30° S as in Levi instead of the expected 53;30° S as in Bar Ḥiyya (star 1.3) and Ptolemy. The mediation and declination here were clearly derived using latitude 13;30° S: in a medieval Hebrew script it is easy to confuse 13 (*yg*) and 53 (*ng*).

ad 2. Arabic: *al-naṣīr* instead of the expected *al-khaḍīb* as in Bar Ḥiyya (star 2.1) and Levi. Longitude: the entry here agrees with the value in Bar Ḥiyya's list increased by the precession of 4;20°. Latitude: The entry here agrees with the entry in Bar Ḥiyya's list. Mediation and declination: Accurately computed with an obliquity of 23;35° and the entries here for longitude and latitude, the mediation should be: 11^s 24;6° (text: 1^s 23;1°: was this originally 11^s 23;1° ?), and the declination should be: 26;12° (text: 26;4°).

ad 10. Hebrew: MSS P, V read: "Who closes his eye" as in Ibn Ezra's list, star 6.

ad 14. Arabic and Hebrew: "luminary". This corresponds to the entry in the column for magnitudes, *muḍī'*, in al-Ḥajjāj's translation of the *Almagest*; however, the Arabic term here, *al-munīr,* does not appear in that version of the *Almagest* (cf. Comments on Bar Ḥiyya's Star Lists, star 2.13). Longitude: This entry supports the text of Bar Ḥiyya (star 2.13) because the ending of 7 minutes follows exactly from Bar Ḥiyya's longitude with a precession of 4;20°. Levi's value is Vir 12;7°.

ad 15. Arabic: Elsewhere in the literature this term refers to the Pleiades, and hence it does not belong here: note that Bar Ḥiyya and Levi have no entry for the Arabic name of this star. Longitude: The ending of 18 minutes follows exactly from Bar Ḥiyya's long-

itude with a precession of 4;20°. Latitude: 53;0° N instead of the expected 54;0° N as in Bar Ḥiyya (star 2.7) and Ptolemy. The variants 13° N and 23° N produce much worse agreement with the mediation. On the other hand, the closest agreement with the entry for declination comes from latitude 23° N. The London copy of Levi's text has 53° N while the Mantua copy has 13° N.

ad 17. The ending of 14 minutes here supports the reading in Bar Ḥiyya's text for star 1.9.

ad 19. Longitude: With Bar Ḥiyya's value and a precession of 4;20° we arrive at 8^s 1;30° (text: 8^s 0;30°). Since Levi's text has Sgr 0;30°, we would expect 8^s 1;30° here. The values in the text for mediation and declination show slightly better agreement with those recomputed with longitude 8^s 0;30° than with longitude 8^s 1;30°.

ad 21. Magnitude: Bar Ḥiyya (and Ibn Ezra) consider this star to be of 2nd magnitude but here, as in Levi's list, it is considered of 1st magnitude. Longitude: With Bar Ḥiyya's value and a precession of 4;20° we arrive at 9^s 21;40° (text: 9^s 21;52° with the variant 9^s 21;22° supported by Levi's Cap 20;22°). While the variants 52′ and 22′ are easily explained (50 [*n*] and 20 [*k*] look alike in many Hebrew manuscripts), the discrepancy with respect to Bar Ḥiyya's text is not. Latitude: 29;0° N instead of the expected 29;10° N as in Bar Ḥiyya and Ptolemy; the 10 minutes have been dropped as in Levi's list.

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NOTES

1. *Variant Readings for Bar Ḥiyya's Star List: 1st Magnitude*
   Sigla. MV: ed. of Millás Vallicrosa (p. 124: variants for coordinates only); P1: Paris, heb. 1038 (fol. 60b); P2: Paris, heb. 1045 (fol. 54a); P3: Paris, heb. 1046 (fol. 34b); P4: Paris, heb. 1064 (fol. 106b); H: Bodleian Hunt. 379 (fol. 69a).
   1: 57;10] P2: 15;14. 5;10] P2: 5;6, H: 8;6. 13;19] H; 14;19.
   2: 64;20] H: 24;20, MV: 24;31. 31;30] P1: 21;30.
   4: ṣad te'omim] H: ṣarha' omi. al-jawzā] H: y.n.y.z.'. ayman] P4, H om. 81;30] P1: 81;36. 5;20] P2: 2;20.
   5: 103;40] P2: 150;40, H: 106;40. 16;10] P2, P4: 16;0. 6;28] P1, P2, P3, H: 10;28. 102;8] P1: 102;22, H: 102;5.
   6: kelev gadol] P4: ha-kelev ha-gadol. 15;14] P1, P2: 15;16.
   7: al-ᶜayyūq] P2: al-fayyūq. 44;6] P2: 42;6. 60;4] H: 60;20.
   8: ha-nitmakh] H: ha-nehemakh. al-rāmiḥ] P2, P3, P4, H: ramiḥ. 205;24] P2, P4: 25;24.
   9: mezuyyan] P1: mesuyyan. aᶜzal] P1: al-ᶜazāl. 191;14] P4: 196;14. 190;12] P2: 150;12.
   10: 271;50] P2: 271;3. 271;28] MV: 281;28.
   11: sof] P2, P4: ᶜav, P4: fum. aṣl] P4 om. dhanab] P2: rakab. 277;18] P4: 270;17, MV: 287;18. 6;30] P2, H: 6;32, P4: 10;30. 30;3] P1: 33;50.
   12: qalb] P4: kalb. 15;16] P1, MV: 15;10.
   13: ha-mequddam] P2: ha-niqdemet. 202;40] P1, P2, P4: 220;40.
   14: fūm] P2: fi, P1: fīm (Read: fam). 20;20] P1, P2: 2;20, H: 20;30. 330;20] P1, P3, P4: 330;2.
2. *Variant Readings for Bar Ḥiyya's Star List: 2nd Magnitude*
   Sigla. MV: ed. of Millás Vallicrosa (p. 125); B: Berlin, heb. 649 (fol. 57b [plate in MV following p. 112]: cited only when it differs from MV); P1: Paris, heb. 1038 (fol. 61a); P2: Paris, heb. 1045 (fol. 54b); P3: Paris, heb. 1046 (fol. 34b); P4: Paris, heb. 1064 (fol. 107a); H: Bodleian Hunt. 379 (fol. 69b).
   1: al-kaff] P3, P4, B: kaff. 26;0] P2: 27;0.
   2: 4;6] P2: 2;6. 71;10] P4: 31;10, H: 79;10, MV: 18;10 (B: 79;10).

3: ha-shed] P2: ha-shor. ra's] P1: ra'sh. al-ghūl] P4: al-gozel, B: al-nim. 23;0] P1, P3, P4, MV: 53;0. 39;12] P2: 32;12. 35;14] P4: 35;4.
4: zenav] P2: ᶜav. dhanab] P2: rakab. al-asad] P2, H: al-ḥad. al-ṣarfā] P4: al-ṣafla. 159;0] P1, P2: 151;0. 18;34] P2: 18;32.
5: 209;10] P1: 259;10, P2, H: 29;10, P4: 159;10. 254;12] P2, H: 222;12, P4: 224;12.
6: 4;0] H: 20;0, P1: 4;6. 24;2] MV: 24;20 (B: 24;2). 236;7] P1: 46;7.
7: ha-zenav] P2: ha-shor. 53;0] P2, P3: 23;0. 199;0] P2: 299;0.
8: al-nasr] P3, P4: nasr. al-ṭā'ir] H: al-mā'ir. 6;36] P1: 6;16, P4: 6;30. 283;56] P2: 263;57.
9: zenav] P2: ᶜav. al-ridf] P1: dhanab al-dajāja. 323;40] MV: 232;40 (B: 323;40), P4: 324;40. 60;0] P1: 60;6. 300;38] MV: 305;35 (B: 300;38).
10: rukbat] P2: rukba. 27;35] H: 27;38. 306;35] MV: 305;35 (B: 306;35), P2: 310;35.
11: ha-yemini] P2, H: yemini. 345;40] P1, P4: 341;40. 22;48] P2: 14;20, P4: 22;47, H: 52;48. 331;31] P2: 120;28.
12: shidrat ha-ari] P4: sidrat pe'ari. ha-ari] P2: ha-'eres, H: ha-aryeh. al-asad] P2: al-asrir (?), P4: al-asār. 120;28] P4: 102;27.
13: ha-ari] P2: ha-'or, H: ha-ayil. veha-nitmakh] P1: ha-nitmakh, P2: veha-nistar, P3: veha-nehemakh, B: ha-neḥmad. al-dhu'-āba] P1: al-dhūba, P2, P3, P4: al-dhu'āya, H: al-dhā-kaf (?). 35;27] MV: 35;24 (B: 35;27), H: 35;26. 173;40] P2, P3: 193;40, H: 143;40 (?).
14: suhayl] P1: saqal, H: suqayl. 75;0] MV: 85;0 (B: 75;0).

3. *Variant Readings for Ibn Ezra's Star List*

Sigla. Ea1: Paris, heb. 1045 (fol. 190b); Ea2: Paris, heb. 1053 (ff. 18a–20b); Ea3: Paris, heb. 1061 (ff. 159a–160a); Eb1: Paris, heb. 1031 (ff. 154a–154b); Eb2: Paris, heb. 1054 (ff. 9b–10a); Eb3: Paris, heb. 1081 (ff. 47a–47b); Ea: readings common to Ea1, Ea2, Ea3; Eb: readings common to Eb1, Eb2, Eb3. An asterisk (*) in the variants that follow signifies that this entry does not appear in any of these manuscripts (see note 5).

1: 27;48] Ea1: 27;4, Ea2: 27;50, Ea3: 26;50, Eb1: 27;28.
2: te'omim] Ea: ha-kelev. rijl] Ea3 om. 31;50] Eb1, Eb2: 37;2, Eb3: 37;21.
3: al-ᶜayyūq] Eb1: al-ᶜaynuq. 10;21] Ea2: 7;21, Ea3: 7;51, Eb: 8;21. 22] Ea2, Ea3: 16;30, Eb: 62;30.
4: al-jabbār] Ea3 om. 17;8] Ea1: 18;8, Ea2: 25;8, Ea3 om., Eb1: 17;18. 17] Ea1 om., Ea2: 40;20, Ea3 om., Eb1: 17;40, Eb2: AG (?).
5: ᶜover ha-afudda] Ea2: shekhem ha-gibbor, Ea3 om., Eb: ha-amiṣ she-ᶜavar ha-ḥeshev (?). al-shiᶜrā] Ea1: shiᶜrā. 2;48] Ea1: 2;47, Eb1: 50;48, Eb2, Eb3: 48. 39;10] Ea1, Ea3: 30;15, Eb2: 30;9.
6: 16;10] Ea1, Ea3, Eb2: 16.
7: 17;38] Ea2, Ea3: 17;31, Eb1, Eb3: 17;35. 0 N] Ea1: 10 S, Ea2, Ea3: "it has no latitude at all, and it lies to the south".
8: 9;38] Eb2: 8;38. 11;50] Eb1: 11;6, Eb3: 11;20.
9: Ea1, Eb1, Eb3 omit this entire line. ha-gibbor] Ea3: ha-govah. 11;48] Eb2: 12;48. 6] Eb: 60.
10: Ea1, Eb3 omit this entire line. ha-gibbor] Ea3: ha-govah. al-simāk al-rāmiḥ] Ea om., Eb2: al-simak al-rāmiḥ.r. 27;20] Eb: 25;7. 31;30] Ea: 6;31.
11: al-wâqiᶜ] Ea2: al-āqiᶜ. 2;28] Ea2, Ea3: 15;25, Ea1: 28. 60] Ea2, Ea3: 36;10.
12: fam] Ea3, Eb1, Eb3: fūm, Eb2: fūr. 22;8] Ea1, Eb2: 20;28, Ea2, Ea3: 24;10. 23 S] Ea1: 23 N, Ea2, Ea3: 13 N.
13: 2;38] Eb: 2;28. 26 N] Eb: 26 S, Ea2, Ea3: 12;5 N.

14: 23] Eb3: keneged.
15: Eb omits this entire line.
16: shekhem] Eb: shekhem ha-kelev. 5;28] Eb: 5;38. 17;30] Eb1: 10;38.
17: Eb omits this entire line.
18: Ea2, Ea3, Eb omit this entire line. 8;28*] Ea1: 5;28 (?), the degrees are written *he-yod,* with a dot over each letter, which might be a miscopying of a *ḥet* in which case the text originally reads: 8;28.
19: Eb omits this entire line. 11;48] Ea2, Ea3: 28;48. 30;15] Ea1: 15.
20: Eb omits this entire line. ʿunq al-asad] Ea2, Ea3: ʿunqal.
21: Eb omits this entire line. ha-menaṣṣe*ḥ] Ea2, Ea3: ha-aryeh. al-ward alladhī fī ʿunq al-shujāʿ] Ea2: al-dafī ʿunqāl al-shūjaʿ, Ea3: alladhī fī ʿunqal al-shūjaʿ. 15;8*] Ea1: 358, Ea2: 50;28, Ea3: 9;25. 20] Ea2: 28.
23: Eb omits this entire line. berekh] Ea1: bederekh 2;8*] Ea: 28. 18 S] Ea1: 18 N, Ea2: 18;14 S, Ea3: 18;14 N.
24: 2;53] Ea1: 2;58, Ea2, Ea3: 2;23. 23] Ea2, Ea3: 53.
25: 18;1] Ea: 18. 29] Eb1: 20, Eb2: 32, Eb3: 30;20.
26: al-dajāja] Ea2, Ea3: al-ṭazījā, Eb1: al-dūja. 24;18] Eb2, Eb3: 21;18. 60 N] Ea2: 8 S, Ea3: 5 S, Eb: 31;30 N.
27: Eb omits this entire line.
28: 17;18] Ea1: 17. 31] Ea1, Ea3: 31;20, Ea2: 31;28.
29: Ea2, Ea3, Eb2 omit this entire line. al-shamālī min al-naṭḥ] Ea1: al-nāṭiḥ al-shamāl. 8;20] Ea1: 5;20, Eb3: 8;2.
30: ha-semolit] Ea1: ha-yeminit, Ea2, Ea3: ha-semoli. rijl] Ea1 om. 2;3*] Ea: 2, Eb1: 21, Eb2, Eb3: 20;1. 28] Eb2: 22;28.
31: ha-te'om] Ea1: ha-kelev. ha-yemini] Ea2 om. al-ayman min] Ea om. al-jawzā] Ea1: al-y.ḥā (?), Ea3: al-jawzaʿ. 10;48] Ea2, Ea3: 18;48, Eb1, Eb3: 10;49, Eb2: 49. 5*] Ea1: 37, Ea2, Ea3: 34, Eb: 36.
32: Eb omits this entire line. 3;8*] Ea1: 21;9, Ea2, Ea3: 28;9. 0;40 N*] Ea: 60;40.
33: Eb omits this entire line. 7;18*] Ea: 7;19. 8;30 N*] Ea2: 38, Ea3: 35, Ea1 om.
34: Eb omits this entire line. mi] Ea2, Ea3 om. lo] Ea2, Ea3: bo. al-ḫāwī*] Ea1: al-hāwir, Ea2, Ea3: al-qāwid. 9;38] Ea2, Ea3: 26;38. 36] Ea2, Ea3: 32.
35: Eb omits this entire line. 20;21] Ea1: 21. 22;30 N*] Ea1: 62;30 S; Ea2, Ea3: 40;30 S.
36: Eb omits this entire line. Psc 20;48*] Ea1: 25;5, Ea2, Ea3: 20;25. 20;20*] Ea: 22.

4. The longitudes listed in this column are those of the *Almagest* plus 15;8° for the precession from Ptolemy's epoch to that of Ibn Ezra.
5. This entry has been emended: see the list of manuscript variants in note 3.
6. This entry disagrees with Ibn Ezra's text: see the comments on this list.
7. *Variant Readings for the Star List of 1392 A.D.*
Sigla. B: British Library, Or. 10,878 (fol. 1b); C: Casanatense, heb. 203 (fol. 128b); J: New York, Jewish Theological Seminary of America, heb. 2597 (fol. 68b); P: Paris, heb. 1069 (fol. 185a); V: Vatican, heb. 379 (fol. 29a).
Note: The Arabic star names appear only in P and V.
1: aḥarit] V: aḥarei. 0^{s} 19;0] B: 0^{s} 18;0. 13;30 S] V: 16;30 S, C: 13;0 S. 5;34 S] V: 7;30 S.
2: al-naṣīr] Read: al-khaḍīb. ha-yad] B: yad, C, P, V: kaf. 0^{s} 6;20] J: 0^{s} 6;2. 26;0 N] C: 26;4 S, J: 26;0 N, B: 21;0 N.
3: ha-shed] P, V: ha-saṭan.

4: ʿeyn ha-shor] B, C, J: al-dabaran. 15;4 N] B: 15;6 N.
5: 31;30 S] P, V: 35;30 S.
6: 2nd M.] C: 1st M. 2^s 12;50] B: 2^s 12;20, J. P, V: 2^s 18;50.
7: al-ʿayyūq] P: al-ʿayyū'q. 22;30 N] J, P, V: 16;30 N. 2^s 6;44] J: 2^s 4;46, B: 2^s 17;40.
8: 2^s 25;20] B: 2^s 24;20, C, J: 2^s 25;50. 2^s 28;2] C: 2^s 56;2, B, J: 2^s 26;2. 6;29 N] P, V: 16;29 N, B, C: 6;24 N.
9: 15;46 S] P, V: 46;46 S, B: 46;47 S.
10: kelev qaṭan] P, V: ha-soger et ʿeyno. 3^s 18;0] C: 3^s 17;0. 3^s 16;51] C: 10^s 16;51.
11: 4^s 21;40] P, V: 4^s 27;40, B: 4^s 29;40. 14;27 N] C, J om.
12: faqār] P: faqūr. 4^s 4;55] P, V: 4^s 6;55. B, C: 4^s 10;55. 32;54 N] C, J, P: 32;24 N.
13: 11;50 N] B: 11;20 N. 5^s 27;20] B: 5^s 21;20, C: 5^s 21;50. 16;58 N] B, C, J: 16;28 N.
14: 6^s 2;35] J, P, V: 6^s 0;35. 33;26 N] C: 33;56 N.
15: benot] V: bat. 5^s 18;38] P, V: 5^s 18;30, B: 5^s 18;35, C: 5^s 17;37. 53;0 N] B, P, V: 23;0 N, C: 13;0 N.
16: al-rawmiḥ] Read: al-rāmiḥ. 6^s 15;50] B: 5^s 15;10.
17: 7;32 S] B: 7;33 S.
18: 7^s 17;3] C: 7^s 16;3, B: 7^s 16;15.
19: 4;0 S] B: 5;0 S.
20: 9^s 6;10] V: 9^s 6;6, P: 9^s 6;30. 9^s 4;1] P, V: 9^s 4;7. 38;33 N] C: 32;33, P, V: 38;34.
21: nasīr] Read: al-nasr. 9^s 21;52] B: 9^s 21;22. 29;0 N] C, J: 59;0 N, V: 18;0 N, P: 58 N. 9^s 20;12] C: 9^s 20;13.
22: arkovet] P: regel. tarnegolet] V: ha-tarnegolet. 10^s 25;50] B: 10^s 25;50.
23: al-rādf] Read: al-ridf. tarnegolet] C, P, V: tarnegol. 60;0 N] B: 9;0 N. 43;59 N] B: 43;19 N.
24: 31;0 N] V: 38;0 N. 11^s 7;37] B: 11^s 7;34. 24;40 N] C: 54;40 N, B: 22;40 N.

8. MS J: 1393.

Note in proof: Dr. Tzvi Langermann (Jerusalem) has informed me that another copy of the star list for 1392 is to be found in MS Bodleian Library, heb. 2080, fol. 3b, displaying only the Hebrew star names, mediations, declinations and directions. After the 24 stars that appear in the other copies, there are 9 additional stars. This text is in a poor state of preservation and is difficult to decipher completely.