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## Astronomy and the Jewish Community in Early Islam

Islam became the dominant force in the Middle East in the mid-seventh century, within a generation of the death of its founder, Muḥammad. The attraction to Islam of the population ruled by its adherents set off a wave of conversions that continued for several centuries. Even many of those who did not convert actively participated in Islamic culture. Of special interest to us is the fact that, in the early years, Christians and others were involved in the translation of scientific and philosophical works from a variety of languages into Arabic. These works quickly became part of a ninth- and tenth-century research program that has been called the “Renaissance of Islam.”<sup>1</sup>

<sup>1</sup> See, e.g., J. Kraemer, *Humanism in the Renaissance of Islam*, 2nd ed. (Leiden, 1992), p. xxiv; F. Rosenthal, *The Classical Heritage in Islam* (Berkeley and Los Angeles, 1975), p. 13; and G. Saliba, *A History of Arabic Astronomy* (New York, 1994), pp. 51ff. R. Rashed emphasizes that translation and advanced research went on simultaneously and not consecutively, as is often assumed: see R. Rashed, “Problems in the Transmission of Greek Scientific Thought into Arabic: Examples from Mathematics and Optics,” *History of Science* 27 (1989): 199–209, esp. p. 202.

In an important study, A. I. Sabra has argued persuasively that science, including astronomy, was not marginal to Islamic culture; rather, it was appropriated by and incorporated into it.<sup>2</sup> Sabra's account allocates a significant role to Ya<sup>c</sup>qūb al-Kindī (d. ca. 870), a scion of a distinguished Arab family and closely associated with the Abbasid court, who made philosophy and science an integral part of Arabic culture. Al-Kindī's interests included both astronomy and astrology.<sup>3</sup> But there is another way to look at the development of scientific activity in the Islamic world. The incorporation of Greek (and, to a lesser extent, Indo-Iranian) "wisdom" had the effect of creating a secular domain of study, referred to as the "sciences of the ancients" or the "foreign sciences," in contrast to the sciences of Islam—law, theology, ḥadīth, commentaries on the Koran, etc. Participants in the former by no means thought of themselves as engaged in heretical activity, although occasionally some "orthodox" scholars expressed hostility to the "foreign" (i.e., Greek) sciences. For philosophers and scientists in the Islamic world, "Greek" science was a universal subject, not the property of a particular community.<sup>4</sup> As a result, there were Muslims willing to cooperate fully with Christians, Jews, Sabeans, and others in scientific matters. Al-Kindī introduced this idea in his treatise, *On First Philosophy*, addressed to fellow "Arabophones" (*abl lisāninā*; lit. "the people of our language"—"co-linguists" in Franz Rosenthal's translation) rather than to his co-religionists:

We ought not to be ashamed of appreciating the truth and of acquiring it wherever it comes from, even if it comes from races distant and nations different from us. For the seeker of truth nothing takes precedence over the truth, and there is no disparagement of the truth, nor belittling either of him who speaks it or of him who conveys it. (The status of) no one is diminished by the truth; rather does the truth ennoble all.<sup>5</sup>

- <sup>2</sup> A. I. Sabra, "The Appropriation and Subsequent Naturalization of Greek Science in Medieval Islam," *History of Science* 25 (1987): 225–43. Sabra's work serves as a corrective to the classic article by Goldziher, indicating its limitations and modifying the claim that the religious scholars in Islam held negative attitudes towards Greek science and philosophy: see I. Goldziher, "Stellung der alten islamischen Orthodoxie zu den antiken Wissenschaften," *Abhandlungen der k. preussischen Akademie der Wissenschaften*, Jahrgang 1915, no. 8 (Berlin, 1916), pp. 3–46, trans. as: "The Attitude of Orthodox Islam Toward the 'Ancient Sciences,'" in M. L. Swartz, *Studies on Islam* (New York and Oxford, 1981), pp. 185–215. For a devastating critique of Goldziher's portrayal of "Orthodox" Islam, see D. Gutas, *Greek Thought, Arabic Culture: The Greco-Arabic Translation Movement in Baghdad and Early 'Abbāsīd Society (2nd-4th/8th-10th Centuries)* (London and New York, 1998), pp. 166ff.
- <sup>3</sup> F. Sezgin, *Geschichte des arabischen Schrifttums* (Leiden, 1978), 6: 151–55; (Leiden, 1979), 7:130–34.
- <sup>4</sup> See, e.g., Muḥammad b. Aḥmad al-Khwārizmī's encyclopedia, *Mafātiḥ al-ʿulūm* (tenth century), trans. in Rosenthal, *Heritage*, p. 54: "I have divided my work into two books. One of them is devoted to the sciences of the Islamic religious law and the Arabic sciences connected with it, and the second to the sciences originating from foreigners such as the Greeks and other nations." Although this distinction is surely older than the tenth century, it may not have been as rigid as it later became: cf. J. L. Berggren, "Islamic Acquisition of the Foreign Sciences: A Cultural Perspective," in *Tradition, Transmission, Transformation*, F. J. Ragep and S. P. Ragep, eds. (Leiden, 1996), pp. 263–83; and A. Heinen, "Mutakallimūn and Mathematicians: Traces of a Controversy with Lasting Consequences," *Der Islam* 55 (1978): 57–73. See also Kraemer, *Humanism*, pp. xxvii f.; Kraemer (pp. xi ff.) vigorously and persuasively defends the use of certain Western concepts, such as 'humanism' and 'secularism,' in his description and interpretation of medieval Islam; cf. J. Samsó, *Las ciencias de los antiguos en al-Andalus* (Madrid, 1992), p. 16.
- <sup>5</sup> Al-Kindī, trans. A. Ivry, *Al-Kindī's Metaphysics* (Albany, 1974), p. 58; cf. p. 126 ad 102.5<sup>2</sup>.

Thus Sabra is correct to emphasize the legitimization and appropriation of Greek wisdom by Muslims. I would add, however, that al-Kindī also favored an “ecumenical” approach to the search for truth, one that allowed for cooperation with members of other religious communities.

Abraham Ibn Ezra (d. 1167) expressed his support for this scientific outlook in the preface to his translation of Ibn al-Muthannā’s commentary on the astronomical tables of Muḥammad b. Mūsā al-Khwārizmī (fl. 830), while taking some liberties with the historical data on the introduction of Indian astronomy to the Islamic world:<sup>6</sup>

There arose a great king of the Arabs whose name was al-Safāḥ [the first Abbasid caliph: 750–754]. He heard that in India there were many sciences, and so he ordered that a wise man be sought, fluent in both Arabic and the language of India, who might translate one of the books of their wisdom for him. He thought that some mishap might befall the translator because profane sciences (*ḥokmot ḥiṣoniyyot*) were still unknown in Islam. They had only the Koran and the wise traditions which they received from Muḥammad.<sup>7</sup>

As far as we can tell, Jews were not participants in the general culture in the years immediately preceding the rise of Islam, either in the Eastern Roman Empire or in the Sasanian Empire in Persia and Iraq. It was Talmudic culture that was the vital force in the Jewish communities of that period.<sup>8</sup> Along with most of their neighbors, Jews spoke and wrote Aramaic. In the Islamic world, however, most Jews began to speak Arabic (as did their neighbors) and to use Arabic, often written in Hebrew characters, as a literary language.<sup>9</sup>

Apart from occasional references in the Talmud, discussions of astronomy or astrology can be found in only a few Hebrew texts that may date from the period before the rise of Islam. Each of these texts

poses difficulties of various sorts, and their dates and authorship have been disputed in the modern scholarly literature. *The Chapters of Rabbi Eliezer* was considered in the Middle Ages to have been written by Rabbi Eliezer of the second century C.E.; but that date and

- 6 For a modern account of this transmission, see D. Pingree, "The Fragments of the Works of Ya'qūb ibn Ṭāriq," *Journal of Near Eastern Studies* 27 (1968): 97–125.
- 7 B. R. Goldstein, *Ibn al-Muthannā's Commentary on the Astronomical Tables of al-Khwārizmī* (New Haven, 1967), p. 147. For the evidence that the translation movement began under the second Abbasid caliph, al-Manṣūr, see Gutas, *Greek Thought*, esp. pp. 28ff.
- 8 There is really no adequate survey of astronomy and astrology in the Talmud; but see A. Altmann, "Astrology," in *Encyclopaedia Judaica* (Jerusalem, 1972), 3:788–95. W. M. Feldman, *Rabbinical Mathematics and Astronomy* (London, 1931), surveys the material, but this book is seriously out of date. The oldest medical text, by Asaph the Physician, now dated to the sixth century CE, may also reflect some astronomical or astrological lore: see S. Muntner, "Asaph ha-Rofe," in *Encyclopaedia Judaica*, 3:673–76. The earliest mathematical treatise in Hebrew, *Mišnat ha-middot*, was dated by Gandz to the second century CE: see S. Sternberg, ed., *Studies in Hebrew Astronomy and Mathematics by Solomon Gandz* (New York, 1970), p. 312; but Sarfatti argued that it was influenced by Arabic material and dated it to a time between the ninth and the twelfth centuries: see G. B. Sarfatti, *Mathematical Terminology in Hebrew Scientific Literature of the Middle Ages* (Jerusalem, 1968), p. 60 (in Hebrew with English summary).
- 9 For a nuanced discussion of the gradual introduction of Arabic in different genres of Jewish literature, see R. Drory, "'Words beautifully put': Hebrew versus Arabic in Tenth-Century Jewish Literature," in *Genizah Research after Ninety Years: The Case of Judeo-Arabic*, ed. J. Blau and S. C. Reif (Cambridge, 1992), pp. 53–66. For the suggestion that there is some continuity in Jewish cosmogonic speculation, see Y. T. Langermann, "Sa'adya and the Sciences," Essay II in Y. T. Langermann, *The Jews and the Sciences in the Middle Ages* (Aldershot, 1999), esp. pp. 9–10.

attribution have been disputed in the recent literature. Beller, for example, dates it to the early Islamic period.<sup>10</sup> Only part of the *Chapters* can be considered scientific, and it is certainly not at the level of Greek scientific works like Ptolemy's *Almagest*. Another text with astronomical content is the *Baraita di-Shmuel*; despite the example it includes for the year 776 C.E., it has been argued that the early chapters of this text date to the third century C.E.<sup>11</sup> Finally, there is *The Book of Creation (Sefer Yeşirah)*, which many in the Middle Ages attributed to the patriarch Abraham. Recent scholars maintain, however, that it was composed either in the centuries before the rise of Islam or in its early years. Again, it is difficult to assess its scientific content; in fact, in the tenth century it was held to be a philosophical text and later it was revered as a mystical work.<sup>12</sup>

In Islam, astronomy as a separate discipline began with the translation into Arabic of Sanskrit works in Baghdad in the late eighth century. Only in the ninth century did Greek astronomical works begin to displace the Indian legacy, but the displacement was not complete. Indeed, fundamental concepts such as the idea of a sine table (rather than a chord table) derived from Indian astronomy. Moreover, Indian methods in astronomy continued to be studied, particularly in Islamic Spain (al-Andalus) and later in medieval Latin Europe. But the dominant spirit of Islamic astronomy was Greek, and Ptolemy's *Almagest* continued to play a decisive role throughout the Middle Ages.

It is important to emphasize that from the very beginning, in the eighth century, Muslims and non-Muslims worked together in astronomical matters.<sup>13</sup> It may well be that some episodes in pre-Islamic Iran served as precedents for scientific cooperation by members of different communities, for both Shāpūr I (240–270) and Khusrau I (531–579) encouraged Greek (or Greco-Syrian) and Indian scholars to engage in scientific activities at their courts.<sup>14</sup> The effective founder of the Abbasid dynasty, the caliph al-Manşūr (reigned: 754–775), built the

- <sup>10</sup> *Pirḳê de Rabbi Eliezer*, trans. G. Friedlander (London, 1916); E. Beller, "Ancient Jewish Mathematical Astronomy," *Archive for History of Exact Sciences* 38 (1988): 51–66, esp. p. 55.
- <sup>11</sup> See Beller, "Jewish Astronomy." For a more recent discussion of the calendar in the *Baraita di-Shmuel*, see Sacha Stern, "Fictitious Calendars: Early Rabbinic Notions of Time, Astronomy, and Reality," *Jewish Quarterly Review* 87 (1996): 103–129, esp. pp. 117ff.
- <sup>12</sup> G. Scholem, *Kabbalah* (New York, 1974), p. 26. Scholem's views on the dating of *Sefer Yeşirah* have now been superseded by a careful examination of the various issues involved: S. M. Wasserstrom, "Sefer Yeşira and Early Islam: A Reappraisal," *Journal of Jewish Thought and Philosophy* 3 (1993): 1–30. Wasserstrom argues that *Sefer Yeşirah* was most probably written in the early ninth century by a Jew living in a Muslim milieu (and interacting with non-Jews). See also R. C. Kiener, "The Status of Astrology in the Early Kabbalah: From the *Sefer Yeşirah* to the *Zohar*," *Proceedings of the Second International Conference on the History of Jewish Mysticism*, Jerusalem Studies in Jewish Thought, vol. 6 (Jerusalem, 1987), 1\*–42\*.
- <sup>13</sup> There was an analogous phenomenon in the field of medicine: "Denominational lines were easily crossed. [For example,] Isaac Israeli [d. 950] was trained by the famous Muslim physician Işāq ibn 'Imran, and he in turn taught Muslim as well as Jewish pupils" (S. W. Baron, *A Social and Religious History of the Jews* [New York, 1958], 8:236).
- <sup>14</sup> D. Pingree, "Astronomy and Astrology in India and Iran," *Isis* 54 (1963): 229–46, esp. pp. 241–42. There was a medical school at Jundishapur, southeast of Baghdad, established under the Sasanian Dynasty (224–651 C.E.), and we are told that some physicians from Jundishapur served the Abbasid caliphs, beginning with al-Manşūr: see Rosenthal, *Heritage*, pp. 6 and 20. According to Ibn Yūnus (d. 1009), astronomical observations were made at Jundishapur by al-Nihāwandī, ca. 790 C.E.: see, e.g., E. S. Kennedy, *A Survey of Islamic Astronomical Tables*, Transactions of the American Philosophical Society 46(2) (Philadelphia, 1956), p. 124. On the appropriation of Sasanian imperial ideology in early Abbasid times, see Gutas, *Greek Thought*, pp. 34ff.

new city of Baghdad near the ruins of the ancient sites of Babylon and the Sasanian capital, Ctesiphon. The date for the founding of the city was decided in consultation with a group of astrologers who worked for the caliph; they included a Jew, known as Māshāʾallāh (d. ca. 815), along with Muslims, some of whom were of Iranian background.<sup>15</sup> Māshāʾallāh is not mentioned in Jewish sources until much later, and what little information we have about him comes from Muslim authors.<sup>16</sup> We are told that he was a Jew from Basra, and that his name, given as Mīshā by Ibn al-Qiftī, was probably Menasseh in Hebrew. Māshāʾallāh was one of the principal authorities in astrological matters for Muslims, Jews, and Christians in the Middle Ages. His known works reflect an interest and knowledge of Greek, Syriac, and Pahlavi<sup>17</sup> sources, but nothing specifically Jewish has been found in his voluminous writings. While it is possible that some traces of his Jewish origin may be discovered in his works (not all of which have been carefully studied), it is worth noting that he fully participated in this formative stage of Islamic culture as the bearer of earlier cultures in a context where his own ethnic identity was not a determining factor.

It is certainly the case that Islam in the early Abbasid period was generally tolerant of religious diversity, but something much more surprising happened as well. An intellectual domain was created in which Muslims and non-Muslims could participate equally without compromising their separate identities. The extent of this domain may be difficult to determine, but astronomy and astrology were certainly part of it.<sup>18</sup> The Abbasid caliph most closely associated with astronomy is al-Maʾmūn (reigned: 813–833), who sponsored the first serious set of astronomical observations since antiquity. One member of his team of astronomers was Sanad ibn ʿAlī, a Jewish convert to Islam. Al-Bīrūnī (d. 1048) relates that when the caliph, during a military campaign against the Byzantines, passed by a high mountain, he “ordered [Sanad] to climb that mountain, and to measure at its summit the dip of the sun, [from which] he derived the circumference of the earth.”<sup>19</sup> Al-Bīrūnī



then goes on to give details of the method and comments that, using the same method at the summit of a different mountain, he himself was able to confirm its accuracy. Sanad also composed a set of astronomical tables that does not survive and constructed a number of observational

- <sup>15</sup> See D. Pingree, "The Fragments of the Works of al-Fazārī," *Journal of Near Eastern Studies*, 29 (1970): 103–23, esp. p. 104.
- <sup>16</sup> D. Pingree, "Māshā'allāh," in *Dictionary of Scientific Biography*, ed. C. C. Gillispie (New York, 1970–1980), 9:159–62; E. S. Kennedy and D. Pingree, *The Astrological History of Māshā'allāh* (Cambridge, Mass., 1971).
- <sup>17</sup> Pahlavi, or Middle Persian, was the language of Persia during the period of the Sasanian Dynasty. Māshā'allāh's main Pahlavi source was the *Zīj al-Shāh*, an astronomical handbook that is no longer extant: see Kennedy and Pingree, *Māshā'allāh*, pp. 65f. et passim. For the Pahlavi translation of Ptolemy's *Almagest*, see D. Pingree, *The Thousands of Abū Ma'shar* (London, 1968), p. 13 n. 2; cf. P. Kunitzsch, *Der Almagest: Die Syntaxis Mathematica des Claudius Ptolemäus in arabisch-lateinischer Überlieferung* (Wiesbaden, 1974), pp. 123ff.
- <sup>18</sup> As reported in Muslim sources, there were some scientific and philosophical séances involving Jews, Muslims, and others in Iraq in the tenth century: see Kraemer, *Humanism*, p. 59: "The rules of discussion proscribed appeal to the authority of revelation; each discussant was restricted to arguments derived from reason." Wasserstrom, "Reappraisal," pp. 8–9, cites Shī'ite reports (possibly apocryphal) of the caliph, al-Ma'mūn, meeting with leaders of the Jewish, Christian, Sabean, and Zoroastrian communities, and believes that such meetings took place "in some form." He adds (p. 16) that in early Abbasid times "Jews must have been in contact with non-Jewish individuals and groups who were interested in scientific matters, including the occult sciences," although the precise extent of this "interconfessional activity" is not known. Cf. H. A. Wolfson, *The Philosophy of the Kalam* (Cambridge, Mass., 1976), pp. 89–90.
- <sup>19</sup> Al-Bīrūnī, *The Determination of the Coordinates of Cities*, trans. J. Ali (Beirut, 1966), pp. 185ff.

instruments for the caliph and his astronomers.<sup>20</sup> Muslim sources report that Sanad built a *kanīsa* near the Shammāsīya gate of Baghdad; modern scholars have disputed whether this refers to a synagogue or an astronomical observatory. Suter<sup>21</sup> took it to be a reference to an observatory, but Steinschneider<sup>22</sup> and, following him, Sayili,<sup>23</sup> understood it to be a synagogue, presumably built by Sanad before his conversion to Islam. Indeed, Sayili argued that there is no evidence that a special building served as an observatory at that time. None of the sources discusses the motives for Sanad's conversion, but there is no suggestion that he needed to do so in order to serve the caliph.

A third Jewish intellectual active during the formative period of Islamic science was Sahl ibn Bishr al-Yahūdī, one of the leading astrological scholars of the early ninth century, whose works were studied throughout the Middle Ages.<sup>24</sup> Again, there is nothing in his work to indicate his Jewish background; his references to Māshāʾ allāh are not related to the ethnic affiliation of either of them. For reasons I cannot explain, there were no prominent Jewish astronomers or astrologers in the succeeding generations in Iraq; there was significant Jewish participation in these disciplines subsequently only in Spain. But there was a Jewish astrologer in Baghdad at the end of the ninth century, ʿAlī ibn Dāwūd al-Yahūdī, who is cited for a single work in Arabic that is not extant.<sup>25</sup> A Jewish scholar, Dunash ibn Tamīm of Kairouan (in modern Tunisia), served the Fatimid caliph in North Africa, al-Manṣūr (reigned: 946–952), and wrote in Arabic on astronomy and astrology.<sup>26</sup> Yet the impact of astronomy and astrology on Jewish communities is evident in Jewish sources beginning in the tenth century. Before turning to Jewish sources, however, let us consider two Muslim astronomers of the eleventh century who commented on Jewish scientific achievements, al-Bīrūnī and Ṣāʿid al-Andalusī.

Al-Bīrūnī's most extended discussion of Jewish contributions to science comes in his *Chronology of Ancient Nations*, a work of great

erudition devoted to the various calendars known at that time. Chronology became a scientific discipline in the Islamic world, where an important part of astronomy was the study of methods for converting dates from one calendar to another. Al-Bīrūnī went well beyond the minimum needed for this purpose and explored in detail each of the calendars he considered. In the case of the Jewish calendar,

- <sup>20</sup> E. S. Kennedy, *Survey*, p. 136; A. Sayili, *The Observatory in Islam* (Ankara, 1960), pp. 51–53; A. M. Heinen, “An Unknown Treatise by Sanad ibn ‘Alī on the Relative Magnitudes of the Sun, Earth, and Moon,” *Annals of the New York Academy of Sciences* 500 (1987): 167–74.
- <sup>21</sup> H. Suter, *Die Mathematiker und Astronomen der Araber und ihre Werke* (Leipzig, 1900), p. 13.
- <sup>22</sup> M. Steinschneider, *Mathematik bei den Juden*, 2nd ed. (Hildesheim, 1964), p. b99.
- <sup>23</sup> Sayili, *Observatory*, p. 53.
- <sup>24</sup> Ibn al-Nadīm, *Kitāb al-fibrīst* (Beirut, 1988), p. 333 (in Arabic); Ibn al-Nadīm, *The Fibrīst of Ibn al-Nadīm*, trans. B. Dodge (New York, 1979), p. 651; Suter, *Mathematiker*, p. 15; Sezgin, *Geschichte*, 7:125–28.
- <sup>25</sup> Ibn al-Nadīm, *Fibrīst*, p. 337 (in Arabic), p. 659 (trans. Dodge); Suter, *Mathematiker*, p. 38; Sezgin, *Geschichte*, 7:18, 330. We are told by al-Mas‘ūdī that Thābit ibn Qurra (d. 901) had a Jewish student of mathematics, Judah b. Joseph b. Abī l-Thanna of Raqqa: see Wasserstrom, “Reappraisal,” p. 10 n. 30. Kraemer, *Humanism*, p. 84, argues, on the basis of Muslim sources, that the number of Jews engaged in philosophy was significantly greater than medieval Jewish sources suggest. The same may be said about the number of Jews engaged in astronomy and astrology.
- <sup>26</sup> S. M. [Samuel Miklos] Stern, “A Treatise on the Armillary Sphere by Dunas ibn Tamīm,” in *Homenaje a Millás Vallicrosa* (Barcelona, 1954–56), 2:373–82; Sezgin, *Geschichte*, 6:196; Steinschneider, *Mathematik*, pp. 62–63. Dunash b. Tamīm also wrote a commentary on *Sefer Yeširah*: see, e.g., H. Malter, *Saadia Gaon: His Life and Works* (Philadelphia, 1942), pp. 48–49; G. Vajda, “Dunash ibn Tamim,” *Encyclopaedia Judaica*, 6:271–72.

his description is one of the earliest sources we have, though it has now been pre-empted by another Arabic text, said to have been composed by al-Khwārizmī in the ninth century.<sup>27</sup> It is clear that al-Bīrūnī admired the Jewish calendar, even though he argued that there is sometimes a difference between the Jewish computation and astronomical methods.<sup>28</sup> The passage is not entirely free of anti-Jewish polemics, for we read concerning the *tequfot* (the moments of equinoxes and solstices), that

and on this rule [the Jews] have based their calculations for the determination of the *tequfot* [which were rendered necessary for this reason, that] the Jewish priests forbade the common people to take any food at the hour of the *tequfah*, maintaining that this would prove injurious to the body. This, however, is nothing but one of the snares and nets which the Rabbis have laid for the people, and by which they have managed to catch them and bring them under their sway.<sup>29</sup>

Elsewhere, al-Bīrūnī informs us that

[According to the Jews,] the interval between the expulsion of Adam from Paradise till the deluge in the time of Noah is 1656 years; according to the Christian copy [of the Bible] the same interval is 2242 years, and according to the Samaritan copy it is 1307 years. According to one of the historians, Anianus, the interval between the creation of Adam and the night of the Friday when the deluge commenced is 2226 years 23 days and 4 hours. This statement of Anianus is reported by Ibn al-Bāzyār in his *Kūtab al-Qirānāt* (*Book of the Conjunctions*); it comes very near that of the Christians. However, it makes me think that it is based on the methods of the astrologers, because it betrays evidently an arbitrary and too subtle mode

of research. Now if such is the diversity of opinion, as we have described, and if there is no possibility of distinguishing—by means of analogy—between truth and fiction, where is the student to search for exact information?<sup>30</sup>

Moreover, al-Bīrūnī continues, according to the Jews there were 1792 years from the deluge to the Era of Alexander (i.e., the Seleucid Era),

There are also a large number of astrological fragments in Arabic preserved in the Cairo Geniza, of which only a few have been published. Some are in Arabic script and others in Hebrew script; the earliest is a horoscope dated May 25, 955 (Strasbourg, Bibliothèque Universitaire, MS 4109, f. 5a). See S. D. Goitein, “Religion in Everyday Life as Reflected in the Documents of the Cairo Geniza,” in *Religion in a Religious Age*, ed. S. D. Goitein (Cambridge, Mass., 1974), pp. 3–17, esp. p. 15; B. R. Goldstein and D. Pingree, “Astrological Almanacs from the Cairo Geniza,” *Journal of Near Eastern Studies* 38 (1979): 153–75 and 231–56; B. R. Goldstein and D. Pingree, “Additional Astrological Almanacs from the Cairo Geniza,” *Journal of the American Oriental Society* 103 (1983): 673–90; B. R. Goldstein and D. Pingree, “Horoscopes from the Cairo Geniza,” *Journal of Near Eastern Studies* 36 (1977): 113–44; B. R. Goldstein and D. Pingree, “More Horoscopes from the Cairo Geniza,” *Proceedings of the American Philosophical Society* 125 (1981): 155–89.

<sup>27</sup> See E. S. Kennedy, “Al-Khwārizmī on the Jewish Calendar,” *Scripta Mathematica*, 27 (1964): 55–59; repr. in E. S. Kennedy, *Studies in the Islamic Exact Sciences* (Beirut, 1983), pp. 661–65; and Y. T. Langermann, “When was the Jewish Calendar Established?” *Asupot* 5747/[1987], 1:159–68 (in Hebrew).

<sup>28</sup> Al-Bīrūnī, *The Chronology of Ancient Nations*, trans. C. E. Sachau (London, 1979), p. 159.

<sup>29</sup> *Ibid.*, p. 163.

<sup>30</sup> *Ibid.*, p. 25. The astrologer Ibn al-Bāzyār, none of whose work survives, was a student of Ḥābāsh, a famous ninth-century astronomer: Ibn al-Nadīm, *Fihrist*, p. 334 (Arabic), p. 654 (trans. Dodge). Al-Bīrūnī claimed that astrology was invented by astronomers

whereas “the Christians derive from their Torah for the same period 2938 years. . . . The astrologers have tried to correct these years, beginning from the first of the conjunctions of Saturn and Jupiter. . . .”<sup>31</sup> In fact, according to Jewish tradition 1656 years elapsed from the creation of Adam to the Flood, and this figure was accepted by a Muslim astrologer, al-Tanūkhī. According to the astrologer Abū Maʿshar (d. 886), however, there were about 2226 years between these two epochs.<sup>32</sup> The date of the flood was evidently a matter of controversy in the Islamic world and was often made to depend on astronomical or astrological considerations.<sup>33</sup> In this context, it was surely important for Jews to defend their version of the biblical text; to do so they needed to understand the astronomical and astrological issues that had been raised. Perhaps there is an allusion to such a controversy in a treatise by Abraham Bar Ḥiyya (d. ca. 1136), based on Saadia’s *Sefer ha-hakkarah* (only partially extant), dating from 927 C.E. According to Bar Ḥiyya, “everything you have heard contrary to what we have said, whether it concern the year of the Flood or concern other matters, do not rely on it, for these are false claims (*devarim reqim*).”<sup>34</sup>

Al-Birūnī alludes to an astrological theory according to which historical events are associated with planetary conjunctions. This theory, already described by Māshāʾallāh in the eighth century, had many later adherents, among them such eminent Jewish scholars as Abraham Bar Ḥiyya, Abraham Ibn Ezra, Levi ben Gerson (d. 1344), and Abraham Zacut (d. 1515). Saadia’s view of this theory is unclear; at least I have not found any statement by him in favor or against it. On the other hand, in his *Epistle to Yemen*, Maimonides (d. 1204) attacked the claim made by astrologers that the occurrence of the Flood was due to a planetary conjunction.<sup>35</sup>

Ṣāʿid al-Andalusī (eleventh century, Spain) wrote a classification of the nations, generally translated as *The Categories of the Nations*, in which he distinguished those nations that had cultivated the sciences from those that had not, where “science” is used broadly to cover

as a device for their own protection and is merely a matter of opinion “not based on (intellectual) necessity”: S. Pines, “The Semantic Distinction Between the Terms *Astronomy* and *Astrology* according to al-Bīrūnī,” *Isis* 55 (1964): 343–49, esp. p. 348.

- <sup>31</sup> Al-Bīrūnī, *Chronology* (trans. Sachau), pp. 27–28.
- <sup>32</sup> The date of the Flood in the Jewish tradition, based on the account in Genesis, is given in *Seder Olam* (A. Neubauer, *Medieval Jewish Chronicles* [Oxford, 1887–95], 2:89), an early Rabbinic work on chronology ascribed to Rabbi Jose ben Halafta (2nd century C.E.): see J. M. Rosenthal, “*Seder Olam*,” *Encyclopaedia Judaica* 14:1091–93; Abraham Ibn Daud, *The Book of Tradition*, ed. and trans. G. D. Cohen (Philadelphia, 1967), p. 5. There was a Rabbanite-Karaite dispute concerning the date of Creation, for the beginning of the Seleucid Era (312 B.C.E.) was given by the Rabbanites as 3449 A.M. and by the Karaites as 3475 A.M.: Ibn Daud, *Tradition*, p. 17 n.; commentary by Cohen, p. 151. See also Cohen, p. 108 *ad* 17, for discussion of the addition of one year in Spanish-Jewish sources to Talmudic dates *anno mundi*; according to B *Avodah Zarah* 9a–10a, there were 2448 years from the Creation to the giving of the Torah, and another thousand years to the beginning of the Seleucid Era. Al-Bīrūnī gives the time from Adam to the Seleucid Era, according to the Jews, as 3448 years (= 1656 + 1792); according to the Christians, as 5180 years (= 2242 + 2938). Al-Bīrūnī, *Chronology* (trans. Sachau, p. 18), then adds: “The Christians reproach the Jews with having diminished the number of years with the view of making the appearance of Jesus fall into the fourth millennium in the middle of the seven millennia, which are, according to their view, the time of the duration of the world, so as not to coincide with that time at which, as the prophets after Moses had prophesied, the birth of Jesus from a pure virgin at the end of time, was to take place.” The astrological work by Abū l-Abbās al-Tanūkhī, whose dates are unknown, is preserved in a fourteenth-century Arabic text: see Pingree, *Thousands*, pp. 25, 38.
- <sup>33</sup> Pingree, *Thousands*, pp. 34ff.; Kennedy and Pingree, *Māshā'allāh*, pp. 74ff.; D. Pingree, “The Indian and Pseudo-Indian Passages in Greek and Latin Astronomical and Astrological Texts,” *Viator* 7 (1976): 141–95, esp. p. 149.
- <sup>34</sup> Abraham Bar Ḥiyya, *Sefer ha-Ibbur*, ed. H. Filipowski (London, 1851), p. 98. Saadia’s *Sefer ha-bakkarah* is mentioned on p. 96 (next to last line), and the date on p. 97, line 1 (1238 Seleucid Era); cf. Malter, *Saadia*, pp. 263f., 380ff. A chapter of

various branches of scholarship. According to Šāʿid, only eight nations cultivated the sciences, and one of them is the “Hebrews” (*al-ʿIbrānīyūn*).<sup>36</sup> He devotes a chapter to the “Banū Isrāʾīl” in which he describes the Jewish calendar, adding that “I do not know if it is the product of their own scientists or if they have adopted it from the scientists of another [race].”<sup>37</sup> He then mentions specific individuals, including Sahl ibn Bishr, Saadia, and a number of Andalusian Jews. Incidentally, Sanad ibn ʿAlī is mentioned among the eastern Muslims, but nothing is said about his Jewish origin.<sup>38</sup> Šāʿid does not indicate that any Jews collaborated with him or with other Muslim astronomers, although he mentions several Jewish scholars with whom he was in personal contact. But Isaac Israeli of Toledo (fl. 1310) tells us that there were twelve astronomers in Toledo with “Ben Šāʿid” (from the context, this is clearly Šāʿid al-Andalusī), most of them Arabs (*lit.* Ishmaelites) and a few Jews.<sup>39</sup> Nevertheless, we know the name of one Jewish astronomer of the eleventh century from later references to him: Isaac ben Barukh Ibn Albalia (d. 1094), who served for 20 years as astrologer to King Muʿtamid of Seville (1069–1091).<sup>40</sup>

In addition to their Muslim neighbors’ generally favorable response to the Jews’ interest in astronomy, there were internal reasons for their study of astronomy and astrology. In the early centuries of Islam, the main intellectual battle in the Jewish world took place between Karaites and Rabbanites.<sup>41</sup> As is well known, the Karaites did not accept the rabbinic tradition and had a different understanding of many biblical passages.<sup>42</sup> One of the key elements in the dispute involved the fixed Rabbanite calendar, to which the Karaites raised several objections. First, they objected to the 19-year intercalation cycle intended to maintain the months in the appropriate seasons. They too would not allow the months to wander throughout the solar year, as in the Muslim calendar, but argued that the month of Nisan and the festival of Passover should be determined only by the ripening of barley in the Land of Israel. Second,



Saadia's *Kitāb al-tamyīz* (as the Arabic original of *Sefer ha-hakkarah* is called) was published in M. Zucker, *Saadya's Commentary on Genesis* (New York, 1984), pp. 436–47. This chapter has many polemical remarks about the calendar, but not the passage cited by Bar Ḥiyya. For other evidence concerning Saadia's views on the calendar (some specifically ascribed to his *Kitāb al-tamyīz*) and Karaite responses to it, see S. Poznanski, *The Karaite Literary Opponents of Saadia Gaon* (London, 1908), pp. 23, 38ff, 94ff, 102.

- <sup>35</sup> See B. R. Goldstein, "The Book on Eclipses of Māshā'allāh," *Physis* 6 (1964): 205–13; B. R. Goldstein and D. Pingree, *Levi ben Gerson's Prognostication for the Conjunction of 1345*, Transactions of the American Philosophical Society 80(6) (Philadelphia, 1990); M. Beit-Arié and M. Idel, "Treatise on Eschatology and Astrology by R. Abraham Zacut," *Kiryat Sefer* 54(5739/1979): 174–94 (in Hebrew); I. Twersky, *A Maimonides Reader* (New York, 1972), p. 455. Y. T. Langermann has recently called attention to a passage which clearly implies that, in the view of Maimonides, there was a grand conjunction of the seven planets at Aries 0° at the time of creation: Maimonides, *Mishneh Torah, Hilḥot Berakot* 10:18. Although there are other examples of horoscopes of creation, this set of positions was generally associated in early Islamic times with the conjunction preceding the Flood (see Y. T. Langermann, "Maimonides and Astronomy: Some Further Reflections," Essay IV in Langermann, *The Jews and the Sciences*, pp. 11–12).
- <sup>36</sup> Ṣā'īd al-Andalusī, *Ṭabaqāt al-Umam*, ed. Ḥayāh Bū 'Alwān (Beirut, 1985), p. 40; idem, *Science in the Medieval World: Book of Categories of Nations*, trans. S. I. Salim and A. Kumar (Austin, 1991), p. 6; idem, *Kitāb Ṭabakāt al-Umam (Livre des catégories des nations)*, trans. R. Blachère (Paris, 1935), p. 35.
- <sup>37</sup> Ṣā'īd, *Categories* (trans. Salim and Kumar), p. 79; idem, *Ṭabaqāt*, p. 201. I have added brackets around the word "race" since there is nothing corresponding to it in the Arabic text, despite the translation by Salim and Kumar. Cf. Ṣā'īd, *Categories* (trans. Blachère), p. 155.
- <sup>38</sup> Ṣā'īd, *Ṭabaqāt*, p. 133; idem, *Categories*, p. 47 (trans. Salim and Kumar), p. 104 (trans. Blachère).
- <sup>39</sup> Isaac Israeli, *Liber Jesod Olam*, ed. B. Goldberg and L. Rosenkrantz, 2 vols. (Berlin, 1846–48), book iv, chap. 7, 2:11a (Hebrew); L. Richter-Bernburg, "Ṣā'īd, the *Toledan*

they argued that the New Moon should be determined by the first visibility of the lunar crescent, rather than by arithmetic rules as in the Rabbanite practice. This parallels the Muslim dependence on direct observation for the beginning and end of the month of Ramadan. Third, the Rabbanites of Iraq celebrated a second day of the festivals, whereas the Rabbanites in the Land of Israel adhered to the biblical prescription of a single day. As al-Qirqisānī, a leading Karaite of the tenth century, put it,

thus in the opinion of the people of Iraq [*lit.* Babylonia] the people of the Land of Israel [*lit.* Syria] profane the holidays and transgress the commandment “Thou shalt not diminish [from it],” whereas in the opinion of the people of the Land of Israel the people of Iraq observe feasts not enjoined by God and transgress His commandment “Thou shalt not add thereto” [Deut. 13.1].<sup>43</sup>

No appeal to astronomy is needed to compute dates in the Rabbanite calendar, since the rules (though complex) are all arithmetical and do not require observations of any kind. Defending the calendar, however, involved a great deal of astronomical knowledge, for the Rabbanites argued that the ancient rabbis followed rules that conform to the motions of the sun and the moon. The Rabbanite defense of the calendar was not uniform. Saadia (tenth century) wrote a treatise, *Sod ha-<sup>c</sup>Ibbur*, that survives only in quotations by others; his view, as reported by al-Qirqisānī, was either that the calendrical rules went back to Adam, or, as he seemed to suggest elsewhere, that they went back to Moses with a computation starting from Adam. For a Karaite, Saadia’s claims were absurd and the target of sarcastic remarks.<sup>44</sup> Nevertheless, there was a precedent for them, since the *Chapters of Rabbi Eliezer* suggest that the calendrical rules go back to Adam and were transmitted from him to succeeding generations.<sup>45</sup> On the other hand, Hai Gaon (d. 1038) reported that the calendrical rules were first made public by Hillel

II, the patriarch in the Land of Israel, in 359 CE;<sup>46</sup> however, no such document by Hillel II is extant and it is unclear precisely what he said about the calendar. No less a Rabbanite authority than Maimonides disputed claims for the great antiquity of the calendrical rules:

I am truly astonished over a personage [presumably Saadia] who rejects clear evidence, asserting that the religion of Israel

*Tables, and Andalusī Science,*” *Annals of the New York Academy of Sciences* 500 (1987): 373–401, esp. pp. 374–76.

- <sup>40</sup> Steinschneider, *Mathematik*, pp. 75ff.; Ibn Daud, *Tradition*, pp. 78–81; Abraham Ibn Ezra, *Sefer ha-ʿIbbur* (Lyck, 1874), f. 10b; on Muʿtamid, see H. Kennedy, *Muslim Spain and Portugal* (London, 1996), pp. 164, 310.
- <sup>41</sup> Other Jewish sects also differed with the Rabbanites on a variety of issues, including the calendar. For example, the Mishawites, followers of Mishawayh al-ʿUkbarī (Iraq, ninth century), insisted on a solar calendar of 364 days such that the festivals fall on fixed days of the week, as in the calendar of the *Book of Jubilees*: see Z. Ankori, *Karaites in Byzantium* (New York, 1959), pp. 372 ff. There were also disputes within the Rabbanite community, notably in the tenth century, between Saadia and Ben Meir, over details of the fixed calendar system: see, e.g., Malter, *Saadia*, pp. 69ff.; A. A. Lasker and D. J. Lasker, “642 Parts: More Concerning the Saadia-Ben Meir Controversy,” *Tarbiz* 60 (1990): 119–28 (in Hebrew); Ankori, *Karaites*, pp. 306f.
- <sup>42</sup> See e.g., L. Nemoy, *Karaite Anthology* (New Haven, 1952); U. Simon, *Four Approaches to the Book of Psalms*, trans. Lenn J. Schramm (Albany, 1991), pp. 59–111.
- <sup>43</sup> L. Nemoy, “Al-Qirqisānī’s Account of the Jewish Sects and Christianity,” *Hebrew Union College Annual* 7 (1930): 317–97, esp. p. 381.
- <sup>44</sup> See Maimonides, *Sanctification of the New Moon*, trans. S. Gandz, introduction by J. Obermann, and an astronomical commentary by O. Neugebauer (New Haven, 1956), introduction by Obermann, p. lii.
- <sup>45</sup> *Pirḳê de Rabbi Eliezer* (trans. Friedlander), p. 52.
- <sup>46</sup> Maimonides, *Sanctification*, introduction by Obermann, p. liii.

was based, not on observation of the new moon, but on calculation alone—and yet he affirms the authority of all these passages [concerning observation of the new moon]. I think indeed that he did not believe his own assertions, but he merely wished to repel his [Karaites] adversary by any notion that just occurred to him, be it true or false. . . . Now this secret of the calendar that the Holy One, Blessed be He, entrusted to Moses on Sinai involves computation of the limits of the arc of vision by true astronomical values, while astronomers and philosophers of various nations hold diverse opinions about it, and even to this day their controversies have continued and the correct values [for the arc of vision] have remained unclear to them.<sup>47</sup>

In other words, Maimonides set aside the claims made about the calendar by both Saadia and his Karaite opponents, arguing instead that Moses was aware of the astronomical criteria for determining the visibility of the lunar crescent, a subject of interest to Muslim as well as Jewish astronomers.<sup>48</sup> In his treatise, *Sanctification of the New Moon*, Maimonides devoted one section to the criteria for the visibility of the lunar crescent, arguing that it was necessary to know these matters in the period when the Jewish calendar was determined by observation, and adds:

As regards the logic for all these calculations . . . all this is part of the science of astronomy and mathematics, about which many books have been composed by Greek sages—books that are still available to the scholars of our time. But the books which had been composed by the Sages of Israel have not come down to us. [However,] since all these rules have been established by sound and clear proofs, free from any flaw and irrefutable, we need not be concerned about the identity of the

authors, whether they were Hebrew prophets or gentile sages.<sup>49</sup>

Here Maimonides supports the notion that scientific truth is independently verifiable and is not the property of any particular community.

Maimonides also gives an account of the second day of the festivals that has the ring of a true historical account, with nothing polemical in it.<sup>50</sup> But it can also be understood as a response to the Karaite attack of al-Qirqisānī (mentioned above). Maimonides tells us that

In the time of the Synedrium, when New Moon Days were determined by observation, the rule was as follows: The people in Palestine and in places that could be reached in ample time by the messengers of Tishri, celebrated (each of) the holidays one day only; while those living in more distant places that could not be reached in time by the messengers of Tishri used to celebrate the holidays for two days, because they were in doubt, inasmuch as they did not know which day the Palestinian court had declared as New Moon Day. But in our times when no Synedrium exists and the Palestinian court

<sup>47</sup> Maimonides, *Commentary on the Mishna*, quoted in Maimonides, *Sanctification*, introduction by Obermann, p. liv.

<sup>48</sup> See, e.g., D. A. King, "Some Early Islamic Tables for Determining Lunar Crescent Visibility," *Annals of the New York Academy of Sciences* 500 (1987): 185–225; J. P. Hogendijk, "Three Islamic Lunar Crescent Visibility Tables," *Journal for the History of Astronomy* 19 (1988): 29–44; Maimonides, *Sanctification*, commentary by Neugebauer, pp. 136ff.

<sup>49</sup> Maimonides, *Sanctification* (chap. 17:25), p. 73.

<sup>50</sup> Cf. Sternberg, introd., pp. xxix f.

itself determines the calendar by calculation, it might seem proper that the Jews of all countries, even of the more distant countries of the Dispersion, need celebrate the holidays one day only, just as the Jews of Palestine do—seeing that all follow the same method in determining the calendar. The Sages, however, have seen fit to decree that the Jewish communities adhere to what had been the custom of their ancestors.<sup>51</sup>

Let us return now to the tenth century, the time of Saadia Gaon, the leading Rabbanite thinker of the time and a major target of Karaite fury. Saadia's earliest known polemical work was directed against ḥAnan ben David, the eighth-century founder of the Karaite sect, and anti-Karaite polemic is a "conspicuous feature in most of Saadia's writings."<sup>52</sup> Saadia is perhaps best known today for his philosophical work written in Arabic, *The Book of the Choicest Beliefs and Opinions*, which is closely related to *kalām*, as the theological works of the Muslims are called.<sup>53</sup> Saadia was not the first Jewish scholar in the Islamic world to incorporate philosophy into Judaism, but his work was probably the most influential in persuading Rabbanites that they had nothing to fear from contact with the philosophical ways of thinking in the surrounding Muslim culture. On the contrary, philosophy and science serve as support for the principles of Judaism, so that study of these subjects is a religious obligation. For example, in one passage Saadia remarks:

What is meant by the verse under discussion [Isa. 44:8: "Fear ye not . . ."] is therefore: "There is no wise or distinguished man that I [God] do not know. Hence it is impossible that he should be able to produce an argument against you [Israelites] in the matter of your religion or do injury to your creed, because My knowledge is all-embracing and I have imparted it to you." In this way then—may God be merciful unto thee—do

we conduct our speculation and inquiry, to the end that we may expound concretely by means of rational intuition and logical inference what our Master has imparted to us. With this thesis, however, there is intimately bound up a point that we cannot avoid [bringing up]. It consists of the question: Inasmuch as all matters of religious belief, as imparted to us by our Master, can be attained by means of research and correct speculation, what was the reason that prompted [divine] wisdom to transmit them to us by way of prophecy and support them by means of visible proofs and miracles rather than intellectual demonstrations?<sup>54</sup>

In Saadia's commentary on *The Book of Creation* he introduces both astronomy and astrology in a context that could only be understood as favorable to their study. After giving the date on which he was writing a particular passage in this commentary, he adds a list of the planetary positions at that time—computed according to an unnamed set of

<sup>51</sup> Maimonides, *Sanctification* (chap. 5:4–5), p. 23.

<sup>52</sup> Malter, *Saadia*, pp. 262 f; cf. D. J. Lasker, "Saadya Gaon on Christianity and Islam," in *The Jews of Medieval Islam*, ed. D. Frank (Leiden, 1995), pp. 165–77. For a general survey, see Y. T. Langermann, "Sa' adya and the Sciences."

<sup>53</sup> See Wolfson, *Kalam*; Malter, *Saadia*; Saadia Gaon, *The Book of Beliefs and Opinions*, trans. S. Rosenblatt (New Haven, 1948).

<sup>54</sup> *Ibid.*, pp. 30–31. For the Arabic text with a Hebrew translation, see Saadia, *Kitāb al-mukhtār min al-amānāt wa-l-i'tiqādāt/ha-Nivḥar ba-'emunot u-va-de'ot*, ed. Y. Kafih (Jerusalem, 1970), p. 27. Saadia argues in favor of the study of philosophy and science as a religious obligation throughout the introduction: see *Beliefs and Opinions*, pp. 18–33. Some of Saadia's examples are taken from geometry (*ibid.*, p. 23), and astronomy (*ibid.*, pp. 26, 42). Cf. H. A. Davidson, "The Study of Philosophy as a Religious Obligation," in *Religion in a Religious Age*, ed. Goitein, pp. 53–68.

astronomical tables (*zij*), almost certainly the *zij* of al-Khwārizmī or one closely related to it.<sup>55</sup> He then considers the astrological implications of this list of planetary positions, alluding to astrological indications (or influences) without specifying them (see Appendix 1). As we have seen, Jewish interest in astrology antedated Saadia; but, so far as I am aware, he was the first prominent Rabbanite scholar in the Islamic world to engage in horoscopic astrology, where the planetary positions are located in “houses” with respect to the horizon.<sup>56</sup> Saadia does not indicate whether astrological influences apply to communities or to individuals—standard astrological theory was applied to both. But by placing his remarks in a commentary on a book that many thought went back to Abraham, he was legitimizing the study of both astronomy and astrology in the context of a religiously significant work. On the other hand, the following passage in Saadia’s main philosophical work suggests a negative view of some astrological doctrines:

How, furthermore, [can a person] cherish the hope that he may succeed in resisting either the decrees of fate, if the doctrine of the fatalists be accepted, or the influence of the stars, if the theory of the astrologers be followed, or maintain the vain hope to resist the decision of the Creator of the heavens and the earth, if the view of the seekers of vengeance (*ahl al-hiqd*: *lit.* the people of hatred) be adopted? [Are they not foolish] to imagine that they are beyond God’s control?<sup>57</sup>

I think it likely that the astrological doctrine being attacked is either the claim that the planetary ruler of the day or hour determines favorable and unfavorable times for certain activities or the claim that the planetary ruler of the hour in which a person is born influences his or her life. Both alternatives are discussed in the Talmud: the first is treated more positively than the second.<sup>58</sup> But this passage is by no means a



categorical rejection of the sophisticated doctrines of horoscopic astrology, which differ considerably from simple appeals to the planetary rulers of days or hours.

In a later passage, Saadia supports the quest for scientific knowledge, including knowledge of the stars and the celestial orbs, but adds that it is inappropriate to devote oneself exclusively to such matters:

Exclusive preoccupation with physical science would constitute an abandonment of the cultivation of the science of religion and religious law, whereas the only reason why the love of the former has been implanted in man is in order that it

<sup>55</sup> H. Suter, *Die astronomischen Tafeln des Muḥammed ibn Mūsā al-Khwārizmī* (Copenhagen, 1914); O. Neugebauer, *The Astronomical Tables of al-Khwārizmī* (Copenhagen, 1962).

<sup>56</sup> Cf. Shabbetai Donnolo (tenth century, southern Italy), *Ḥaḳmoni*; and *Baraita de-mazzalot*, which, according to Sarfatti, may also have been written by Shabbetai Donnolo; see G. B. Sarfatti, "An Introduction to 'Barayta de-mazzalot,'" *Bar Ilan Annual* 3 (5725/1965): xiii-xiv, 56-82 (in Hebrew with English summary). Both of these texts include much more detailed astrological information than Saadia presents. See also A. Sharf, *The Universe of Shabbetai Donnolo* (New York, 1976).

<sup>57</sup> Saadia, *Beliefs and Opinions*, p. 392 (trans. Rosenblatt, slightly modified), p. 313 (ed. Kafih). The chapter concerns "the satisfaction of the thirst for revenge" (trans. Rosenblatt, p. 390), and in it we are told that "he [who seeks revenge] is not even deterred by the necessity of having to forsake his Master and His service in order to realize his ambition" (ibid., p. 391). Hence Kafih's Arabic text that has *al-ḥiqd* is to be preferred over the reading *al-ḥaqq* ('the truth'), which underlies the medieval Hebrew translation by Judah Ben Tibbon and is accepted by Rosenblatt. Note that Altmann, "Astrology," p. 791, included Saadia in a list of prominent medieval Jewish scholars who accepted astrology.

<sup>58</sup> See B *Shabbat* 129b and 156a; J *Shabbat* 6:9; cf. Beller, "Jewish Astronomy," p. 65.

might support the latter, both together making an excellent combination.<sup>59</sup>

One of the leading Hebrew poets and philosophers in eleventh-century Spain was Solomon Ibn Gabirol. His long poem, *Keter malkut* (*The Royal Crown*), incorporates a considerable amount of astronomy and astrology that seems to be based on the *Rasāʾil Ikhwān al-Ṣafāʾ*, a tenth-century Arabic encyclopedia introduced into Muslim Spain at the end of the tenth century (or the beginning of the eleventh century) and quite popular there.<sup>60</sup> According to Abraham Ibn Ezra's commentary on Daniel 11:31, Ibn Gabirol also "wished to associate (*liqšor*; *lit.* 'to tie' or 'to bind') the 'end' [of days] with the great conjunction of the two superior planets [i.e., Jupiter and Saturn]." Elsewhere, Ibn Ezra tells us that a great conjunction takes place when Jupiter and Saturn return to the beginning of Aries, which happens about every thousand years.<sup>61</sup> It has been claimed that Ibn Gabirol was the first Jewish scholar to appeal to astrological calculation for determining the "end of days."<sup>62</sup> Abraham Bar Ḥiyya (twelfth century, Spain) developed a variant of this theory, involving a conjunction of Jupiter and Saturn in the year 1345 CE (not a great conjunction), which was to have messianic significance, and coordinated this theory with his interpretation of Daniel.<sup>63</sup> Later in his commentary on Daniel 11:31, Ibn Ezra adds that these astrological theories for determining the date of messianic fulfillment, which he explicitly ascribes to Ibn Gabirol and Abraham Bar Ḥiyya (whom he refers to as Abraham *ba-naṣīʾ*), are completely worthless, as are many other theories to which he alludes. He supports his position from the text of Daniel itself: "For Daniel did not know [the date of] the 'end' [of days]."<sup>64</sup>

Finally, let us consider Judah Halevi (twelfth century, Spain), who was an outspoken but knowledgeable critic of philosophy. He also engaged in polemics against the Karaites,<sup>65</sup> and the calendar was one of the issues he addressed.

- <sup>59</sup> Saadia, *Beliefs and Opinions* (trans. Rosenblatt, p. 394). Astronomical topics unrelated to the calendar are also discussed in Saadia's commentary on the Pentateuch. See, for example, Zucker, *Saadya*, pp. 38ff. (Arabic), 230ff. (Hebrew), where one of the topics is the length of daylight as a function of geographical latitude. See also G. Freudenthal, "Stoic Physics in the Writings of R. Saadia Ga'on al-Fayyumi and its Aftermath in Jewish Mysticism," *Arabic Sciences and Philosophy* 6 (1996): 113–36.
- <sup>60</sup> See R. Loewe, "Ibn Gabirol's Treatment of Sources in the *Kether Malkuth*," in *Studies in Jewish Religious and Intellectual History Presented to Alexander Altmann*, ed. S. Stein and R. Loewe (Tuscaloosa, 1979), pp. 183–94, esp. pp. 186–89, which contains a long quotation from a letter by me (and acknowledged by Loewe). As an example of an astrological allusion in that poem, it is said of Mars that it is responsible for wars, destruction, dearth, etc.: I. Zangwill and I. Davidson, *Selected Religious Poems of Solomon Ibn Gabirol* (Philadelphia, 1923/1974), p. 96; cf. R. Levy and F. Cantera, *Abraham Ibn Ezra: The Beginning of Wisdom* (Baltimore, 1939), p. 197 (Hebrew text: p. xlvi). For the introduction of the *Rasā'il* into Muslim Spain, see Šā'id, *Ṭabaqāt*, p. 172; *Categories*, p. 65 (trans. Salim and Kumar), p. 132 (trans. Blachère); Samsó, *Ciencias*, p. 259.
- <sup>61</sup> Abraham Ibn Ezra, *Sefer ha-'Olam*, ed. J. L. Fleischer (Homonna, 1937; repr. Jerusalem, 5730/[1970]), p. 8, five lines from the bottom.
- <sup>62</sup> A. H. Silver, *A History of Messianic Speculation in Israel* (Boston, 1927/1959), p. 64. See also J. Schirmann, *The History of Hebrew Poetry in Muslim Spain*, edited, supplemented, and annotated by E. Fleischer (Jerusalem, 1995), p. 326 n. 379 (in Hebrew), where the following verse in a poem by Ibn Gabirol is said to indicate his rejection of such computations: Zangwill and Davidson, *Ibn Gabirol*, p. 71 (my translation), "Is there no man in white linen whom one can ask to reveal [the time of] the end? But God commanded: seal up and close the matter!" (cf. Dan. 12:4, 6).
- <sup>63</sup> Abraham Bar Hiyya, *Megillat ha-megalleh*, ed. A. Poznanski and J. Gutmann (Berlin, 1924); cf. Silver, *Speculation*, pp. 71 ff.
- <sup>64</sup> Levi ben Gerson also rejected the claim for messianic significance of the Saturn-Jupiter conjunction of 1345; cf. Goldstein and Pingree, *Levi ben Gerson's Prognostication*, pp. 4–5.
- <sup>65</sup> See Judah Halevi, *The Kuzari, An Argument for the Faith of Israel*, trans. Hartwig

The members of the Synhedrion were bound not to let any science—whether it be true, illusory, or conventional—escape their knowledge, magic and language included. . . . All branches of science were required for the practice of law. . . . The rules of intercalation as handed down by the House of David, based on the revolutions of the moon, are truly wonderful. Though hundreds of years have passed, no mistake has been found in them, while the observations of Greek and other astronomers are not faultless. . . . In the same manner our sages were, without doubt, acquainted with the revolutions of the sun and the other planets.<sup>66</sup>

The basis for all these claims are not explicit, but Halevi does call attention to the *Chapters of Rabbi Eliezer* which is probably his source.<sup>67</sup>

Halevi attacks the Karaites directly in the following passage:

The view of the Rabbis is based on the tradition of the Prophets; the [Karaites], however, on speculation alone. The Sages are in concord, the Karaites in discord. The sayings of the Sages originate with “the place which God shall choose,” and we must therefore accept even their individual opinions. The Karaites have nothing of the kind. I wish I knew their answer regarding the calculation of the new moon. I see that their authorities follow Rabbanite practice in the intercalation of a second [month of] Adar. Nevertheless, they taunt the Rabbanites about the sighting of the new crescent of [the month] Tishri (*ru'yat hilāl tishri*), with the question: “How could it happen that you [once] kept the fast of the Day of Atonement on the *ninth* of Tishri?” Truly, they should be ashamed of themselves! [How dare they reproach us for an illusory difference of a day], while they do not know whether

that very month is Elul or Tishri, in case of intercalation, or whether it is Tishri or Marḥeshvan, if they do not intercalate the year!<sup>68</sup>

Halevi is alluding to the Karaite practice of depending on observation for the declaration of the New Moon and of determining the need for an intercalary month on the ripening of barley in the Land of Israel (although some Karaites accepted Rabbanite rules for the 19-year intercalation cycle). He advocates the Rabbanite practice of depending on calculation alone.<sup>69</sup>

In another passage, Halevi defends the importance of astronomical knowledge:

Hirschfeld, introduction by H. Slonimsky (New York, 1905/1964), pp. 167ff., 187, 248.

<sup>66</sup> Judah Halleivi, *Sefer ha-Kuzari*, ed. and trans. Y. Kafih (Arabic text with a new Hebrew translation (Qiryat Ono, 5757 [1997]), pp. 78–80; pp. 121–123 (trans. Hirschfeld); pp. 76–77 (trans. Ch. Touati [Louvain and Paris, 1994]). The relationship of scientific discussions with the legal tradition in Judaism has yet to be fully explored. For the corresponding situation in medieval Islam, see D. A. King, *Astronomy in the Service of Islam* (Brookfield, Vermont, 1993). There are important differences between Judaism and Islam in these matters; e.g., in Islam there was a substantial literature on the astronomical determination of prayer times, including extensive tables for this purpose, but little of the kind has been found in medieval Jewish sources. As far as I have been able to determine, the earliest tables for the duration of twilight in a Jewish source appear in a rather rare book by B. Cohn, *Tabellen enthaltend die Zeitangaben für den Beginn der Nacht und des Tages... für den jüdischen Ritus* (Strassburg, 1899).

<sup>67</sup> *Kuzari*, trans. Hirschfeld, p. 242.

<sup>68</sup> *Kuzari*, p. 122 (Kafih), p. 170 (Hirschfeld); pp. 120–21 (Touati); see also the translation in Ankori, *Karaites*, p. 345.

<sup>69</sup> Ankori, *Karaites*, pp. 307f., 346ff.

The time when the Moon is not visible prior to the *Molad* [mean conjunction of the Sun and the Moon] and immediately after it also, [can only be calculated] with a great deal of the science of astronomy (*‘ilm al-bayʿa*; *lit.* the science of the form [of the heavens]). Similarly, correctly determining the cardinal points of the year (*al-taḥwīl*), i.e., the four *tequfot* [the equinoxes and solstices], requires for its perfection knowledge of the [solar] perigee and apogee and the various [right and oblique] ascensions (*al-maṭāliʿ*). He who occupies himself [with this study] must also bring to bear on it the rest of the science of astronomy (*‘ilm al-falak*; *lit.* the science of the orb).<sup>70</sup>

This is clearly a case of appropriation of scientific knowledge into the Jewish tradition. In this regard Halevi is following the antecedent philosophical movement in the Jewish community. At the same time, Halevi denied the truth of the rules of astrology while acknowledging celestial influences on terrestrial matters:

We cannot deny that the heavenly realm (*al-‘ulwīyāt*) exercises influence on terrestrial matters. We must admit that the material components of growth and decay are dependent on the orb (*al-falak*), . . . [but] the particulars are unknown to us. The astrologer boasts of knowing them, but we repudiate [his claims], and assert that no mortal can fathom them.<sup>71</sup>

Moreover, Halevi gave quite a different interpretation to the passage in *The Book of Creation* that Saadia took as his point of departure for introducing astrological considerations. For Halevi it merely supported the notion of general influences of the celestial realm on the terrestrial realm and was not an endorsement of any astrological theory.

[*The Book of Creation*, chap. 2.5], then, indicates that the revolution of the orb (*dawarān al-falak*) is the cause of the variety of things, with the following words, “The orb turns forward and backward.”<sup>72</sup>

Despite this apparent opposition to astrology, in another passage Halevi ascribes astrological terms to the *Chapters of Rabbi Eliezer*, a text that he clearly venerates (see Appendix 2).<sup>73</sup> Surprisingly, these topics are not covered in the published version of the *Chapters of Rabbi Eliezer*.<sup>74</sup> They correspond more closely to the topics in the chapters on

<sup>70</sup> *Kuzari*, p. 186 (Kafih), p. 242 (Hirschfeld), p. 188 (Touati). For various names of astronomy in Arabic see, e.g., F. J. Ragep, *Naṣīr al-Dīn al-Ṭūsī's Memoir on Astronomy* (New York and Berlin, 1993), pp. 34f.; and D. Pingree, “*ilm al-hay'a*,” in *Encyclopaedia of Islam*, 2nd ed. (Leiden, 1971), 3:1135–38.

<sup>71</sup> *Kuzari*, p. 162 (Kafih), p. 215 (Hirschfeld). On Halevi's attitude to astrology, cf. Y. T. Langermann, “Some Astrological Themes in the Thought of Abraham Ibn Ezra,” in *Rabbi Abraham Ibn Ezra: Studies in the Writings of a Twelfth-Century Polymath*, ed. I. Twersky and J. M. Harris (Cambridge, Mass., 1993), pp. 28–85, esp. p. 71. On Halevi's approach to the sciences, see Y. T. Langermann, “Science and the *Kuzari*,” *Science in Context* 10 (1997): 495–522.

<sup>72</sup> *Kuzari*, p. 182 (Kafih), p. 237 (Hirschfeld). As Idel points out, “The fact that Maimonides totally ignored the existence of [*The Book of Creation*] can be taken as a silent polemic [against it]:” M. Idel, “Jewish Thought in Medieval Spain,” in *The Sephardi Legacy*, ed. H. Beinart (Jerusalem, 1992), 1:261–81, esp. p. 264.

<sup>73</sup> *Kuzari*, p. 189 (Hirschfeld). Maimonides shared Halevi's enthusiasm for the *Chapters of Rabbi Eliezer*, but did not associate this treatise with astrology: see Maimonides, *The Guide of the Perplexed*, trans. S. Pines (Chicago, 1963), pp. 61, 149, 174, 330, 332.

<sup>74</sup> Cf. *Kuzari*, trans. Touati, p. 188n.: According to the commentary of David Luria, this passage “demonstrates that our present text of *Pirquei [de-Rabbi Eliezer]* is incomplete.”

astronomy in the *Rasā'il Ikhwān al-Ṣafā'*.<sup>75</sup> But these terms are certainly not unique to the *Rasā'il*; hence it is not possible to specify Halevi's source (and whether it was in Hebrew or Arabic).

Halevi's generally negative attitude towards astrology was reinforced by Maimonides (d. 1204), who went so far as to say that astrology is both false and idolatrous. Yet Maimonides still accepted general influences of the heavens on the Earth.<sup>75</sup> Maimonides did not associate astronomy with astrology, for he deemed the study of astronomy to be praiseworthy:

Know, my masters, that the science of the stars that is genuine science is knowledge of the form of the spheres, their number, their measure, the course they follow, each one's period of revolution, their declination to the north or to the south, their revolving to the east or to the west, and the orb of every star and its course. On all this and the like, the wise men of Greece, Persia, and India wrote compositions. This is an exceedingly glorious science. . . . But as for the assertions of the stupid astrologers, they are nothing.<sup>76</sup>

In sum, Jewish interest in astronomy and astrology in the early Islamic period was due in large measure to the general attractiveness of Islamic culture and the openness of Muslims to cooperation in scientific matters with their subject populations. In addition, astronomy played a significant role in the calendrical disputes between Rabbanites and Karaites. Moreover, as we have seen, Jews appropriated aspects of the Muslim scientific tradition, as Muslims had previously done to the Greek tradition.

By the twelfth century, Jewish thinkers clearly distinguished astronomy from astrology. Some rejected astrology in one way or another, while others, such as Abraham Ibn Ezra, became leading authorities on astrological matters for later generations of scholars, both



Jewish and non-Jewish.<sup>77</sup> After the twelfth century, the main centers of Jewish learning were in the Christian world, and both astronomy and astrology came to serve a number of different purposes in a very different cultural context. But that story lies beyond the scope of this paper.<sup>78</sup>

- <sup>75</sup> See G. Freudenthal, "Maimonides' Stance on Astrology in Context: Cosmology, Physics, Medicine, and Providence," in *Moses Maimonides: Physician, Scientist, and Philosopher*, ed. F. Rosner and S. S. Kottek (Northvale and London, 1993), pp. 77–90; Y. T. Langermann, "Maimonides' Repudiation of Astrology," *Maimonidean Studies* 2 (1991): 123–58; Maimonides, *Guide*, ii.5 (trans. Pines, p. 261); Twersky, *Maimonides*, pp. 464 ff. Although Maimonides does not mention Halevi, there is some evidence to suggest that Maimonides was responding to the views of his predecessor: see H. Kreisel, "Judah Halevi's Influence on Maimonides: A Preliminary Appraisal," *Maimonidean Studies* 2 (1991): 95–121 (and the literature cited there).
- <sup>76</sup> Maimonides, "Letter on Astrology," trans. in Twersky, *Maimonides*, pp. 466f.
- <sup>77</sup> See B. R. Goldstein, "Arabic Astronomy and Astrology in the Works of Abraham Ibn Ezra," *Arabic Sciences and Philosophy* 6 (1996): 9–21; and Langermann, "Abraham Ibn Ezra."
- <sup>78</sup> For this period, see G. Freudenthal, "Science in the Medieval Jewish Culture of Southern France," *History of Science* 33 (1995): 23–58; while I greatly admire Freudenthal's erudition, I would interpret some of the data differently.

## Appendix 1

A translation of the Arabic text of Saadia's  
Commentary on *Sefer Yeşira*  
ed. Y. Kafih

(Jerusalem 5732 [1972]), pp. 86–88.

[1] And clearer than the preceding for one who understands this art is the revolution of the orb (*dawarān al-falak*), for whenever it rotates by the amount of a zodiacal sign, configurations (*şuwar*: horoscopic diagrams) are composed that are dissimilar from one another, and so they [i.e., the astrologers] make judgments (*aḥkām*) based on them according to the premises of their art and in accordance with that [ever-changing celestial configuration]. [2] Let us represent (*şawwarna*) the configuration (*şūra*) for the orb at noon of this [current] day of ours, Tuesday, 12 Sivan 1242 [= 31 May 931 CE], at which time [the true planetary positions were]:

Sun	Gem	7°
Moon	Sco	2
Saturn	Cap	15
Jupiter	Psc	25
Mars	Psc	4
Venus	Cnc	25
Mercury	Tau	20

[3] If we make [this configuration] for the first hour or the second hour of the day [counted from sunrise], the strongest [planet] is the Sun, for it is in the ascendant, then Jupiter and Mars, for they are at mid-heaven. [4] The other four planets are “inconjunct” (*şāqīta*) [i.e., “not in aspect”], for Venus is in the second [house], the Moon in the sixth [house], Saturn in the eighth [house], and Mercury in the twelfth

[house]. [5] Everything that the first three planets indicate is strong because their light falls on the ascendant [i.e., they are in signs in aspect to the ascendant], and everything that the other four planet indicate is weak because of the absence of their light [on] the ascendant.

[6] If we make [the configuration] for the third and fourth hours, approximately, the orb will have already rotated by one zodiacal sign. [7] The ascendant will then be Cancer, and all the planets will aspect (*nāzira*) the ascendant, except for the Sun, for Venus will be in the ascendant, the Moon in the fifth [house], Saturn in the seventh [house], Jupiter and Mars in the ninth [house], and Mercury in the eleventh [house]. [8] The indication (*dalāla*) of each of them will be according to its power in its place. [9] If we make [the configuration] for the fifth and sixth hours, [the orb] will have rotated by two zodiacal signs, and the ascendant will be Leo. [10] The strong [planets] will be the Sun, for it is in the eleventh [house]; Mercury, for it is in the tenth [house]; and the Moon, for it is in the fourth [house]. [11] Venus, Saturn, Jupiter, and Mars are all inconjunct, and what they indicate will be in conformity with this [fact].

[12] If we make [the configuration] for the seventh and eighth hours, approximately, a quarter of the orb will have rotated and the ascendant is Virgo. [13] No planet is inconjunct, for the Moon is in the third [house], Saturn in the fifth [house], Jupiter and Mars in the sixth [house], Mercury in the ninth [house], the Sun in the tenth [house], and Venus in the eleventh [house]. [14] All the indications are established in this way. [15] And if we make [the configuration] for the ninth and tenth hours, a third of the orb will have rotated, and the ascendant will be Scorpio and the Moon is in it. [16] And there will be another form (*ḥayʿa*) for the orb, opposite what we explained [previously]. [17] And similarly, their forms in the other two hours, and in what comes after them, will be different, according to its [i.e., the orb's] revolution. [18]

In this way, the judgments of the rays and the aspects and the rest of the conditions (*al-ḥālāt*) will be reversed (*in<sup>c</sup>aqasa*). [19] And, similarly, is the doctrine (*qawl*) that the fixed, variable (*munqalib*), and two-bodied [zodiacal signs] have influences that differ for each quarter of the day, and they are six hours in turn.

[20] Here I only elaborated (*basattu*) these detailed examples because the author of this book made them a pivot (*quṭb*) of his remarks, for he said “the orb returned (or: oscillated) back and forth (*panim we-ʿāḥor*), [and] returns back and forth” [*Sefer Yešira*, chap. 2:5 in Saadia’s version], according to what is recorded.

#### Notes to Appendix I

*Ad* [2]. The true planetary longitudes according to the *zij* of al-Khwārizmī, based on a computer program developed by E. S. Kennedy and H. Mielgo, for year 931 CE, month 5, day 31, 0 h [= noon], are the following:

I	II	III	IV	V
Planet	al-Khwārizmī	al-Khwārizmī rounded	Saadia	diff (IV-III) (Saadia-Khw)
Sun	67;38°	Gem 8°	Gem 7°	-1°
Moon	211;36	Sco 2	Sco 2	0
Saturn	287;56	Cap 18	Cap 15	-3
Jupiter	355;21	Psc 25	Psc 25	0
Mars	329;26	Aqr 29	Psc 4	+5
Venus	112;43	Cnc 23	Cnc 25	+2
Mercury	49;25	Tau 19	Tau 20	+1

The true lunar longitude, computed according to the *zij* of al-Khwārizmī, agrees exactly with the value in Saadia’s text, and this is quite impressive.

*Ad* [3]. Since the hours used by Saadia begin at sunrise, they are seasonal rather than equinoctial hours. A diurnal seasonal hour on a given day is one-twelfth of the time from sunrise to sunset, and a nocturnal seasonal hour on that day is one-twelfth of the time from sunset to sunrise. In general, a nocturnal seasonal hour is not equal to a diurnal seasonal hour. On the relationship of seasonal hours with the astrological houses, see Neugebauer, *al-Khwārizmī*, pp. 76ff.; cf. Goldstein, *Ibn al-Muthannā*, pp. 85f., 209f. There are seven methods for setting up the astrological houses, but in all of them the ecliptic is divided into 12 houses. The first house is counted along the ecliptic, in the order of zodiacal signs, from the intersection of the ecliptic and the eastern horizon (called the ascendant) at the moment in question. The term *ascendant* is here applied to the first house, and *mid-heaven* to the tenth house. See also J. D. North, *Horoscopes and History* (London, 1986).

*Ad* [4]. The astrological aspects are:

conjunction:	0°	between signs, i.e., in the same zodiacal sign
sextile:	60°	between signs
quartile:	90°	between signs
trine:	120°	between signs
opposition:	180°	between signs

For example, al-Bīrūnī describes sextile as follows: “Each sign is in sextile aspect to the third and eleventh [signs] left and right of it, and there is a sixth of the zodiac (60°) between any degree of that sign and the same degree of those named.” Note that the distance between two signs (or houses) can be counted in either direction. Hence, with respect to sign 1 (or house 1), the first, third, fourth, fifth, seventh, ninth, tenth, and eleventh are in aspect to it; but the second, sixth, eighth, and twelfth are not, and they are called “inconjunct”: al-Bīrūnī, *Kitāb al-taḥḥīm*,

*The Book of Instruction in the Elements of the Art of Astrology*, ed. and trans. R. R. Wright (London, 1935), para. 373.

*Ad* [8]. For lists of astrological indications of the planets, see al-Bīrūnī, *Tafhīm*, para. 396ff.

*Ad* [18]. Saadia may be alluding to the doctrine of “projection of rays,” which is associated with the aspects in al-Khwārizmī’s *zij*. See Suter, *al-Khwārizmī*, pp. 206–29; E. S. Kennedy and H. Krikorian-Preisler, “The Astrological Doctrine of Projecting the Rays,” *al-Abhath* 25 (1972): 3–15, reprinted in E. S. Kennedy, *Studies in the Islamic Exact Sciences* (Beirut, 1983), pp. 372–84; J. P. Hogendijk, “The Mathematical Structure of Two Islamic Astrological Tables for ‘Casting the Rays,’ ” *Centaurus* 32 (1989): 171–202.

*Ad* [19]. Cf. al-Bīrūnī, *Tafhīm* (trans. Wright), para. 380: “the first [zodiacal] sign of each season is called tropical (*munqalib*: variable) . . . , the second fixed . . . , and the third bicorporal.”

## Appendix 2

Yehuda Hallevi, *Sefer ha-Kuzari*

Ed. and trans. Y. Kafih (Arabic text with a new Hebrew translation: Qiryat Ono, 5757 [1997]), p. 186; cf. Judah Halevi, *The Kuzari*, introduction by H. Slonimsky, trans. from the Arabic by H. Hirschfeld (New York, 1964), p. 242; and Juda Hallevi, *Le Kuzari*, trans. Ch. Touati (Louvain and Paris, 1994), p. 188

There exists a book on this special subject, called *The Chapters of Rabbi Eliezer*, in which one finds the measure of the Earth and each of the orbs; the natures of the planets [*lit.* stars], the signs of the zodiac and the constellations (*al-ṣuwar*); their domiciles (*buyūtuhā*), their terms (*ḥuẓūẓuhā*; read: *ḥudūduhā* ?); their good fortunes (*suʿūduhā*), and their ill fortunes (*nuḥūsuhā*); their ascendings (*ṣuʿūduhā*) and their descendings (*hubūtuhā*); their exaltations (*sharafuhā*) and their detriments (*wabāluhā*); and the durations of their movements.

### Commentary

The technical terms in this passage are mainly astrological, but the measure of the Earth and of the orbs as well as the periods of planetary motion are properly astronomical. The natures of the planets are discussed in al-Bīrūnī, *Taḥḥīm* (trans. Wright), para. 381; the natures of the zodiacal signs, in para. 347. The term *al-ṣuwar* can mean constellations, but in astrology it can also mean “figures,” which are otherwise called “faces” (*al-wujūh*): see *ibid.*, para. 449–50: “The so-called ‘figures’ are in reality also the faces, but called so (*ṣuwar*) because the Greeks, Hindus, and Babylonians associated with each face, as it arose, the figure of a personage human or divine and, in the case of the Greeks, the faces were also associated with such of the other 48 constellations ascending at the same time.” On the domiciles of the

planets, see al-Bīrūnī, *Tafhīm*, para. 440, and, opposite to them, the detriments, in para. 442. The next word, *ḥuzūzuhā*, is not one that I have found in astrological contexts, though the meaning of *hazz* (plural: *ḥuzūz*), seems to be appropriate: “portion,” “lot,” “fate,” “good fortune.” The usual term in astrology for “lot” is *sahm* (plural: *ashām*; for the “lot of fortune,” see al-Bīrūnī, *Tafhīm*, para. 475), and it is possible that a different word was used in Halevi’s source. But I think it more likely that a copyist misread the word, *khuṭūṭuhā* (lit. “their lines”), an error that requires only the displacement of some dots: cf. D. H. Baneth and H. Ben-Shammai, eds., *Judah ha-Levi’s al-Kitāb al-Khazari* (Jerusalem, 1977), p. 186, Arabic text, which records the variant reading *ḥuṭūṭuhā* in the principal manuscript. Moreover, the medieval Hebrew translation by Judah Ibn Tibbon has nothing corresponding to this word: H. Hirschfeld, *Das Buch al-Chazari des Abū-l-Hasan Jehuda Hallewi* (Leipzig, 1887, p. 287; repr. Jerusalem 5730 [1970]). A more drastic emendation would be to substitute *al-ḥudūd*, meaning “terms,” which fits the context here. On the astrological “terms,” see al-Bīrūnī, *Tafhīm*, para. 453. Among the planets, Saturn and Mars are maleficent (bringing ill fortune), Jupiter and Venus beneficent (bringing good fortune), the Sun is both beneficent and maleficent, and Mercury is either very fortunate or the reverse: al-Bīrūnī, *Tafhīm*, para. 382. The words *al-ṣu‘ūd* and *al-hubūt* refer to certain zodiacal signs: al-Bīrūnī, *Tafhīm*, para. 378; but the word, *al-hubūt*, can also be used for planetary “dejections,” which are opposite the planetary exaltations (*al-ashrāf*): al-Bīrūnī, *Tafhīm*, para. 443.

The *Rasā’il Ikhwān al-Ṣafā’* (4 vols., Beirut, 1957) is a plausible (but not necessarily unique) source for Halevi’s astrology. It was available in Spain at the time and combines astronomy and astrology in elementary ways. In this encyclopedia, part 1, chap. 3, is entitled “Astronomy (*astronomīya*): The science of the stars (*‘ilm al-nujūm*) and the structure of the orbs (*tarkīb al-aflāk*)” (*Rasā’il* 1: 114–57). The sizes of the Earth and of the planetary orbs are discussed in part 2, chap. 2



(“On the Heavens and the World,” *Rasāʿil* 2: 24–51): see especially *Rasāʿil* 2: 51. The periods of the planets are discussed in *Rasāʿil* 1: 126 et passim, and their motions in *Rasāʿil* 2: 36ff. The astrological expressions are introduced as follows: “These 12 zodiacal signs are divided among these seven planets in several ways, and they are classified and delineated in various ways: among them are domiciles (*al-buyūt*) and detriments (*al-wabāl*), apogee and perigee, exaltation (*al-sharaf*) and dejection (*al-hubūt*) . . .” (*Rasāʿil* 1: 119). Then, for each zodiacal sign, we are given a list that includes the domicile, the exaltation, the detriment, the dejection, the faces, and the terms (*Rasāʿil* 1: 134f.). On the good fortune and ill fortune of the planets, see *Rasāʿil* 1: 141f.

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