

6 • Later Cartographic Developments

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About A.D. 1000, Islamic cartographers had two existing cartographic systems on which they could base their work. The first was of Greek origin, derived from Marinus; there seem to be many textual references to it, but the only known Islamic example is the short description given by Suhrāb.¹ However, this system probably involves maps now lost, and certainly the tradition of mapmaking based on Ptolemy survives in the books of the early Muslim descriptive geographers. The second system was that of the Balkhī school, which originated in the tenth century A.D. but must have been very popular in the succeeding centuries, judging by the number of later manuscripts that have survived. The origins of this second system are obscure, although it used earlier Islamic geographical material. One gets the impression that this whole system was produced independently as a reaction against work dependent on Greek and other foreign agencies (see fig. 6.1).²

Another source that came into existence in the eleventh century A.D. and affected the work of Islamic cartographers and geographers was independent Islamic scientific research, although it was mainly the work of one man that influenced the subject we are interested in. This man was Abū al-Rayḥān Muḥammad ibn Aḥmad al-Bīrūnī (362/973 to after 442/1050), whom I will discuss in a moment.

LATER RECENSIONS OF IBN ḤAWQAL'S MAPS

Adaptations of the two cartographic systems mentioned above and the geographical texts that accompany them so as to make the systems compatible with each other began almost as soon as geographers realized they included different materials. Ibn Ḥawqal (fl. second half of the tenth century A.D.) was the first of the Balkhī school geographers to reflect a knowledge of Ptolemy,³ and his concentration on the Mediterranean area made him aware that European sources existed, if only through translation into Arabic. Although he does not state this in so many words, his text and maps have detail in the European areas that cannot be traced to earlier Arabic authors.⁴ The superiority of his Mediterranean map over that of al-Iṣṭakhri, another member of the Balkhī school,

is due to these extra features, but they are roughly contemporary with Ibn Ḥawqal himself and are not based on his knowledge of Ptolemy. However, the version of Ibn Ḥawqal's maps that has been designated Ibn Ḥawqal III⁵ certainly shows the reintroduction of Ptolemaic material that was excluded from the earlier maps of the Balkhī school. This again occurs mainly in the western part of the Islamic empire, around the Mediterranean Sea, and it can be seen especially in the world map from the set of Ibn Ḥawqal III maps, which clearly shows a Ptolemaic Nile as opposed to the Nile of al-Balkhī that appears in the maps of Ibn Ḥawqal designated Ibn Ḥawqal I.⁶ In this set of Ibn Ḥawqal III maps, there is also a map of the Nile taken more or less directly from al-Khwārazmī (fig. 6.2).⁷ A closer look at the Ibn Ḥawqal III world map reveals more features that are possibly Ptolemaic, and

1. This is the rectangular grid that could be used for converting tables of latitude and longitude to map form. See above, pp. 104–5 and fig. 4.7, for Suhrāb's version of it and for further discussion on its introduction into Islamic geographical literature. Presumably this is the projection Ptolemy criticized; see O. A. W. Dilke and editors, "The Culmination of Greek Cartography in Ptolemy," in *The History of Cartography*, ed. J. B. Harley and David Woodward (Chicago: University of Chicago Press, 1987–), 1:177–200, esp. 179–80, although the Muslims do not give any proportional relationship between parallels and meridians.

2. See chapter 5, on the Balkhī school.

3. Abū al-Qāsim Muḥammad Ibn Ḥawqal, *Kitāb ṣūrat al-arḍ*; see J. H. Kramers's edition, *Opus Geographicum*, 2d ed., Bibliotheca Geographorum Arabicorum, vol. 2 (Leiden: E. J. Brill, 1938; reprinted, 1967), 13.

4. Articles dealing with identification of toponyms reveal this fact. For example, C. F. Beckingham, "Ibn Ḥawqal's Map of Italy," in *Iran and Islam: In Memory of the Late Vladimir Minorsky*, ed. Clifford Edmund Bosworth (Edinburgh: Edinburgh University Press, 1971): 73–78.

5. See the classification system above, pp. 112–14 and fig. 5.3.

6. Compare fig. 6.3 with fig. 5.16 above; see also J. H. Kramers, "La question Balḥi-Iṣṭakhri-Ibn Ḥawqal et l'Atlas de l'Islam," *Acta Orientalia* 10 (1932): 9–30, esp. 28. Manuscripts containing maps classified as Ibn Ḥawqal III include Istanbul, Süleymaniye Kütüphanesi, Ayasofya 2934; Istanbul, Topkapı Sarayı Müzesi Kütüphanesi, A. 3347; and Paris, Bibliothèque Nationale, MS. Arabe 2214; see also appendix 5.1.

7. This map is also reproduced by Konrad Miller, *Mappae arabicae: Arabische Welt- und Länderkarten des 9.–13. Jahrhunderts*, 6 vols. (Stuttgart, 1926–31), Band 2, Beiheft, Taf. 10 (Paris, Niffauf). Abū Ja'far Muḥammad ibn Mūsā al-Khwārazmī (d. ca. 232/847) is discussed above, esp. pp. 97–101 and 105–6.

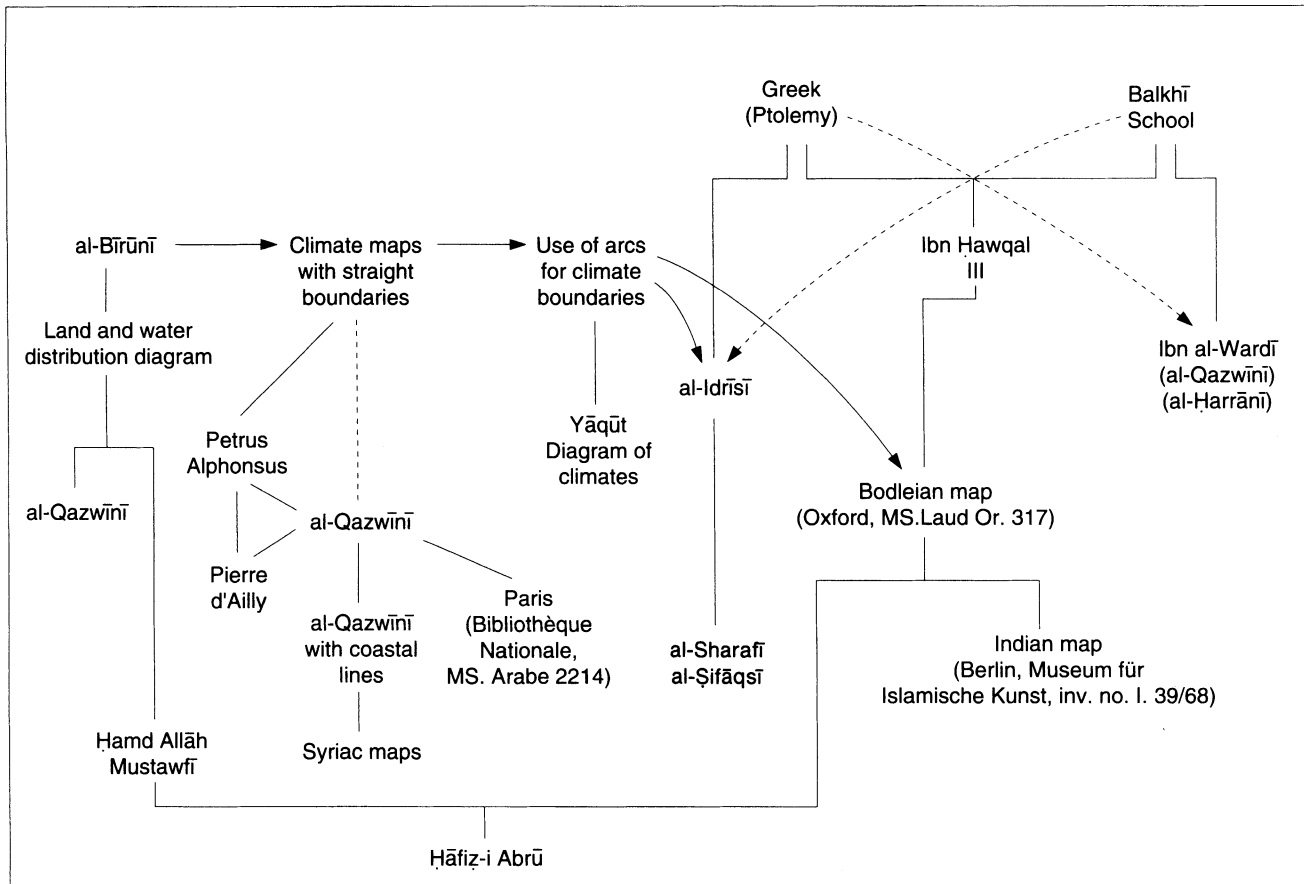


FIG. 6.1. STEMMMA OF LATER ISLAMIC MAPS (A.D. 1000 ONWARD).

there is little doubt that the Ptolemaic parts come via al-Khwārazmī's text.

The world map in Ibn Ḥawqal III manuscripts is oval and may have been copied (at second or third hand) from a world map on Ptolemy's second projection,⁸ with the lower border rounded off to complete the oval (fig. 6.3). The draftsman may have lacked a clear idea of the material he was meant to be representing, but it is possible to identify Ptolemy's Nile system (as I said above) and the islands of Yāqūt and al-Fiḍḍah, which lie beyond the narrow exit to the Indian Ocean formed by the extension of Africa and a peninsula of China, all features that come from al-Khwārazmī. There seems to be no doubt, because of the shape of the landmass, that the editor of this revision, whether or not it was Ibn Ḥawqal, must have used a copy of a world map on a Ptolemaic projection rather than on the rectangular projection recommended by Suhrāb. As a map derived ultimately from Ptolemy, however, it is very corrupt, and one can imagine it was copied many times over until the detail is almost unrecognizable.

It seems to be not really an innovation and an improvement on Ibn Ḥawqal's earlier world map, but a degenerate survival from maps of the al-Khwārazmī variety. Earlier and better copies may have perished. The date of this map is certainly nowhere near the date of Ibn Ḥawqal himself. The earliest version of it cannot be earlier than 540/1145, although its corrupt state could show, as I have said, that the basic map had been in existence for some time.⁹ In addition, in its features as well as in its

8. For discussion and illustration of Ptolemy's second projection, see Dilke, "Culmination of Greek Cartography," 184, fig. 11.3, and 187, fig. 11.5 (note 1).

9. The earliest possible date of the text, according to Kramers from internal evidence, is 540/1145 (Kramers, "La question Balḥi-Isṭahri-Ibn Ḥawqal," 16 [note 6]). Youssouf Kamal illustrates three versions of the world map (from the three manuscripts listed above, note 6); see his *Monumenta cartographica Africae et Aegypti*, 5 vols. in 16 pts. (Cairo, 1926-51), 3.3:805, 810, 812 (this work has been reprinted in facsimile, 6 vols., ed. Fuat Sezgin [Frankfurt: Institut für Geschichte der Arabisch-Islamischen Wissenschaften, 1987]). The earliest version he

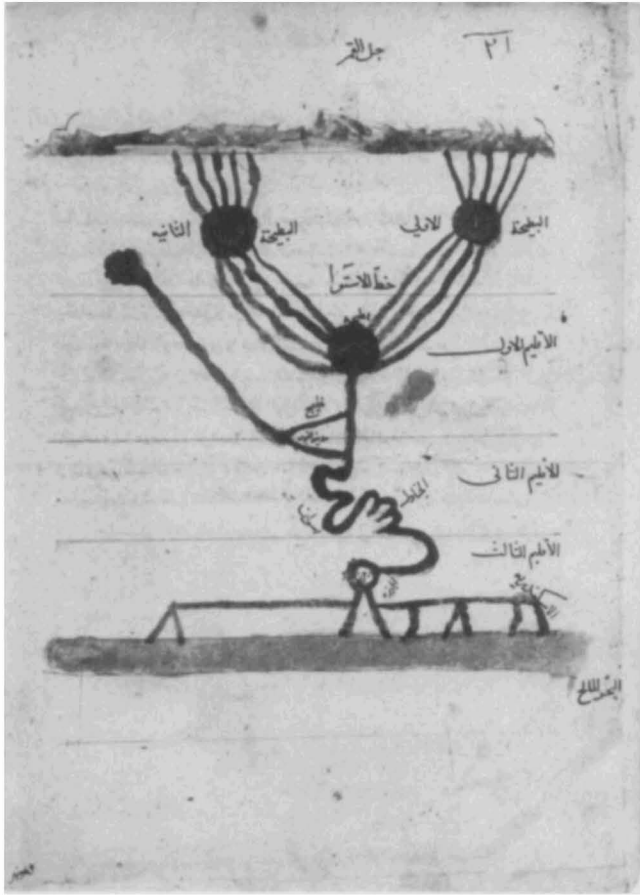


FIG. 6.2. THE NILE FROM THE IBN ḤAWQAL III SET OF MAPS.

Size of the original: 35 × 26.5 cm. By permission of the Bibliothèque Nationale, Paris (MS. Arabe 2214, fol. 13v).

date it is comparable to the circular world map of al-Idrīsī. Yet this type of map had a future, and resemblances if not definite derivations can be seen in several later or contemporary maps, some of which I will discuss below.¹⁰

THE ḤUDŪD AL-ʿĀLAM

Another textual adaptation of these two systems (Ptolemy/Khwārazmī and Balkhī) is found in the anonymous Persian text *Ḥudūd al-ʿālam*.¹¹ This work was dated by its author 372/982. It is a descriptive geography very similar to the earlier descriptive work of the *Kitāb al-masālik wa-al-mamālik* (Books of routes and provinces) type, and there is strong evidence that the lost work of that name by al-Jayhānī was one of the main sources the author used.¹² It is also obvious that for the Persian-speaking areas of Islam, the work of al-Iṣṭakhri was heavily relied on and in many cases directly quoted. Not only

was al-Iṣṭakhri used directly, but Ibn Ḥawqal's version may also have been used.¹³ This work draws on a wide range of sources, so that geographical ideas appear from the descriptive geographers in close conjunction with the more technical material of the astronomer-geographers, including Ptolemaic and Indian influence.

The *Ḥudūd al-ʿālam*, however, gives no coordinates for place-names, and the manuscript that survives has no maps. There was probably no attempt to include a set of maps, in spite of the numerous references from the Balkhī school geographers. However, the text does occasionally refer back to a map, always mentioned in the singular (*ṣūrat*).¹⁴ The impression given is that there was one map—a map of the world—although it is possible that there were other maps and that only one is being referred to at any one time. This recalls the suggestion made above that a large map was in existence at the time and that the text was compiled from the map.¹⁵ References, however, make it appear that the reader was expected to refer to the map, and this implies a map attached to the text.¹⁶ The reference stating that “the houses which are (seen) on the Map between Rukhuhd and Multān are all villages and stations of caravans” is reminiscent of the provincial maps of al-Iṣṭakhri, with little houses or tents sitting on the line of the route.¹⁷

One is left to surmise the form the map or maps took. If there was one world map, we would expect something with considerable detail, and this rather rules out the sort of world map that appears in the Balkhī school maps. Something similar to that suggested by Suhrāb (possibly with a graticule) would be more appropriate, and this fits when we figure that the basic plan of the *Ḥudūd*'s text

regards as the one from Istanbul, Ayasofya 2934, which he dates ca. 600/1200. The Paris manuscript is dated 849/1445.

10. Oxford, Bodleian Library, MS. Laud. Or. 317, is influenced by it, and some of its features can be seen in an Indian map mentioned below. It also occurs in a Persian geographical treatise reproduced in Kamal, *Monumenta cartographica*, 3.5:996 (note 9), where the manuscript is identified as Leiden, Bibliotheek der Rijksuniversiteit, MS. Ar. 1899, and dated 646/1248.

11. This Persian geography has been mentioned in previous chapters and was edited and translated by Vladimir Minorsky, *Ḥudūd al-ʿālam: “The Regions of the World”* (London: Luzac, 1937; reprinted Karachi: Indus, 1980). The original manuscript is presumably now in Leningrad. There is also a preface by V. V. Bartol'd, 3–44.

12. See Minorsky's edition of *Ḥudūd al-ʿālam*, 24 (note 11). Bartol'd suggests that al-Jayhānī is quoted via the work of Gardīzī (ʿAbd al-Hayy ibn al-Ḍaḥḥāk Gardīzī, fl. eleventh century A.D.).

13. Bartol'd's preface to *Ḥudūd al-ʿālam*, 21–22 (note 11).

14. References to the map appear on pages 60, 69, 121, 146, and 157 of Minorsky's edition of the *Ḥudūd al-ʿālam* (note 11). References to the original manuscript are fols. 5b₁₁, 8b₁₀, 25b₁₃, 33b₁₆, and 37a₁₅.

15. See chapter 4 above, esp. pp. 95–96.

16. Minorsky discusses the possibility of a map as a source of this text, *Ḥudūd al-ʿālam*, xv (note 11).

17. Minorsky's edition of *Ḥudūd al-ʿālam*, 121 (manuscript fol. 25b₁₃); and compare, for example, al-Iṣṭakhri's map illustrated above, fig. 5.5.

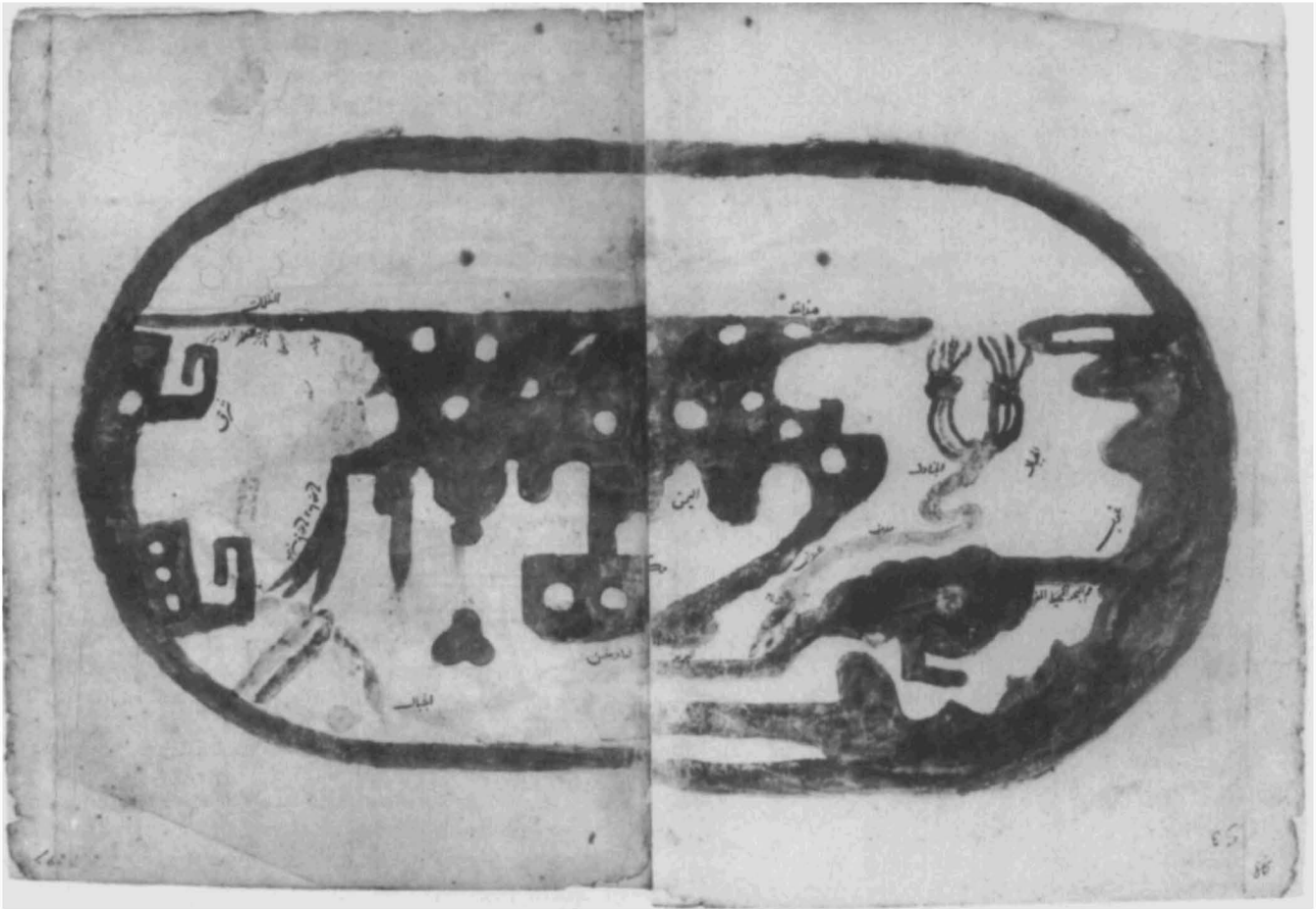


FIG. 6.3. THE WORLD FROM THE IBN ḤAWQAL III SET OF MAPS. Copied in 847/1445. The map is oriented with south at the top (pagination has north at the top). The word in Arabic for island and for peninsula is the same, and although Yāqūt and al-Fiḍḍah are usually referred to as islands in the literature,

they are shown on this map (on the left) as hook-shaped peninsulas.

Size of the original: 35 × 26.5 cm. By permission of the Bibliothèque Nationale, Paris (MS. Arabe 2214, fols. 52v–53).

is more like those of the earlier, pre-Balkhī geographers.

The idea of a basic map from which the text seems to have been compiled occurs again in the *Jaʿrāfiyah* of Muḥammad ibn Abī Bakr al-Zuhri (fl. twelfth century A.D.), which the author describes as ultimately derived from the “*Jaʿrāfiyah . . . al-Maʿmūn*.” By “*Jaʿrāfiyah*” he means a map, for he says that “the earth is spherical, but the ‘*Jaʿrāfiyah*’ is flat as is the astrolabe,”¹⁸ suggesting a flat map. One feels, however, that al-Zuhri produced a map of some sort and then derived his text from it. Al-Idrisi worked in a similar way, and in his case a version of the map survived.¹⁹ The latter’s text is very similar to that of the *Ḥudūd al-ʿālam*, although the general arrangement of material is very different and al-Idrisi’s text is much more dependent on his maps. It is interesting that none of these authors makes any attempt to give coordinates for places.

Whether the map is important as a source for the geo-

graphical text or the text as a source for the maps is a constant dilemma when studying Islamic cartography. Surviving maps, with the exception of al-Idrisi’s, are too vague and lacking in detail to be sources for any comprehensive text, though it is possible they could be used as a framework for the text. Even here it does not seem as if a text follows a pattern that could be set by the map. On the whole, however, when authors mention the maps in their texts they state that the map is a base for the text. This is still not convincing. The opposite, that the map should act as a summary of the material given in the text, is not convincing either. Close comparison between the two is extremely difficult in most cases.

18. See the edition of al-Zuhri’s text by Maḥammad Hadj-Sadok, “*Kitāb al-Djaʿrāfiyya*,” *Bulletin d’Etudes Orientales* 21 (1968): 7–312, esp. 306. Although several manuscripts of al-Zuhri’s work are extant, none contain any maps.

19. For al-Idrisi and his maps, see chapter 7 below.

LATER TABLES AND AL-BĪRŪNĪ

During this period astronomers continued to produce tables of geographical coordinates in conjunction with their tables of stellar coordinates. Ibn Yūnus (d. 399/1009), who worked in Egypt, produced a set of tables similar to those of al-Battānī,²⁰ and he is also credited with producing a map in conjunction with al-Muhallabī.²¹ There was also a tradition of table production in the Maghreb.²² However, the next important set of tables to appear in the eastern part of the Islamic world was that of al-Bīrūnī.

Al-Bīrūnī worked during the first half of the eleventh century A.D., first in his native Khwārazm under the patronage of the last of the local rulers. In 408/1017, on the conquest of Khwārazm by the Ghaznavid ruler Maḥmūd, al-Bīrūnī was carried off to Ghazna almost as part of the booty. Under Maḥmūd I (r. 421–32/1030–40), the son and successor of Maḥmūd, al-Bīrūnī was able to go on with his writing and scientific work. It was here about 427/1036 that he completed his great astronomical work *Kitāb al-qānūn al-Maḥmūdī fī al-hay'ah wa-al-nujūm*, which includes not only his astronomical tables but, in the tradition of al-Battānī, a table of geographical coordinates of important places throughout the world.²³ This table has over six hundred entries and hence is double the size of that of al-Battānī or of Ibn Yūnus.²⁴

Al-Bīrūnī was a first-rate scholar, interested in all branches of science, though it is as a mathematician and an astronomer that he is remembered. He was an excellent critic who read widely. He had good knowledge of Greek scientific sources and was extremely interested in Indian scientific theories, so that he could and did compare the different cultural streams that came the way of the Muslim intelligentsia of his day.

In the geographical field it was mainly the mathematical and astronomical aspects that interested him. Here he was specializing in those aspects that had been neglected by previous geographers, and thus one might expect to see an improvement in Islamic cartography.

Among the projects al-Bīrūnī mentioned in some detail was the remeasurement of the degree of latitude. He carried this out in Khwārazm and in Ghazna, and he produced a new method of measurement by using a convenient mountain from which the horizon could be observed.²⁵ He also attempted to measure the difference in longitude between two places using the distance between them in miles.²⁶ This was difficult, since the direct distances between places could not be worked out with any accuracy. However, he produced a result for the longitude of Ghazna east of Baghdad, setting out the theory behind this operation so that it was there for any later scholar to improve.²⁷ He also gave a complicated theory based on this for calculating the qibla, or the

directions of Mecca from any place.²⁸ Al-Bīrūnī also criticized the projections of Ptolemy and Marinus, and by the latter he obviously meant the rectangular projection as shown us by Suhrāb.²⁹ In his works he gives the theory behind two different projections, one of which would be

20. Abū al-Ḥasan 'Alī ibn 'Abd al-Raḥmān ibn Yūnus was a well-known astronomer, his main work being *al-Zīj al-kabīr al-Ḥakīmī*, named after the Fatimid caliph al-Ḥakīm. The only extant manuscript containing the geographical coordinates is now in Leiden, Bibliotheek der Rijksuniversiteit, MS. Or. 143. Considerable work has been done on these tables, and a bibliography appears in B. R. Goldstein, "Ibn Yūnus," in *The Encyclopaedia of Islam*, new ed. (Leiden: E. J. Brill, 1960–), 3:969–70. Lelewel has notes on the geographical tables (mainly from Jean Baptiste Joseph Delambre, *Histoire de l'Astronomie du Moyen Age* [Paris: Courcier, 1819]) and gives a version in Arabic in Joachim Lelewel, *Géographie du Moyen Age*, 4 vols. and epilogue (Brussels: J. Pilliet, 1852–57; reprinted Amsterdam: Meridian, 1966), 1:43–61 and 165–77 (appendix 2). Abū 'Abdallāh Muḥammad ibn Jābir al-Battānī al-Ṣābī' (before 244/858–317/929) is discussed above, see esp. pp. 97–98.

21. Al-Ḥasan ibn Aḥmad al-Muhallabī was an Egyptian astronomer contemporary with Ibn Yūnus. This world map was said to have been produced on silk cloth with gold and colored silk embroidery. Its form and its use as a map are not known. See S. Maqbul Ahmad, "Kharīṭa," in *Encyclopaedia of Islam*, new ed., 4:1077–83, esp. 1079. See p. 97 (text and note 27).

22. The main author was al-Zarqallo of Toledo. His source is again mainly al-Battānī.

23. A critical edition of al-Bīrūnī's *Kitāb al-qānūn al-Maḥmūdī* (The Maḥmūdī canon) has been published by the Dairatu'l-Ma'ārif of Hyderabad, India: *al-Qānūn al-Maḥmūdī (Canon Masudicus)*, 3 vols. (Hyderabad: Osmania Oriental Publications Bureau, 1954–56), 2:547–79, for the geographical tables. The tables are available in full in Arabic only. The geographical tables also appear in Ahmed Zeki Velidi Togan, ed., *Bīrūnī's Picture of the World*, Memoirs of the Archaeological Survey of India, no. 53 (New Delhi, 1941), 9–53.

24. The origin of al-Bīrūnī's tables must have been al-Battānī. He does not seem to have used Ibn Yūnus; see Syed Hasan Barani, "Al-Bīrūnī and His Magnum Opus *al-Qānūn al-Maḥmūdī*," in the *al-Qānūn*, 1:i-lxxx, esp. iv (note 23).

25. See chapter 8 below for a fuller description of al-Bīrūnī's work related to geodesy. Syed Hasan Barani, "Muslim Researches in Geodesy," in *Al-Bīrūnī Commemoration Volume*, A.H. 362–A.H. 1362 (Calcutta: Iran Society, 1951), 1–52, esp. 33–39.

26. J. H. Kramers, "Al-Bīrūnī's Determination of Geographical Longitude by Measuring the Distances," in *Al-Bīrūnī Commemoration Volume*, A.H. 362–A.H. 1362 (Calcutta: Iran Society, 1951), 177–93; reprinted in *Analecta Orientalia: Posthumous Writings and Selected Minor Works of J. H. Kramers*, 2 vols. (Leiden: E. J. Brill, 1954–56), 1:205–22.

27. Kramers, "Al-Bīrūnī's Determination of Geographical Longitude," 179–82 (note 26).

28. In the *Kitāb taḥdīd nihāyāt al-amākin li-tashīḥ masāfat al-masākin*, 272:17–290:13, al-Bīrūnī calculates the qibla of Ghazna by various methods as an example. See Edward S. Kennedy, *A Commentary upon Bīrūnī's "Kitāb taḥdīd al-amākin": An 11th Century Treatise on Mathematical Geography* (Beirut: American University of Beirut, 1973), 198–219.

29. Al-Bīrūnī, *Taḥdīd*, 233:15–18. For an English translation, see Jamil Ali, trans., *The Determination of the Coordinates of Positions for the Correction of Distances between Cities* (Beirut: American University of Beirut, 1967), 198–99.



FIG. 6.4. AL-BĪRŪNĪ'S SKETCH MAP OF THE DISTRIBUTION OF LAND AND SEA. Copy from a manuscript of al-Bīrūnī's *Kitāb al-taḥḥīm*, dated 420/1029. Diameter of the original: ca. 9.5 cm. By permission of the British Library, London (MS. Or. 8349, fol. 58a).

known today as an azimuthal equidistant projection and the other as a globular projection.³⁰ Finally, he made scientific comments on the distribution of land and water on the face of the globe.³¹

Few of these points were taken up by al-Bīrūnī's successors, and his scientific work exerted very little influence on future Islamic cartographers. No one took the azimuthal projection, drew a graticule, and placed toponyms in their proper places. If al-Bīrūnī himself did so, we have no surviving examples, and his successors do not mention it. Al-Bīrūnī's latitude and longitude refinements are incorporated in his tables and were copied to some extent after his death. Perhaps the most accepted piece of information was the distribution of land and water, because the eastern extension of southern Africa toward China, which was a prominent feature of the Islamic

world map up to al-Bīrūnī's time, was now discontinued. Only al-Idrīsī and direct copies of earlier maps like those of the Balkhī school insisted that the African landmass filled the southern part of the *oikoumene* from west to east. Al-Bīrūnī's only direct contribution to cartography was a sketch map showing this distribution. It appears in the manuscripts of the *Kitāb al-taḥḥīm li-awā'il ṣinā'at al-tanjīm* (Book of instruction on the principles of the art of astrology) (copied 635/1238) and is his version of the circular world map showing how independent his thought was from the contemporary standard of Islamic cartography (fig. 6.4).³² He so reduced this eastward extension of Africa, which was a legacy of Ptolemy, that the Indian Ocean appeared to cover the whole Southern Hemisphere. This sketch map was occasionally used directly by later authors—for instance, al-Qazwīnī in his cosmographical work *'Ajā'ib al-makhlūqāt* (see below)—but its influence was very clear in practically all future Islamic maps of the world.

LATER GEOGRAPHICAL WRITERS

From this time to the end of our period, there are a considerable number of geographical writers throughout the Islamic world whose works are basically taken from earlier authors. Some authors give a wider range of sources, and throughout the period there is a tendency to name sources, first by giving a list at the beginning of

30. Edward S. Kennedy and Marie-Thérèse Debarnot, "Two Mappings Proposed by Bīrūnī," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 1 (1984): 145–47, and J. L. Berggren, "Al-Bīrūnī on Plane Maps of the Sphere," *Journal for the History of Arabic Science* 6 (1982): 47–112. On the two projections, see J. A. Steerts, *An Introduction to the Study of Map Projections*, 14th ed. (London: University of London Press, 1965), 71–73 and 159–61.

31. In the printed edition of *Kitāb al-taḥḥīm* edited and translated by Robert Ramsay Wright, *The Book of Instruction in the Elements of the Art of Astrology* (London: Luzac, 1934), this occurs on pp. 120–24 (reproduced from British Library, London, MS. Or. 8349). There is little new in the actual text, but the map that accompanies it on p. 124 shows for the first time this new conception of the world.

32. See Wright's translation of *Kitāb al-taḥḥīm* (note 31), where a copy is mentioned on p. 124. J. H. Kramers, "Djughrafiyā," in *The Encyclopaedia of Islam*, 1st ed., 4 vols. and suppl. (Leiden: E. J. Brill, 1913–38), suppl. 61–73, esp. 72, has another version from a manuscript in Berlin (Staatsbibliothek Preussischer Kulturbesitz, MS. 5666). Yāqūt's version appears in his *Kitāb mu'jam al-buldān* (see Jacut's *geographisches Wörterbuch*, 6 vols., ed. Ferdinand Wüstenfeld [Leipzig: F. A. Brockhaus, 1866–73], 1:22), and this is reproduced with the place-names translated in *The Introductory Chapters of Yāqūt's "Mu'jam al-buldān,"* ed. and trans. Wadie Jwaideh (Leiden: E. J. Brill, 1959; reprinted, 1987), 31. See also Seyyed Hossein Nasr, *Islamic Science: An Illustrated Study* (London: World of Islam Festival, 1976), 38 (figs. 14 and 15), and Miller, *Mappae arabicae*, Band 5, 125, 129 (note 7). Kamal, *Monumenta cartographica*, 3.3:713 (note 9), gives four versions of this sketch for comparison from manuscripts of al-Bīrūnī's *Kitāb al-taḥḥīm*, while 3.5:1050, illustrates two versions from manuscripts of al-Qazwīnī's *'Ajā'ib al-makhlūqāt*.

the work and then by quoting the source against the individual fact. Quite often two sources are quoted, giving different results for the same piece of information. Another variation is that some authors may use special sources—for instance, local sources on particular areas—so that they may be strong in such areas but follow the usual pattern for the main part of the work. There are generally two types of geographical productions: the general geographical treatise, usually divided by the Ptolemaic climates, and the work in dictionary form. There were also (partly because of the fractionalization of the Islamic area into small dynastic states) a growing number of works of local interest, again of both forms.

The main authors of general geographical treatises are al-Kharaqī (d. 533/1138), al-Zuhri (fl. 530/1140), al-Idrīsī (d. 560/1165), al-Qazwīnī (d. 682/1283), Ibn Saʿīd (d. 685/1286), al-Dimashqī (d. 727/1327), Abū al-Fidāʾ (d. 732/1331), and Ibn al-Wardī (d. 861/1457). Dictionary compilers of importance were al-Bakrī (d. 487/1094) and Yāqūt (d. 626/1229).³³ Although some of these authors reproduced earlier sketch maps and climate diagrams, there are no detailed maps in any of the manuscripts of these works, apart from the work of al-Idrīsī.

Abū ʿAbdallāh Muḥammad ibn Muḥammad al-Sharīf al-Idrīsī is the outstanding person in Islamic cartography. There has survived in his name a set of maps that are so important that they have been described separately in chapter 7. In spite of this importance, al-Idrīsī's influence on future Islamic cartography was minimal, and those authors who have been influenced by him (in the format of their geographical works or specifically in their maps) are discussed in that chapter below.

THIRTEENTH-CENTURY AND LATER WORLD MAPS

By the thirteenth century we have three forms of world map that seem to persist through the following centuries in Islamic works, apart from continual reproductions of existing maps. The first of these is the world map found generally only in the work of Ibn al-Wardī (although it appears occasionally in the works of al-Qazwīnī and al-Ḥarrānī). The second is a sketch map based on al-Birūnī's sketch map of land and water distribution and elaborated on by al-Qazwīnī and some later authors. The third is the world map possibly based on the same model as that used in later recensions of Ibn Ḥawqal (III).

The Ibn al-Wardī world map was based on that of Ibn Ḥawqal I (plate 8 and compare fig. 5.16 above). It occurs regularly in the many copies of his *Kharīdat al-ʿajāʾib wa-farīdat al-gharāʾib* (The unbored pearl of wonders and the precious gem of marvels) and becomes a very stiff geometrical map, but always recognizable. It has the eastward extension of Africa containing the Mountains

of the Moon, in which rises the Nile. This river then flows due west to make a right-angle turn to the north and enter the southeastern corner of the Mediterranean. Both the Mediterranean and the Indian Ocean have parallel north and south coasts, but the Arabian Peninsula is present as a semicircle surrounded by pincerlike arms of the Red Sea (Baḥr al-qulzum) and the Persian Gulf (Baḥr al-Yaman). The Bosphorus too is prominent as a straight line of water directly opposite the mouth of the Nile.³⁴

Ibn al-Wardī was known only from this one work, which is supposed to plagiarize the *Jāmiʿ al-funūn* (The gatherer of the sciences) of Aḥmad ibn Ḥamdān al-Ḥarrānī.³⁵ Ibn al-Wardī's work, however, was extremely popular, and there are many manuscripts of it in existence. Therefore most of the maps of this sort come from copies of his work. There is, however, a copy of al-Ḥarrānī's work in Gotha that contains one of these world maps, and it is possible that the map originated in the work of al-Ḥarrānī (fig. 6.5).³⁶ Unfortunately it is undated, but the map closely follows the geometrical pattern of those in the Ibn al-Wardī manuscripts.

33. The only texts to appear in translation are al-Idrīsī's *Nuzhat al-mushtāq*; see *Géographie d'Edrisi*, 2 vols., trans. Pierre Amédée Emilien Probe Jaubert (Paris: Imprimerie Royale, 1836–40); Shams al-Dīn Abū ʿAbdallāh Muḥammad ibn Ibrāhīm al-Dimashqī's *Nukhbat al-dahr*; see *Manuel de la cosmographie du Moyen-Age*, ed. and trans. A. F. M. van Mehren (Copenhagen: C. A. Reitzel, 1874; reprinted Amsterdam: Meridian, 1964); and Abū al-Fidāʾ, *Taqwīm al-buldān*; see *Géographie d'Aboulféda: Traduite de l'arabe en français*, 2 vols. in 3 pts., trans. Joseph Toussaint Reinaud and S. Stanislas Guyard (Paris: Imprimerie Nationale, 1848–83). Al-Zuhri's *Jaʿrafiyah* has been edited by Hadj-Sadok with an introduction, “Kitāb al-Djaʿrafiyya” (note 18); ʿAlī ibn Mūsā ibn Saʿīd al-Maghribī, *Kitāb baṣṭ al-arḍ fi ṭūliha wa-al-ʿarḍ*; see *Libro de la extension de la tierra en longitud y latitud*, trans. Juan Vernet Ginés (Tetuan: Instituto Muley el-Hasan, 1958); Zakariyāʾ ibn Muḥammad al-Qazwīnī's *Āthar al-bilad* and ʿAjāʾib al-makhlūqāt; see *Zakariya ben Muhammed ben Mahmud el-Cazwini's Kosmographie*, 2 vols., ed. Ferdinand Wüstenfeld (Göttingen: Dieterichschen Buchhandlung, 1848–49; facsimile reprint Wiesbaden; Martin Sändig, 1967); and Sirāj al-Dīn Abū Ḥafṣ ʿUmar ibn al-Wardī, *Kharīdat al-ʿajāʾib*, only partly edited and translated by Carl Johann Tornberg, *Fragmentum libri Margarita mirabilium* (Uppsala, 1835–39) (there are also modern printed editions); Yāqūt's large dictionary, *Muʿjam al-buldān*, was edited by Wüstenfeld (note 32); and Abū ʿUbayd ʿAbdallāh ibn ʿAbd al-Aziz al-Bakrī's *Kitāb al-masālik wa-al-mamālik* and al-Kharaqī's *Muntahāʾ al-idrāk fi taqsim al-aflāk* have never been published entirely. A set of six maps or diagrams from a single manuscript of Yāqūt's work is given in Kamal's *Monumenta cartographica*, 3.5:965 (note 9).

34. Miller, *Mappae arabicae*, Band 5, Beiheft, Taf. 75–79 (note 7), gives a number of versions of this Ibn al-Wardī world map. It also appears in Kamal, *Monumenta cartographica*, 3.5:971 (note 9), where it is reproduced from a Leiden manuscript of a work of Ibn al-ʿArabī.

35. Al-Ḥarrānī was a lawyer who flourished in Egypt. This Ibn al-Wardī (d. 861/1457) should not be confused with Ibn al-Wardī, a Syrian literary writer, who lived a hundred years earlier and was in fact a contemporary of al-Ḥarrānī.

36. Gotha, Forschungsbibliothek; MS. Orient A. 1513; see Wilhelm Pertsch, *Die orientalischen Handschriften der Herzoglichen Bibliothek*

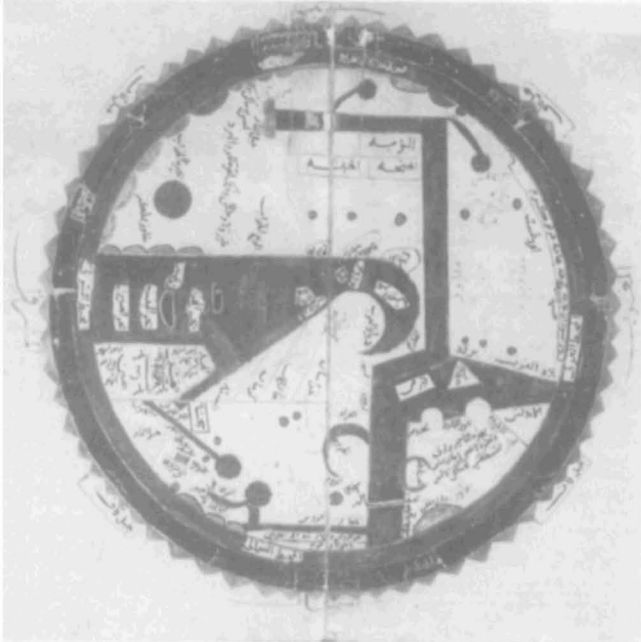


FIG. 6.5. WORLD MAP FROM AL-ḤARRĀNĪ'S *JĀMI' AL-FUNŪN*.

Size of the original: ca. 18 × 24 cm. By permission of the Forschungsbibliothek, Gotha (MS. Orient A. 1513, fols. 46b–47a).

A less stiff version of this map is found also in a manuscript of al-Qazwīnī's *ʿAjāʾib al-makhlūqāt* (plate 9).³⁷ It is dated on internal evidence to the early seventeenth century, although as a writer al-Qazwīnī (d. 682/1283) is considerably earlier than al-Ḥarrānī (fl. 730/1330) or Ibn al-Wardī (d. 861/1457). It is difficult to know whether the al-Qazwīnī map is the forerunner of the Ibn al-Wardī map or a less formal version developed at a later date. All three authors were cosmological writers whose works were popular right into the Ottoman period and in India.³⁸ The map from al-Qazwīnī's work has a flowing Nile instead of a rectangular one and a rather formless Mediterranean, though much of the rest has the geometrical stiffness of the true Ibn al-Wardī maps.

Most of the manuscripts of al-Qazwīnī's *ʿAjāʾib al-makhlūqāt* have a completely different map of the world. This is the second type of world map mentioned above, and it represents al-Bīrūnī's sketch map of the distribution of land and sea (compare fig. 6.4 above).³⁹ In al-Qazwīnī's texts this map tends to become stylized (fig. 6.6). The south coast of the land is stretched across the middle of the world circle and consists of a series of roughly parallel peninsulas separated by symmetrical bays.⁴⁰ These peninsulas are China, India, Arabia, and Africa. The northern coast of the landmass follows the circle around, leaving a series of indentations where Europe and the Mediterra-

nean are expected. The Nile appears as a wide channel dividing Africa in two, and this may be the origin of the double peninsula for southern Africa that appears in some later maps. Finally, the Caspian Sea and the Aral Sea appear as two "bubbles" in the middle of the land.

The third type of world map was less stylized, taking considerably more notice of the accounts of the world written in geographical texts. It tends to be more detailed than those mentioned above, and Ptolemaic influence is noticeable. There were two varieties of this map, one with an eastward extension of Africa (hence making the Southern Hemisphere all land) and one following al-Bīrūnī's influence, which maintains an open Indian Ocean with the Southern Hemisphere mostly sea.

In fact, the first variety is limited to the circular world map of al-Idrisī. This map, though it has many Ptolemaic features, has kept the look of al-İṣṭakhri's world map.⁴¹ However, al-Idrisī has much more detail and has also tidied it up, mainly by drawing in climate boundaries and inserting the material into the correct climate. This is the first time this information has appeared on a detailed world map.

It is possible that more detailed versions of the Ibn Ḥawqal III world map were produced in later times, and if so they would fit the first category of our classification here. Ibn Ḥawqal III and al-Idrisī have several Ptolemaic features in common deriving from al-Khwārazmī that the open Indian Ocean maps do not have. The narrow entrance to the Indian Ocean and the peninsula of China with the islands of al-Fiḍḍah and Yāqūt beyond are common to Ibn Ḥawqal III and some versions of al-Idrisī and are implicit from al-Khwārazmī's text, although Ptolemy's map is somewhat different. Al-Khwārazmī's version

zu Gotha, pt. 3, *Die arabischen Handschriften*, 5 vols. (Gotha: Perthes, 1878–92), vol. 3, no. 1513. No date is given for it.

37. Gotha, Forschungsbibliothek; see Pertsch, *Die arabischen Handschriften*, vol. 3, no. 1507 (note 36). The map is reproduced in Miller, *Mappae arabicae*, Band 5, Beiheft, Taf. 80 (Kazwini Goth.), and is mentioned in Band 5, 128–29 (note 7). It is also given by Kamal, *Monumenta cartographica*, 3.5:1049 (note 9).

38. See, for example, pp. 220–21 and 389–90.

39. Al-Qazwīnī was the author of two main works, a cosmography, *Kitāb ʿajāʾib al-makhlūqāt wa-gharāʾib al-mawjūdāt* (Marvels of things created and miraculous aspects of things existing), and a geography, *Āthār al-bilād* (Monuments of the lands). The influence of his texts on later geographical writers was considerable. The maps appear in copies of both works.

40. Other versions of this map are mentioned in note 32. Transliterations of al-Qazwīnī's version can also be found in Miller, *Mappae arabicae*, Band 5, 129–30 (Bild 6 and 7) (note 7).

41. For al-Idrisī's circular world map, see pp. 160–62 and figs. 7.1 to 7.5 and plate 11.

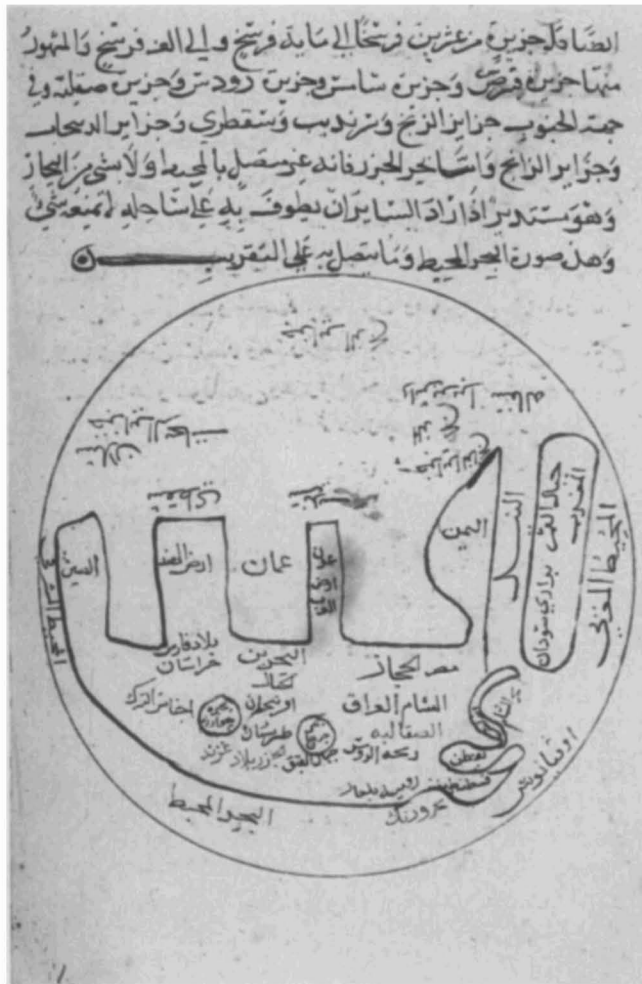


FIG. 6.6. AL-QAZWĪNĪ'S DISTRIBUTION OF LAND AND SEA. Copy from a manuscript of al-Qazwīnī's *'Ajā'ib al-makhlūqāt*, dated 945/1539 and originating from al-Bīrūnī (compare fig. 6.4 above). Diameter of the original: 13 cm. By permission of the Bodleian Library, Oxford (MS. Pococke 350, fol. 73v).

of Ptolemy's Nile is also in both of them. The Iberian Peninsula and the way Italy fits on to Europe are other common features and are also noticeable on the Bodleian map that follows. The Iberian Peninsula is triangular in both al-Idrīsī's map and the Bodleian map. This too is a Ptolemaic feature, but it is not so obvious on the Ibn Ḥawqal III world map.

The second variety of this world map with an open Indian Ocean is represented by a map found in a manuscript in the Bodleian Library, titled *Kitāb al-bad' wa-al-ta'rikh* (Book of beginning and history) (977/1569–70). Although the date of the map is very late, its derivation from Ibn Ḥawqal III is noticeable. However, one would expect a missing link somewhere between the two that may or may not have had the open Indian Ocean. For convenience I will refer to this map as the Bodleian

map (plate 10). The work it accompanies is anonymous but was originally attributed to Ibn Sa'īd.⁴² Kropp has shown that there is no connection with the work of Ibn Sa'īd, and all we can really say is that it was produced in North Africa and in its present form dates from approximately the latter half of the sixteenth century, the period of the manuscript in which it is found.⁴³ But the origin of the map must be back in the twelfth or thirteenth century, and it is influenced by Ibn Ḥawqal III and by al-Bīrūnī's sketch of land and water distribution. Thus the southern half of the world circle consists mainly of water. The Northern Hemisphere is very similar to that of the circular world map of al-Idrīsī, and the pattern of arcs of circles for climatic boundaries is another feature derived from that author.⁴⁴ The south coast of Asia resembles more than anything else the same area from the Ibn Ḥawqal III world map, whereas Africa shows the two peninsulas mentioned earlier, with no landmass to the south and east—only an open ocean. This is what will be found in future Islamic world maps. This map is from the Islamic west in the al-Idrīsī tradition, but the same features will be seen in the map of Ḥamd Allāh Mustawfī in the east and in a later map of Indian origin. It is reasonably detailed and from this point of view excels the map of Ḥamd Allāh Mustawfī, but it cannot compare in detail of topographical content with the sectional maps of al-Idrīsī or the world map of his successor al-Ṣifāqīs. Nevertheless, it shows considerable development in geographical content and as such is extremely interesting.

Maps resembling this one survived until comparatively recent times, and degenerate copies appear from time to time, especially in the Indian subcontinent. An interesting and detailed map that must derive ultimately from this source exists in the Museum für Islamische Kunst in

42. Most of the maps attributed to Ibn Sa'īd by Miller and others who follow Miller are really from the later version of Ibn Ḥawqal (Ibn Ḥawqal III) mentioned earlier. Manuscripts of Ibn Sa'īd's work have no maps.

43. Oxford, Bodleian Library, MS. Laud. Or. 317. This manuscript and the map are discussed in an article by Manfred Kropp, who attributed the work to al-Shāwī al-Fāsi, the writer of the manuscript; see Manfred Kropp, "Kitāb al-bad' wa-t-ta'rikh" von Abū l-Ḥasan 'Alī ibn Aḥmad ibn 'Alī ibn Aḥmad Aṣ-Ṣawī al-Fāsi und sein Verhältnis zu dem 'Kitāb al-Ġā'rafiyya' von az-Zuhri," in *Proceedings of the Ninth Congress of the Union Européenne des Arabisants et Islamisants, Amsterdam, 1st to 7th September, 1978*, ed. Rudolph Peters (Leiden: E. J. Brill, 1981), 153–68. A legend on the map states that the map is compiled according to an account taken by al-Kindī and al-Sarakhsī from the book of Ptolemy. This is a dubious statement, since these two authors were not geographers and are not mentioned in connection with maps until centuries after their deaths.

44. Kropp, "Kitāb al-bad'" (note 43), compares the text that accompanies the map with that of al-Ṣifāqīs and also with that of al-Zuhri. The former writer was certainly influenced by al-Idrīsī. Details of the al-Sharafī al-Ṣifāqīs family and their maps can be found below, pp. 284–87, and in Miller, *Mappae arabicae*, Band 5, 175–77, and Band 6, Taf. 79–80 (note 7).

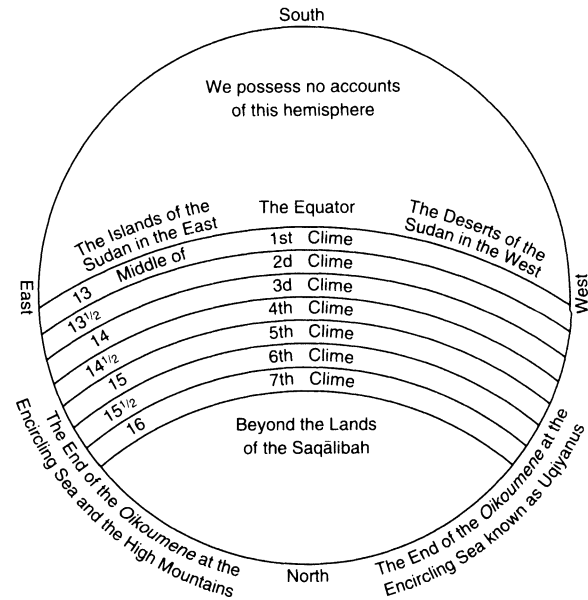
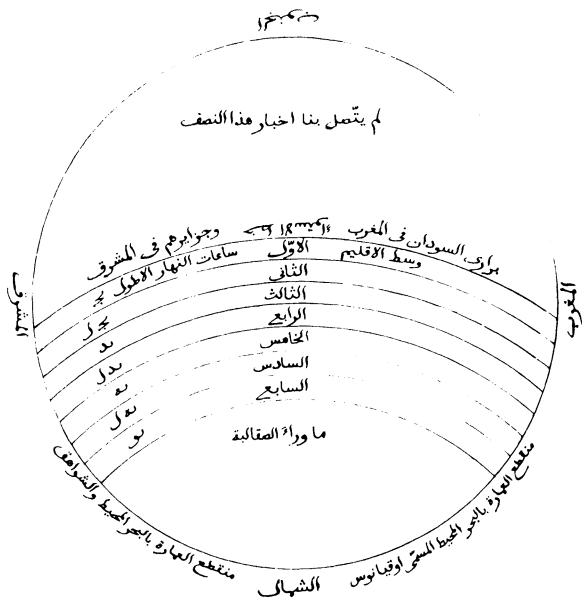


FIG. 6.7. THE CLIMATE (ZONE) MAP. The simple climate diagram as reproduced by Yāqūt from the printed edition of his *Muʿjam al-buldān*. Translation on the right.

Diameter of the original: ca. 12 cm. From *Jacut's geographisches Wörterbuch*, 6 vols., ed. Ferdinand Wüstenfeld (Leipzig: F. A. Brockhaus, 1866–73), vol. 1, between pp. 28 and 29 (fig. 4), by permission of F. A. Brockhaus.

Berlin⁴⁵ and probably comes from the eighteenth century. It is basically an Arab map in Arabic, though some Persian forms appear and place-names in India are given in both Arabic and Hindi scripts. However, the whole map is nothing but a very decadent and late version whose ancestry goes back through some map similar to the Bodleian map to a version of Ibn Ḥawqal III, but without an African landmass spreading throughout the Southern Hemisphere. As an Indian map it has been described in detail and illustrated in part 2 of this volume (pp. 394–96, fig. 17.4, and plate 29).

The semicircular world map from the work of Ṣādiq Iṣfahāni (illustrated below, fig. 17.1) shows a similar derivation, as do several other maps of Indian origin that have been published.⁴⁶ The later they are, the more decadent they appear. The map (albeit in a European copy) Bagrow illustrates as a Persian map⁴⁷ may not appear to be related either to the world map of Ibn Ḥawqal III or to that of al-Idrīsī. It is nevertheless their ultimate descendant through a long series of maps in the Indian subcontinent.⁴⁸

CLIMATIC (ZONE) MAPS AND THEIR VARIANTS

Here I must mention a secondary cartographic development in the Islamic world, the climate map similar in design to that of Pierre d'Ailly (fourteenth-fifteenth century A.D.) in Europe.⁴⁹ This map develops from a cosmographical diagram whose origin is difficult to place.

The simplest and possibly the earliest form of this diagram consisted of a world circle with straight lines across it demarcating the climates. A version of this appears in al-Idrīsī's *Rawḍ al-faraj wa-nuzhat al-muhaj* (Gardens of pleasure and recreation of the souls) (dated A.D.

45. Klaus Brisch et al., *Islamische Kunst in Berlin: Katalog, Museum für Islamische Kunst* (Berlin: Bruno Hessling, 1971), "Weltkarte mit Miniaturen aus dem Alexanderroman" (no. 3, pp. 12–13) and fig. 23.

46. The world map comes from a set of maps in a manuscript in the British Library (MS. Egerton 1016) of the *Shahid-i Ṣādiq* (Persian atlas) of the geographer/encyclopedist Ṣādiq Iṣfahāni (d. ca. A.D. 1680). The regional maps of this set resemble al-Idrīsī in that they fit together to give world coverage. They improve on al-Idrīsī cartographically in that they are formed on a grid of equal-sized squares whose sides are one degree in length. I am indebted to Susan Gole for acquainting me with the existence of this set. See figs. 17.9 and 17.10 below.

47. See below, fig. 17.2, and Leo Bagrow, *History of Cartography*, rev. and enl. R. A. Skelton, trans. D. L. Paisley (Cambridge: Harvard University Press; London: C. A. Watts, 1964; reprinted and enlarged, Chicago: Precedent, 1985), fig. 72 (p. 209).

48. Susan Gole also introduced me to these maps. They include one published by William Ouseley, "Account of an Original Asiatick Map of the World," in *The Oriental Collections*, vol. 3 (London: Cadell and Davies, 1799), 76–77, and one illustrated in Bagrow, *History of Cartography* (note 47), originally published by Edward Rehatsek, "Fac-simile of a Persian Map of the World, with an English Translation," *Indian Antiquary* 1 (1872): 369–70. Another similar map shown to me was a loose sheet found in a Delhi bazaar in 1984; see below, pp. 392–94 and figs. 17.2 and 17.3.

49. David Woodward, "Medieval *Mappaemundi*," in *The History of Cartography*, ed. J. B. Harley and David Woodward (Chicago: University of Chicago Press, 1987–), 1:286–370, esp. 253–54.



FIG. 6.8. A MORE ELABORATE CLIMATE DIAGRAM. This example shows vestiges of a coastline and comes from the *Āthār al-bilād* of al-Qazwīnī; manuscript dated 729/1329. Diameter of the original: ca. 16 cm. By permission of the British Library, London (MS. Or. 3623, fol. 5).

1192).⁵⁰ Other authors, however, prefer a diagram with climate boundaries drawn as arcs of a circle, as shown by Yāqūt in his *Kitāb muʿjam al-buldān* (Dictionary of countries), which is dated about A.D. 1224 (fig. 6.7). But in the climate (zone) maps of the world that develop from this diagram it is the straight boundaries that are most common; the arced variety are relatively rare. The arced boundary lines, however, appear on more detailed world maps like those of al-Idrīsī and the Bodleian map already mentioned.⁵¹

The next elaboration is the insertion of the names of countries and other features between the climate lines. This form occurs in some manuscripts of al-Qazwīnī's *ʿAjāʾib al-makhlūqāt* and his *Āthār al-bilād*, and also in one Ibn Ḥawqal manuscript (Paris, Bibliothèque Nationale, MS. 2214, which contains the abridgment of Ibn Ḥawqal) (see fig. 3.6). Whichever is the earliest manuscript would therefore represent the first appearance in

Islamic sources of this type of climatic diagram.⁵² A further development occurs in some of the al-Qazwīnī manuscripts when short lines are inserted that represent linear features on the earth's surface such as coastlines (fig. 6.8), and this is taken still further in some Syriac maps of this period that show an almost continuous coastline (the world landmass can often be clearly seen). The Syriac maps also have considerably more detail in the toponymy and are distinguished by representing only the northern part of the inhabited world in a semicircle instead of showing a full circle as in the Islamic diagrams (fig. 6.9).⁵³

As I said, the origin of this sort of diagram is difficult to ascertain. The earliest and simplest example comes from Europe in a diagram of Petrus Alphonsus that dates from approximately A.D. 1100.⁵⁴ There seems to be nothing in Arabic texts before A.D. 1200, however. Yāqūt seems to attribute his version of this diagram to al-Bīrūnī,⁵⁵ but the extant texts of al-Bīrūnī do not give the diagram—only a table of climate boundaries with latitude values.⁵⁶ Al-Bīrūnī would be earlier than Petrus Alphonsus, and it is interesting that Petrus Alphonsus fills the southern half of his map with a representation of the city of Arin, a conception that must have come from the

50. The climate diagram from al-Idrīsī's *Rawḍ al-faraj* is reproduced below, fig. 7.16.

51. Compare the world map from al-Idrīsī's *Nuzhat al-mushtāq* and the Bodleian map previously mentioned.

52. The earliest dated version of the map is 729/1329, in the British Library's manuscript of al-Qazwīnī (MS. Or. 3623, fol. 5r); the Paris manuscript is dated 847/1445. Two reproductions of climate diagrams from al-Qazwīnī's *Āthār al-bilād* appear in Kamal, *Monumenta cartographica*, 3.5:1050 (note 9). Reproductions of the zonal map from the Paris manuscript can be seen in Miller, *Mappae arabicae*, Band 5, Beiheft, Taf. 71 (Paris₂) (note 7), and in Kamal, *Monumenta cartographica*, 3.3:811 (note 9). The other manuscripts of this Ibn Ḥawqal abridgment do not seem to have this map.

53. These Syriac maps are four slightly different versions of a climate map, three appearing in three manuscripts of the *Menāreth qudhshē* (The candlestick of the sanctuary) of Bar Hebraeus (A.D. 1226–86) and one in an Arabic-Syriac lexicon by Bar ʿAlī that was written in the latter part of the twelfth century. The surviving manuscripts were not written before A.D. 1400, however, and the form of the map leads us to assume that this map was a development of the Islamic climatic map that appears in al-Qazwīnī's work. The four manuscript maps are (1) Paris, Bibliothèque Nationale, MS. Syr. 210, fol. 38r (A.D. 1404); (2) Paris, Bibliothèque Nationale, MS. Syr. 299 (Bar ʿAlī lexicon), fol. 204v (A.D. 1499); (3) Berlin, Staatsbibliothek Preussischer Kulturbesitz, no. 190 (MS. Sachau 81) (A.D. 1403); and (4) Cambridge University Library, MS. Add. 2008 (fifteenth century A.D.). All are in Miller, *Mappae arabicae*, Band 5, 168–72 (Bild 25 and 26) (Paris manuscripts), Band 5, Beiheft, Taf. 81 (Berlin and Cambridge manuscripts) (note 7). The first three are also illustrated by Kamal, *Monumenta cartographica*, 4.1:1096 (nos. 1 and 3) and 1097 (no. 2) (note 9).

54. Woodward, "Medieval *Mappaemundi*," 354–55 (note 49).

55. Yāqūt, *Muʿjam al-buldān*; see Wüstenfeld's edition, 1:27–28 (note 32).

56. Al-Bīrūnī, *Kitāb al-taḥfīm*; see the translation by Wright, 138 (note 31).

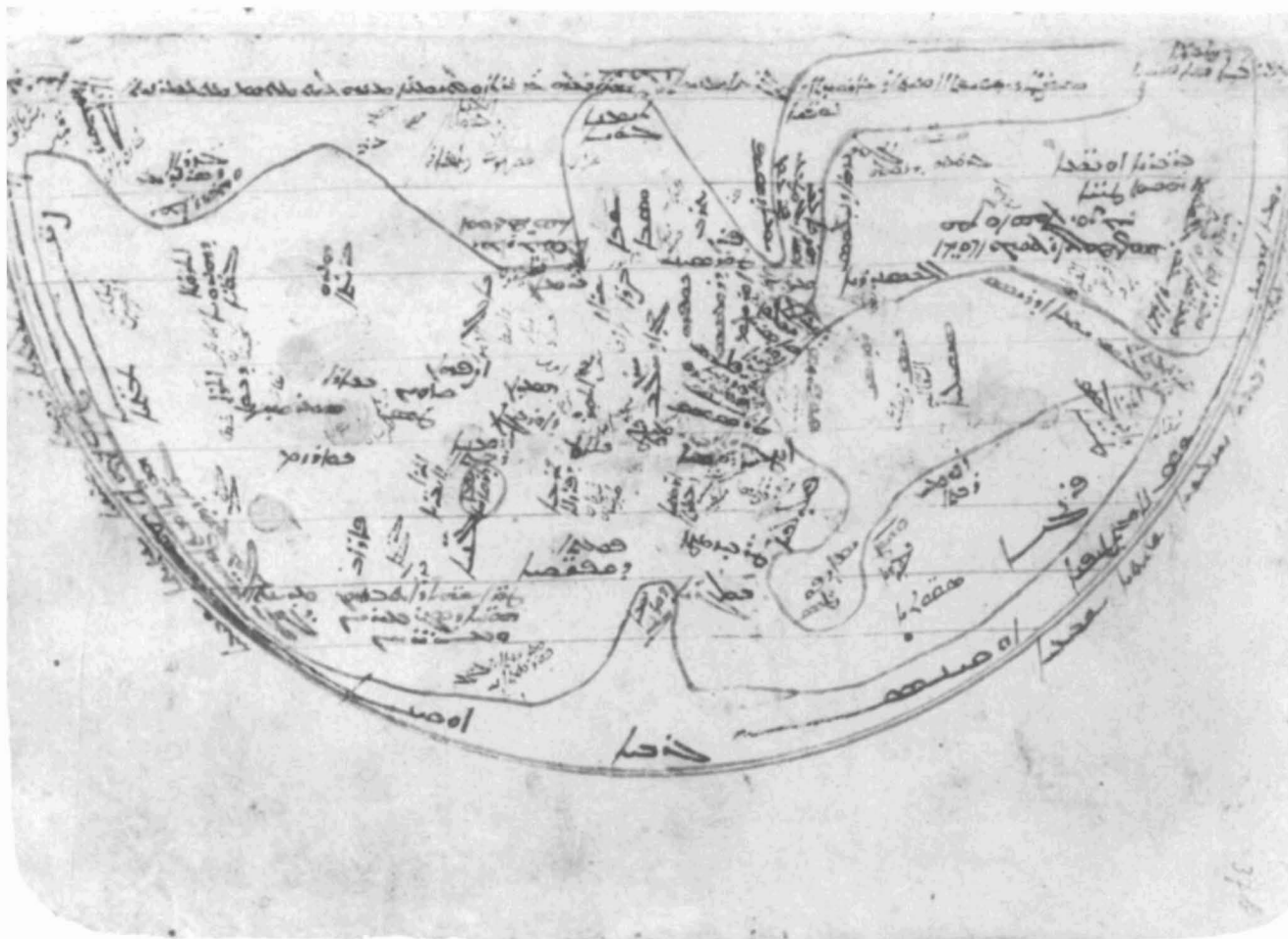


FIG. 6.9. SYRIAC MAP BASED ON THE ARAB CLIMATE DIAGRAM. This is taken from Bar Hebraeus, *Menāreth qudshē*.

Size of the original: not known. By permission of the Staatsbibliothek Preussischer Kulturbesitz, Berlin (Orientabteilung, MS. Sachau 81, fol. 37b).

Arabs. Although it is mentioned by the Arabs much earlier,⁵⁷ the concept looms large in al-Bīrūnī because of his interest in things Indian.⁵⁸ Yet it is still possible that the origin of this diagram is from the classical world and was known to both the Muslims and the medieval Europeans. Macrobius's zonal maps seem to be related, but the Islamic maps seldom have the tropics marked—they show only the climate divisions. The equator is often mentioned along the southern boundary of the first climate. The final development as shown in the Syriac maps mentioned above does not appear in European texts. The most elaborate of these maps in Europe, dated about A.D. 1410—that of Pierre d'Ailly—is not advanced enough in the sequence to include a rudimentary coastline.⁵⁹

FIRST USE OF A GRATICULE

The final development of medieval Islamic cartography was the attempt to place a graticule on the Islamic circular

world map. This was first attempted not with a graticule of degrees of longitude and latitude, but with the insertion of climate divisions onto the map. This latter can first be seen through the development of the climate dia-

57. The first Arab use of Arin appears in Ibn Rustah ca. 290/900; see p. 103 above and J. H. Kramers, "Geography and Commerce," in *The Legacy of Islam*, ed. Thomas Arnold and Alfred Guillaume (Oxford: Oxford University Press, 1931), 78–107, esp. 93.

58. Al-Bīrūnī's reference is from his history of India; see *Alberuni's India: An Account of the Religion, Philosophy, Literature, Geography, Chronology, Astronomy, Customs, Laws and Astrology of India about A.D. 1030*, 2 vols., ed. Eduard Sachau (London: Trübner, 1888; Delhi: S. Chand, [1964]), 1:304.

59. Pierre d'Ailly's map is reproduced in Bagrow, *History of Cartography*, 48–49 (figs. 7a and b) (note 47), and in Joachim G. Leithäuser, *Mappae mundi: Die geistige Eroberung der Welt* (Berlin: Safari-Verlag, 1958), 161, 173. Those of Macrobius are given in Woodward, "Medieval Mappaemundi," 300 (fig. 18.10) and 354 (fig. 18.70) (note 54). For discussion of other climate diagrams in a cosmographical context, see pp. 76–80.

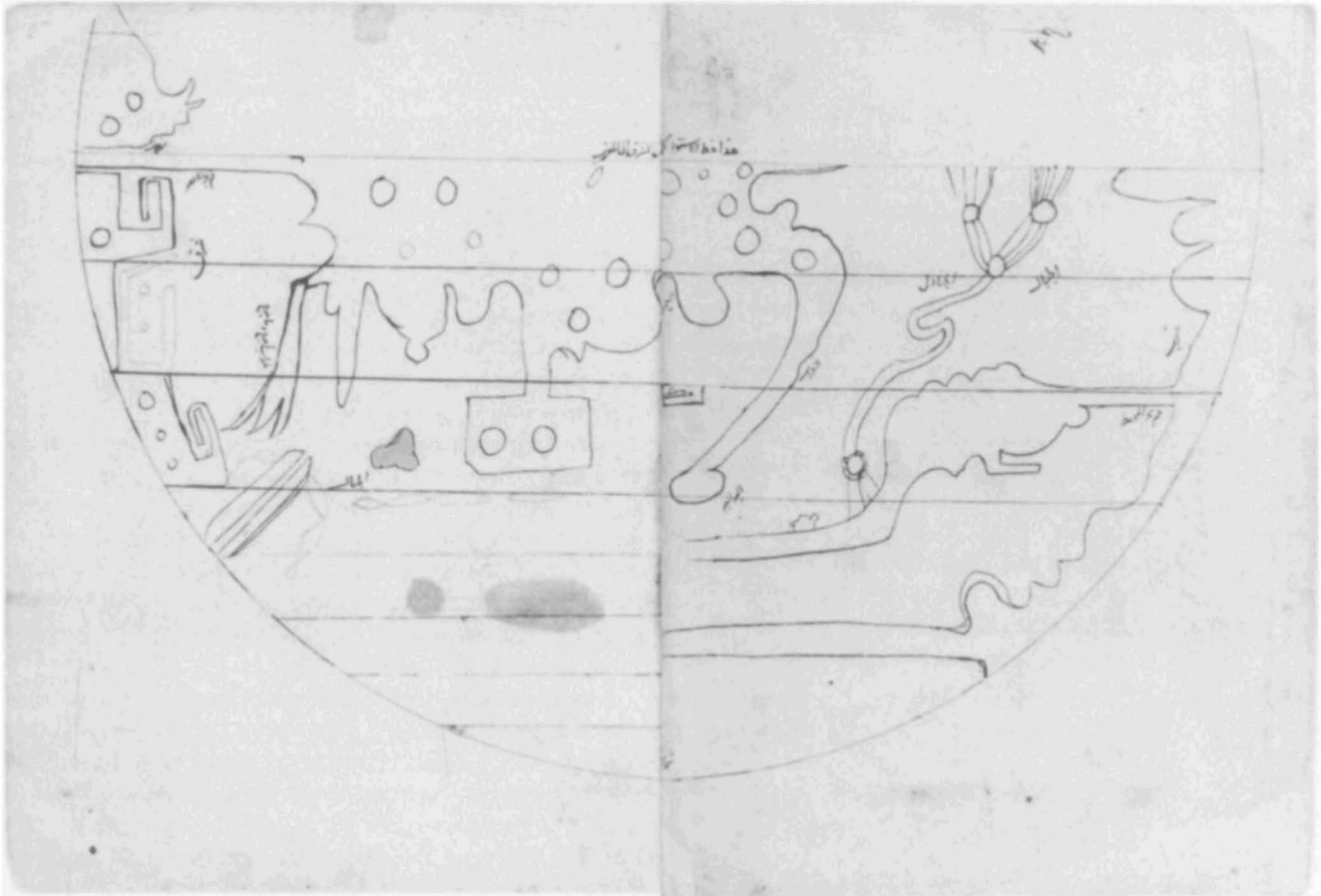


FIG. 6.10. SEMICIRCULAR MAP OF THE WORLD. Size of the original: not known. By permission of the Bibliothèque Nationale, Paris (MS. Arabe 2214, fol. 3).

gram mentioned in the previous section, and the Syriac map (fig. 6.9 above) is a fairly good representation of this principle. As I mentioned before, climate boundaries were given fixed latitude values quite early on by Muslims, and place-names were listed in their correct climates, hence delimiting their position latitudinally.⁶⁰ Al-Idrisi successfully placed climate divisions as arcs of a circle on his circular world map and transferred them to his sectional maps as straight lines (or vice versa).⁶¹ The Paris abridgment of Ibn Ḥawqal, in addition to its climate division diagram based on a complete circle and its oval world map, contains a semicircular map of the world with the climate divisions marked as straight lines (fig. 6.10).⁶² This map has little nomenclature but has a continuous coastline based on the oval world map. However, it differs in form from the Syriac maps.

Attempts to place the world on a graticule of lines of longitude as well as latitude, which would of course simply be perpendicular to climate divisions, were fraught with difficulties. Nevertheless, by the fourteenth century such attempts were made. The earliest are two world maps attached to the work *Nuzhat al-qulūb* (Diversion for the hearts) of Ḥamd Allāh Mustawfī, a Persian writer who died in 740/1339 (fig. 6.11). Similar maps appear in

the works of Ḥāfiẓ-i Abrū (d. 833/1430) (fig. 6.12) and the British Library copy of the *Shāhid-i Ṣādiq* of Ṣādiq Iṣfahānī.⁶³ These authors found adopting a grid very difficult, and their use of it was extremely awkward. The grid was usually based on a square outside the circle, and the parallels and meridians remain at right angles to each other throughout, with no attempt at a projection to fit

60. See chapter 4, esp. pp. 97ff.

61. The straight lines are the top and bottom borders of his sectional maps.

62. This is also reproduced in Miller, *Mappae arabicae*, Band 5, Beiheft, Taf. 71 (Paris₃) (note 7).

63. Ḥamd Allāh ibn Abī Bakr al-Mustawfī Qazvīnī's main work was the *Nuzhat al-qulūb*, a mainly cosmographical and geographical work, which is best known for the light it sheds on the history of the end of the Ilkhanid Empire. There are four manuscripts in the British Library containing maps: MS. Or. 7709, MS. Or. 23543, MS. Or. 23544, and MS. Add. 16736. The world maps from two of these are reproduced in Miller, *Mappae arabicae*, Band 5, Beiheft, Taf. 83 (note 7). Ḥāfiẓ-i Abrū (ʿAbdallāh ibn Luṭf Allāh al-Bihdādīnī, d. 833/1430) was a Persian historian at the time of Timūr and Shāhrukh. His maps appear in an untitled and unfinished geographical work written for Shāhrukh between A.D. 1414 and 1420, said to be a translation from the Arabic. In addition to the world map illustrated in fig. 6.12, a world map by Ḥāfiẓ-i Abrū appears in British Library, MS. Or. 1987. For Ṣādiq Iṣfahānī's world map, see fig. 17.1 below.

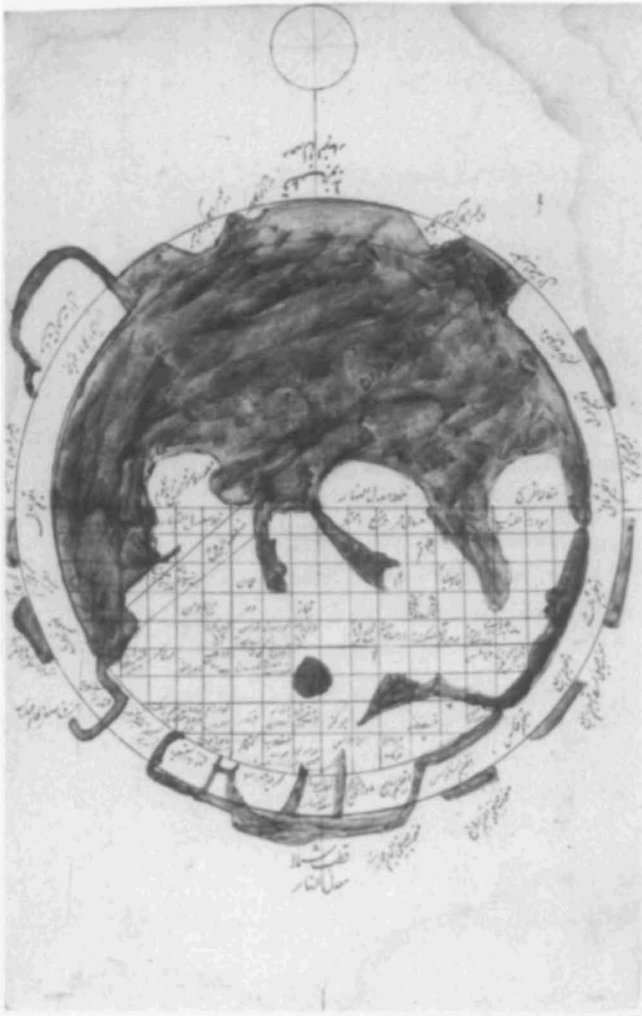


FIG. 6.11. WORLD MAP OF ḤAMD ALLĀH MUSTAWFĪ. From a seventeenth-century manuscript copy of his work *Nuzhat al-qulūb*.

Diameter of the original: ca. 15.5 cm. By permission of the British Library, London (Add. MS. 23544, fol. 226v).

into the circle. The Ḥamd Allāh Mustawfī maps have removed that part of the grid that is left outside the circle, whereas Ḥāfiẓ-i Abrū retains it: Sādiq show only vestiges of this outer grid. Ḥāfiẓ-i Abrū also has five-degree squares instead of the usual ten-degree squares, and in some cases there is a smaller grid on land or on the northern half of the grid.

The form of the world landmass in the maps of these authors does not resemble either that of the Balkhī school or al-Idrīsī. It derives ultimately from the sketch of al-Bīrūnī showing the land-water relationship, probably through al-Qazwīnī. There are comparisons with the Bodleian map mentioned above, but unlike maps of this latter sort, it has a very simple coastline. All the geographical toponyms are written on the land, including the graticule when it appears inside the world circle, leaving the sea (usually colored a heavy blue) completely fea-

tureless. Ḥamd Allāh Mustawfī also divides Africa into two peninsulas like the Bodleian map. Generally Ḥamd Allāh Mustawfī's map has more original features and Ḥāfiẓ-i Abrū's is more conventional and schematic. Climate divisions are given by Ḥāfiẓ-i Abrū outside the square of the graticule, but the climate lines are not very successfully aligned with the graticule. Ḥamd Allāh Mustawfī only numbers the climates in the outer edge of the circle.

In addition, Ḥamd Allāh Mustawfī drew a map of the Iranian-Turkestan area that was highly original when it was first drawn in the fourteenth century (fig. 6.13). Longitude and latitude lines appear, forming a graticule of one-degree squares, and in a square only one location is given, which has the coordinates belonging to that square. In two manuscripts of this map, a coastline is given but no other linear features, and a third version does not bother with a coastline.⁶⁴ Ḥāfiẓ-i Abrū has other maps of the Mediterranean and Persian seas, but they are only outline maps and are taken more or less directly from those of al-İṣṭakhri.

There is a map of the world reproduced in a manuscript of the work of Aḥmad ibn Yaḥyā ibn Faḍl Allāh al-ʿUmārī (d. 749/1349) titled *Masālik al-abṣār fī mamālik al-amṣār* (Ways of perception concerning the most populous [civilized] provinces) (fig. 6.14). The same manuscript also has maps of the first three climates. Although the climates are not divided into sections, the general impression is that the maps are derived from those of al-Idrīsī. These maps have been referred to by Fuat Sezgin and dated A.D. 1340, making them contemporary with the author of the work, Ibn Faḍl Allāh al-ʿUmārī.⁶⁵ There is no reason why the geographical information on the world map should not date from the time of Ibn Faḍl Allāh al-ʿUmārī; as I have said, it is ultimately derived from al-Idrīsī. However, from its appearance it seems to have been compiled from the text of the *Kitāb baṣṭ al-arḍ fī ṭūlihā wa-al-ʿarḍ* (Exposition of the earth in length and

64. The varying versions of this map are shown in Miller, *Mappae arabicae*, Band 5, Beiheft, Taf. 84–86 (note 7). British Library, MS. Or. 7709, has no coastline. Joseph Needham thinks these grids show Chinese influence because of their equal-sized squares; see his *Science and Civilisation in China* (Cambridge: Cambridge University Press, 1954–), vol. 3, *Mathematics and the Sciences of the Heavens and the Earth* (1959), 564–65. However, the typical Chinese grid is based on linear measurement on the ground and not on angular measure (latitudes and longitudes) like these Islamic grids. Placing nomenclature in the squares instead of against an actual point is reminiscent of Chinese mapping, however.

65. Fuat Sezgin, *The Contribution of the Arabic-Islamic Geographers to the Formation of the World Map* (Frankfurt: Institut für Geschichte der Arabisch-Islamischen Wissenschaften, 1987), 41 and figs. 11–14. Karatay in his bibliography of Arabic manuscripts in the Topkapı Sarayı usually mentions maps in the description of a manuscript, but he does not mention any for this one or for any manuscript of this work; Fehmi Edhem Karatay, *Topkapı Sarayı Müzesi Kütüphanesi: Arapça Yazmalar Kataloğu*, 3 vols. (Istanbul: Topkapı Sarayı Müzesi, 1962–66).

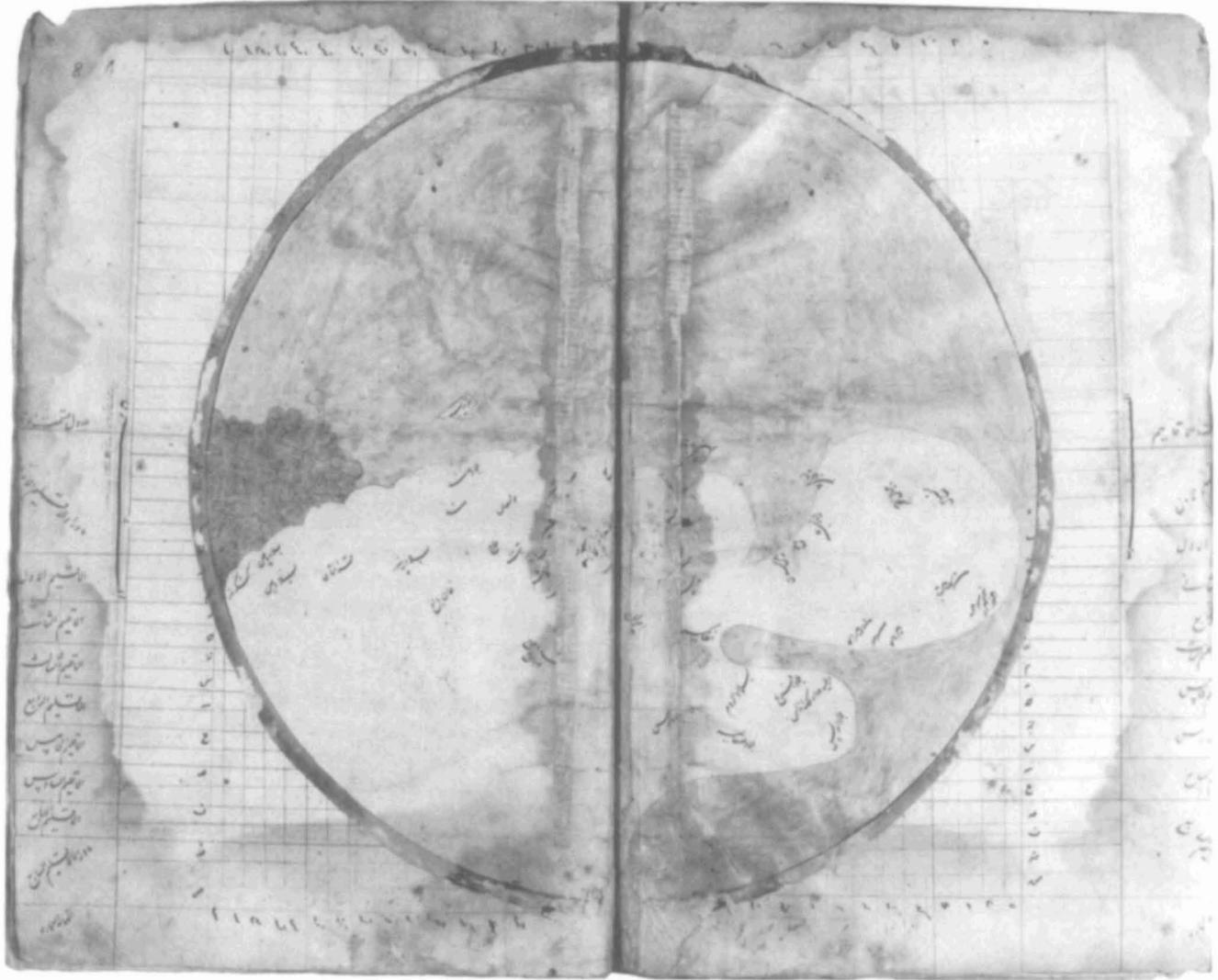


FIG. 6.12. WORLD MAP OF ḤĀFIẒ-I ABRŪ. From a manuscript of his work dated 1056/1646.

Diameter of the original: ca. 29.5 cm. By permission of the British Library, London (MS. Or. 1577, fols. 7v–8r).

breadth) by Ibn Saʿīd (d. 685/1286). This is the only set of Islamic maps I have seen that could be said to have been so compiled. Al-ʿUmarī's text does mention a map and gives a few examples of longitude and latitude, but on the whole they do not correspond with the positions given on the world map.

An accurate graticule has been drawn over the world map such as I have not come across on Islamic maps of the fourteenth or even fifteenth century A.D. One cannot be certain on the origin of this graticule without seeing the original, but it looks as if the draftsman added the graticule when copying the map for this manuscript. It is likely that the original would have had a series of straight parallels representing the climate boundaries and that these were changed by the draftsman into a kind of orthographic graticule with equidistant parallels of latitude, much as the climate boundaries probably were before

(some manuscripts of al-Idrīsī's world map have equidistant climate boundaries when drawn either as arcs or as straight lines). This graticule, with straight lines for parallels and arcs for meridians, appears similar to the projection Roger Bacon suggested in his *Opus Maius* (ca. A.D. 1267), but of course it is not so; the parallels are positioned according to a different principle.

Most of the Istanbul manuscripts of Ibn Faḍl Allāh's al-ʿUmarī's work are not dated. However, the earliest one to be dated is A.D. 1585, suggesting that this and most other copies were prepared for the libraries of the Ottoman sultans of that period. By that time the idea of a graticule was well known from European sources and could have been added to bring the map up to date. Note that the latitudes and longitudes given by Ibn Saʿīd for toponyms do not correspond to the actual positions on the map for the same toponyms.

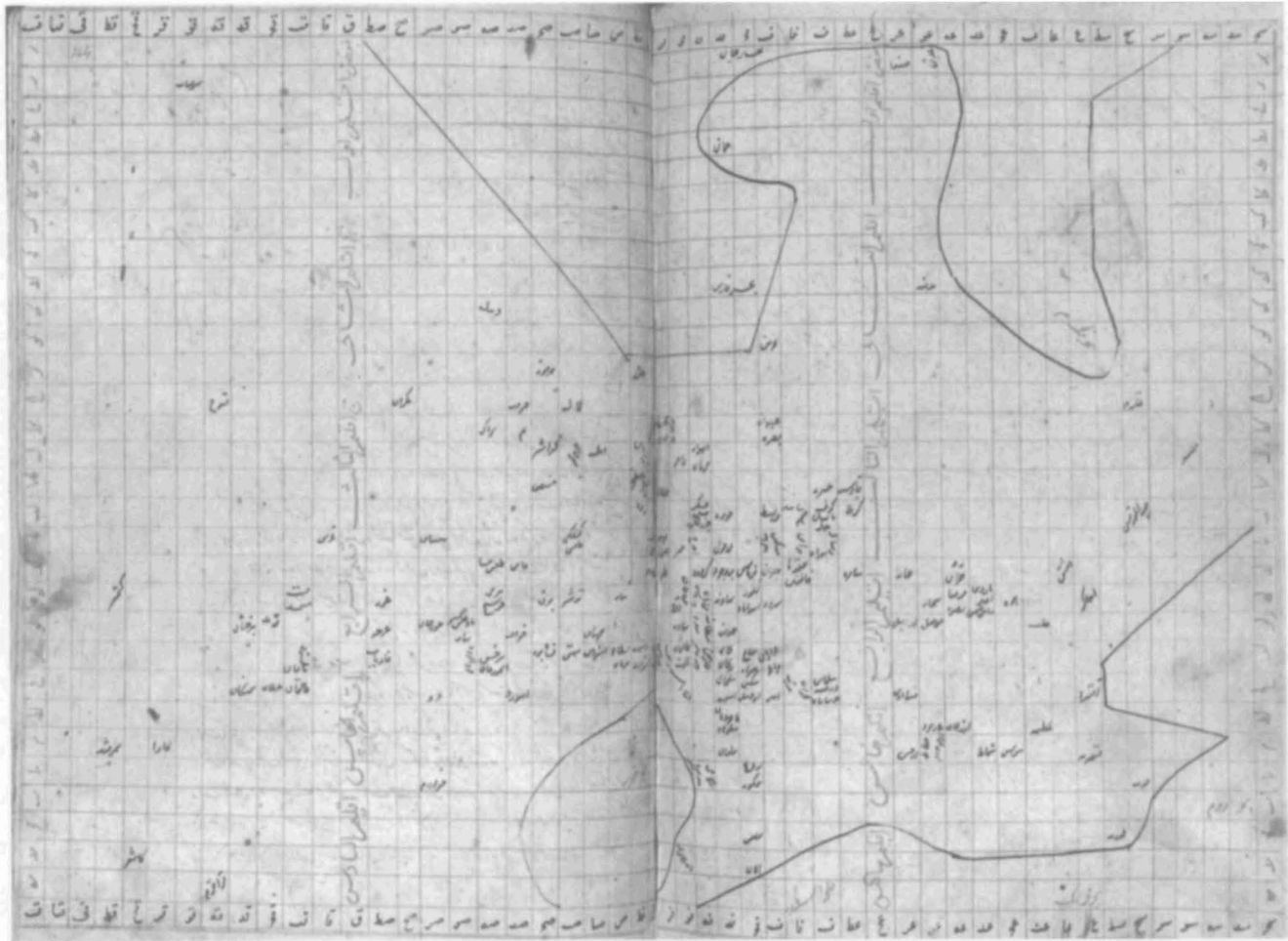


FIG. 6.13. MAP OF THE MIDDLE EAST BY ḤAMD ALLĀH MUSTAWFĪ. From a manuscript of his work, *Nuzhat al-qulūb* (sixteenth-century copy).

Size of the original: ca. 32 × 23.5 cm. By permission of the British Library, London (Add. MS. 16736, fols. 143v–144r).

OTHER MAPS

Manuscripts of al-Dimashqī's *Nukhbat al-dahr fi 'ajā'ib al-barr wa-al-baḥr* (Gems [selections] of the age from the marvels of the land and the sea) contain an odd collection of sketch maps. First we have a representation of the Persian *kishvar* system arranged in column form (3, 1, 3) instead of the usual six *kishvars* around a central one. Next there appears a very corrupt zonal map with no climate divisions but with countries arranged in columns, and finally a freehand drawing of the Mediterranean that resembles the sketch maps from the manuscript of al-Khwārazmī (fig. 6.15).⁶⁶ This sketch appears to have no importance for the development of Islamic cartography, but it is interesting because it has north at the top and shows no apparent resemblance to any other Mediterranean map either before or since.

Another unusual cartographic form is the plan of the city of Kazvin (Qazwīn) given in manuscripts of al-Qazwīnī.⁶⁷ As it occurs in the British Library manuscript, it is a very stylized diagram consisting of four concentric circles forming the regions (1) Sharistān, the old central city, (2) the larger modern (thirteenth-century) city, (3) the gardens, and (4) the surrounding cultivated fields (fig. 6.16). No orientation is given. As such this diagram could represent any Middle Eastern city, but superimposed on

66. Al-Dimashqī lived near Damascus, from which he takes his name. He wrote several books but is mainly known for his cosmographical and geographical compilation, the *Nukhbat al-dahr* (note 33). Transliterations of the two sketch maps in fig. 6.15 can be found in Miller, *Mappae arabicae*, Band 5, 140–41 (Bild 15–17) (note 7). Al-Khwārazmī's maps are illustrated above, figs. 4.8, 4.9, and plates 4 and 5.

67. A transliteration can be found in Miller, *Mappae arabicae*, Band 5, 132 (Bild 11) (note 7).

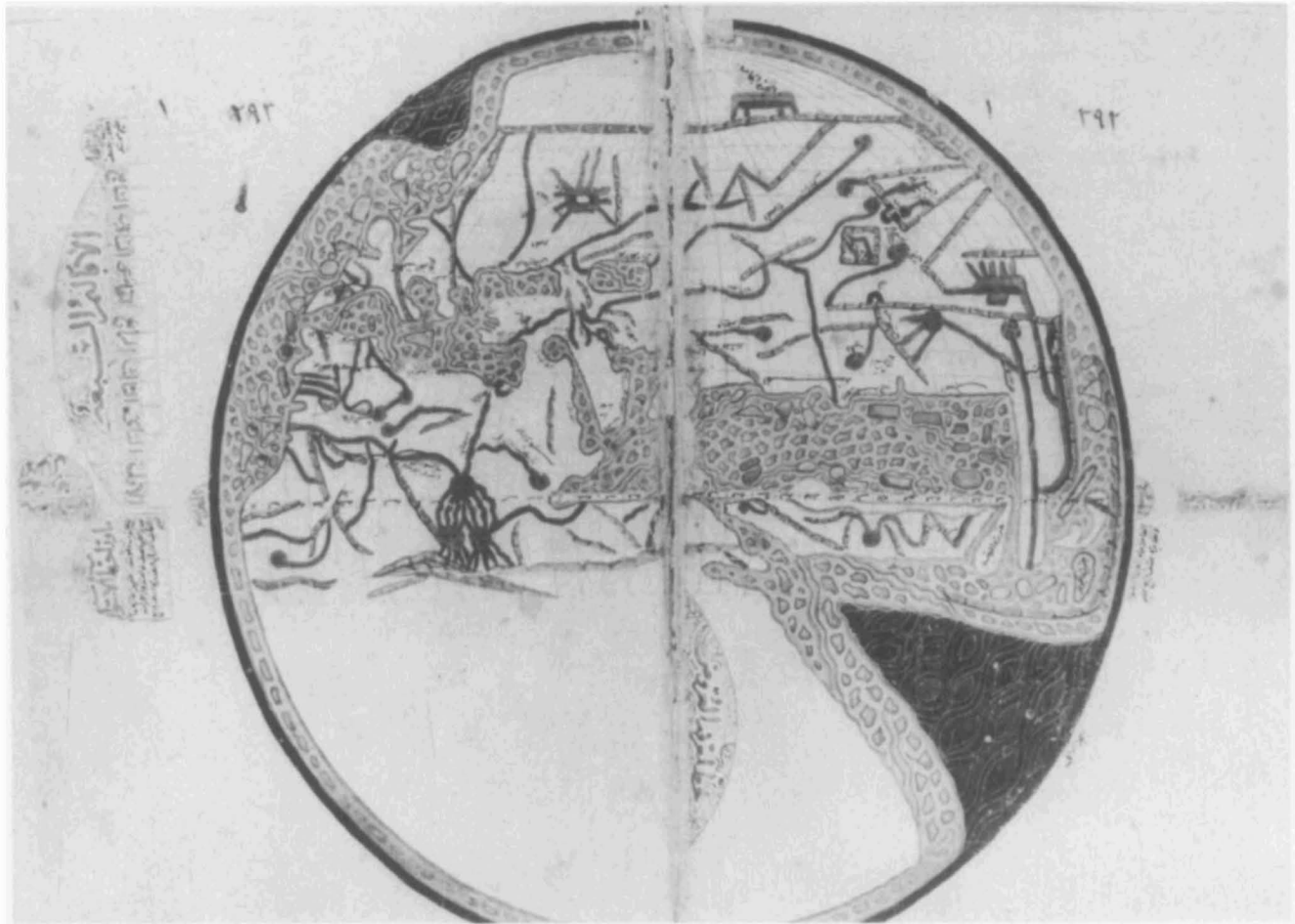


FIG. 6.14. WORLD MAP OF IBN FAḌL ALLĀH AL-ʿUMARĪ. The information on this map may derive ultimately from sources such as al-Idrīsī and Ibn Saʿīd. The graticule—which is most uncharacteristic for manuscripts from the fourteenth or even fifteenth century—appears to have been modified by a

copyist at the time the map was drafted, perhaps in the sixteenth century.

Size of original: not known. By permission of the Topkapı Sarayı Müzesi Kütüphanesi, İstanbul (A. 2797, fols. 292v–293r).

the whole are the two wadis or riverbeds that transverse the city of Kazvin, Wādī al-dharraj and the Wādī al-turk. The former flows right through the city, though it misses the old city, while the latter penetrates as far as the outer city and then performs a right-angle bend to depart. This second riverbed does not seem to exist on modern plans of the city.

The last map to be mentioned is that of al-Kāshgharī, a Turkish grammarian of the eleventh century A.D., whose map of the world appears as an illustration to his Turkish grammar.⁶⁸ This itself is unusual, and the map is certainly unlike any other map in Islamic literature. The individual elements of the map, symbols, and so forth, are all very much the same as those that appear on any other Islamic map, but its concept is most unusual (fig. 6.17). Although it is a map of the world, it is centered on the Turkish-speaking areas of Central Asia, with other

countries receding from them toward the circumference of the world circle. In addition, the scale seems to be reduced as one gets nearer the edge of the map, so that one has the impression of a fish-eye representation of the globe with Turkestan magnified in the center.

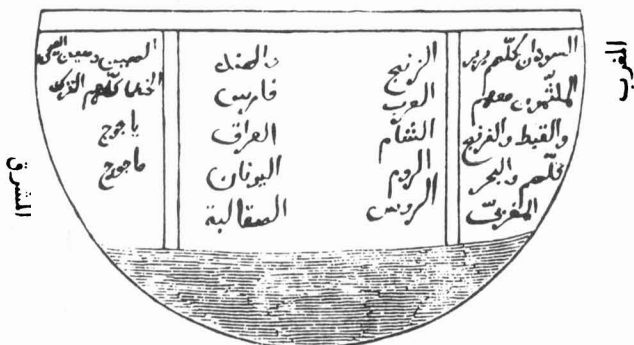
68. Maḥmūd ibn al-Ḥusayn al-Kāshgharī was a Turkish scholar and lexicographer whose most important work was the *Diwān lughāt al-Turk* (465–69/1072–76), a book on the Turkish language. The only surviving manuscript, in the Millet Genel Kütüphanesi in İstanbul, is dated 664/1266, and this may be the date of the map. A lengthy description and a translation of the map can be found in Albert Herrman, “Die älteste türkische Weltkarte (1076 n. Chr.),” *Imago Mundi* 1 (1935): 21–28, and a translation also appears in a recent English translation of al-Kāshgharī’s *Diwān lughāt al-Turk: Compendium of the Turkic Dialects*, 3 vols., ed. and trans. with introduction and indexes by Robert Dankoff in collaboration with James Kelly (Cambridge: Harvard University Press, Office of the University Publisher, 1982–85), vol. 1 between pp. 82 and 83. It can also be found illustrated and described

CONCLUSION

By the end of the fifteenth century classical Islamic geographical cartography was very much in decline. Various attempts by more scholarly geographers produced short bursts of productive activity in the cartographic field, but the end product was very much a rundown version of the highlights of the tenth and eleventh centuries A.D.

a

هذه القسمة موافقة لما هي المعمورة غلبه من مساكن الأمم
 بجغرافيا وهذه جهة الجنوب وقبلة أهل الشام وخط الأستواء



جهة الشمال وما تحت القطب الشمالى

b

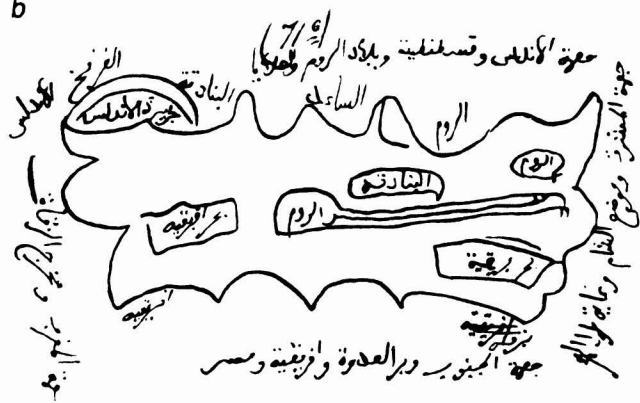


FIG. 6.15. MAPS FROM THE *NUKHBAT AL-DAHR* OF AL-DIMASHQĪ. (a) World diagram and (b) sketch map of the Mediterranean, both from the published version (from four manuscripts) edited by A. F. M. van Mehren, *Cosmographie de Chems-ed-Din . . . ed-Dimichqui, texte arabe* (Saint Petersburg, 1866; new impression Leipzig: Otto Harrassowitz, 1923), ed. and trans. Mehren as *Manuel de la cosmographie du Moyen Age* (Copenhagen: C. A. Reitzel, 1874; reprinted Amsterdam: Meridian, 1964), p. 26 and p. 40 of the 1923 text, by permission of Otto Harrassowitz, Wiesbaden.
 Size of the originals: (a) 8 × 10.5 cm; (b) 7.5 × 12.5 cm.

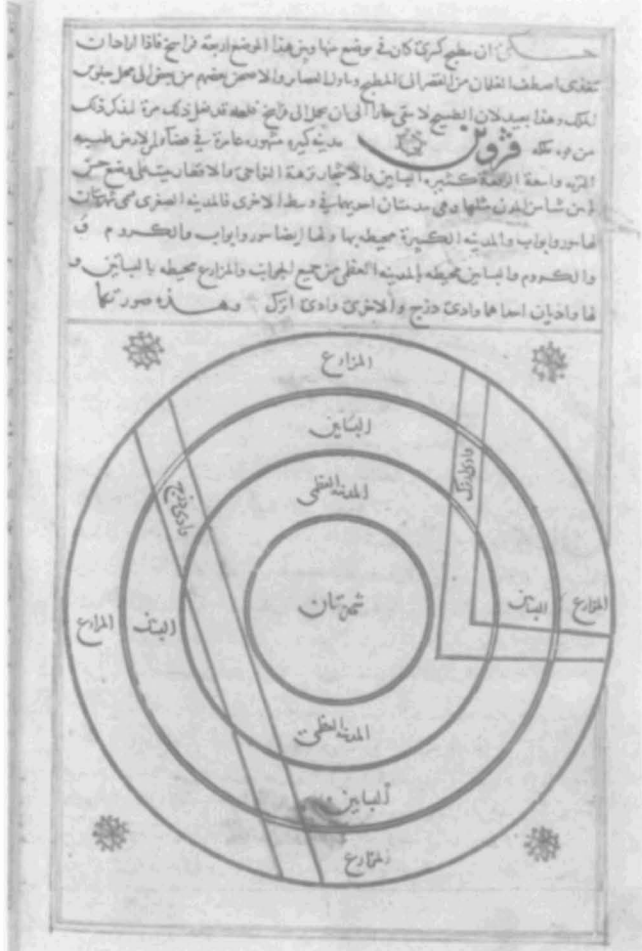


FIG. 6.16. PLAN OF THE CITY OF KAZVIN. From the *Āthār al-bilād* of al-Qazwīnī; this manuscript is dated 729/1329. Diameter of the original: ca. 15 cm. By permission of the British Library, London (MS. Or. 3623, fol. 119v).

There was a large gap between theory and practice, so that surviving finished maps do not reflect the work of the great narrative geographers or of the great scientific geographer al-Bīrūnī. The tables of Ptolemy and their Arabic adaptations were never really applied overall to Islamic maps, except perhaps in the large sectional maps of al-Idrīsī, which themselves never became the common property of the whole Islamic world. Lost maps are thought to have applied Ptolemaic construction, but nothing that has survived shows the influence of any of these missing maps. A detailed Ptolemaic projection comes to the Middle East only with a European printed version arriving in Ottoman Istanbul in the last years of the fifteenth century.⁶⁹

in Miller, *Mappae arabicae*, Band 5, 142-48 (note 7); Bagrow, *History of Cartography*, pl. XXVIII (note 47); Leithäuser, *Mappae mundi*, 104 (note 59); and in Kamal, *Monumenta cartographica*, 3.3:741 (note 9).

69. There were Arabic translations of the *Geography* available in Istanbul before the end of the fifteenth century, see p. 210. See also Ahmad, “*Kharīṭa*,” fig. 2 (note 21).

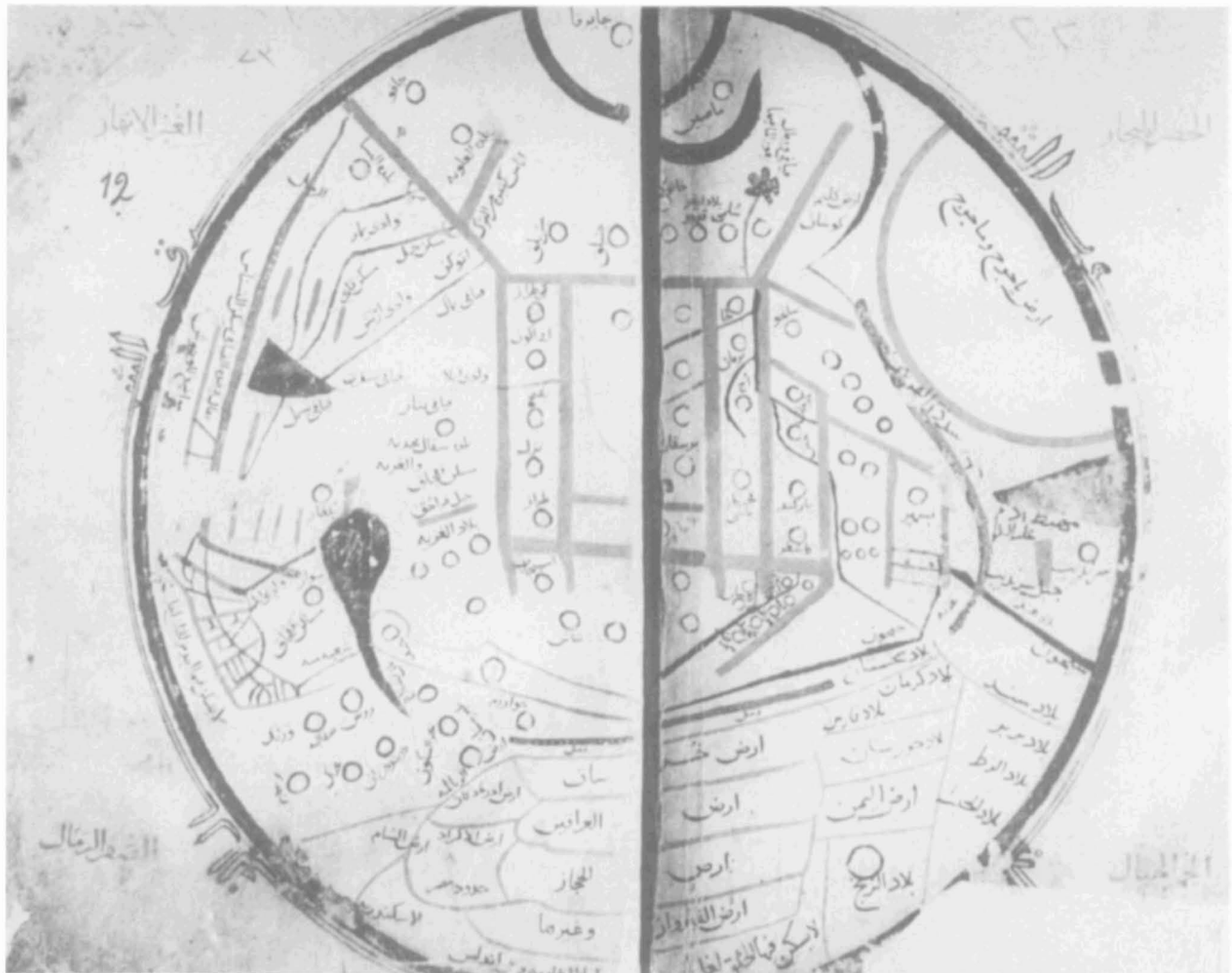


FIG. 6.17. WORLD MAP OF AL-KĀSHGHARĪ. This world map, oriented with east at the top, is from a unique manuscript of al-Kāshgharī’s *Diwān lughāt al-Turk*. The colors are described in the original as gray for rivers, green for seas, yellow for deserts, and red for mountains.

Size of the original: not known. The Millet Genel Kütüphanesi, Istanbul (Ali Emiri 4189).

Al-Bīrūnī’s various theories and projections also failed to be used practically. His sketch of land and sea distribution was taken up and caused later Islamic maps to reject the large southern landmass that dominates the maps of the Balkhī school and those of al-Idrīsī. Thus the more “modern” maps showed sea over most of the Southern Hemisphere, while those of al-Idrīsī and those derived directly from the Balkhī school, such as the maps of Ibn al-Wardī, showed the Southern Hemisphere consisting of a landward extension of Africa. These various

traditions of mapmaking persisted even into the nineteenth century, especially when included in new manuscripts of the work to which they were originally attached. Of course, practically all surviving Islamic maps were illustrations to texts and do not survive as independent artifacts. As manuscripts were copied from one another through the centuries, the surviving maps became more and more decadent until they were hardly recognizable and would be of no practical use.