and its commentaries), we can thus see how much the birth of successful doctrines owes to the followers and interpreters who, quite often, do not capitalize on all the possibilities contained in the original texts. As we are mainly concerned with Islamic science, we regret the absence of a more in depth review of the bibliography on the islamic criticism about Ptolemy. K.V. Snedegar, a self-confessed disciple of Prof. North offers an extremely interesting article on Simon Bredon ["The Works and Days of Simon Bredon, a Fourteenth-Century Astronomer and Physician", pp. 285-309], one of Richard of Wallingford's contemporaries, which reproduces, in the micro-cosmic dimensions of an article, most of his master's virtues.

The third section, "Early Modern Philosophy and Scholarship" closes the book with four articles that have a great deal to offer the specialist and even those whose formation and interests stop in the Renaissance and even before [L. Nauta, "A Humanist Reading of Boethius's *Consolatio Philosophiae*: The Commentary by Murmellius and Agricola (1514)", pp. 313-338; D. Pätzold, "Ist Tschirnhaus' *Medicina mentis* ein Ableger von Spinozas Methodologie?", pp. 339-364; H. Van Ruler, "'Something, I Know Not What'. The Concept of Substance in Early Modern Thought", pp. 365-393; G. Federici Vescobini, "Les *Vite di matematici Arabi* de Bernardino Baldi (Urbino 1553-1617)", 395-407]. As far as medieval and Islamic science are concerned, the first and the last of these articles are interesting contributions to understand the influence of this heritage in the Modern world.

Miquel Forcada

David A. King, *World-Maps for Finding the Direction and Distance to Mecca. Innovation and Tradition in Islamic Science*. Al-Furqān Islamic Heritage Foundation (London), Brill, Leiden-Boston-Köln, 1999. XXVIII + 638 pages.

Although the title might suggest that the book is restricted to the description of world-maps used for finding the *qibla*, that is to say the sacred direction towards Mecca, it actually offers much more: a thorough account of early astronomers who dealt with the determination of the *qibla* as well as the tables and mathematical methods used; a complete review of medieval Islamic cartographic methods and Renaissance European developments in this field and an extensive assessment of the History of Safavid science and technology, especially the instruments, together with an appraisal of its relationship with Islamic and European science.

The two remarkable brass Islamic World-maps, which became available for study in 1989 and 1995, are dated from 17th century Iran. They are fully described and studied in the second part of the book, while in the first part, entitled "First Orientations", the author offers a complete account of all the background knowledge. The range of fields dealt with is wide: from astronomical instruments to Islamic mathematical and sacred geography through cartography, folk astronomy, technology, clocks and watches, metal-work and the transmission of science. In fact, following his earlier idea of "Rewriting History through Instruments", King presents a wide treatment of the history of Islamic science, focusing in particular on instruments, cartography, and determination of the *qibla*, subjects in which he is a renowned expert. The book ends with a good bibliography, an updated account of the most important books of reference, limited of course by the wide range of subjects addressed. The interested reader will also find a list of related instruments and manuscripts and, last but not least, a set of appendixes presenting important and until now mostly unknown geographical lists, followed by the corresponding indexes. The quantity of information provided is impressive. Important new data are to be found throughout the work and so the book deserves not only to be read but also to be kept close at hand for consulting.

It is well known that to perform the most important ritual acts Muslims need the help of astronomy and mathematics. This applies for the determination of the times of the prayers, but also for the sacred direction, or *qibla*, towards which Muslims must face when praying. Knowledge of this direction is also necessary for other acts such as burial or slaughter of animals for food. To facilitate this determination is the main aim of these instruments, which bear a cartographic grid centered on Mecca, so devised that it preserves both direction and distance to the holy city of Islam. With it one can find the *qibla* and the distance accurately for any locality between Spain and China.

The instruments are unusual, and in the author's words "of a kind previously unknown to the history of science, engraved with world-maps of a kind previously unknown to the history of cartography". These instruments preserve the only Islamic world-maps with a properly-drawn coordinate-grid that are known to survive today. They represent the culmination of Islamic mathematical cartography applied to the problem of finding the *qibla* and are a good example of the practical application of science for religious purposes.

Both instruments originated in Iran, possibly from the late 17th century, and are clearly copies of earlier world-maps of the same kind (centered on Mecca), although it seems difficult to establish the relationship between them.

The function of these instruments is double. The first, in accordance with the Islamic tradition, is to determine the direction and distance to Mecca, which can be read easily thanks to the highly ingenious mathematical markings on the world-map. The second, within the European tradition, is to find the time before and after midday for any desired latitude, with the aid of the universal inclined sundial. This function, however, is of no use for displaying the day-light times of prayers for any latitude.

The inclusion of the sundial, which is obviously irrelevant to Muslims, is seen by King as a result of successful "European marketing". It is well known that in the 17th century several European watch and clock-makers set up in Isfahan. By that time, Iranians had already had two centuries of access to western mechanical devices, albeit limited, and nine centuries of access to Islamic science, part of which developed in Persia in the Persian language. Furthermore, the instruments, whose authenticity is beyond doubt, are entirely characteristic of the Iranian tradition of decorated metalwork. At the same time, in spite of the inclined sundial, they are wholly independent of Renaissance European developments in cartography, while within the earlier Islamic tradition of constructing world-maps based on geographical tables (9th to 16th centuries); the innovation is that these maps are centered on Mecca.

Most of the geographical data on these Safavid instruments comes from a geographical table, which seems to date from 15th century Timurid Central Asia. The table containing 274 localities, for which longitude, latitude, *qibla* and distance to Mecca are given, is only known to us from a 18th century astrolabe treatise compiled by ᶜAbd al-Raḥīm Ibn Muḥammad in Najaf (al-ᶜIrāq). Beyond any doubt, this table, until now unknown, must be taken into account in present and future studies of geographical coordinates.

Although both maps represent a Safavid tradition, the original inspiration for them seems to go back to an earlier period. From the 9th century we know of treatises on the determination of the *qibla* in which different cartographic solutions are presented, although they contain not a single word about maps. In fact the azimuth equidistant projection used for preserving distance and direction to Mecca in these maps was already used in mapping the ecliptic on the rete of Ḥabash's melon-shaped astrolabe (first half of 9th century). As has recently been shown by Kennedy et al. (Kennedy, E.S., Kunitzsch, P., and Lorch, R.P., *The Melon-Shaped Astrolabe in Arabic Astronomy*. Stuttgart, 1999, 177-220) references to this kind of astrolabe are found from the 9th century (al-Farghānī) to the 17th century (Ḥājjī Khalīfa), which proves that this projection method for preserving distance and direction to a central point was widely known. In fact, al-Bīrūnī also described this mapping amongst the different projection methods referring to the celestial sphere, although he suggests that they could be applied to the terrestrial sphere So it becomes clear that this kind of projection preserving direction and distance to a central point is not due to Guillaume Postel or Gerard Mercator but to Ḥabash. However, the construction of both instruments also shows a certain European influence, such as the numeral forms, the screws and some features of the compasses.

The range of fields covered is so huge that, inevitably, there will be some disagreement and readers will argue according to their own interests and knowledge. For my part, I have only minor remarks. For instance, I cannot agree with the statement (2.4) that "the first accurate longitude values of localities in the Islamic world became available only with first sporadic and then systematic cartography surveys of the 18th and 19th centuries". Of course I would agree if we were talking of a picture of the whole world, but not of a picture of the Islamic countries, which is the one presented in these maps. Extraordinarily accurate longitudes are found in Andalusian sources from the 11th century onwards such as those of al-Zayyāt or Ibn al-Raqqām, some of whose values are found in later Persian, Eastern Arabic, Maghribi, and Latin and Hebrew European sources. In these Andalusian sources, the difference of longitudes often varies from modern values by some 0;30°. As far as the orientation of the maps is concerned (8.3.1), it is true that it is difficult to determine in most of the cases. However, in my opinion, most of the maps were usually devised to be looked at from any of the different sides. The use of the compass, pointing to the North, could have been the main reason for changing Southern Islamic and Eastern European orientations to a general Northern orientation. On the other hand, as no original Ptolemaic maps are preserved - the maps we have appear in later copies - it is difficult to assert with any confidence which orientation Ptolemy actually used.

From the very beginning of the book it is clear that the author was confronted with the dilemma of giving all the information he had at hand or a text that was easy to read but omitted most of the details. Although, due to his full command of the subject, the amount of information was enormous and he risked overwhelming the reader with numerous unavoidable cross references, fortunately, he opted to provide the reader with all the details, thus considerably enlarging the range of the readership.

In conclusion, this is not only a richly illustrated book but also a masterly comprehensive survey, a work full of insights and references to materials for further research and unsolved problems put forward for disscusion. It deserves not only to be read and appreciated but also to be used as a reference work, for this was one of the aims of the author in including all these materials in the book. In the author's words "all the investment of time and energy may have been worthwhile if others find that just reading about discoveries amongst unresearched historical materials excites them too". I am sure this will be the case for most of the future readers of this book, which is strongly recommended.

Mercè Comes

Jan P. Hogendijk (ed.) *Die Schrift des Ibrāhīm b. Sinān b. Thābit über die Schatteninstrumente. Übersetzt und erläuted von Paul Luckey*. Islamic Mathematics and Astronomy, 101, Institut for the History of Arabic-Islamic Science at the Johann Wolfgang Goethe University, Frankfurt am Main, 1999. XVI + 283 pages.

Jan P. Hogendijk has edited a part of Paul Luckey's Ph. Dissertation on Ibrāhīm ibn Sinān's (907-946) treatise on shadow instruments. Let us say, first, that Paul Luckey was one of the most important historians of Arabic-Islamic mathematics in the 20th century, whose work may not have received the recognition it deserves, due to the circumstances in which he lived, and the course of Germany history in the first half of the ending century. Paul Luckey was a mathematician born in 1884, in Eberfeld near Wuppertal, where he worked for several years as a high school teacher. During a later teaching period in Marburg, from 1924 to 1932, he published some papers on the teaching of mathematics in German journals of education. He also authored a long paper on ancient Egyptian geometry in the international journal *Isis*, and, between 1938 and the date of his death (1949), Luckey published six articles on the history of Arabic mathematics. Three more appeared between 1950 and 1953.

Luckey retired early, at the age of 47, and spent several years studying Arabic and preparing his Ph. D. He defended his dissertation (edited by J. P. Hogendijk) in 1941 at the University of Tübingen. The work dealt with Ibrāhīm ibn Sinān's shadow instruments treatise. The dissertation was not published in full, but only summarized at this time; the edition of Ibn Sinān's Arabic text was not included in the dissertation and, though if prepared by Luckey, it was only recently found among his papers in the Orientalisches Seminar in Tübingen. Luckey included an introduction to the cultural atmosphere of the Sābians of Harrān, the region where the family of Ibrāhīm ibn Sinān lived, and details on the scientist's lineage, biography and works. He also reviewed the Ancient and Arabic theory on sundials and gnomonics from the works of many of historians of science such as Schoy, Schmalzl, Wiedemann, Frank, Garbers, and