REVIEW

David A. King (1999), *World-Maps for Finding the Direction and Distance to Mecca: Innovation and Tradition in Islamic Science*, Brill/Al-Furqān, Leiden/London, xxix+638 pp, HB, ISBN 90 04 11367 3

> If one finds a microchip in a tomb in a pyramid then either some modern put it there or we should revise our opinions of the technological achievements of the ancient Egyptians…But perhaps the idea behind the microchip is simpler than most people would think. (xiii)

These tantalizing opening lines of a book, whose somewhat misleading and euphemistic title and short "Foreword" suggest that it is a book about the discovery of two scientific instruments (simply called A and B) previously unknown to the historians of science, leads us directly into the heart of a fascinating work by one of the most respected historians of Islamic scientific tradition. But the writing of this work seems to have progressed through spurts of creative insights, meticulous rechecking of facts, figures, data, and, sadly, through numerous after-thoughts. Thus, the work, though coherent in its parts and concise in its details, suffers from an internal incoherence, as if the paint has been applied on unprepared walls, as if the growth of the book has been allowed to happen without a general plan. But in spite of this, the book is a fascinating account of two creative processes which intersect each other at various levels and planes throughout the book: the one dealing with the mysterious instruments and the other providing insights into the working of a creative and analytical mind; both processes provide an opportunity to know more intimately the person behind the book whose solitary labor of love and decades of research have blunted none of the human qualities that one expects from a scholar studying Islamic tradition—a tradition which is deeply entrenched and rooted in genuine human relationships.

There is something direct, spontaneous and richly human in David King's work. Whether it is the description of seminars at the Institute for the History of Science in Frankfurt, a short note about spur-of-the moment trips to London, Paris and Basle, or a frank sentence where he tells us that in the spring of 1993 when he visited Nuremberg to view the first public display of the first world-map, his students knew that in spite of "my ostensibly-learned description of the object in the catalogue, I did not

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really know much about it"—all radiate a warmth; this book is no exception. King's narrative makes the book more than a dry account of solitary research on two instruments. The book is replete with real-life situations, involving scholars, dignitaries, students, taxi drivers, and librarians. Even the historical figures one encounters in the book pulsate with such life-force and vitality that one expects to meet al-Bīrūnī at a street corner in Tehran.

At times, the narrative is highly suggestive: "Have you ever prayed in the qibla?" King was asked by a "Muslim dignitary" after his lecture in Istanbul in July 1983. "If not, then you know nothing about the qibla". This terse remark, which forms the epigram of "Preface I", opens a small window on to the vastly different perspectives of a researcher interested in history of science and a believer whose sole interest in that research is to put it to practice—something which inspired the making of the instruments in the first place.

The curiosity aroused by the opening sentences carries us through a very brief account of Western interest in Islamic geography, starting in the sixteenth century. Toward the end of this brief introductory passage, King reclaims the suspense created by the opening sentence through a dramatic sentence: "…although numerous texts awaited detailed study I did think that the whole subject of the determination of the qibla was more or less under our control.…Then in 1989 the first Mecca-centered world-map (A) became available for study, and in 1995, before I really understood the first one, the second one (B) showed up… … ." (xviii)

This unfinished sentence is followed by "Preface 2", a sort of research-in-progress account, filled with chronologically arranged anecdotes that take us right into King's academic life. This section, which reads like a personal journal, tells a story: In December 1995, King inspected the first world-map, "together with Dr. Assadullah Souren Melikian-Chirvani, one of the world's leading authorities on Iranian metalwork…[who] was taken by the elegance and precision of the engraving and suggested a dating of 1700±20 years; he also inclined to favour a provenance from Khurasan, *i.e.* North East Iran, rather than Isfahan." Then King pulls us right into his personal life: "The months of January and February, 1996, I spent in France not only to finalize the text but also to upgrade it on a new computer with new software… "(xxi) Here we have a story that not only unravels the mystery of the two instruments, it also tells us much about the

academic life of a historian whose pioneering work has opened several new vistas in the history of Islamic science.

The two instruments initiate many vital questions for King, the historian: when were they made? By whom? For whom? What is the relationship between the craftsmen who made the fine instruments and the scientist or scientists who worked out the complex mathematical equations used to design the instruments? What is the relationship of these instruments to the previously known instruments for finding the direction of qiblah and measuring the distance to Makkah? If the two instruments were indeed made at the turn of the eighteenth century, what implications does this have for our understanding of the Islamic scientific tradition which is supposed to have come to a grinding halt way back in the thirteenth century? How do these instruments change, revise, and accentuate our understanding of Islamic scientific tradition in such fields as cartography, mathematical geography, applied mathematics, and especially trigonometry? What about technology which could produce such fine metalwork? And most of all, what do these instruments tell us about the cultural and religious settings in which they came into existence?

These substantial questions originate from the very center of academic research in the history of Islamic scientific tradition. They are not easy questions to answer and require a breadth of vision, understanding, and competence in a range of subjects, as diverse as literature, mathematics, history, linguistics, and of course, a solid training in research methodologies. Since it is impossible to write the story of the two instruments without dealing with most of these questions, the book inevitably digresses, over and over, into these areas and since these questions are not supposed to be the main subject of the book, the treatment they receive seems ad hoc rather than emerging from a clearly conceived framework of inquiry.

"Aspects of Islamic Science", the first chapter of the book, is a brief introduction to the religious and cultural milieu in which the Islamic scientific tradition, and especially the astronomical tradition, took shape. In the middle of this systematic account, there appears a section entitled "Some Muslim scientific personalities", providing short notes on Ḥabash al-Ḥāsib, al-Bīrūnī, Naṣīr al-Dīn Ṭūsī, Ulugh Beg, Bahāʾ al-Dīn al-ʿĀmili and a few lesser known scientists. These biographical notes provide valuable information about scientists whose work is considered in the

subsequent chapters and for an average reader, this information may even be indispensable.

"The Determination of the Sacred Direction in Islam", the second chapter of the book, is an historical account of developments of this science in the Islamic civilization and, like other chapters, contains beautiful reproductions of numerous astrolabes, geographical tables, old world-maps, pictures of metalwork, sundials, and maps.

The third chapter, "The Main Sources of Safavid Mathematical Geography" bring considerable focus to the book by narrowing down the topics under discussion to the geographical area from where the two instruments emerged. Here we have a fine example of King's grasp on the subject. It is as if one were reading his mind filled with information about all relevant previously published studies. The book, thus, becomes a handbook of bibliography on the subject through its copious footnotes.

The discovery of these two instruments is an important event in the history of Islamic science for they are forcing historians to revise many earlier conclusions. In a subtle manner, King alludes to this by quoting one such conclusion in the epigraph of Chapter 4, "The Instruments on which the Maps are Engraved": "In spite of all this activity, we have few artifacts to show, and it is doubtful there was much to show at the time. The ultimate outcome of all these tables of longitude and latitude was virtually nothing cartographic" (G. R. Tibbetts, 197). In recent decades, this, and similar, judgments on Islamic scientific traditions have been challenged and seriously criticized by many historians of science. This book contributes toward this adjustment both with new data as well as by bringing to attention what was already known but was scattered in various journals.

"The Geographical Data on the Maps", the fifth chapter of the book, surveys the localities represented on the world-maps. King concludes that "the positions of the markers were copied from those on other instruments rather than read from some manuscript list… [and] that the two world-maps… must have been copied from other maps of the same type". (229)

From the point of view of history, one of the most significant parts of the instruments is their cartographic grids, discussed in the sixth chapter of the book, "The Cartographic Grids". Maps on both instruments have a common feature in that "the individual degrees are indicated in a rather carefree manner by four dots within each 5^0-interval." (235) During the course of this chapter, King takes us right into the process of examination

by providing a clue to the working of his mind through sections entitled "First thoughts" and "Second thoughts" and through his "Reflections on the errors on the grids". He investigates the markings on one of the maps by laying a grid of computer-generated markings printed on a transparent folio placed directly on top of the actual grid, which is reproduced in the book (Fig. 6.7.2). He discovered two things: (i) "the actual markings, to all intents and purposes, agree with the accurate markings over the entire map; (ii) the underlying parameter which underlies the latitude curves of the actual grid." (249)

But who made these instruments? "The Makers of the Safavid Instruments", the seventh chapter of the book, investigates this aspect of the two instruments, one of which (B) has an inscription which tells us that it was the work of a certain Muḥammad Ḥusayn, "a name previously unknown to modern literature on Islamic astronomical instruments". King is inclined to think that the person who made this second instrument (B) is Muḥammad Ḥusayn, son of the mathematician Muḥammad Bāqir ibn Zayn al-ʿĀbidīn Yazdī, the author of *ʿUyūn al-ḥisāb*, listed in Brockelmann (see n.13, p. 131). As for the maker of the unsigned instrument A, King states that since virtually all known Safavid astronomical instruments are signed, the signature on instrument A was probably on the sundial that once adorned it. Starting from this assumption, King leads us into the intricacies of his search a la Sherlock Holmes: "Ever since I first saw world-map A in 1989 I have been trying to figure out who could have made it. And ever since I first saw world-map B in April, 1995, I have been convinced that world-map A was <u>not</u> also made by Muḥammad Ḥusayn." (257)

Sifting through all available records where he might find a possible candidate, King presents name after name along with short descriptions of astrolabes known to have been made by these skilled artisans—names which have a rich evocative power. While he sifts through records, King holds us in suspense, telling us something about the "School of the makers" with a list of surviving works, or about "Some unresolved problems" in the field, only to finally tell us that he is not sure who made world-map A. At this point, he also reconsiders his previous opinion about world-map B and tells us that he is actually not sure who made world-map B. (270). This is a careful historian at work!

Chapter 8, "Traces of European Influence on the Instruments" is the product of a methodology that King himself calls "shooting in the dark"

(275). This chapter searches for European influences on the two world-maps through an intricate, long, but well-documented and "disparate, limited and sometimes contradictory evidence" (276).

The questions posed by King are tantalizing enough to keep the suspense:

> Why were the maps engraved on metal? Why are there screws on the instruments, screws being essentially a feature of (ancient and) European technology, not attested in early Islamic technology? What do the feet on the base of the instruments tell us?...Why was there any need at all for a sundial to be attached to a world-map, not least when such a European sundial does not indicate the times of Muslim prayer and when other Islamic sundials which did just that were available? Was the only reason successful marketing on the part of this Europeans?" (276-7)

In the course of answering these questions, King's twenty-five years of working in manuscript libraries allows him to resource a vast array of data—from previous studies on European influence on the Islamic instruments to minute and precise personal observations. The numbers on the sundial on instrument B, he tells us, are highly stylized but these "forms are completely outside the Islamic tradition of representing the Arabic or Persian numerals and they are also unrelated to Arabic alphanumerical (*abjad*) notation found on the longitude and latitude scales of world-maps A and B." (284-5) He concludes that these numbers were engraved by a Muslim instrument-maker "after a European model." (289)

"Further Reflections on Mecca-Centered World-Maps", the ninth chapter of the book, revisits earlier observations and conclusions, "this time in terms of Islamic science"(329). Once again King formulates a number of basic questions: "Where did the idea behind these two Safavid world-maps come from? Were they modeled on a Tīmūrid original, perhaps on paper, or was it the contact with Europeans in the mid-17th century that inspired the combination of a world-map on a brass plate (after the fashion of 16th century European astrolabes) and a sundial with compass in the European tradition?" (332). He concludes his investigation with a tentative result: "I deem it highly probable, however, that such an early treatise dealing with a Mecca-centred grid preserving direction and distance to the center was rediscovered by some Tīmūrid astronomer in, say, the fifteenth century,

and that he actually made one of these grids, putting on it the series of localities more or less as attested in TMR, but already with some errors or discrepancies (such as Cordova and Rome)." (363)

"Epilogue" (chapter 10) brings the investigation to an end. The remainder of the book, 265 pages in all, contains bibliographies, indices, tables, lists of instruments cited in the text, and appendices—precisely the resources every scholar wishes to have on his or her desk. These pages further enhance the value of this book by one of the leading historians of Islamic science.

One of the epigrams used for the final chapter of the book mentions a key problem in the current research on Islamic scientific tradition. This quotation, from an article by George Saliba ("al-Khafrī's Critique of Ptolemaic Astronomy") provides an insight into the core issue:

> …I wish to conclude [this essay on a highly sophisticated early-seventh century Safavid treatise on theoretical astronomy] by stressing that such texts as the ones we have been discussing not only force us to revise our periodization scheme regarding the age of decline of Islamic science, but also require that we investigate the relationship between that science and the religious circles that seem to have protected and propagated it. For the investigation of the last point much more work needs to be done, but before it can be undertaken we need to develop for its analysis a conceptual methodology that must be completely different from that employed in the study of the relationship between science and religion in Europe. (365)

This call for developing a conceptual methodology, different from the one used for science and religion discourse in Europe (and by extension in the West in general), is perhaps the most important task at this time in the field of Islam and science. The new data arising from the study of manuscripts and instruments needs to be put in a framework of inquiry that would allow us to understand the broader parameters of Islamic scientific tradition. Historians of science have been aware of this need for sometime now but the daunting task has not been accomplished yet. In the absence of such a conceptual scheme, confusion, ideologically driven false claims and counter-claims abound. For example there are those who deny

any link between Islam as a religion and the science that flourished in the Islamic civilization and there are those who wish to subjugate all that existed in the Islamic scientific enterprise to religious motives. For most historians of science, groomed in the secular western educational institutions, there is no essential linkage between Islam as religion, the civilization it created and various dimensions of that civilization, such as the scientific tradition. But perhaps such a task is not for the historian of science.

As a work written in the tradition of history of science and assessed from the secular-Western perspective, King's book is, indeed, a fine example of investigative vigor and precision of research. He exhibits a unique gift: an eye for detail which seeks to make all possible logical connections with sources. But even this characteristic feature of his mind does not allow him to penetrate the realm where the Islamic scientific tradition is perceived in its totality—with all its integral links to the metaphysical doctrines of Islam intact. The physical cosmos studied by the Islamic science was a cosmos borne out of a unique worldview that was steeped in a transcendent vision of reality in which all constituting parts were connected to each other and to the Ultimate Reality through the unifying principle of *tawḥīd*, the Oneness of God.

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