The Rise of Early Modern Science, second edition

This study examines the long-standing question of why modern science arose only in the West and not in the civilizations of Islam and China, despite the fact that medieval Islam and China were more scientifically advanced. To explain this outcome, Toby E. Huff explores the cultural – religious, legal, philosophical, and institutional – contexts within which science was practiced in Islam, China, and the West. He finds in the history of law and the European cultural revolution of the twelfth and thirteenth centuries major clues as to why the ethos of science arose in the West, permitting the breakthrough to modern science that did not occur elsewhere. This line of inquiry leads to novel ideas about the centrality of the legal concept of corporation, which is unique to the West and gave rise to the concepts of neutral space and free inquiry.

Toby E. Huff is Chancellor Professor of Sociology at the University of Massachusetts, Dartmouth. He has held visiting professorships at the National University of Singapore, the Max Weber College of the University of Erfurt, and the University of Malaya. His previous publications include *Max Weber and the Methodology of the Social Sciences*; he is the editor of *On the Roads to Modernity: Conscience, Science, and Civilizations. Selected Writings by Benjamin Nelson*, and co-editor of *Max Weber and Islam* (with Wolfgang Schluchter).

"Huff cogently substantiates how the underlying cultural values of a society and civilization assist or check scientific inquiry, and thus discloses modern science as an intercivilizational phenomenon." – *Choice*

"Huff provides a thorough, coherent hypothesis and thus helps sharpen the debates on the rise of modern science." – MESA *Bulletin*

"Huff's comparison of Catholic Europe, Islamic Asia, and Confucian China in terms of natural philosophy and educational institutions is timely and rewarding." – Benjamin Elman, *American Journal of Sociology*

"Huff's excellent book is a comparative study of the development of these exclusive commitments within the thoughts, institutions, and beliefs about the nature of existence and of man in the West, and of the contrasting consequences of the different commitments and beliefs of Islam and China. His scope is impressive." – A. C. Crombie, *Journal of Asian Studies*

"... provides a definitive, albeit implicit, commentary on the thesis much beloved by some theologians that the Christian doctrine of creation was responsible for the rise of modern science ... casts light on the general theme of the origins of modernity ... of sustained interest and full of copious reference to primary and secondary literature." – *Religious Studies*

The Rise of Early Modern Science

Islam, China, and the West

Second Edition

Toby E. Huff
University of Massachusetts Dartmouth

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For Judylein, Erik, and Niki,
three of life's companions who have made it brighter

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Preface to the second edition

When this study first went to press in the early 1990s, there was a lingering suspicion in some quarters that modern science was a peculiar preference of the Western world, that in the history of global science the Arabs and Muslims as well as the Chinese (with their more otherworldly values) had other preferences and never intended to contribute to modern science. And who needs it anyhow?

Today that sense has dissipated. It now seems evident that modern science and technology are intimately connected to economic development and to the amelioration of the human condition. Moreover, historians of what is now identified as "colonial science" have begun to suggest that at least early and tentative steps toward modern science were made long ago in many countries around the world by indigenous individuals who were drawn to the study of the natural world before the encroachment of the West. Although some of these studies have gone a little too far in extolling ethnically based cognitive systems that purport to be self-contained and complete, others have found more open-ended endeavors that can be seen as contributions to "universal" science.[1]

In the field of medicine, surgeons in many Muslim countries today, such as Iran, Saudia Arabia, Pakistan, and Tunisia, have the skills to perform and have been performing organ transplants (heart, liver, cornea) for some time. Tunisia has had this capacity since the early 1970s. Now Tunisia has an organ donor program and even a very low-profile genetic counseling program to avert the genetic consequences of cousin marriages in Arab populations.

[1] See Zaheer Baber, *The Science of Empire: Scientific Knowledge, Civilization, and Colonial Rule in India* (Albany: State University of New York Press, 1996); and Roy MacLeod, ed., *Colonial Science* (special issue of *Osiris*, vol. 15, 2001).

Likewise, some Chinese scientists are currently at the cutting edge of stem cell research.

The major question facing developing countries today is not whether they will accept the results of natural science but whether their governing elites will grant autonomy to all of their aspiring scientists – social and natural. Will they allow their scientists to objectively describe the social and natural worlds and publicly report their results, above all, when those results cast political authorities in a poor light? That is the challenge of the twenty-first century.

At the end of the twentieth century – if not before – it became evident that science, technology, and democratic development, as well as economic development, share certain prerequisites. These include the unfettered flow and exchange of information and the permissibility of open discussion in forums that approximate "neutral space," a domain of discourse free from political and religious censors. With the advent of the Internet, a technical and universal means for putting into place such a neutral "cyberspace" seems at least possible. Whether or not an uncensored national space of Internet-based communication can be put in place in developing countries, it is apparent that mastery of all the latest scientific and technological knowledge is a prerequisite for that development. In short, modern science belongs to all of the peoples of the world, and it is a necessary ingredient of the modern social order. None of this discounts the potential for social disruption, environmental degradation, or chemical warfare that can result from such developments.

Those societies and civilizations that stumbled on the way to modern science now show an eagerness to master the contemporary base of science and technology, not least of all for the purpose of enabling their citizens to enjoy the benefits of higher standards of living, and it is to be hoped, democratic modes of government. The history of the paths along which major groupings of societies (i.e., "civilizations") traversed on this long march to the present – long after the advent of "guns, germs, and steel" – has an intrinsic interest. I hope that history reveals for us some of the major religious, legal, and institutional challenges that had to be overcome to make modern science possible, along with democratic modes of government. It may be said that democratic government makes its own contributions to the free flow of information that has culminated in seemingly miraculous new insights into the makeup of the natural world, as well as the human genome.

After the comparative studies of the attempted development of modern science in the civilizations of Islam, China, and the West have been laid out in the main body of this study, I return, in the Epilogue, to the question of contemporary scientific development in China and in the Muslim world. Changes have obviously been afoot since the sixteenth- and seventeenth-century breakthrough to modern science, and it is useful to have an overview of the struggles

that persisted in the Muslim world, especially in the nineteenth century, on its way to accommodating modern science on the eve of the twentieth century. China's struggle to learn and advance the modes of modern scientific inquiry is a twentieth-century story to which I also give attention.

As I wrote in 1993, the present moment is filled with anticipation and apprehension as to whether the forces of equality and inclusiveness will prevail, or whether the forces of ethnic and religious exclusivity will further divide the communities of the world.

The present inquiry contains three case studies, each compared against the other. The central theme is why modern science arose in the "West" and not in the civilization of Islam or China. Some readers will be interested in reading only the chapters on Arabic-Islamic science, while others will read only those pertaining to China. It has been necessary, therefore, to make comparisons between the European West and the Arabic-Islamic world as well as between China and the West in the respective chapters. Consequently, there is some inevitable overlap in the discussion of Western intellectual and institutional developments. I have tried in this edition to limit those comparisons as much as possible, but since the point of reference is the sequence of transformations that occurred in the West, discussing them in the two other cases is indispensable, and I therefore beg the reader's indulgence when reading these passages.

Preface to the first edition

This book is about the rise of modern science and how the world got to be the way it is. The twentieth century has witnessed extraordinary collisions of societies, cultures, and civilizations. As a by-product of the newly intensified global economy, the last quarter of this century has experienced unprecedented fusions of cultures. What has not been sufficiently recognized, however, is the degree to which the cultural and legal forms forged in the twelfth and thirteenth centuries in the West laid the foundations for the present world order. Among these early modern cultural forms are those that created forums of free and open discourse that have led to universal forms of participation – in the world of thought, in government, and in commerce. Modern science is one striking example of a universalizing form of social discourse and participation. The continuing globalization of the practice of modern science represents a prime test of the proposition that universal forms of dialogue and participation exist and that they appeal to peoples of diverse cultures of origin. The possible shift of the center of modern science from the West to the East further dramatizes the universality of this mode of dialogue.

Nevertheless, alongside these universalizing forms of discourse and participation are equally strong forces asserting the priority of ethnic and local particularities. There are also those who fear more sinister uses of the fruits of scientific understanding. Likewise, the battle over the ascendancies of the various forms of reason and rationality will continue unabated. The present moment is filled with anticipation and apprehension as to whether the forces of equality and inclusiveness will prevail, or whether the forces of ethnic exclusivity and indigenous identities will further divide the communities of the world.

Acknowledgments

This book has been a long time in the making. Consequently, I owe a debt of gratitude to many individuals and organizations. The National Endowment for the Humanities granted me a year of study at the University of California, Berkeley, in 1976–7 (Grant F76-240), where I attended a seminar, "Tradition and Interpretation," directed by Robert Bellah. That fellowship gave me the first opportunity to write down my thoughts on the problem of Arabic science.

In 1978–9 the Institute for Advanced Study in Princeton, New Jersey, sponsored a year of study during which I was supposed to work on the present book. Instead, the year was devoted to Benjamin Nelson's book, *On the Roads to Modernity*, due to his sudden death. That period in Princeton, however, was invaluable in many ways for the present work.

In the fall of 1980 I was granted a sabbatical leave by my own university, and I spent it as a visiting scholar in the History of Science Department at Harvard University. During that fall semester I first presented the outline of the thesis of this book to the History of Science Seminar at Harvard. I am very grateful to Professor A. I. Sabra of Harvard for his support of my project and for his many comments over the year. I twice partially audited his course on the history of Arabic science and gained many invaluable insights from his discussions. It should be understood, however, that Professor Sabra and I hold different points of view.

Another sabbatical leave from my university, in the fall of 1987, allowed me the leisure to explore a variety of questions in the comparative history of law. Without that opportunity, the thesis of this book would be weaker and differently stated. I am most grateful for that leave.

I trust that it will be evident to my readers that this study could not have been carried out without access to a formidable array of library resources and

that I have benefited from libraries from Maine to California. The computer-based OCLC (Ohio College Library Consortium) system through the library at the University of Massachusetts Dartmouth, gave me access to many materials that I otherwise would not have been able to consult. The Consortium deserves a special note of thanks and recognition. I also owe a special debt to the new Thomas P. O'Neill, Jr., Library at Boston College, where I wrote large portions of Chapters 4 through 8 of this book. The O'Neill Library's exceedingly pleasant surroundings, highly efficient information-retrieval system, and well-arranged open stacks made progress on this book in its advanced stages much easier and more rapid than would otherwise have been possible. That is a benefit I gratefully acknowledge. Most of the dates of historical figures referred to in this study have been standardized according to Webster's *New Biographical Dictionary*; otherwise, I followed the *Dictionary of Scientific Biography.*

Finally, I must acknowledge that this study would not have been undertaken at all but for the example and encouragement of my New School mentor, Dr. Benjamin Nelson. Although he died shortly after reading what was a mere sketch of the present study, which I had written at Berkeley in 1977, by the early seventies he had already published the essays I needed to guide this study. I can only hope that this book evokes the spirit of his wide-ranging knowledge, the generosity of his person, and the prescience of his many insights.