



Multicivilizational Exchanges in the Making of Modern Science

Needham's Dialogical Vision

Edited by

Arun Bala · Raymond W. K. Lau ·
Jianjun Mei

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Editors

Arun Bala
IHPST, University of Toronto
Toronto, Canada

Raymond W. K. Lau
Hong Kong Metropolitan University
Lam Tin, Hong Kong

Jianjun Mei
Needham Research Institute
University of Cambridge
Cambridge, UK

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Foreword

As a relatively young industrial chemist in the 1970s, I was privileged to work with Dr Joseph Needham in the East Asian History of Science Library in Cambridge University from 1975–77. I was exploring with his guidance ancient Chinese applications of Pigments and Dyes for Section 34 of Volume 5 of the *Science and Civilisation in China* (SCC) series. I vividly recollect the numerous occasions, during our regular late afternoon tea breaks, when we engaged in active discussions. One important concern was what would follow next once the SCC series was completed. Needham would always answer without hesitation that much remained to be done for similar studies of East Asian, South Asian, Persian, and Islamic civilizations. He always expressed strongly his view that modern science has multicivilizational origins, and that no single civilization can claim monopoly for contributing to the rise of modern science.

These conversations with Needham, and his understanding of modern science as the outcome of exchanges between civilizations were in my thoughts when I, as Chairman since 2014, steered the Joseph Needham Foundation for Science and Civilisation (JNFSC) to support Needham

Conference 2023 titled “Needham’s Dialogical Vision: Understanding Science as a Multi-Civilizational Outcome.” JNFSC jointly organized this international conference with the Hong Kong University of Science and Technology, the Needham Research Institute, the Faculty of Asian and Middle Eastern Studies of the University of Cambridge, and the Jao Tsung-I Petite Ecole of the University of Hong Kong.

The chapters of this book are compiled from selected and revised papers presented in the conference. I hope this study would be a first step in realizing the wider global vision of science articulated by Joseph Needham, and will serve not only as a must-read reference about the multicultural origins of modern science, but also provide a teaching resource for university-level courses.

Finally, I would like to express my gratitude and heartfelt appreciation for the most generous financial support from Bai Shan Tang Foundation, Jao Tsung-I Petite Ecole of Hong Kong University, the Croucher Foundation and the Hong Kong University of Science and Technology, and above all, to the distinguished speakers and many volunteers who made the conference a success and this book possible.

Peter L. Lee, PhD
Chairman
Joseph Needham Foundation for
Science and Civilization

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Notes on Contributors

Arun Bala has an MSc in Physics and PhD in Philosophy. He is the author of *The Dialogue of Civilizations in the Birth of Modern Science* and *Complementarity Beyond Physics: Niels Bohr's Parallels*, and edited *Asia, Europe and the Emergence of Modern Science*, and *The Bright Dark Ages: Comparative and Connective Perspectives*. He held teaching and research appointments with various universities, including National University of Singapore, University of Toronto, and Western University. He is Director (Research) with Joseph Needham Foundation for Science and Civilization, and Visiting Scholar, Institute for the History and Philosophy of Science and Technology, University of Toronto.

H. Floris Cohen is Emeritus Professor of Comparative History of Science at Utrecht University (Netherlands). His active concern with the history of science in China and in Islamic civilization dates from the mid-1980s. He has a lively remembrance of his sense of excitement when, in the summer of 1987, he immersed himself in Joseph Needham's essay collections and corresponding chapters in *Science and Civilisation in China*.

Prasenjit Duara is a historian and holds the Oscar Tang Chair of East Asian Studies at Duke University. He has worked on rural China, nationalism and imperialism as well as environmental history. He was Professor and Chair of History at the University of Chicago (1991-2008) and Raffles Professor and Director of Asia Research Institute at the National University of Singapore. He was awarded the *doctor philosophiae honoris causa* from the University of Oslo in 2017 following the publication *The Crisis of Global Modernity: Asian Traditions and a Sustainable Future* (Cambridge 2015).

Nader El-Bizri is the Dean of the College of Arts, Humanities, and Social Sciences at the University of Sharjah, and is also affiliated with the Department of History and Philosophy of Science at the University of Cambridge. Prior to that, he was a tenured Professor in Philosophy and Civilization Studies at the American University of Beirut, and a Leverhulme Visiting Professor of History of Science at Durham University. He obtained his PhD in Philosophy in 1999 from the New School of Social Research in New York and the M.Arch-II in Architecture in 1994 from the Graduate School of Design at Harvard University.

Imre Galambos is a specialist of Chinese manuscripts. After receiving his PhD from Berkeley in 2002, he worked for the International Dunhuang Project (IDP) at the British Library for ten years. Then he moved on to teach at the University of Cambridge, from where he left in 2023, taking up a professorship at the School of Literature, Zhejiang University. His books include *Orthography of Early Chinese Writing* (2006), *Manuscripts and Travellers* (2012, co-authored with Sam van Schaik), *Translating Chinese Tradition and Teaching Tangut Culture* (2015), and *Dunhuang Manuscript Culture* (2020).

Roger Hart is a leading scholar of science and technology in twenty-first-century China, focusing on the Second Quantum Revolution. He is Professor of History at Texas Southern University. Previous appointments include Wilson Center, Seoul National Univ., UT Austin, UChicago, Institute for Advanced Study, Stanford, UC Berkeley, and Harvard. Previous awards include ACLS, NEH, Mellon, and Fulbright. Publications include two research monographs published by Johns Hopkins UP.

He earned his B.S. from MIT, M.S. from Stanford, and Ph.D. in Chinese history and history of science from UCLA. He has lived in China for seven years; his Chinese is near-native. Website: <http://www.rhart.org/>. Email: rhart@rhart.org.

George Gheverghese Joseph University of Manchester, is a mathematician and historian of mathematics. Born in Kerala, he grew up in Kenya, and completed his degrees in England. He has held university appointments across the world, including East and Central Africa, India, Papua New Guinea, New Zealand, and South East Asia. He has authored many books including *The Crest of the Peacock: Non-European Roots of Mathematics*, *A Passage to Infinity: Medieval Indian Mathematics from Kerala and Its Impact*, and *Indian Mathematics: Engaging with the World from Ancient to Modern Times*. He was also Editor of *International Seminar and Colloquium on 1500 Years of Aryabhateeyam* and *Knowledge and Cultures: Crossing Boundaries in History*.

Tung-Yi Kho is interested in comparative approaches to the study of civilizations and cultures. His research interests are transdisciplinary and focus on issues fundamental to human livelihood and well-being, especially under the conditions of coloniality/modernity. The fields implicated by such interests cut across the human-cultural and natural sciences, encompassing the disciplines of Anthropology, Cultural Studies, Political Economy, Global Development Studies, Sociology, History, Philosophy, and Quantum Physics.

Wen-Hua Kuo teaches Social Studies of Medicine at National Yang Ming Chiao Tung University, Taiwan. A licensed physician and acupuncturist, his work revolves around pharmaceutical regulation and controversies in East Asian medicines attempting to be modernized and used globally. His scholarly publications appear in a range of journals crossing several disciplines, including one on Needham that appears in *Isis*. In addition to his current research on care and caring professions, he has served as one of the Associate Editors of *Social Studies of Science* since 2023 and will serve as the President of Society for the Social Studies of Science from 2025 to 2027.

Raymond W. K. Lau was Professor of Sociology, Hong Kong Metropolitan University, until retirement and currently Visiting Senior Research Fellow, Hong Kong Shue Yan University. Originally trained as a sociologist focusing on theory, in the latter 2000s, he began researching into the development of ancient Chinese thoughts in a comparative context. He has published primary research on the philosophies of Xunzi, Laozi, and Zhuangzi in Chinese and in English. In 2020, he published in English a monograph titled *Intellectual Developments in Greece and China: Contingency, Institutionalization and Path Dependency*, which has led to his current work on the Needham Question.

Keekok Lee is a philosopher trained in the analytical tradition of “Anglo-Saxon philosophy.” She taught at the National University of Singapore before moving to the University of Manchester, UK. Since taking early retirement in 1999, she has continued to research and publish in several philosophical domains, including the Philosophy of Biology/Genetics and the Philosophy of Medicine. The latter domain has investigated both Biomedicine and Classical Chinese Medicine. Of late, she has also been pre-occupied with the notion of Coloniality, both Exogenous and Endogenous with regard to non-European systems of knowledges. (For details, see <http://www.keekoklee.org/>)

Jongtae Lim is a professor, Department of Science Studies, Seoul National University, South Korea. He earned his PhD at Seoul National University in 2003, with his dissertation titled ‘Chinese and Korean Scholars’ Understanding of the Jesuits’ Geographical Knowledge in the 17th and 18th Centuries.’ Since 2006, he has been teaching the history of science in Korea in the Department of Science Studies at Seoul National University. His research interests cover topics in the history of early modern Korean science, such as Western learning, Sino-Korean scientific exchanges, and science in the state bureaucracy.

Gordon McOuat is Professor and former Director of the History of Science and Technology Program at the University of King’s College/ Dalhousie University and Director of the “Cosmopolitanism and the Local in Nature and Science, East and West” project. His research focuses on the history and philosophy of logic, classification, and the

origins of “natural kinds”, including works on “Bentham’s Logic,” “The Origins of Natural Kinds,” “Cataloguing Power,” and “Species, Rules and Meaning.” Recently, his research has turned to the study of the situatedness of knowledge and the international circulation of cosmopolitan science, co-editing *Circulation of Knowledge between England, India and China* (Brill 2013), *Narratives of Nature and Science, East and West* (Routledge, 2015), and *Spaces of Enlightenment Science* (Brill, 2021).

Jianjun Mei is Director of the Needham Research Institute in Cambridge, UK. He holds concurrent positions as Director of Research at the McDonald Institute for Archaeological Research, University of Cambridge; Visiting Professor of the University of Science and Technology Beijing; Editor-in-Chief of the Editorial Board for *Advances in Archaeomaterials*. His primary research interests are the history of metallurgical technology in China and the history of scientific and technological exchanges between China and other countries. He has published two monographs and more than one hundred academic papers in both Chinese and English.

Hyunhee Park is Professor of History at John Jay College and the Graduate Center of the City University of New York. She specializes in the history of cross-cultural contacts in East Asia and the Islamic world, particularly Sino-Islamic contacts, focusing on information/knowledge transfers, including transfers of geographical knowledge, foodways, and distillation technologies. She is the author of *Mapping the Chinese and Islamic Worlds: Cross-Cultural Exchange in Pre-Modern Asia* (2012), and *Soju: A Global History* (2021), and has published thirty academic articles and book chapters.

Hans Pols is Professor at the School of History and Philosophy of Science at the University of Sydney. He is interested in the history of colonial medicine and the transformation medical research and practice underwent during the process of decolonization. His research has focused on the Dutch East Indies and Indonesia, and on psychiatry and mental health. His book *Nurturing Indonesia: Medicine and Decolonisation in the Dutch East Indies* was published by Cambridge University Press in 2018.

Sundar Sarukkai has held positions of professor of philosophy at the National Institute of Advanced Studies, Founder-Director of the Manipal Centre for Philosophy and Humanities, and Visiting Faculty at the Centre for Society and Policy, Indian Institute of Science. He is the author of the following books—*Translating the World: Science and Language*, *Philosophy of Symmetry*, *Indian Philosophy and Philosophy of Science*, *What is Science?*, *JRD Tata and the Ethics of Philanthropy*, *Philosophy for Children: Thinking, Reading, Writing*, *The Social Life of Democracy*, and two books co-authored with Gopal Guru—*The Cracked Mirror: An Indian Debate on Experience and Theory and Experience*, *Caste and the Everyday Social*. His latest book is a novel, *Following a Prayer*. He is the Series Editor of Routledge's *Science and Technology Studies*, as well as the Co-Chief Editor of the *Springer Handbook of Logical Thought in India*.

John Steele is Wilbour Professor of Egyptology and Assyriology at Brown University. A historian of astronomy, he has research interests in Babylonian astral science, the circulation of astronomical knowledge, and the reception of ancient science from the seventeenth to the twentieth century. He is the author of several books including *The Babylonian Astronomical Compendium MUL.APIN* (Routledge 2019; co-authored with Hermann Hunger) and *The Allure of the Ancient: Receptions of the Ancient Middle East, ca. 1600–1800* (Brill, co-edited with Margaret Geoga).

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1

Introduction

Arun Bala, Raymond W. K. Lau, and Jianjun Mei

1 Needham's Dual Legacy

This volume brings together scholars who have articulated or contributed to Needham's dialogical vision of science as the outgrowth of multicivilizational interactions. They span not only diverse civilizations but also diverse disciplines. The organization of the chapter themes of the book has drawn inspiration from the way Needham framed his monumental project into seven volumes each reflecting a disciplinary theme. Although Needham focused his studies on Chinese science as these volumes testify,

A. Bala (✉)

Institute for the History and Philosophy of Science and Technology,
University of Toronto, Toronto, Canada
e-mail: arun.bala@yahoo.com

R. W. K. Lau

Hong Kong Shue Yan University, North Point, Hong Kong

J. Mei

Needham Research Institute, University of Cambridge, Cambridge, UK

he supported the dialogical turn when he reflected in his final summing up volume in 2004 on the broader implications of his achievement:

Modern science is indeed composed of contributions from all the peoples of the Old World, and each contribution has flowed continuously in it, whether from Greek and Roman antiquity, or from the Islamic world or from the cultures of China and India. (Needham 2004, p. 25)¹

What is significant is that Needham has an ecumenical image of modern science as growing through contributions from many civilizations in both its technological and, to a certain extent, theoretical development in terms of techniques and ideas. This is also evident in his ‘rivers and ocean view’ of modern science articulated later in the same volume:

I have pictured modern science as being like an ocean into which the rivers of all the world’s civilizations have poured their waters. (Needham 2004, p. 201)

In the later stages of his work, Needham had already begun making forays in such a multi-civilizational direction. In 1979 he published his reflections in his book *Within the Four Seas: The Dialogue of East and West*. Later in his inaugural lecture in 1985, that began what is now called the Needham Memorial Lecture Series, he titled his talk ‘Gunpowder as the Fourth Power, East and West.’ This reflected his view that exchanges between China, the West and other civilizations shaped modern society today.²

¹ Although Volume 7 was published in 2004, the text cited here was based on his Presidential Address delivered to Section X (General) on 31 August 1967 at the Leeds Meeting of the British Association (Needham 2004, p. 24, note 1).

² Needham writes: ‘For three thousand years a dialogue has been going on between the two ends of the Old World. Greatly have they influenced each other, and very different are the cultures they have produced. We have now good reason to think that the problems of the world will never be solved so long as they are considered only from a European point of view. It is necessary to see Europe from the outside, to see European history, and European failure no less than European achievement, through the eyes of that larger part of humanity, the peoples of Asia (and indeed also of Africa)’ (Needham 1979, p. 11). See also Needham (1985)

Joseph Needham developed two questions in the course of his study of the history of Chinese science. The first concerned why modern science emerged in Europe but not in China? This is his famous comparative question that has engaged historians, philosophers and sociologists ever since he framed it. It has parallels with the question why modern industrial society and capitalism emerged in Europe but not elsewhere that has engaged attention since it was framed by Max Weber.

The second is the question that Needham also raised and that can be seen as the dialogical question—how and possibly why China was able to contribute scientific and technological ideas that nurtured and enriched modern science. Like the Weberian question this has been extended to other civilizations—especially those such as the Middle Eastern and Indian that had achieved as high, or even higher levels, of achievement in the areas of technology and science than Europe before the modern era. But since Europe was about as developed as South East Asia at the time of Charlemagne, at least that part where modern science and capitalism first took of others have extended the question to ask ‘Why did modern science emerge in Europe rather than South East Asia?’³

There is a third question to which attention has been paid even less than the dialogical question embodied in Needham’s rivers-into-oceans metaphor. This concerns whether modern science has ignored dimensions of nature that could be rectified by learning from pre-modern cultures. This other aspect of Needham’s view, albeit developing later in his project’s life, also surprisingly emerges in quite a number of contributions to this volume. They mirror notions that in areas such as medicine and environmental natural knowledge modern science could profit by learning from pre-modern cultures.⁴

³ South East Asia rarely features in the addressing of the Needham Question but there are exceptions. See Bala (2016) and Low (1999).

⁴ A pioneering study in this area is Nandy (1989) See also Goonatilake (1999). Interestingly a leading contemporary philosopher of science Hasok Chang has argued that history of science, that offers understanding and appreciation of displaced theories in science could offer a reservoir of ideas and techniques that may turn out to be useful in constructing future science. Basically he sees history of science as complementing science in enriching its context for discovery. His argument could also be extended to scientific ideas from cultures outside the West, and in the light of dialogical histories of science (both ancient and modern). See Chang (2016).

Today there is a great deal of interest that includes essays on exchanges in Africa and the Atlantic Americas that is ignored in this volume. This is because the book focuses on the issue of why and how Needham's dialogical question has been marginalized in contrast to his comparative question. The comparative debates have to date centered on Chinese, Islamic, Indian, Babylonian, Japanese and Korean sciences. Hence the chapters are also confined to these areas. But the issues raised in the volume could in future be extended to include a wider global context.

A vast body of literature has emerged since Needham's pioneering work, in part inspired by his groundbreaking efforts and inspiration, which showed that what was important was to understand how inter-connections of civilizations over the last three thousand years, and the exchanges of cosmological, mathematical, geographical, physical, biological and medical technologies, techniques, practices and knowledge had been woven together to make modern science possible. Although Needham himself had on numerous occasions stressed the importance of the connected history of science and technology, and the circulations of know-how and knowledge with associated dialogical exchanges, this crucial dimension of science history has hitherto been marginalized by the overemphasis on his comparative question.

2 Structure of the Book Themes

The organization of the themes in this volume follow closely the way Needham structured his volumes for *Science and Civilisation in China*.⁵ Needham had framed his project into 7 volumes—many of them were later divided into sub-volumes. The book has five themes that are drawn from Needham's categorization of his volumes. The first volume is a history of China and the last volume on The Social Background has two parts—one deals with Language and Logic in China

⁵ This structure also follows the way the panels were defined for Needham Conference 2023. The conference titled 'Needham's Dialogical Vision: Understanding Science as a Multicivilizational Outcome' was organized by the Joseph Needham Foundation for Science and Civilization, Needham Research Institute, Hong Kong University of Science and Technology, and the Faculty of Asian and Middle Eastern Studies in Cambridge University.

and the other on General Conclusions and Reflections concerns with addressing Needham's Grand Comparative Question concerning why modern science emerged in Europe and not China. The first volume and part one of the last volume have set the tone for the thematic issue of Historical Sociologies in Dialogue that is the theme of the first section of the book. It has three chapters by Prasenjit Duara, Raymond Lau and Tung-yi Kho.

Needham's second volume was entitled *History of Scientific Thought*. It largely focused on the philosophical background of Chinese science, especially on the way Chinese philosophies—Taoism, Confucianism, Mohism, Legalism and to an extent Buddhism—came to shape and influence Chinese science. The last theme of this volume follows this epistemological and methodological orientation of Needham and is titled *Modes of Inquiry in Dialogue*. We have four chapters by Sarukkai, Bala, McOuat and Cohen that deal with these generally philosophical questions.

Indeed, there has been little appreciation that three of Needham's seven volumes address the history (volume 1), philosophy (volume 2) and sociology (volume 7) of Chinese science. This framing of the current volume helps to rectify this neglect, and even stress the important significance Needham attached, long before it became fashionable, to connect together the history, philosophy and sociology of any tradition of science in order to understand its growth and evolution.

In between his historical, philosophical and sociological volumes Needham frames the four volumes that focus on specific scientific disciplines. These are titled *Mathematics and the Sciences of the Heavens and Earth* (volume 3), *Physics and Physical Technology* (v.4), *Chemistry and Chemical Technology* (v.5), and *Biology and Biological Technology* (v.6). Much of Needhamian scholarship has focused on widening his explorations of Chinese science, but ignored the wider science studies context in which he framed his project.

In acknowledgment of his studies in the specific sciences, the present book has three themes. The second on *Cosmologies in Dialogue* includes contributions by John Steele, Jongtae Lim and Hyunhee Park. The third section *Natural Sciences in Dialogue* includes the chapters of Joseph,

Hart, El-Bizri and Galambos. In the penultimate section *Medical Traditions in Dialogue* carries contributions by Hans Pols, Wen-Hua Kuo and Keekok Lee.

Moreover, the areas of cosmology, natural sciences of physics and chemistry, and biomedical sciences have largely been approached through a comparative perspective with the view to addressing Needham's question 'Why did modern science develop in Europe but not in China or any other major Eurasian civilization?' By contrast this volume focuses upon Needham's dialogical question 'How and why were China, and other major Asian civilizations, able to articulate knowledge that subsequently came to enrich modern science?' or carry knowledge that can enrich science in future. The essays take Needham's project forward in two directions—advancing his dialogical vision of the growth of science, and his multicivilizational perspective of modern science.

It is, of course, possible to ask whether framing the studies of Chinese science into categories of modern science is the right way to approach the issue. Are we not guilty of the sins of anachronism and teleology whichever direction we look at the historical connections. The renowned classical scholar Geoffrey Lloyd who has also researched into comparative studies of Chinese science has recently emphasized this by writing:

The multiple volumes of SCC are truly monumental. Yet the plan and execution are, as we all know, very much of their time, and this has certainly contributed to its relative lack of influence in history and philosophy of science circles in the West – in contrast to the continuing mass of attention it still attracts in China itself. Joseph decided to organise the work according to Western categories: astronomy, mathematics, physics, engineering, medicine and so on. He was convinced not just that science is now universal but that those disciplinary boundaries can be used in relation to the science of much earlier times... (Lloyd 2020, p. 2)

But Needham himself had recognized this concern and made an answer to it four decades earlier when he wrote:

I suppose we all generally agree that there is only one unitary science of nature, approached more or less closely and built up more or less successfully and continuously, even if very slowly, by the several groups

of mankind from age to age. This means that we could expect to trace an absolute continuity between the first beginnings of astronomy and medicine in ancient Babylonia or ancient Egypt, through the advancing natural knowledge of mediaeval China, India, Islam and the classical Western world, to the break-through of late Renaissance Europe when, as has been said, the most effective method of discovery was itself discovered. (Needham 1978, p. 110)

Nevertheless, dialogical studies will continually face this problem of crossing boundaries—how do we select the conceptual frames for understanding knowledge in one frame in order to see its relevance for transmission to another frame. We will in this volume stay with Needham's choice even if it remains a problematic epistemological concern.

3 Explorations in Needham's Dialogical Vision

The chapters in this volume can be seen as exploring from multiple perspectives Needham's vision of science as evolving through multicultural engagements. They are defined by the different volumes of his grand project to both document and understand the intellectual, socio-cultural and historical evolution of not only Chinese science in particular, but also its relevance for global science. It begins with the section *Historical Sociologies in Dialogue*. These are three chapters by Prasenjit Duara, Raymond WK Lau and Tung-yi Kho that explore the scope and limits of Needham's position.

The second chapter by Prasenjit Duara attempts to go beyond, and yet build upon, Needham's conception of pre-modern sciences from various civilizations as rivers flowing into the ocean of modern science. By extending and deepening the metaphor of the ocean Duara offers a more nuanced and rich perspective of historical exchanges of knowledge including that of science and technology. He offers a picture of history in terms of oceanic flows where single events ripple or crash across multiple boundaries, join other currents and eddies, or fall into thermohaline depths to upwell elsewhere. His chapter outlines a metaphor of

knowledge exchanges as involving circulatory processes that interact and transform in patterns of stability and change that oceanic flows display rather than Needham's simplistic notion of separate rivers merging into a single ocean. He argues that such a circulatory history—as he terms it—does not privilege ownership of historical origins of scientific ideas and discoveries. He illustrates this by showing how a methodology of scientific rationality circulated through successive Eurasian religious traditions without any recognition of roots or pedigree.

In the following chapter Raymond Lau begins by acknowledging that, largely inspired by Needham, a strong case for dialogism or the dialogical perspective had been established by the 2000s. He notes that this has led some Eurocentric scholars to resort to neo-Eurocentric arguments that no longer claim science to have arisen from Europe's 'autochthonous' development. Instead, they argue that Europe was able to make use of non-European inputs to breakthrough into modern science due to certain 'unique' European 'qualities.' Such neo-Eurocentrism signals a connatural shortcoming of dialogism: While dialogism is able to show that intellectual inputs into Latin Europe from non-European civilizations constituted indispensable pre-conditions for the breakthrough into modern science, it is unable to explain why Latin Europe was able to make the breakthrough itself on the basis of such inputs. Lau proposes that it is necessary to transcend dialogism to provide an adequate non-Eurocentric account for the rise of modern science. He offers an analytical framework that takes into account scholarly traditions and the transformation of late Renaissance scholarly agency in the post-1453 era due to the conquest of Constantinople to transcend dialogism and account for modern science in fully non-essentialist terms.⁶

In contrast to the above views Tung-yi Kho's historical sociology presents a decolonial perspective which repudiates the notion of accommodating multicivilizational knowledges into modern science. He maintains that as modernity was emerging and being celebrated by the West, it was accompanied by a darker side—coloniality—in non-Western societies. Coloniality is implicated not only in its nurture of an exploitative

⁶ For a more detailed and thoroughgoing account of this non-essentialist analytical framework see Lau (2020).

political economy, but also its repression of cultural and knowledge production outside Europe. This makes Needham's perspective problematic because of two premises undergirding his Grand Question why modern science first arose in Europe but not elsewhere. Firstly, it makes the questionable assumption that modern science represents the pinnacle of knowledge; and second, that because modern science was first 'discovered' in the West, the latter represents the ideal of civilization. Using Chinese examples, Kho shows why Needham's line of inquiry is misdirected, and offers in its stead a more expansive understanding of science and civilization which does not embrace Needham's exclusive vision of modern science as the sole and ultimate arbiter of natural knowledge.

The next section cosmologies in dialogue includes discussions on the dialogical exchanges that shaped scientific exchanges in three areas—in the astral sciences of diverse civilizations by John Steele, in astronomy, mathematics and geography between Qing China and Korea by Jongtae Lim, exchanges of geographical knowledge between China and the world of Islam by Hyunhee Park, ending with Joseph's account of the growth of mathematics as a result of knowledge circulations across many Afro-Eurasian cultures.

Steele examines how elements of Babylonian astral science circulated over wide areas including the eastern Mediterranean, Iran and, in particular, he explores its adoption, adaptation and assimilation into different cultures and languages. His study raises questions such as why and how did such circulations occur, what were the processes of transformation that shaped its adaptations into local cultures and traditions, and why these changes were such that it becomes no more useful to refer to the knowledge that traveled as 'Babylonian.' Its spread has made this knowledge truly multicivilizational. He uses three case studies of the assimilation of aspects of Babylonian astral science by Greek, Indian and Jewish scholars to illustrate two key features of the circulation of knowledge in general, and scientific knowledge in particular. One is the appropriation of perceived useful Babylonian knowledge, and the second is the adaptation of such material within existing knowledge systems. His key notions of appropriation and adaptation contribute to a wider understanding of the way knowledge travels across civilizations, instead of being locked into civilizational silos of science as is widely assumed.