



**HAL**  
open science

# Perspectives on the 'Collapse' of Angkor and the Khmer Empire

Damian Evans, Martin Polkinghorne, Roland Fletcher, David Brotherson,  
Tegan Hall, Sarah Klassen, Pelle Wijker

► **To cite this version:**

Damian Evans, Martin Polkinghorne, Roland Fletcher, David Brotherson, Tegan Hall, et al.. Perspectives on the 'Collapse' of Angkor and the Khmer Empire. *The Angkorian World*, pp.541-553, 2023. hal-04109009

**HAL Id: hal-04109009**

**<https://hal.science/hal-04109009v1>**

Submitted on 29 May 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

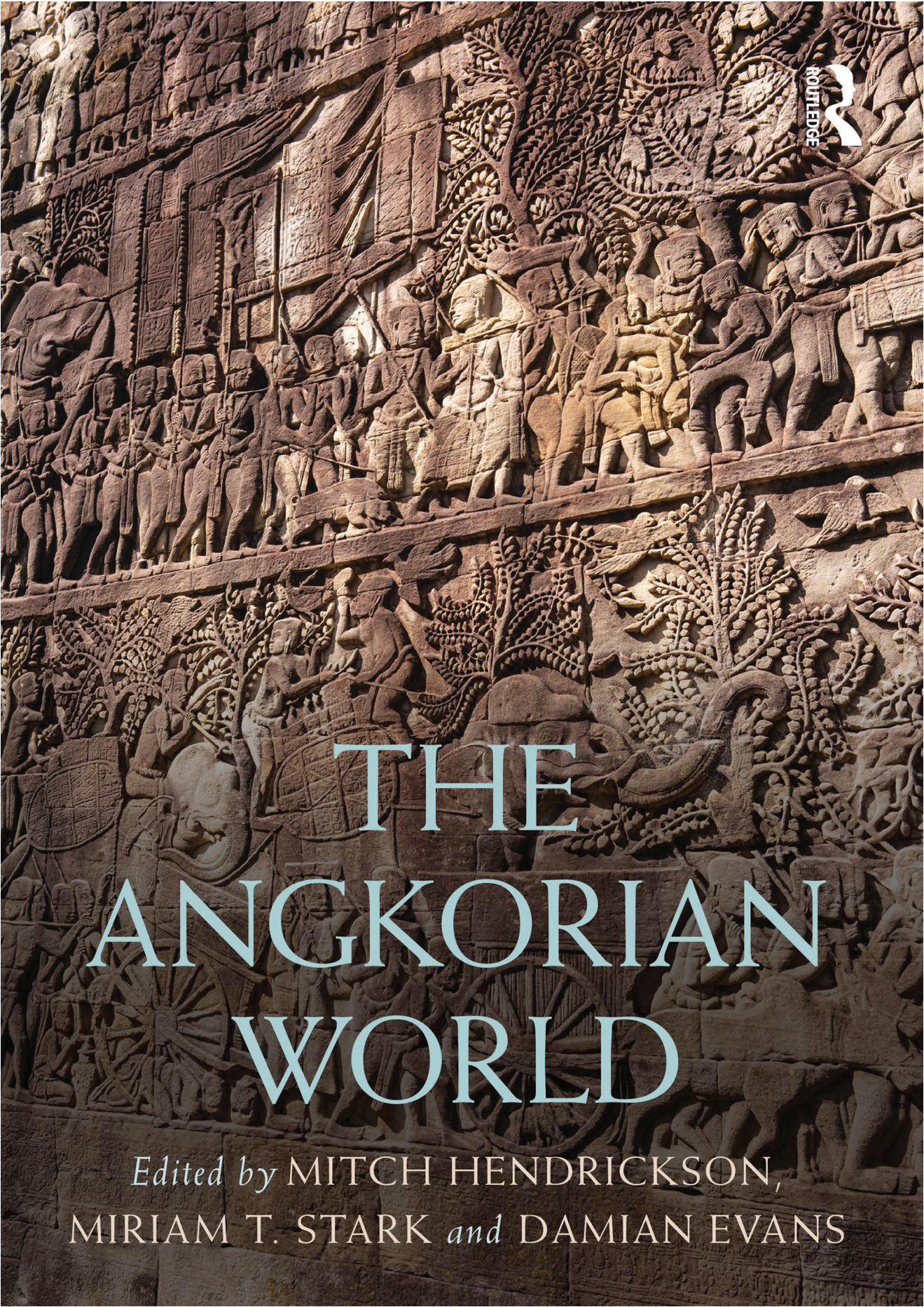
L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License



ROUTLEDGE



# THE ANGKORIAN WORLD

*Edited by* MITCH HENDRICKSON,  
MIRIAM T. STARK *and* DAMIAN EVANS

# THE ANGKORIAN WORLD

*The Angkorian World* explores the history of Southeast Asia's largest ancient state from the first to mid-second millennium CE. Chapters by leading scholars combine evidence from archaeology, texts, and the natural sciences to introduce the Angkorian state, describe its structure, and explain its persistence over more than six centuries.

Comprehensive and accessible, this book will be an indispensable resource for anyone studying premodern Asia. The volume's first of six sections provides historical and environmental contexts and discusses data sources and the nature of knowledge production. The next three sections examine the anthropogenic landscapes of Angkor (agrarian, urban, and hydraulic), the state institutions that shaped the Angkorian state, and the economic foundations on which Angkor operated. Part V explores Angkorian ideologies and realities, from religion and nation to identity. The volume's last part reviews political and aesthetic Angkorian legacies in an effort to explain why the idea of Angkor remains central to its Cambodian descendants. Maps, graphics, and photographs guide readers through the content of each chapter. Chapters in this volume synthesise more than a century of work at Angkor and in the regions it influenced.

*The Angkorian World* will satisfy students, researchers, academics, and the knowledgeable layperson who seeks to understand how this great Angkorian Empire arose and functioned in the premodern world.

**Mitch Hendrickson** is Associate Professor of Anthropology at the University of Illinois at Chicago, USA. He worked as an archaeologist in northwest Mexico, the Canadian Plains, and High Arctic before shifting his focus to Cambodia in 2001. His initial research on the establishment and role of the Angkorian road system enabled him to develop two ongoing projects in collaboration with the Ministry of Culture and Fine Arts on the technological transformation that enabled expansions of the Khmer Empire and understanding religious transition at the site of Preah Khan of Kompong Svay.

**Miriam T. Stark** is Professor of Anthropology and Director of the Center for Southeast Asian Studies at the University of Hawai'i at Mānoa, USA. Her 40-year career includes fieldwork in North America, the Near East, and Southeast Asia; she launched her first field project in Cambodia in 1996. Her Cambodian research, through multiple projects in collaboration with Cambodia's Ministry of Culture and Fine Arts, focuses on protohistoric to Angkorian period urbanism, early state formation, and political economy.

**Damian Evans** is Senior Research Fellow at the École française d'Extrême-Orient in Paris and an Honorary Associate in the Department of History, School of Philosophical and Historical Inquiry at the University of Sydney. He is involved in a diverse array of projects across Southeast Asia encompassing archaeology, heritage, and the earth sciences, and he has initiated and overseen archaeological projects in Cambodia since the late 1990s. His work focuses on using earth observation technologies such as satellite imagery, radar and lidar to understand the relationship between humans and their environments from the deep past to the present day.

## ROUTLEDGE WORLDS

The Routledge Worlds are magisterial surveys of key historical epochs, edited and written by world-renowned experts. Giving unprecedented breadth and depth of coverage, they are the works against which all future books on their subjects will be judged and are essential reading for anyone with a serious interest in the subject.

### THE ANGKORIAN WORLD

*Edited by Mitch Hendrickson, Miriam T. Stark and Damian Evans*

# THE ANGKORIAN WORLD

*Edited by Mitch Hendrickson, Miriam T. Stark  
and Damian Evans*

Cover image: Erika Piñeros

First published 2023  
by Routledge

4 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge  
605 Third Avenue, New York, NY 10158

*Routledge is an imprint of the Taylor & Francis Group, an informa business*

© 2023 selection and editorial matter, Mitch Hendrickson, Miriam T. Stark and Damian Evans; individual chapters, the contributors

The right of Mitch Hendrickson, Miriam T. Stark and Damian Evans to be identified as the authors of the editorial material, and of the authors for their individual chapters, has been asserted in accordance with sections 77 and 78 of the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this book may be reprinted or reproduced or utilised in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying and recording, or in any information storage or retrieval system, without permission in writing from the publishers.

*Trademark notice:* Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

*British Library Cataloguing-in-Publication Data*

A catalogue record for this book is available from the British Library

*Library of Congress Cataloging-in-Publication Data*

Names: Hendrickson, Mitch, editor, author. | Stark, Miriam T., editor, author. | Evans, Damian, editor, author.

Title: The Angkorian World / edited by Mitch Hendrickson, Miriam T. Stark and Damian Evans.

Description: New York : Routledge, 2023. | Series: Routledge Worlds | Includes bibliographical references and index. |

Identifiers: LCCN 2022058733 (print) | LCCN 2022058734 (ebook) | ISBN 9780815355953 (hardback) | ISBN 9781032439266 (paperback) | ISBN 9781351128940 (ebook)

Subjects: LCSH: Angkor (Extinct city)—History. | Angkor (Extinct city)—Civilization. | Cambodia—Antiquities.

Classification: LCC DS554.98.A5 A545 2023 (print) | LCC DS554.98.A5 (ebook) | DDC 959.6/01—dc23/eng/20221214

LC record available at <https://lcn.loc.gov/2022058733>

LC ebook record available at <https://lcn.loc.gov/2022058734>

ISBN: 978-0-8153-5595-3 (hbk)

ISBN: 978-1-032-43926-6 (pbk)

ISBN: 978-1-351-12894-0 (ebk)

DOI: 10.4324/9781351128940

Typeset in Bembo  
by Apex CoVantage, LLC

# CONTENTS

<i>List of Figures</i>	<i>ix</i>
<i>List of Tables</i>	<i>xiv</i>
<i>List of Contributors</i>	<i>xv</i>
<i>Acknowledgements</i>	<i>xix</i>
0 Prologue: An Introduction to the Angkorian World <i>Mitch Hendrickson, Miriam T. Stark, Damian Evans with Roland Fletcher</i>	1
<b>PART I</b>	
<b>Contexts</b>	<b>15</b>
1 An Environmental History of Angkor: Beginning and End <i>Dan Penny and Tegan Hall</i>	17
2 Texts and Objects: Exploiting the Literary Sources of Medieval Cambodia <i>Dominique Soutif and Julia Estève</i>	25
3 ‘Invisible Cambodians’: Knowledge Production in the History of Angkorian Archaeology <i>Heng Piphah, Seng Sonetra and Nhim Sotheavin</i>	42
4 The Mekong Delta before the Angkorian World <i>Miriam T. Stark and Pierre-Yves Manguin</i>	64
5 The Early Capitals of Angkor <i>Jean-Baptiste Chevance and Christophe Pottier</i>	80

*Contents*

6	Angkor's Multiple Southeast Asia Overland Connections <i>Kenneth R. Hall</i>	97
7	Angkor and China: 9th–15th Centuries <i>Miriam T. Stark and Aedeon Cremin</i>	112
<b>PART II</b>		
<b>Landscapes</b>		<b>133</b>
8	Forests, Palms, and Paddy Fields: The Plant Ecology of Angkor <i>Tegan Hall and Dan Penny</i>	135
9	Angkor and the Mekong River: Settlement, Resources, Mobility and Power <i>Heng Piphall</i>	154
10	Trajectories of Urbanism in the Angkorian World <i>Damian Evans, Roland Fletcher, Sarah Klassen, Christophe Pottier and Pelle Wijker</i>	173
11	Angkor's Temple Communities and the Logic of its Urban Landscape <i>Scott Hawken and Sarah Klassen</i>	195
12	Angkor as a 'Cité Hydraulique'? <i>Terry Lustig, Jean-Baptiste Chevance and Wayne Johnson</i>	216
<b>PART III</b>		
<b>State Institutions</b>		<b>235</b>
13	Angkorian Law and Land <i>Tess Davis and Eileen Lustig</i>	237
14	Warfare and Defensive Architecture in the Angkorian World <i>David Brotherson</i>	254
15	Āśramas, Shrines, and Royal Power <i>Chea Socheat, Julia Estève, Dominique Soutif and Edward Swenson</i>	272
16	Education and Medicine at Angkor <i>Chhem Rethy, Damian Evans, Chhom Kunthea, Phlong Pisith and Peter D. Sharrock</i>	287



Contents

<b>PART IV</b>	
<b>Economies</b>	<b>307</b>
17 Angkor's Economy: Implications of the Transfer of Wealth <i>Eileen Lustig, Aedeon Cremin and Terry Lustig</i>	309
18 The Temple Economy of Angkor <i>Heng Piphah and Sachchidanand Sahai</i>	327
19 Angkor's Agrarian Economy: A Socio-Ecological Mosaic <i>Scott Hawken and Cristina Cobo Castillo</i>	338
20 From Quarries to Temples: Stone Procurement, Materiality, and Spirituality in the Angkorian World <i>Christian Fischer, Federico Carò and Martin Polkinghorne</i>	360
21 Crafting with Fire: Stoneware and Iron Pyrotechnologies in the Angkorian World <i>Mitch Hendrickson, Ea Darith, Chhay Rachna, Yukeitsugu Tabata, Phon Kaseka, Stéphanie Leroy, Yuni Sato and Armand Desbat</i>	385
22 Food, Craft, and Ritual: Plants from the Angkorian World <i>Cristina Cobo Castillo</i>	401
<b>PART V</b>	
<b>Ideologies and Realities</b>	<b>421</b>
23 Gods and Temples: The Nature(s) of Angkorian Religion <i>Julia Estève</i>	423
24 Bodies of Glory: The Statuary of Angkor <i>Paul A. Lavy and Martin Polkinghorne</i>	435
25 'Of Cattle and Kings': Bovines in the Angkorian World <i>Mitch Hendrickson, Eileen Lustig and Siyonn Sophearith</i>	459
26 An Angkor Nation? Identifying the Core of the Khmer Empire <i>Ian Lowman, Chhom Kunthea and Mitch Hendrickson</i>	479
27 The Angkorian House <i>Alison K. Carter, Miriam T. Stark, Heng Piphah and Chhay Rachna</i>	494

Contents

28	Vogue at Angkor: Dress, Décor, and Narrative Drama <i>Gillian Green</i>	508
29	Gender, Status, and Hierarchy in the Age of Angkor <i>Trude Jacobsen Gidaszewski</i>	525
<b>PART VI</b>		
<b>After Angkor</b>		<b>539</b>
30	Perspectives on the ‘Collapse’ of Angkor and the Khmer Empire <i>Damian Evans, Martin Polkinghorne, Roland Fletcher, David Brotherson, Tegan Hall, Sarah Klassen and Pelle Wijker</i>	541
31	Uthong and Angkor: Material Legacies in the Chao Phraya Basin, Thailand <i>Pipad Krajaejun</i>	554
32	Mainland Southeast Asia After Angkor: On the Legacies of Jayavarman VII <i>Ashley Thompson</i>	574
33	Early Modern Cambodia and Archaeology at Longvek <i>Martin Polkinghorne and Yuni Sato</i>	592
34	Yama, the God Closest to the Khmers <i>Ang Choulean</i>	614
35	Inarguably Angkor <i>Penny Edwards</i>	629
	<i>Appendix A</i>	645
	<i>Glossary</i>	647
	<i>Index</i>	653

# FIGURES

0.1	Timeline of the Angkorian World.	7
0.2	South and Southeast Asia, showing key sites.	8
0.3	Southeast Asia, showing key sites.	9
0.4	Heartland of the Khmer Empire, showing key sites and extent of the Angkorian road system.	10
0.5	Greater Angkor, showing major temple sites and the extent of infrastructure.	11
0.6	Capital region of Yaśodharapura, highlighting the urban layout in and around Angkor Thom and Angkor Wat.	12
0.7	Capital region of Hariharālaya (Roluos).	13
2.1	Silver vase with inscription (K. 1294).	28
2.2	Śivakumbha prepared for a dīkṣā (initiation) in Cuddalore, India.	32
2.3	Grinding stone with inscription (K. 1215).	34
2.4	Prasat towers σ, ρ, π, and τ in Preah Khan of Kompong Svay.	36
2.5	K. 1335, detail of the lower part of the southern door jamb.	37
2.6	Detail of vertical ‘bayonet-cut’ joints in the corbelled vault from prasat tower ρ in Preah Khan of Kompong Svay.	38
3.1	Henri Marchal, a pioneer of the anastylosis method in Angkor, with his Khmer assistant, Chan, and workmen at Banteay Srei temple restoration in 1934.	46
3.2	Henri Marchal and an unnamed Khmer assistant at the restoration of Banteay Srei (Damdek) in 1952.	53
4.1	The Mekong Delta and the Angkorian World before Angkor.	65
5.1	Aerial view of Trapeang Phong.	83
5.2	Archaeological map of the Roluos region.	84
5.3	Rong Chen temple-mountain.	86
5.4	Banteay, the Royal Palace of Mahendraparvata.	87
5.5	Archaeological map of the Kulen plateau highlighting the urban layout of Mahendraparvata.	88
5.6	Newly identified buildings and enclosures within the West Baray.	91
5.7	Archaeological map of the West Baray area.	92
6.1	Potential 12th century communication networks connecting to Angkor.	102

## *Figures*

6.2	Pre-1500 Champa coastline ports-of-trade and hypothesised Western overland connections contesting the Malay Peninsula.	105
7.1	Cambodia and China in premodern Southeast Asia.	116
7.2	Cavalry officer leading Cham men into battle.	122
7.3	Musicians in a military procession.	123
7.4	Recent examples of draped images in Angkor Wat.	125
8.1	Land use maps in Southeast Asia and the Greater Angkor region.	136
8.2	Select Angkor monuments and sediment coring sites from which palaeoecological records were obtained.	141
8.3	Summary of palynological records for the four sites across Angkor.	144
8.4	Ecological group data plotted as z-scores and compared across the four sites.	147
9.1	Location of inscriptions used in this chapter.	155
9.2	The Lower Mekong River region.	156
9.3	Angkorian centres along the Mekong and state-sponsored temples.	157
10.1	Archaeological map of the intramural area of Angkor Thom.	177
10.2	Archaeological map of the Greater Angkor region.	178
10.3	Map of Óc Eo.	180
10.4	Archaeological map of Sambor Prei Kuk.	181
10.5	Lidar renderings of gridded urban areas of the Angkor Period.	184
11.1	Comparison of local community temples versus state and other temples within the civic ceremonial centre and suburban centres of Greater Angkor.	196
11.2	Reconstruction of a mediaeval settlement and village shrine in the south of Angkor.	202
11.3	Range of variations in local temple sites and their associated community settlements.	204
11.4	Density of local community temples per square kilometre in Greater Angkor.	206
11.5	Shift in community temple construction within Greater Angkor between the 8th and 13th centuries.	209
12.1	Angkor's complex hydraulic network.	217
12.2	Water flowing out from a reservoir during rainfall, when irrigation not needed.	219
12.3	Water infrastructure associated with Mahendraparvata.	220
12.4	Inferred layout of stoplog sluice gates along the outlet from Thnal Thom reservoir at Mahendraparvata.	221
12.5	West Baray and surrounding water infrastructures and possible proto-baray.	221
12.6	Zig-zag outlet of the Rahal ( <i>baray</i> ) at Koh Ker.	222
12.7	Main reservoir at Koh Ker showing existing and former rivers.	223
12.8	West Mebon inside West Baray.	227
12.9	Two rock carvings of Viṣṇu in Anantaśayin mode, Kbal Spean River, Phnom Kulen.	228
13.1	The statue of Duryodhana now returned to Cambodia, June 3, 2014.	238
14.1	Narrative scenes of warfare from bas-reliefs on Angkor Period temples.	255
14.2	Defensive features of the Angkor Thom gopura.	264
14.3	Lidar elevation model of central Angkor with highlights of landscape features and embankment extensions in the 12th century.	266
14.4	Horizontal and vertical holes in upper masonry blocks of the external enclosure wall of Angkor Wat.	267
14.5	'Gateway gap' masonry fill in the external enclosure wall of Angkor Wat.	268

## Figures

14.6	Hypothetical reconstruction of defensive structure built along the external enclosure walls of Angkor Wat.	268
15.1	Location of known Yaśodharāśramas, Vīrāśramas, resthouses, and hospitals of Jayavarman VII.	274
15.2	Examples of a typical hospital chapel and fire shrine resthouse.	275
15.3	Lidar image of Prasat Komnap South.	276
15.4	Examples of stela shelters.	277
15.5	Reconstruction of the ‘Long Building’.	278
15.6	Plan of Prasat Neak Buos illustrating the location of the potential Yaśodharāśrama and Vīrāśrama.	280
15.7	Plan of Prasat Khna illustrating the location of the potential Yaśodharāśrama and Vīrāśrama.	284
16.1	Distribution of Jayavarman VII hospital chapels.	298
16.2	Organisation of Jayavarman VII hospital chapels.	299
17.1	Distribution of inscriptions and rice land in Cambodia.	311
17.2	Purchase of land by increasingly high-ranking officials.	312
19.1	Agrarian patches identified within Greater Angkor.	346
19.2	The Pre Rup matrix.	347
19.3	The Phnom Bok matrix.	349
19.4	Lidar relief maps of Angkor Wat and Ta Prohm.	352
19.5	Lidar map of Angkor Thom.	353
19.6	Archaeobotanical remains from some of Angkor’s major temples.	355
20.1	Range of materials used in Khmer temple construction.	361
20.2	Distribution of sandstone formations and location of major archaeological sites and ancient quarries.	363
20.3	Examples of Terrain Rouge sandstone usage in the Angkor Period.	365
20.4	Examples of ‘Grès Supérieurs’ series sandstone usage in the Angkor Period.	366
20.5	Examples of Terrain Rouge (a, b, c, e, g, h, i) and Triassic (d, e, f) sandstone usage at Hariharālaya.	368
20.6	Texture and petrography of the Triassic sandstone.	369
20.7	Incomplete sculptures from stone workshops in Greater Angkor.	371
20.8	Evidence of quarries.	373
20.9	Various types of sandstone used in a decorative wall at Banteay Chhmar.	374
20.10	Triassic sandstone quarries.	375
20.11	Triassic sandstone with a characteristic mottled texture.	377
21.1	Angkorian stonewares types and vessel forms.	386
21.2	Iron objects produced during the Angkor Period.	387
21.3	Pryotechnological production sites in Cambodia and northeast Thailand, stoneware (crosses) and iron (circles).	388
21.4	Kiln morphologies in the Angkor Period.	390
21.5	Characteristics of Angkorian iron smelting sites.	391
22.1	Examples of archaeobotanical remains recovered from five Angkor Period sites.	404
22.2	Summary of the archaeobotanical results from five Angkor Period sites.	406
22.3	Proportions of economic crops found in Ta Prohm over time.	407
22.4	Proportion of <i>indica</i> and <i>japonica</i> rice.	416
22.5	Number of economic taxa identified in each of the sites.	417
24.1	Relief sculptures depicting deity-images in worship.	437

## *Figures*

24.2	Brahmanical (Hindu) deities.	441
24.3	Personalisation of images during the reign of Jayavarman VII.	444
24.4	Sculptural innovation, archaism, and transformation.	446
24.5	Types of Buddha images from the late Angkor and Middle Periods.	449
24.6	Angkorian statuary venerated in the present.	450
25.1	Sandstone Nandin statues.	461
25.2	Depiction of cows in Angkorian bas-relief.	464
25.3	Buffalo images from the Pre-Angkor and Angkor Period.	465
25.4	Milk churning imagery.	468
25.5	Scene depicting Brahmins milking a cow and drinking milk from Ta Prohm.	469
25.6	Trapeang in the Angkorian World.	471
25.7	Comparison of modern cattle densities, Angkorian trapeang and temples.	472
26.1	Distribution of Angkor Period temples and inscriptions including the maximum limit of control as defined by B.-P. Groslier.	481
26.2	Proposed extent of the Angkorian heartland.	483
26.3	Communication corridors of the major Angkorian kings.	484
26.4	State-level infrastructures used by Khmer kings to assert influence within the Angkorian heartland.	485
27.1	Everyday life in Cambodia, past and present.	497
27.2	Possible fence posts identified in an excavated wall profile at Angkor Wat.	498
27.3	Overhead view of excavation trenches at Angkor Wat showing flat-lying sandstone pieces.	499
27.4	Possible hearth from excavations within the Angkor Wat enclosure.	500
27.5	Trash pit from excavations within the Ta Prohm enclosure.	501
27.6	Chinese water dropper in the shape of a chicken found in an excavation at Angkor Wat.	502
28.1	Examples of Angkorian individuals wearing sampot.	509
28.2	Śiva wearing a pleated sampot worn high at the waist, Baphuon style, 11th–12th century.	510
28.3	Devatas wearing double-layer sampot ensembles, Angkor Wat, 12th century.	511
28.4	Examples of short sampot chong kben.	512
28.5	Variations in window blind decorations.	516
28.6	Tapestry medallion with paired phoenix, Angkor Wat, 12th century.	518
28.7	Specific motifs found in narrative tapestries.	519
28.8	Clay model of Maitreya from Sum Tsek temple, Alchi, Ladakh, mid-10th to 11th century.	521
29.1	Key sites discussed in the text.	526
29.2	Relationships between Pre-Angkorian and Angkorian elite, 7th–11th centuries.	529
29.3	Mahidharapura–Angkor marriage relationships.	530
31.1	Sequence of Uthong Art style based on classification by Griswold and Buriphan (1952).	558
31.2	Examples of Buddha statues with traits of Style B and C.	561
31.3	Comparison of Style B Uthong and post-Bayon Buddhas.	563
31.4	Post-Bayon Buddha frieze inside Prasat Ta Tuot, Angkor.	564
31.5	Distribution of Uthong Style A, B, and C Buddha statues on the central plain of Thailand.	566
31.6	Four bronze miniature stūpas typical of the Pre-Ayutthaya and Ayutthaya Periods.	568

## Figures

32.1	12th–18th c. mainland Southeast Asian sites mentioned in the text.	575
32.2	Jayavarman VII period imagery.	582
32.3	Bronze tricephalous elephant statue from the Jayavarman VII period.	587
33.1	Overview map of major Early Modern sites in Cambodia.	594
33.2	Stūpa and sculptures from Wat Sithor.	597
33.3	Archaeological map of Longvek.	598
33.4	Distribution and relative quantities of trade ceramics and types from surface collections ( $n = 34,385$ registered sherds).	602
33.5	Details of infrastructure and excavations at Longvek and the site of Tuol Bay Ka-ek.	603
33.6	Selection of imported ceramic types from Longvek surface collections.	604
33.7	High-value trade ceramics from central occupation mound, Trench 28.	605
33.8	Aerial view from Tonle Sap River looking south.	606
33.9	Selection of brown-glaze storage jars from Longvek ordered by country of manufacture.	607
34.1	Yama judging souls to hell on the bas-reliefs of Angkor Wat.	616
34.2	Statue of Yama, Angkor Period.	617
34.3	Schematic layout of cremation area typical in rural Khmer villages.	620
34.4	Altar dedicated to Yama (far left) placed within the northeast corner of cremation area.	621
34.5	Schematic layout of area for rice cultivation ritual at Thlork village.	623
34.6	Five sand mounds and Yama altar erected for rice cultivation ritual, Thlork village.	624
34.7	Female medium performing dance to Yama before rice cultivation ritual.	625
34.8	Rice stacked between the Yama altar and shelter.	626

# TABLES

7.1	Cross-chronology of Chinese dynasties and Cambodian time periods.	114
7.2	Desirable products of Cambodia and China, listed by Zhao Rugua and Zhou Dagan, with botanical names, comments, and variant translations added where appropriate.	115
8.1	Details, including characteristic plant species, relevant to each of the three WWF-recognised ecoregions of the Greater Angkor region.	137
8.2	Vegetation regions surveyed in Ashwell (1993) and the corresponding JICA (2002) land-use type (where possible, based on spatial and/or descriptive correlation).	137
8.3	The array of pollen types identified in the palaeoecological records analysed and the ecological groups to which they were assigned.	142
11.1	Epigraphic territorial terms and their definitions.	202
13.1	Social status and associated fines from K. 323 (889 CE, sts. 78–82).	248
14.1	Epigraphic sources for warfare in the Angkor Period.	256
14.2	Dimensions of temple enclosure walls in the Pre-Angkor and Angkor Periods.	261
19.1	Distribution of recovered plants across the three study sites.	354
20.1	Main characteristics of the different sandstone lithotypes used during the Angkor Period.	364
22.1	Summary statistics of the five sites.	403
22.2	Presence and absence of economic crops in the five study sites.	408
22.3	Charred rice plant parts found in the five sites.	415
24.1	Epigraphic references for the emplacement of pratimā (likenesses) of Hindu deities and Buddha statues.	440
25.1	Pre-Angkorian and Angkorian inscription data on bovines.	466
25.2	Cow products in the Khmer inscriptions.	467
31.1	Thermoluminescence dating results from this study.	560
31.2	Uthong sites identified in each river basin and city in Thailand based on 2018–2019 surveys.	565
33.1	Types of ceramics recovered from surface collection and excavation at Longvek.	601



# CONTRIBUTORS

**Ang Choulean** is Emeritus Professor of Anthropology at the Royal University of Fine Arts (CAM).

**David Brotherson** is an honorary associate, Department of Archaeology, University of Sydney (AUS).

**Federico Carò** is Research Scientist in the Department of Scientific Research of the Metropolitan Museum of Art, New York (USA).

**Alison K. Carter** is Assistant Professor of Anthropology at the University of Oregon (USA).

**Cristina Cobo Castillo** is Honorary Researcher at UCL Institute of Archaeology (UK).

**Chea Socheat** is an archeologist of the Authority for the Protection and Safeguarding of Angkor and the Region of Angkor and a research associate of the *École française d'Extrême-Orient* centre in Siem Reap (CAM).

**Jean-Baptiste Chevance** is an archaeologist and the Program Director for the Archaeology & Development Foundation—Phnom Kulen Program, Siem Reap (CAM).

**Chhay Rachna** is Head of the Ceramic Study Office in the Angkor International Centre of Research and Documentation, APSARA National Authority, Siem Reap (CAM).

**Chhem Rethy** is a distinguished professor of technology and humanities at the Cambodia University of Technology and Science (CamTech) (CAM).

**Chhom Kunthea** is an epigrapher and researcher in Apsara National Authority (CAM).

**Aedeen Cremin** is an independent scholar (AUS)

### *Contributors*

**Tess Davis** is a lawyer and archaeologist and is currently Executive Director of the Antiquities Coalition and teaches cultural property law at Johns Hopkins University (USA).

**Ea Darith** is Director of the Department of Conservation and Archaeology for the National Authority for Preah Vihear (CAM).

**Armand Desbat** is Emeritus research director at CNRS (FRA).

**Penny Edwards** is Professor of Southeast Asian Studies in the Department of South and Southeast Asian Studies at the University of California, Berkeley (USA).

**Julia Estève** is Lecturer in Department of Global Buddhism, UTK, Institute of Science Innovation and Culture, Bangkok (THA).

**Damian Evans** is Senior Research Fellow at the École française d'Extrême-Orient in Paris (FRA) and an Honorary Associate in the Department of History, School of Philosophical and Historical Inquiry, Faculty of Arts and Social Sciences, at the University of Sydney (AUS).

**Christian Fischer** is an independent scholar and Co-Director of the Molecular and Nano Archaeology Lab & Archaeomaterials Group at UCLA (USA).

**Roland Fletcher** is Professor of Theoretical and World Archaeology at the University of Sydney (AUS).

**Gillian Green** is an independent scholar. She is immediate past president of the Asian Arts Society of Australia and formerly Honorary Associate in the Department of Art History (AUS).

**Kenneth R. Hall** is Professor of History at Ball State University (USA).

**Tegan Hall** is a landscape architect and Lecturer at the Australian Catholic University and the Queensland University of Technology (AUS).

**Scott Hawken** is Director of the Landscape Architecture and Urban Design Program at the University of Adelaide (AUS).

**Mitch Hendrickson** is Associate Professor of Anthropology at the University of Illinois at Chicago (USA).

**Heng Piphai** is Post-Doctoral Fellow at the Cotsen Institute of Archaeology, UCLA (USA).

**Trude Jacobsen Gidaszewski** is Professor of South and Southeast Asian History and faculty associate in the Center for Southeast Asian Studies, a Title VI National Resource Center, at Northern Illinois University (USA).

**Wayne Johnson** is Senior Archaeologist with Place Management NSW (Australia) and Archaeological Field Director for Sydney University's Greater Angkor Project (AUS).

### *Contributors*

**Sarah Klassen** is Marie Skłodowska-Curie Fellow in the Digital Archaeology department at Leiden University (NLD).

**Pipad Krajaejun** is Assistant Professor in the Department of History, Faculty of Liberal Arts, Thammasat University (THA) and a PhD candidate at SOAS, University of London (UK).

**Paul A. Lavy** is Associate Professor of Art History at the University of Hawai'i at Mānoa (USA).

**Stéphanie Leroy** is Senior Researcher in archaeometallurgy at the French National Research Center (FRA).

**Ian Lowman** is an independent scholar based in Aberdeen, North Carolina (USA).

**Eileen Lustig** is an independent scholar based in Sydney (AUS).

**Terry Lustig** is an independent scholar based in Sydney (AUS).

**Pierre-Yves Manguin** is Emeritus Professor at the École française d'Extrême-Orient, Paris (FRA).

**Dan Penny** is Associate Professor in the School of Geosciences at the University of Sydney and Co-Director of the Angkor Research Program at the University of Sydney (AUS).

**Phlong Pisith** is Lecturer at the Faculty of Archaeology, Royal University of Fine Arts, Phnom Penh (CAM).

**Phon Kaseka** is Director General of the Institute of Humanities and Social Sciences, Royal Academy of Cambodia, Phnom Penh (CAM)

**Martin Polkinghorne** is a Senior Lecturer in archaeology at Flinders University, Adelaide (AUS).

**Christophe Pottier** is Associate Professor at the École française d'Extrême-Orient, Paris (FRA).

**Sachchidanand Sahai** is Resident Scholar at the ASPARA National Authority, Siem Reap (CAM).

**Yuni Sato** is a researcher at the Nara National Research Institute for Cultural Properties (JPN).

**Seng Sonetra** is a PhD candidate at the Department of History of Art and Archaeology, SOAS-University of London (UK).

**Peter D. Sharrock** is a Senior Teaching Fellow in the Department of the History of Art and Archaeology, School of Oriental and African Studies, University of London (UK).

*Contributors*

**Siyonn Sophearith** is Lecturer of Cambodian history at the Royal U of Fine Arts and a government official of the Ministry of Culture and Fine Arts, Phnom Penh (CAM).

**Nhim Sotheavin** is a researcher at the Sophia Asia Center for Research and Human Development, Sophia University, Japan (JPN)

**Dominique Soutif** is Lecturer of Southeast Asian archeology at the École française d'Extrême-Orient (FRA).

**Miriam T. Stark** is Professor of Anthropology and Director of the Center for Southeast Asian Studies at the University of Hawai'i at Mānoa (USA).

**Edward Swenson** is Professor of Anthropology and the Director of the Archaeology Centre at the University of Toronto (CAN).

**Yukitsugu Tabata** is Professor in the Faculty of Letters, Arts and Sciences at Waseda University, Tokyo (JPN).

**Ashley Thompson** is Hiram W. Woodward Chair in Southeast Art and Professor in the Department of the History of Art and Archaeology at the School of Oriental and African Studies, University of London (UK).

**Pelle Wijker** is a doctoral student at Université Paris-1 Panthéon-Sorbonne and the École française d'Extrême-Orient (FRA).

# ACKNOWLEDGEMENTS

## **Chapter 1—Penny & Hall**

The authors acknowledge the Cambodian National Authority for the Protection of the Site and the Management of the Region of Angkor (APSARA) for their long-standing support and collaboration. This research is funded by the Australian Research Council and the Australian Nuclear Science and Technology Organisation.

## **Chapter 2—Soutif & Estève**

The research program *Corpus des Inscriptions Khmères* is a collaboration between the École française d'Extrême-Orient (EFEO), the Cambodian National Authority for the Protection of the Site and Management of the Region of Angkor (APSARA), UTK Krungthep, and the Ministry of Culture and Fine Arts of Cambodia. This research has benefited from the financial support of the EFEO and the Dharma project, which has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme.

## **Chapter 4—Stark & Manguin**

The authors would like to thank their host institutions for supporting their Mekong Delta-based research in Cambodia (Stark) and Vietnam (Manguin). Cambodia's Ministry of Culture and Fine Arts and its Archaeology Faculty of the Royal University of Fine Arts were invaluable throughout the 1996–2009 Lower Mekong Archaeological Project field investigations. Vietnam's Southern Institute of Social Sciences (Ho Chi Minh City) was EFEO's research partner during the work at Óc Eo and surrounding areas. All mistakes remain the authors' responsibility.

## **Chapter 5—Chevance & Pottier**

The authors would like to thank Damian Evans for his careful proofreading; Lionel Courty for the translation; and H.E. Hang Peou, Director-General of the APSARA National Authority, for the unwavering support of APSARA and its departments. The Franco-Khmer Archaeological Mission on the Development of the Angkorian Territory (MAFKATA) is directed by

### *Acknowledgements*

Christophe Pottier and operates in cooperation with APSARA. MAFKATA takes place under the auspices of the French Ministry of Europe and Foreign Affairs through its *Commission des fouilles* and is co-financed by the French School of Asian Studies (EFEO). The Fondation Simone et Cino Del Duca has also supported MAFKATA. The Archaeology and Development Foundation (ADF) is directed by Jean-Baptiste Chevance in partnership with the APSARA National Authority. This research has been partly supported by the Mohamed S. Farsi Foundation.

### **Chapter 7—Stark & Cremin**

Our thanks go to Cambodia's Ministry of Culture and Fine Arts and to APSARA National Authority for supporting our work in Cambodia since 1996, some of which enabled us to produce the scholarship in the chapter.

### **Chapter 8—Hall & Penny**

The authors acknowledge the Cambodian National Authority for the Protection of the Site and the Management of the Region of Angkor (APSARA) for their long-standing support and collaboration. This research is funded by the Australian Research Council and the Australian Nuclear Science and Technology Organisation.

### **Chapter 10—Evans *et al.***

The authors gratefully acknowledge the support of the Cambodian Ministry of Culture and Fine Arts and its various agencies, as well as the members of the Khmer Archaeology LiDAR Consortium. The contribution of D.E. and P.W. is funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme. The contribution of M.P. is funded by the Australian Research Council.

### **Chapter 11—Hawken & Klassen**

The authors acknowledge the Cambodian National Authority for the Protection of the Site and the Management of the Region of Angkor (APSARA) as well as the EFEO, Paris, and UCL, London, for supporting residencies for Dr. Scott Hawken in June and July of 2019. Thanks also to the School of the Built Environment, UNSW, Sydney, for supporting Dr. Scott Hawken's sabbatical. Additionally, the authors acknowledge the Social Sciences and Humanities Research Council of Canada Postdoctoral Fellowship and for supporting residencies for Dr. Sarah Klassen at the University of British Columbia in 2019 and 2020 Dumbarton Oaks Research Library and the Andrew W. Mellon Foundation (Mellon Initiative in Urban Landscape Studies) for supporting a residency in 2018. The authors are particularly grateful to Dr. Eileen Lustig for her thoughtful feedback on an initial draft of the chapter. The authors would also like to thank the editors for their detailed feedback on the various drafts of the chapter.

### **Chapter 12—Lustig *et al.***

The authors would like to thank Aeedeen Cremin, John Downey, Damian Evans, Marnie Feneley, Nina Hofer, Eileen Lustig, Dan Penny, Sam Player, Martin Polkinghorne, Christophe Pottier, Sakhoeun Sakada, the Royal Angkor Foundation, and Chandana

### *Acknowledgements*

Withannachchi for their comments, criticisms, and readiness to provide us with the benefits of their specialised knowledge.

#### **Chapter 13—Davis & Lustig**

The authors would like to acknowledge the late Philip Jenner for the translations of the Khmer inscriptions that are available online through his Pre-Angkorian and Angkorian dictionaries. In addition, the authors would like to thank the US Department of Homeland Security (ICE) for the ability to reprint the image of the Duryodhana sculpture.

#### **Chapter 14—Brotherson**

The author wishes to thank the APSARA National Authority and the Greater Angkor Project. Research was funded by the Australian Research Council, the Australian Postgraduate Award, the Carlyle Greenwell Research Fund, and the Endeavour Fellowship. Thanks also to Michael Charney for comments on an early draft of this chapter.

#### **Chapter 15—Chea *et al.***

The research program Yaśodharāśrama is a collaboration between the École française d'Extrême-Orient (EFEO), the University of Toronto, the Cambodian National Authority for the Protection of the Site and Management of the Region of Angkor (APSARA), UTK Krungthep, and the Ministry of Culture and Fine Arts of Cambodia. This research has benefited from the financial support of the EFEO; the Commission des fouilles of the French Ministry of Foreign and European Affairs; the Dharma project, which has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme; and the Hal Jackman Foundation.

#### **Chapter 16—Chhem *et al.***

The authors gratefully acknowledge the *Canadian Journal of Buddhist Studies*, who gave us permission to adapt parts of Chhem (2007), from which sections of our text were drawn. Funding for this contribution derives in part from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme.

#### **Chapter 17—Lustig *et al.***

The authors would like to acknowledge the late Philip Jenner for the translations of the Khmer inscriptions that are available online through his Pre-Angkorian and Angkorian dictionaries.

#### **Chapter 19—Hawken & Castillo**

The authors would like to thank the Cambodian National Authority for the Protection of the Site and Management of the Region of Angkor (APSARA) and Ministry of Culture and Fine Arts for their support. In addition, we thank Dr Eileen Lustig, Sarah Klassen, and the editors of the book for helpful feedback to improve the chapter. Scott Hawken would like to acknowledge both Damian Evans and Christophe Pottier of the EFEO for hosting his stay in Paris during the writing of the chapter and Dorian Fuller, who hosted him at the Institute of Archaeology at

### *Acknowledgements*

UCL in London. This chapter was written with the support of the Faculty of the Built Environment, UNSW Sydney.

#### **Chapter 20—Fischer *et al.***

We thank the Ministry of Culture and Fine Arts of Cambodia, the APSARA National Authority, the National Museum of Cambodia, and the École française d'Extrême-Orient. Special thanks go to Dominique Soutif and Bertrand Porte (EFEO) and to the Cambodian team of the stone workshop at the National Museum of Cambodia. Part of this research was supported through grants from the Robert H.N. Ho Family Foundation, the PSL/Scripta and the Corpus des inscriptions khmères projects, the University of California Los Angeles, and by fellowships from the Andrew W. Mellon Foundation at the Metropolitan Museum of Art and the E.W. Forbes Fund at the Freer Gallery of Art.

#### **Chapter 21—Hendrickson *et al.***

The authors wish to thank the Ministry of Culture and Fine Arts and the APSARA Authority for their long-standing support and continued collaborations. Thanks also to Dominique Soutif at the École française d'Extrême-Orient and the University of Sydney Robert Christie Research Centre, particularly So Malay, in Siem Reap. Funding for this work was provided in part by the National Science Foundation, Agence Nationale de la Recherche, and Robert H.N. Ho Family Foundation Program in Buddhist Studies. Finally, thanks to the National Museum of Cambodia for permission to include the effigy vessel image from their collection.

#### **Chapter 22—Castillo**

Thanks to the Cambodian National Authority for the Protection of the Site and Management of the Region of Angkor (APSARA) for their continued support. I would like to thank my colleague and friend Mitch Hendrickson, who continued to push me to finish this chapter and had faith in my work through some difficult times. I would also like to thank my many collaborators: Miriam T. Stark, Alison K. Carter, Martin Polkinghorne, Heng Piphah, Rachna Chhay, and the GAP and INDAP teams.

#### **Chapter 23—Estève**

This chapter is part of the Corpus des Inscriptions Khmères research program (<https://cik.efeo.fr/>), in charge of the inventory of 'K. numbers' initiated by George Cœdès (*IC VIII*) and continued by Claude Jacques (1971). It is part of the project Dharma that has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme.

#### **Chapter 25—Hendrickson *et al.***

The authors would like to acknowledge the late Philip Jenner for the translations of the Khmer inscriptions that are available online through his Pre-Angkorian and Angkorian dictionaries. The authors wish to thank the National Museum of Cambodia in Phnom Penh for permission to publish the image of the buffalo cistern from their collection.



## Acknowledgements

### Chapter 27—Carter *et al.*

The authors wish to thank the APSARA Authority for their cooperation and collaboration in undertaking this research. We also thank Dr. Roland Fletcher for his guidance and support of our project. We extend our deepest gratitude to So Malay and Martin King for administrative support and the University of Sydney Robert Christie Research Centre. We also thank the Greater Angkor Project field crews from 2010–2015. This work was supported by the Australian Research Council, National Geographic Society Committee for Research and Exploration, and Dumbarton Oaks.

### Chapter 30—Evans *et al.*

The authors gratefully acknowledge the support of the Cambodian Ministry of Culture and Fine Arts and its various agencies. The contribution of D.E. and P.W. is funded by the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme. The contribution of M.P. is funded by the Australian Research Council.

### Chapter 33—Polkinghorne & Sato

Archaeological data in this chapter were collected with the permission of the Department of Archaeology and Prehistory, Ministry of Culture and Fine Arts, Royal Government of Cambodia. Special thanks to H.E. Minister Dr Phoeurng Sackona, Secretary of State H.E. Chuch Phoeurn, Secretary of State H.E. Prak Sonnara, H.E. Ok Sokha, and Mr Voeun Vuthy. Funding was provided by an Australian Research Council Discovery Early Career Researcher Award and an Australian Research Council Discovery Grant. The authors recognise the contributions of fieldwork teams (2015–2019) and advisors. We acknowledge the community of Ukna Bang Village, Kompong Chhnang Province, for their generosity in the field. Martin Polkinghorne is an honorary research fellow of the University of Sydney.

### Chapter 35—Edwards

Thanks to Ben Bartu for his editorial eye, David Chandler for his comments on an earlier draft, and Heng Chhun Oeurn and Chap Prem for research assistance in Phnom Penh on a related project. I would also like to thank Sor Sokny at the Buddhist Institute for permission to reproduce verses from *Niras Nokor Wat*. Draft fragments of this chapter were presented at the Northern Illinois University Graduate Student Colloquium on Southeast Asian Studies, May 2015, and at the Department of South and Southeast Asian Studies, University of California, Berkeley, February 2006. Conversations with Dr. Thibodi Buakamsri and Dr. Trent Walker, during a directed study on Suttantaprija Ind’s poem *Niras Nokor Wat* in 2012, deepened my understanding of that poem and the *niras/nirat* genre in general.

# PERSPECTIVES ON THE 'COLLAPSE' OF ANGKOR AND THE KHMER EMPIRE

*Damian Evans, Martin Polkinghorne, Roland Fletcher, David Brotherson, Tegan Hall, Sarah Klassen and Pelle Wijker*

The decline of Khmer political dominance in mainland Southeast Asia in the mid-second millennium CE has been a topic of enduring fascination for scholars since the 19th century. The phenomenon is conventionally described as a 'collapse' and is usually traced to some combination of social, political, and economic factors including religious change, shifting currents in international trade, invasion and warfare, and overexertion from the immense building works of the 12th to 13th centuries. In the mid-20th century, a growing preoccupation with long-term relationships between humans and their environment set the stage for another hypothesis: that the elaboration of a vast engineered landscape either created or amplified a series of profound challenges to Angkor's long-term sustainability. In this view, processes such as urban and agricultural extensification, infrastructural development and the rise of densely populated urban areas significantly degraded the local environment, increased dependence on an over-extended infrastructural network, and created systemic vulnerabilities to social and environmental change.

These hypotheses were first systematically elaborated from the 1950s to the 1970s, and since then they have been met with widespread resistance and occasional controversy. For example, few researchers these days accept B.-P. Groslier's precise vision of Angkor as a powerhouse of irrigated rice agriculture. Others have questioned his famous 'hydraulic city' theory on theoretical or even ethical grounds, as scholars have sought to come to terms with the colonial legacies that are clearly entangled with classic notions of 'abandonment' and 'collapse'. On the other hand, evidence from recent work makes it difficult to deny that there were profound demographic and cultural shifts in Cambodia toward the end of the Angkor Period, even if the precise nature and tempo of those changes remain to be elucidated. To explain these transformations remains a central challenge in regional history.

## **Defining the Problem**

In recent years, there has been a broad re-evaluation of the notion of 'collapse' in the archaeological literature (see Hall 2017 for a discussion), even as the notion has been brought to the forefront of the popular imagination by the work of Jared Diamond (2011) in particular. Critics (see McAnany and Yoffee 2009 for a representative cross-section) contend that the very concept of collapse is a legacy of racist and colonial approaches to the past that systematically underestimates and ignores evidence for persistence and resilience in the archaeological record;

cherry-picks or misrepresents the evidence; and offers naively deterministic models to explain the supposed failures of early societies, often in ways that have been politically useful for those seeking to justify present-day occupation and subjugation (Edwards 2008) or, conversely, to promote narratives of nostalgia and loss (Mikaelian 2013, 2016).

These critiques should immediately give us reason to pause and reflect on the validity of the notion of ‘collapse’ as applied to Angkor and the broader Khmer world: fantasies about the ‘decline’ of the Angkorian civilisation have always been used as a tacit justification for European colonialism in Cambodia (Edwards 2005, 2008; Falser 2020), archaeological practise has been tightly linked with the creation of the modern nation-state since the mapping and survey work of the earliest ‘explorers’ who ‘rediscovered’ Angkor and the Khmer Empire (Evans 2007, 31–44), and efforts to restore ‘lost’ cities and civilisations to their former grandeur have featured prominently in political messaging in Cambodia from as early as the Angkor Period (Evans 2007, 124–25) right through to the Khmer Rouge regime in the 20th century (Evans 2007, 107–15).

It is important therefore to define what we mean when we speak of the ‘decline’ of Angkor and the Khmer Empire, to get a sense of whether there is a phenomenon here that actually exists and is worth explaining, and to understand what measures may be useful for quantifying it. A detailed treatment is beyond the scope of this chapter, but in summary, recent attempts to redefine or re-orient the notion of ‘collapse’ have tended to point toward social and political complexity as key considerations in tracing and evaluating the trajectories of past societies (Hall 2017, 1). In this view, following Tainter (1988), the building of societal complexity ostensibly presents as a hugely successful problem-solving tool and in its initial stages encourages population surges; human health improvements; the development of social hierarchy; differentiation and specialisation of economic duties; higher degrees of social, political, and economic integration; and greater information processing and exchange; conversely, ‘collapse’ or ‘transformation’ can be defined as a substantial decline in urban and regional populations, a reduction in social complexity and territorial control and the failure or restructuring of economic and ideological systems (Hall 2017, 1–2).

There is significant evidence that the 13th to 15th centuries at Angkor represented a time of profound transformation in the Khmer world across various domains such as religion, politics, economy, trade, engagement with the outside world, spatial organisation, and material culture (see Coe and Evans 2018, 239–80 for a recent summary). In many cases, the details or even the overall nature of these changes are unclear or contested. Still, we may usefully narrow in on demographic change as a key indicator of broader societal transformations, since it has been the focus of intensive archaeological research in recent years and there is abundant evidence for patterns of residence and occupation in the later Angkor Period (Carter et al. 2018, 2019, 2021; Klassen et al. 2021b).

At the height of the Angkor Period in the 12th to 13th centuries CE, the Greater Angkor region of 3000 km<sup>2</sup> was home to something in the order of three-quarters of a million people (Klassen et al. 2021b), with a densely inhabited, formally planned urban core giving way to a diffuse urban and agricultural network marked by nodes of dense habitation around major temple sites (Evans 2016; Evans et al. 2007, 2013). By the 19th century, however, European accounts describe a sparsely populated landscape consisting of a handful of villages, with two reliable sources from the turn of the 19th and 20th centuries giving population estimates of 2000–4000 people for Siem Reap district and 10,000–18,000 people for the entire province spanning around 10,000 km<sup>2</sup> (Brotherson 2019, 374).

Therefore, historical and archaeological evidence indicates a decline in the population of the Angkor area of around two orders of magnitude between the 13th and 19th centuries, concurrent with seismic changes in the social, political, and cultural landscape of the region. At the

same time, we should move beyond problematic notions of 'collapse' and the 'rise and fall of civilisations' while recognising that understanding the processes at work here provides us with critical insights into long-term socio-cultural trajectories and the making of modern Southeast Asia.

### **Perspectives on Collapse**

The reasons for the 'collapse' of Angkor have long fascinated observers, who typically infer from the existence of massive temples that Angkor had an extremely large population that was overwhelmed and greatly diminished by external environmental or military pressures, or some combination of the two. For instance, Delaporte (1880, 39) assumed that Angkor was home to 'millions'. Indeed, with only two notable exceptions (Coe 1957, 1961; Miksic 2000), the idea that Angkor was a populous city has been the dominant one in the literature since the mid-1800s. Notwithstanding persistent difficulties in defining exactly where the 'urban' space of Angkor begins and ends (see Evans et al. 2023, this volume), it is now reasonably clear that the Greater Angkor landscape was home to between 700,000 to 900,000 people at its height (Klassen et al. 2021b). It is worthwhile, therefore, to re-assess traditional theories of 'collapse', which since the 1970s have tended to converge around a population estimate of around a million or so inhabitants (Groslier 1979).

### **Conflict**

The first detailed European accounts of Angkor in the 19th century drew on local histories, myths and legends, and evidence from Ayutthayan and Cambodian chronicles to argue that the demise of Angkor and the Khmer Empire was due to military conflict with the neighbouring Ayutthayan civilisation (Briggs 1948; Brotherson 2019, 10–16; Vickery 1977), whose capital was 350 km due west of the Angkorian heartland. The dominant view here was that, from around the 12th century onward, expanding populations in present-day Thailand gave rise to ever more powerful kingdoms which by the 14th century began to pose an existential threat to Angkor, and that after multiple invasions in the Angkorian heartland throughout the 14th and 15th centuries, the capital of the Khmer was finally overrun by Ayutthaya.

Over the course of the 20th century, there was growing scepticism about this conventional narrative. Briggs (1948), for example, rejected the idea that there were multiple invasions by Ayutthaya and pointed to a single, decisive conquest of Angkor by the forces of Ayutthaya in 1431. By the 1970s Michael Vickery, after an exhaustive review of the primary sources (1977), also concluded that a series of 'invasions' by Ayutthaya was unlikely and pointed instead to a single occupation event lasting from 12 to 15 years. The idea of an 'invasion' is difficult to square with other lines of evidence: although signs of fortification and defensive modification of Angkor's urban infrastructure suggest an increased concern for the security of its population from perhaps the 13th century onwards, these alterations are difficult to date with precision, and there is no archaeological evidence at all which suggests a violent collapse or destruction of the capital (Brotherson 2015, 2019; Klassen et al. 2021a). The few scholars who have studied the issue in detail in recent years tend to underscore the remarkable cross-pollination in religious and artistic expression between Ayutthaya and Angkor in the 15th to 16th centuries (Polkinghorne et al. 2013). Nevertheless, the notion of an Ayutthayan 'sacking' of Angkor continues to enjoy widespread currency in the tertiary literature on Angkor (Hall 2018).

Even if we do accept that the Ayutthayan invasion of 1431 was as violent and as final as conventional sources would have us believe, then, as Michael Vickery has noted, this still leaves

us with the question of why Angkor, which had been resilient in the face of external military incursions for several centuries, was weak enough to finally fall to Ayutthaya in the mid-1400s (1977, 509–10). Since the 1800s, scholars have therefore sought to identify the ultimate cause of Angkor's decline in addition to the proximal explanation provided by military aggression from Ayutthaya. Typically, these theories have revolved around one or two main ideas: that overbuilding and overextension of the Empire in the 12th to 13th centuries 'exhausted' Angkorian society and that the transition from Brahmanism to Buddhism as the state religion undermined the rigid ideologies and power structures that had traditionally held Angkor together (Brotherson 2019, 10–23; Polkinghorne 2018).

### ***Overextension, Exhaustion, and Religious Transformation***

King Jayavarman VII, whose reign spanned around 40 years straddling the turn of the 12th to 13th centuries, was responsible for more monumental construction activity than any of his predecessors. In addition to temples such as the Bayon and Ta Prohm at Angkor, his works included massive and sprawling temple complexes across the Empire at places like Banteay Chhmar and Preah Khan of Kompong Svay and many hundreds of smaller temples dotting the region. His civil engineering works were also unmatched by any monarch before or after: cities and giant reservoirs were built at Angkor and beyond, connected to Angkor by a network of earthen highways (Hendrickson 2010, 2012). The sheer scale and ambition of these works has led many to believe that his reign exhausted the Empire by depleting its resources or demoralising the work force, making it vulnerable to invasion by foreign invaders; in some accounts, a rebellious and overworked populace revolted against Brahmanical rulers by adopting the more democratic or anti-authoritarian faith of Theravāda Buddhism (Briggs 1999[1951], 257–61; Brotherson 2019, 15; Finot 1908; Polkinghorne 2018).

Despite its widespread currency since the 19th century, there is no particular evidence to support this hypothesis, and there are some reasonably compelling counter-arguments. As Vickery (1977, 511) has pointed out, the building spree of Jayavarman VII occurred more than two centuries before the purported sacking of the capital, which would have provided ample opportunity to recover and regroup from the mammoth building efforts of the 12th to 13th centuries. The raw materials from which cities and temples were built—stone, iron, thatch, and earth—remained in abundant supply. Moreover, in many cases—for example, Angkor Thom (Gaucher 2017) and Preah Khan of Kompong Svay (Hendrickson and Evans 2015)—we see that temples and cities typically ascribed to the reign of Jayavarman VII have long and complex life histories and were developed over decades or even centuries leading up to his reign.

Indeed, a new and as-yet unpublished inscription, K. 1297, brings to light the very important career of the Buddhist king Tribhuvanāditya (r. 1149–ca.1180 CE) and underscores that all but one of the major kings for a 200-year period from 1080 to 1270 CE were Buddhist (Sharrock 2018), which tends to undermine the supposed exceptionalism of the reign of Jayavarman VII. This also has far-reaching implications for another recurring explanation for the vulnerability of Angkor in 1431: that the transition from Brahmanism to Buddhism as the state religion—and in particular the rise of Theravāda Buddhism toward the very end of the Angkor Period—undermined the power structures that had held together a fractious Empire over many centuries. In this view, with its inward and personal focus, Theravāda was a subversive force against a state ideology that had for many centuries revolved around religious and personality cults focused on Brahmanical kings (Briggs 1999[1951], 259–60; Brotherson 2019, 18–19; Finot 1908; Polkinghorne 2018, 2022).

First of all, it is important to underscore, after Stark (2019), that the Angkorian state was always inherently fragile under kings of all religious faiths. Second, although we can imagine that the transition to Buddhism as a state religion may have challenged longstanding power structures in the Angkorian World, we must once again recognise that it was a process that unfolded over centuries, that Angkorian religion was always characterised by coexistence and syncretism (see Estève 2023, this volume), and that the high-water mark of the Khmer Empire was under the reign of Buddhist kings (Hendrickson 2010, 2012; Sharrock 2018). There is nothing *necessarily* or inherently 'democratic' or 'anti-authoritarian' about Theravāda Buddhist political ideology *in practise*: one only needs to look across the Indian Ocean to early historic and medieval Sri Lanka to find Theravāda Buddhist monarchies of the 'Classic' Period that were stable, durable, and capable of undertaking and sustaining vast engineering projects while ruling over diverse and cosmopolitan societies (Coningham et al. 2017). Indeed, as Vickery (1977, 511) has pointed out, it is logically incoherent to claim that an ascendant Theravāda Buddhist state—Ayutthaya—was only able to overcome Angkor because the Khmer state was doomed by the embrace of Theravāda Buddhism.

### ***Trade and Globalisation***

The historiography of Southeast Asia is characterised by a distinctive model of the growth and decline of early civilisations and their urban centres, revolving around indigenous responses to exogenous cultural currents. In this view, early chiefdoms along the 'Maritime Silk Road' developed into complex societies through exposure to Chinese and Indian socio-cultural systems (see e.g. Hall 1982; Higham 2014; Mabbett 1977). Through the selective appropriation of elements of Indian culture, in particular, indigenous elites were able to fundamentally transform Southeast Asian societies, eventually translating the success of coastal trading centres into vast inland agrarian-based empires largely disengaged from the changing fortunes of international trade. Extending this model some centuries forward in time, the logical corollary has been that a resurgence in maritime trade in the 12th to 15th centuries driven by China (Vickery 1977, 515–22) and in subsequent centuries by Europeans (Reid 1988, 1993) presented a profound challenge to the sustainability of the classic inland agrarian empires of Southeast Asia. By the 15th century, they had collapsed, as local elites increasingly sought to exploit the economic opportunities afforded by globalisation, and coastal, trade-oriented centres of power flourished once again across mainland Southeast Asia (see also Hall 2023, this volume).

Although compelling on some levels, this model is not without its problems. Lieberman (1995), for example, points out the substantial variability between circumstances in particular sub-regions of Southeast Asia and calls into question Reid's notion of an overarching 'Age of Commerce'. Wade (2009) points out that a burgeoning maritime trade existed in the region for several centuries before the 'Age of Commerce', even as the great inland empires of Southeast Asia developed to their apogee. Although an inland agrarian capital, Angkor was always connected to regional and international trading networks, and according to studies of material culture by David Brotherson, it remained so for centuries after its 'collapse' (Brotherson 2019). Reynolds (1995), meanwhile, suggests that the historiographical fascination with trade and external influences is a function of Eurocentric scholarship; still others point to the over-reliance on external records, in particular Chinese texts, which are often trade-centric (Stark 1998; Stark and Allen 1998). Finally, we may reasonably question the degree of relative trading advantage conferred by any relocation to the Phnom Penh region, since it, too, sits at a distance of hundreds of kilometres from the coast by way of (the very same) difficult-to-navigate network of Mekong Delta waterways.

Recent research has undoubtedly highlighted how Post-Angkorian urban centres were very much engaged in, and oriented towards, burgeoning international trading activity in the Early Modern Period (Polkinghorne 2018; Polkinghorne et al. 2019; see also Polkinghorne and Sato 2023, this volume). Once again, however, we are also left with the question of proximate vs. ultimate causes. As Vickery (1977, 522) notes:

One question which cannot yet be answered is why the Angkorean elite, or part of it, decided sometime in the 13th–14th centuries that it would be worthwhile to shift emphasis from inland agrarian activities to integration in the China-Southeast Asia trading network, or, phrased in another way, why the new Mekong ports were able to accumulate enough wealth to attract people away from Angkor.

### ***The Hydraulic City, Climate, and Infrastructural Breakdown***

Since at least Delaporte (1880, 39), many (if not most) observers have believed that the success of Angkor derived at least partly from the ability to manage seasonal monsoon water flows and irrigate rice fields using massive hydraulic infrastructure. It was B.-P. Groslier who, from the 1950s onwards, developed this notion into a coherent theoretical framework (most fully elaborated in Groslier 1979; see Evans 2007 for a broader overview). According to Groslier's famed 'hydraulic city' theory, the immense, state-run network of *baray*, reservoirs, and canals around which the city of Angkor cohered could have enabled the harvest of multiple crops of rice per year and certainly acted as a hydraulic failsafe device, 'smoothing out' disruptive fluctuations in the yearly monsoon by storing water and, when necessary, distributing it across vast stretches of the landscape for irrigation. According to Groslier, however, the system carried within it the seeds of its own downfall, as overexploitation led to erosion, siltation, and soil degradation. A race to the bottom ensued: new channels and reservoirs were dug to replace defunct sections of the network, with ever-decreasing returns, until the system ceased to function entirely. With Angkor's elites no longer able to guarantee the provision of water and rice to their subjects, the polity itself finally fell victim to its enemies.

Groslier's 'hydraulic city' theory was problematic for several reasons (Bourdonneau 2010; Evans 2007) and provoked a fierce debate that has still not been entirely resolved (see Terry Lustig et al. 2023, this volume). For example, recent scholarship has tempered his overly generous estimates of the hydraulic system's capacity to sustain additional population numbers (Acker 1998). Nevertheless, as Pottier (2000), Fletcher et al. (2003, 116) and Evans et al. (2013, 12598) have argued, even a modest increase in rice production through irrigation could have played a key role in stabilising the annual food supply. Crucially, it would have allowed for the support of a large and specialised population of non-rice-producers in the densely inhabited urban cores that developed throughout the 11th to 13th centuries (Evans 2016; Evans et al. 2013); conversely, failure of the system would have disrupted that support and undermined the foundations of Angkor as an urban society (Brotherson 2019, 339).

Moreover, evidence has emerged in recent decades that supports elements of Groslier's narrative, although perhaps in ways that he may not have precisely foreseen. The emergence of long-term, high-resolution paleoclimate data is a case in point. Analysis of tree ring data has shown that the region suffered a series of severe and prolonged droughts, punctuated by episodes of heavy rain, in the mid- to late 14th and early 15th centuries (Buckley et al. 2010). These would have dealt a double blow to Angkor's hydraulic infrastructure: sustained drought overtaxed the capacity of the *baray* to act as a 'failsafe', while rapid floods caused critical damage to key components of the hydraulic network and threatened habitation areas. Indeed, the

archaeological record shows several instances of failure and hasty repair of the hydraulic infrastructure (Evans et al. 2007, 2013). Eventually, the damage to the water management system may well have become so severe that repair was either impossible or simply too costly to pursue (Buckley et al. 2014). As shall be seen subsequently, however, although these climatic stresses broadly coincided with the period of Angkor's decline, significant demographic and cultural shifts were already in motion by this time (Brotherson 2019; Penny et al. 2019).

### ***Engineering, Inertia, and Adaptive Capacity***

Despite the so-called 'collapse' of Angkorian civilisation, many of its works have proven remarkably durable: most of the great temples remain, of course, and the *baray* still stand, even if not all retain water. The floodplain between the Tonle Sap and the Kulen hills is crisscrossed by the remains of hundreds of kilometres of canals, roads, and causeways constructed during the Angkor Period. Roland Fletcher has argued that it is precisely the scale and durability of these monumental constructions that contributed to Angkor's vulnerability and eventual decline (2009, 2012). In this view, 'The huge scale and interconnectedness of the network would largely have precluded any abrupt and easy alterations to the system. The system, therefore, suffered from severe inertia' (Fletcher and Evans 2012, 53). In essence, Angkor's infrastructure imposed a path dependency effect, as infrastructure became progressively less adaptable to changing circumstances, and society became ever more limited in its range of responses to external challenges. This line of reasoning revives some of the fundamental ideas of the 'hydraulic city' model within a new theoretical framework: note that Groslier, too, commented that 'once they [the Khmer] had adopted their course of action, they found themselves as if dragged down the slope without any power to stop themselves' (Lustig and Pottier 2007, 174).

Lending support to this view is an analysis by Penny et al. (2018) of Angkor's hydraulic network, drawing on systems theory. Penny et al. conclude that because of its immense size and the functional interdependence of its many parts, the system in its final phase of development was highly vulnerable to cascading failure in response to even moderate perturbation. The previously identified climatic stresses of the 14th and 15th centuries (Buckley et al. 2010, 2014) could easily have triggered such a failure, leading to breakdown within the water management network and significant attenuation of the diverse practical and symbolic functions that it served.

A similar lack of adaptive capacity can be seen at other settlement complexes within the Angkorian World. At Koh Ker, a provincial centre that briefly blossomed as the capital of the Empire in the mid-10th century, a single, unprecedentedly large water control structure in the form of a 7-kilometre-long dam was responsible for as much as 85% of the water supply (Klassen 2018). When structural flaws in the dam's construction led to its failure, Lustig et al. (2018) argue that the resulting damage to Koh Ker's subsistence as well as to royal prestige contributed to the subsequent decision to move the seat of power back to Angkor.

### ***Mobility and Diaspora***

As we have seen, the long period between the 13th and 19th centuries saw a decline in the population of the Angkor region of up to two orders of magnitude, raising the obvious question of what kind of fate befell such a large population. In the conventional narrative that held sway for much of the 20th century, the answer was straightforward, if extraordinary in its claims: following the devastating Ayutthayan invasion of 1431, the urban population abruptly moved south, along with its kings, to the new capitals established near the confluence of the Mekong and Tonle Sap rivers. Briggs (1999[1951], 261), for instance, described the end of Angkor as



‘the sudden and permanent movement of [an] immense mass of people from one side of the kingdom to the other’.

While much of this traditional narrative has been called into question, a more recent perspective, advanced by Lucero et al. (2015), also envisages an episode of significant demographic movement, in which infrastructural breakdown induced by climate change triggered both political reorganisation among the elite and abandonment of the metropolitan heartland by the farming population. In this model, the latter demographic abandoned the agricultural mode dependent on hydraulic infrastructure and reverted to more sustainable practices in the peripheral regions of the former Empire. Suggested parallels to this process can be seen in Sri Lanka and Mesoamerica, where other low-density, agrarian-based urban complexes, under similar circumstances, likewise experienced a rapid decline and a move into an ‘urban diaspora’ on the fringes of their polities.

Others have pointed to the current lack of evidence for mass migration (Evans 2016; Polkinghorne 2018). Analysis of remote sensing data for the Post-Angkorian capitals of Srei Santhor, Longvek, and Oudong has made it clear that they could not have housed populations at anywhere near the scale of those of Angkor, casting doubt on the notion that urban populations migrated along with the political centre of gravity. Instead of moving away *en masse*, populations may simply have fallen over time in the absence of the food security that the urban water management system had provided. In this view, the ‘illusion of pre-modern mobility and urban disjuncture’ (Evans 2016, 172) created by the movement of royal centres across the political landscape masks a far slower process of gradual demographic decline.

### ***Resilience, Continuity, and the Scale and Tempo of Decline***

In the current literature on Angkor, it is common, and unfortunately still necessary, to emphasise that Angkor was never completely abandoned, in contrast to the popular myth of a ‘lost city’ in the jungle (see e.g. Polkinghorne 2018). Increasingly, scholars underscore the degree of continuity between the Angkor Period as traditionally defined and the subsequent centuries, and various lines of investigation have converged that point to a complex and protracted period of decline spanning several centuries instead of a sudden and precipitous ‘collapse’ (Castillo et al. 2018; Hall et al. 2021; Penny et al. 2019).

Stratigraphic and palaeobotanical analysis of the Angkor Thom moat by Penny et al. (2019) indicates that land use patterns in the surrounding area, the very heart of Angkor’s urban complex, began to shift in the early 1300s, suggesting a gradual demographic decline that predated the severe droughts of the mid-14th century by a matter of decades and the supposed Ayutthayan invasion by more than a hundred years. By the end of the 14th century, the moat was overgrown and appears no longer to have been maintained. Similarly, inside Angkor Thom geochemistry, palynology, and fire history analysis demonstrate that from the 14th century land use attenuation continued, with the exception of a possible short period of reoccupation in the 16th century (Hall et al. 2021). Ceramics survey of an array of sites in central Angkor likewise shows that a contraction in the range of settled spaces took place over the course of the 14th century (Brotherson 2019, 323–40).

If population numbers and centralised control at Angkor were much reduced thereafter, key parts of the complex nevertheless remained in use. The accounts of early European visitors indicate the continued existence of an urban centre at Angkor in the 15th to 16th centuries (Groslier 2006). Religious and economic activity and even architectural restoration works continued into the 15th and 16th centuries (Castillo et al. 2018). Some of these projects, such as the reconfiguration of Phnom Bakheng and the Baphuon into enormous representations of the Buddha, are

of a considerable scale, indicating the presence of a sizeable number of worshipers (Leroy et al. 2015; Polkinghorne 2018; Polkinghorne et al. 2013). At Angkor Wat, similarly converted into a Theravāda sanctuary and pilgrimage site, excavation and radiocarbon dating hint at a complex occupation history extending as late as the 18th century (Carter et al. 2019; Polkinghorne 2022). Continuity is also apparent in the more peripheral agricultural zone of Angkor. While ceramic remains decline there from the 14th century onwards, its dispersed settlement pattern nevertheless persists into the 16th and 17th centuries (Brotherson 2019, 353–64). Overall, the evidence seems to underscore the long-term resilience and durability of rural, agrarian life at Angkor and beyond, especially when compared to the apparent fragility of the Angkorian state and the urban centres populated by elites (Brotherson 2019; Lucero et al. 2015; Stark 2019).

Turning to the other urban complexes in the Angkorian World, the chronology of collapse is complicated further, as a series of palaeobotanical studies led by Tegan Hall (2017) and Dan Penny has shown. Mahendraparvata in the Kulen hills was largely abandoned as an urban centre in the 12th century (Penny et al. 2014). The ephemeral 10th-century capital of Koh Ker, on the other hand, appears to have maintained a relatively intense degree of occupation until the 15th century, when populations at Angkor had already fallen substantially (Hall et al. 2018). Finally, the complex of Preah Khan of Kompong Svay saw a gradual attenuation of land use during the 14th century, but occupation and iron production at the site continued for another two or three centuries (Hall et al. 2019). Overall, it would seem that the 'collapse' of settlement in the Angkorian World was a protracted process, starting as early as the 12th to 13th centuries in some areas, gathering pace in the 14th century in particular at Angkor, with a 'long tail end' and a significant degree of variability in the life histories of individual settlement complexes across the region, depending on localised factors (Hall 2017).

## **Discussion and Conclusion**

Broadly speaking, our view of these processes is complicated by shifts in material culture in the late Angkor Period towards less durable materials, which have much less visibility in the archaeological record (Coe and Evans 2018, Chapter 8; Polkinghorne 2018): inscriptions in stone gave way to manuscripts inscribed on palm leaves and other more perishable media; religious construction began to privilege the reconfiguration of existing masonry structures and the use of wood and brick as architectural materials, instead of raising vast stone monuments from scratch; and the production of stone statuary diminished relative to the production of works in other media such as wood. All of these processes intensified and became well-established in Early Modern Cambodia, as Khmer society transitioned decisively away from re-engineering entire landscapes and from vast, industrial-scale exploitation of stone resources, towards a suite of materials and behaviours that is more recognisably 'modern' in character and that persisted until the 20th century.

As with questions of urbanism (see Evans et al. 2023, this volume), a large part of the difficulty here derives from ill-defined categories, loose definitions, and inadequate consideration of scale (both spatial and temporal). The term 'collapse' implies a loss of social complexity that is sudden and catastrophic, and even the term 'transformation' requires that we define a particular temporal frame of reference in order to identify it or present it as a compelling alternative to 'collapse'. Again, the unique scale of Angkor creates a dilemma, since we may choose to see the Angkor region as a succession of distinct and relatively fragile urban centres spanning a period from the mid-first millennium CE to the mid-second millennium CE, prone to constant transformation and change, or, on the other hand, and on a completely different spatial scale, a uniquely resilient and sustainable urban complex which endured as the capital of the Empire for half a millennium. Seeing 'the end of Angkor' through either of these lenses necessarily changes our perception of the

significance and uniqueness of the changes that took place at Angkor in the 14th and 15th centuries CE and also the degree to which the ‘shifting capitals’ that came after Angkor in the Middle Period (see Polkinghorne and Sato 2023, this volume) represent something different and new.

The lack of archaeological data is also a serious problem. In particular, more spatial and chronological resolution is needed within our data to elucidate demographic change and trajectories of both urbanism and agriculture. This is particularly true of the Early Modern Period, a long-neglected era that is not only deserving of study in its own right (see Polkinghorne and Sato 2023, this volume) but whose story will also have much to tell us about the end of Angkor and its Empire. Again, the sheer scale of what was achieved at Angkor creates a specific set of practical and interpretive problems: the amount of archaeological excavation that has been completed at Angkor is vanishingly small in relation to the spatial extent of the archaeological remains, and this situation is unlikely to ever change. For now, there is a wide zone of archaeological uncertainty between data from excavations focusing on household archaeology, which offer rich chronological detail but are very constrained in spatial scale (see Carter et al. 2023, this volume) and new archaeological maps that provide excellent spatial coverage but relatively coarse chronological resolution (see Evans et al. 2023, this volume). Studies of pollen have already gone some way to filling in this broad lacuna (see Hall and Penny 2023, this volume); in the future, we may hope to complement that work with other approaches, for example, using biomarkers to infer demographic change and using environmental DNA to infer land-use change over wider areas with much higher spatial and temporal resolutions.

In conclusion, what emerges from a quarter-century of intensive archaeological research into the decline of Angkor and the Khmer Empire is a complex set of data that moves us further away from neat explanations such as ‘exhaustion’, ‘sacking’, or ‘religious transformation’. Instead, recent work tends to suggest that the development of massive, inertial infrastructures of a particular model severely constrained the available responses to specific social and environmental changes, that this lack of adaptive capacity characterised settlement complexes across the Angkorian World, and that transformations were relatively long and drawn-out and thus inconsistent with longstanding theories of ‘collapse’. Although significant gaps remain in our knowledge, the causal linkages between climate variability, societal challenges, and large-scale transformations are particularly well articulated in the Angkorian World and compel us to move beyond merely noting the correlation between events like megadroughts and significant societal change. As more data become available, there will also be debate and discussion about the role of exogenous forces such as globalisation in shaping the trajectory of Southeast Asian societies and how to balance that with evidence for indigenous agency, about how we may assign proximal and ultimate causes to transformations at specific scales of time and space, and about the extent to which those transformations may be explained by more generalised social theory (see e.g. Fletcher 2009; Hall 2017; Hawken and Fletcher 2021; Lucero et al. 2015; Penny et al. 2018). In the meantime, one thing that we may conclude with relative certainty is that the evidence is inconsistent with conventional narratives that proposed an abrupt and dramatic ending for Angkor deriving from one or two factors in isolation.

## **Funding**

*Funding for this contribution derives in part from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (grant agreements 639828 and 866454).*

## **References**

- Acker, R., 1998. New geographical tests of the hydraulic thesis at Angkor. *South East Asia Research* 6(1), 5–47.  
Bourdonneau, É., 2010. Pour en finir avec la “cité hydraulique”? *Bulletin de l’École française d’Extrême-Orient* 97–98, 409–37.

Perspectives on the 'Collapse' of Angkor and the Khmer Empire

- Briggs, L.P., 1948. Siamese attacks on Angkor before 1430. *The Journal of Asian Studies* 8(1), 3–33.
- Briggs, L.P., 1999[1951]. *The Ancient Khmer Empire* (American Philosophical Society, Philad. Transactions. New ser. ; v.41, pt. 1.). Bangkok: White Lotus.
- Brotherson, D., 2015. The fortification of Angkor Wat, *Antiquity* 89(348), 1456–72.
- Brotherson, D., 2019. *Commerce, the capital & community: trade ceramics, settlement patterns & continuity throughout the demise of Angkor*. PhD dissertation. Sydney: The University of Sydney.
- Buckley, B.M., K.J. Anchukaitis, D. Penny, R. Fletcher, E.R. Cook, M. Sano, L.C. Nam, A. Wichienkeeo, T.T. Minh & T.M. Hong, 2010. Climate as a contributing factor in the demise of Angkor, Cambodia. *Proceedings of the National Academy of Sciences of the United States of America* 107(15), 6748–52.
- Buckley, B.M., R. Fletcher, S.-Y.S. Wang, B. Zottoli & C. Pottier, 2014. Monsoon extremes and society over the past millennium on mainland Southeast Asia. *Quaternary Science Reviews* 95, 1–19.
- Carter, A., P. Heng, M. Stark, R. Chhay & D. Evans, 2018. Urbanism and residential patterning in Angkor. *Journal of Field Archaeology* 43(6), 492–506.
- Carter, A.K., S. Klassen, M.T. Stark, M. Polkinghorne, P. Heng, D. Evans & R. Chhay, 2021. The evolution of agro-urbanism: a case study from Angkor, Cambodia. *Journal of Anthropological Archaeology* 63, 101323.
- Carter, A.K., M.T. Stark, S. Quintus, Y. Zhuang, H. Wang, P. Heng & R. Chhay, 2019. Temple occupation and the tempo of collapse at Angkor Wat, Cambodia. *Proceedings of the National Academy of Sciences* 116(25), 12226–31.
- Carter, A., M.T. Stark, P. Heng & R. Chhay, 2023. The Angkorian house, in *The Angkorian World*, eds. M. Hendrickson, M.T. Stark & D. Evans. New York: Routledge, 494–507.
- Castillo, C.C., M. Polkinghorne, B. Vincent, T.B. Suy & D.Q. Fuller, 2018. Life goes on: archaeobotanical investigations of diet and ritual at Angkor Thom, Cambodia (14th–15th centuries CE). *The Holocene* 28(6), 930–44.
- Coe, M., 1957. The Khmer settlement pattern: a possible analogy with that of the Maya. *American Antiquity* 22, 409–10.
- Coe, M., 1961. Social typology and the tropical forest civilisations, *Comparative Studies in Society and History* 4, 65–85.
- Coe, M. & D. Evans, 2018. *Angkor and the Khmer Civilization*. London: Thames & Hudson.
- Coningham, R., M. Manuel, C. Davis & P. Gunawardhana, 2017. Archaeology and cosmopolitanism in early historic and medieval Sri Lanka, in *Sri Lanka at the Crossroads of History*, eds. Z. Biedermann & A. Strathern. London: UCL Press, 19–43.
- Delaporte, L., 1880. *Voyage au Cambodge: L'architecture Khmer*. Paris: C. Delagrave.
- Diamond, J., 2011. *Collapse: How Societies Choose to Fail or Succeed*. New York: Penguin.
- Edwards, P., 2005. Taj Angkor: enshrining l'Inde in le Cambodge, in *France and 'Indochina': Cultural Representations*, eds. K. Robson & J. Yee. Lanham, MD: Lexington Books, 13–27.
- Edwards, P., 2008. *Cambodge: The Cultivation of a Nation, 1860–1945*. Chiang Mai: Silkworm Books.
- Estève, J., 2023. Gods and temples: the nature(s) of Angkorian religion, in *The Angkorian World*, eds. M. Hendrickson, M.T. Stark & D. Evans. New York: Routledge, 423–34.
- Evans, D., 2007. *Putting Angkor on the map: a new survey of a Khmer 'hydraulic city' in historical and theoretical context*. PhD dissertation. Sydney: The University of Sydney.
- Evans, D., 2016. Airborne laser scanning as a method for exploring long-term socio-ecological dynamics in Cambodia, *Journal of Archaeological Science* 74, 164–75.
- Evans, D., R.J. Fletcher, C. Pottier, J.-B. Chevance, D. Soutif, B.S. Tan, S. Im, D. Ea, T. Tin, S. Kim, C. Cromarty, S. De Greef, K. Hanus, P. Bâty, R. Kuszinger, I. Shimoda & G. Boornazian, 2013. Uncovering archaeological landscapes at Angkor using lidar. *Proceedings of the National Academy of Sciences of the United States of America* 110(31), 12595–600.
- Evans, D., C. Pottier, R. Fletcher, S. Hensley, I. Tapley, A. Milne & M. Barbetti, 2007. A comprehensive archaeological map of the World's largest preindustrial settlement complex at Angkor, Cambodia. *Proceedings of the National Academy of Sciences* 104(36), 14277–82.
- Evans, D., R. Fletcher, S. Klassen, C. Pottier & P. Wijker, 2023. Trajectories of urbanism in the Angkorian World, in *The Angkorian World*, eds. M. Hendrickson, M.T. Stark & D. Evans. New York: Routledge.
- Falser, M., 2020. *Angkor Wat—A Transcultural History of Heritage*. Berlin/Boston: Walter de Gruyter GmbH & Co KG.
- Finot, L., 1908. Les études indochinoises. *Bulletin de l'École française d'Extrême-Orient* 8(1), 221–33.
- Fletcher, R., 2009. Low-density, agrarian-based urbanism: a comparative view. *Insights* 2(4), 1–19.
- Fletcher, R., 2012. Low-density, agrarian-based urbanism: scale, power and ecology, in *The Archaeology of Complex Societies*, ed. M.E. Smith. New York: Cambridge University Press, 285–320.

- Fletcher, R., M. Barbetti, D. Evans, H. Than, I. Sokrithy, K. Chan, D. Penny, C. Pottier & T. Somaneath, 2003. Redefining Angkor: structure and environment in the largest, low density urban complex of the pre-industrial World. *Udaya, Journal of Khmer Studies* 4, 107–21.
- Fletcher, R.J. & D. Evans, 2012. The dynamics of Angkor and its landscape: issues of scale, non-correspondence and outcome, in *Old Myths and New Approaches: Interpreting Ancient Religious Sites in Southeast Asia*, ed. A. Haendel. Clayton: Monash University Publishing, 42–62.
- Gaucher, J., 2017. L'enceinte d'Angkor Thom: Archéologie d'une forme, chronologie d'une ville, in *Deux Décennies de Coopération Archéologique Franco-Cambodgienne à Angkor*, eds. A. Beschtaouch, F. Verellen & M. Zink. Paris: Académie des Inscriptions et Belles-Lettres, 27–41.
- Groslier, B.-P., 1979. La cité hydraulique angkoriennne: exploitation ou surexploitation du sol? *Bulletin de l'École française d'Extrême-Orient* 66, 161–202.
- Groslier, B.P., 2006. *Angkor and Cambodia in the Sixteenth Century: According to Portuguese and Spanish Sources*. Bangkok: Orchid Press.
- Hall, K.R., 1982. The “Indianization” of Funan: an economic history of Southeast Asia's first state. *Journal of Southeast Asian Studies* 13(1), 81–106.
- Hall, K.R., 2018. *Gale Researcher Guide for: The Angkor Khmer Empire*. Farmington Hills, MI: Gale.
- Hall, K.R., 2023. Angkor's multiple Southeast Asia overland connections, in *The Angkorian World*, eds. M. Hendrickson, M.T. Stark & D. Evans. New York: Routledge, 91–111.
- Hall, T., 2017. *A broader view of collapse: using palaeoecological techniques to reconstruct occupation dynamics across a networked society undergoing transformation*. PhD dissertation. Sydney: The University of Sydney.
- Hall, T., D. Penny & R. Hamilton, 2018. Re-evaluating the occupation history of Koh Ker, Cambodia, during the Angkor period: a palaeo-ecological approach. *PLoS ONE* 13(10), e0203962.
- Hall, T., D. Penny & R. Hamilton, 2019. The environmental context of a city in decline: the vegetation history of a Khmer peripheral settlement during the Angkor period. *Journal of Archaeological Science: Reports* 24, 152–65.
- Hall, T., D. Penny, B. Vincent & M. Polkinghorne, 2021. An integrated palaeoenvironmental record of early modern occupancy and land use within Angkor Thom, Angkor. *Quaternary Science Reviews* 251, 106710.
- Hall, T. & D. Penny, 2023. Forests, palms and paddy fields: the plant ecology of Angkor, in *The Angkorian World*, eds. M. Hendrickson, M.T. Stark & D. Evans. New York: Routledge, 135–53.
- Hawken, S. & R. Fletcher, 2021. A long-term archaeological reappraisal of low-density urbanism: implications for contemporary cities. *Journal of Urban Archaeology* 3, 29–50.
- Hendrickson, M., 2010. Historic routes to Angkor: development of the Khmer road system (ninth to thirteenth centuries AD) in mainland Southeast Asia. *Antiquity* 84(324), 480–96.
- Hendrickson, M., 2012. Connecting the dots: investigating transportation between the temple complexes of the medieval Khmer (9th to 14th centuries CE), in *Old Myths and New Approaches: Interpreting Ancient Religious Sites in Southeast Asia*, ed. A. Haendel. Clayton: Monash University Publishing, 84–102.
- Hendrickson, M. & D. Evans, 2015. Reimagining the city of fire and iron: a landscape archaeology of the Angkor-Period industrial complex of Preah Khan of Kompong Svay, Cambodia (ca. 9th to 13th centuries A.D.). *Journal of Field Archaeology* 40(6), 644–664.
- Higham, C., 2014. *Early Mainland Southeast Asia: From First Humans to Angkor*. Bangkok: River Books.
- Klassen, S., 2018. *Adaptive capacity of the water management systems of two medieval Khmer cities, Angkor and Koh Ker*. PhD dissertation. Tempe: Arizona State University.
- Klassen, S., T. Atorre, D. Brotherson, R. Chhay, W. Johnson, I. Moffat & R. Fletcher, 2021a. Deciphering a timeline of demise at medieval Angkor, Cambodia using remote sensing. *Remote Sensing* 13(11), 2094.
- Klassen, S., A.K. Carter, D.H. Evans, S. Ortman, M.T. Stark, A.A. Loyless, M. Polkinghorne, P. Heng, M. Hill & P. Wijkker, 2021b. Diachronic modeling of the population within the medieval greater Angkor region settlement complex. *Science Advances* 7(19), eabf8441.
- Leroy, S., M. Hendrickson, E. Delqué-Kolic, E. Vega & P. Dillmann, 2015. First direct dating for the construction and modification of the Baphuon temple mountain in Angkor, Cambodia. *PLoS ONE* 10(11), e0141052.
- Lieberman, V., 1995. An age of commerce in Southeast Asia? Problems of regional coherence—A review article. *The Journal of Asian Studies* 54(03), 796–807.
- Lucero, L.J., R. Fletcher & R. Coningham, 2015. From ‘collapse’ to urban diaspora: the transformation of low-density, dispersed agrarian urbanism. *Antiquity* 89(347), 1139–54.
- Lustig, T., S. Klassen, D. Evans, R. French & I. Moffat, 2018. Evidence for the breakdown of an Angkorian hydraulic system, and its historical implications for understanding the Khmer Empire. *Journal of Archaeological Science: Reports* 17, 195–211.

*Perspectives on the 'Collapse' of Angkor and the Khmer Empire*

- Lustig, T. & C. Pottier, 2007. Bernard Philippe Groslier. The Angkorian Hydraulic City: Exploitation or Over-Exploitation of the Soil? Translated by Terry Lustig and Christophe Pottier. *Aséanie* 20, 133–40.
- Lustig, T., J.-B. Chevance & W. Johnson, 2023. Angkor as a “cité hydraulique”?, in *The Angkorian World*, eds. M. Hendrickson, M.T. Stark & D. Evans. New York: Routledge, 216–34.
- Mabbett, I.W., 1977. The ‘indianization’ of Southeast Asia: reflections on the historical sources. *Journal of Southeast Asian Studies* 8(2), 143–61.
- McAnany, P.A. & N. Yoffee, 2009. *Questioning Collapse: Human Resilience, Ecological Vulnerability, and the Aftermath of Empire*. Cambridge: Cambridge University Press.
- Mikaelian, G., 2013. Des sources lacunaires de l’histoire à l’histoire complexifiée des sources. Éléments pour une histoire des renaissances khmères (c. XIVE–c. XVIIIe siècles). *Péninsule* 65, 259–304.
- Mikaelian, G., 2016. Le passé entre mémoire d’Angkor et déni de Lañvaek: La conscience de l’histoire dans le royaume khmer du XVIIe siècle, in *Le Passé Des Khmers. Langues, Textes, Rites*, eds. G. Mikaelian, N. Abdoul-Carime & J. Thach. Bern: Peter Lang, 167–212.
- Miksic, J.N., 2000. Heterogenetic cities in premodern Southeast Asia. *World Archaeology* 32(1), 106–20.
- Penny, D., J.-B. Chevance, D. Tang & S. De Greef, 2014. The environmental impact of Cambodia’s ancient city of Mahendraparvata (Phnom Kulen). *PLoS ONE* 9(1), e84252.
- Penny, D., T. Hall, D. Evans & M. Polkinghorne, 2019. Geoarchaeological evidence from Angkor, Cambodia, reveals a gradual decline rather than a catastrophic 15th-century collapse. *Proceedings of the National Academy of Sciences* 116(11), 4871–76.
- Penny, D., C. Zachreson, R. Fletcher, D. Lau, J.T. Lizier, N. Fischer, D. Evans, C. Pottier & M. Prokopenko, 2018. The demise of Angkor: systemic vulnerability of urban infrastructure to climatic variations. *Science Advances* 4(10), eaau4029.
- Polkinghorne, M., 2018. Reconfiguring kingdoms: the end of Angkor and the emergence of early modern period Cambodia, in *Angkor: Exploring Cambodia’s Sacred City*, eds. T. McCullough, S.A. Murphy, P. Baptiste & T. Zéphir. Singapore: Asian Civilisations Museum, 255–69.
- Polkinghorne, M., 2022. 17th- and 18th-century images of the Buddha from Ayutthaya and Lan Xang at Angkor, in *Early Theravadin Cambodia: Perspectives from Art and Archaeology*, ed. A. Thompson. Singapore: NUS Press, 269–305.
- Polkinghorne, M., C.A. Morton, A. Roberts, R.S. Popelka-Filcoff, Y. Sato, V. Vuthy, P. Thammapprecha-korn, A. Stopic, P. Grave, D. Hein & L. Vitou, 2019. Consumption and exchange in early modern Cambodia: NAA of brown-glaze stoneware from Longvek, 15th–17th centuries. *PLoS One* 14(5), e0216895.
- Polkinghorne, M., C. Pottier & C. Fischer, 2013. One Buddha can hide another. *Journal Asiatique* 301(2), 575–624.
- Polkinghorne, M. & Y. Sato, 2023. Early modern Cambodia and archaeology at Longvek, in *The Angkorian World*, eds. M. Hendrickson, M.T. Stark & D. Evans. New York: Routledge.
- Pottier, C., 2000. Some Evidence of an inter-relationship between hydraulic features and rice field patterns at Angkor during ancient times. *Journal of Sophia Asian Studies* 18, 99–120.
- Reid, A., 1988. *Southeast Asia in the Age of Commerce 1450–1680: volume 1: The Lands Below the Winds*. New Haven and London.
- Reid, A., 1993. *Southeast Asia in the Age of Commerce 1450–1680: volume 2: Expansion and Crisis*. New Haven and London.
- Reynolds, C.J., 1995. A new look at old Southeast Asia. *The Journal of Asian Studies* 54(2), 419–46.
- Sharrock, P.D., 2018. Cham-Khmer interactions in 1113–1220 CE, in *Vibrancy in Stone: Masterpieces of the Đà Nẵng Museum of Cham Sculpture*, eds. T.K. Phuong, V.V. Thắng & P.D. Sharrock. Bangkok, Thailand: River Books, 111–19.
- Stark, M.T., 1998. The transition to history in the Mekong delta: a view from Cambodia. *International Journal of Historical Archaeology* 2(3), 175–203.
- Stark, M.T., 2019. Universal rule and precarious empire: power and fragility in the Angkorian State, in *The Evolution of Fragility: Setting the Terms*, ed. N. Yoffee. Cambridge: McDonald Institute for Archaeological Research.
- Stark, M.T. & S.J. Allen, 1998. The transition to history in Southeast Asia: an introduction. *International Journal of Historical Archaeology* 2(3), 163–74.
- Tainter, J., 1988. *The Collapse of Complex Societies*. Cambridge: Cambridge University Press.
- Vickery, M.T., 1977. *Cambodia after Angkor: the chronical evidence for the fourteenth to sixteenth centuries*. PhD dissertation. New Haven: Yale University.
- Wade, G., 2009. An early age of commerce in Southeast Asia, 900–1300 CE. *Journal of Southeast Asian Studies* 40(2), 221–65.