link between the two layers (pattern-triggered immunity and effector-triggered immunity) of plant immunity, invigorating new thinking in immune signalling.

Each chapter in this volume includes future issues, which opens up new opportunities/directions for research with possibilities for developing novel strategies for disease management. These will positively impact modern crop breeding for sustainable agriculture. To sum up, this volume is laudable for the breadth and depth of its content, and its ability to remain up-to-date. It serves the needs not only of plant pathologists, but all those interested in the science of plant life, as probing diseases makes known the unknowns.

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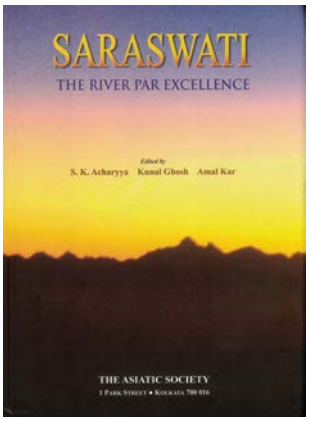

Saraswati: The River Par Excellence. S. K. Acharyya, Kunal Ghosh and Amal Kar (eds). The Asiatic Society, 1 Park Street, Kolkata 700 016. 2020. xiv + 249 pp. Price: Rs 2500.

The Saraswati River, labelled as 'The River Par Excellence' in this edited volume, has also been previously referred to as 'The Lost River' and 'The Prehistoric River Saraswati' but more of that later in this review. What then is the Saraswati River? Is it an active river system in the present geography of northwestern India or is it a fluvial palaeodrainage of the distant past that supported the Harappan Civilization almost four millennia ago and left behind archives of its geologic records? Is it a mythical entity or was it a real large river with ample discharge that supported the Harappans for about a millennium? And then, there is also the most unresolved question of how and when the decline of this large river took place and how that decline was related to the collapse of the Harappan/Saraswati Civilization? Such are the intriguing questions that have continued to engage for over a century, the scholars from the disciplinary diversity of archaeology, climate science and palaeoclimate, geology and palaeohydrology, geomorphology and remote sensing, as well as ancient Indian history and cultures. The scientific study of this palaeodrainage system alongside the archaeological studies of the excavations of the Harappan cities and settlements in the region has led to considerable cross-disciplinary exchanges resulting in continuous and ongoing dialogue, debate, and controversy in the past few decades.

As noted by the Editors of this volume, several epithets were bestowed on this river in the Rig Veda, such as *Nadinam asurya* (the most powerful among the rivers), *Nadinam suchi* (the purest among the rivers) and *Naditame* (best among the rivers). Lost rivers and their lost civilizations do not fade away, even though millennia may go by, because they arouse the curiosity and imagination of those societies and civilizations that follow them. The present is but a fleeting moment in the continuum between the past and the future. The future is not for us to see, but glimpses of the past are there for us to see, and the exploration of the past is ingrained in us so that we may enlarge the envelop of variability of natural processes that the study of the present allows us.

The exploration of the Saraswati River is an ongoing endeavour in unravelling the geography and history of northwestern India and as noted earlier, it has drawn in several other disciplines. In the past two decades, three other books have preceded the present edited volume. A comprehensive account of two centuries of work on this river system and its linked civilization was synthesized in a book by Michel Danino in 2010 under the title of '*The Lost River – On the trail of the Sarasvati*'. Two other books '*Saraswati: the river that disappeared*' (2002) and '*Prehistoric River Saraswati, western India*' (2017), both authored by late K. S. Valdiya together bear testimony to the interest that persists in demystifying this 'lost river' through multi-disciplinary studies both on the landscape and the lives of those who populated those riverscapes. Incidentally, the present volume includes contributions by the late K. S. Valdiya (chapter 1) and Michel Danino (chapter 8) as well as those who bring a multi-disciplinary perspective to this subject from the aspects of geology and tectonics; geography, remote sensing and mapping; rivers and cultural linkages; geohydrology, geoarchaeology and bioarchaeology.

As has been the case with many other disciplines, the exploration of the Saraswati River was also impacted by the use of satellite technologies in the seventies of the previous century. Two influential studies – the first by Ghose *et al*. on 'The lost courses of the Saraswati River in the Great Indian Desert – new evidence from Landsat Imagery' published in the *Geographical Journal* in 1979, and the second by Yashpal *et al*. in 1980 on 'Remote Sensing of the lost Saraswati River' published in the *Proceedings of the Indian Academy of Sciences* were the pioneering works that led to a renewal of interest on the drainage reorganization of a part of northwestern India (Haryana Plains, Rajasthan and Kutch). Much has transpired since then and the literature on the Saraswati River has grown manifold. The last decade or so has witnessed new directions of study that include, besides remote sensing aided palaeochannel studies, the recognition and reconstruction of buried channel networks that have a distinctive Higher Himalayan provenance for the deposited sands. The fingerprinting of the provenance of the sands that were deposited in the palaeochannels related to the Sutlej system was based on U–Pb geochronology of detrital zircon grains; and that has settled the question of whether the provenance of the Saraswati palaeochannel was in the Higher Himalaya or not in favour of the former.

Despite several recent published studies, there is still debate as to whether the river had avulsed from the wide valley of the Ghaggar basin before the Harappans or whether the river had a substantial flow during the Early and Mature phases of the Harappan Civilization. The questions of how and when the river avulsed to the present valley of the Sutlej remain open.

Although reference was made to the possible existence of a large river system (following the earlier references in the Rig Veda) as early as the second half of the nineteenth century in 1855, questions remain to be answered. Hence this edited volume is a welcome addition to our developing knowledge base on the subject.

Revival of the Saraswati River near Pehowa

The present volume consists of eight chapters besides an Introduction and a Subject Index that is provided at the end of the book. Chapter 1 by the late K. S. Valdiya provides a summary view of the geomorphic, geophysical, structural, sedimentological and isotope geological data in order to emphasize that the Saraswati River comprised of two branches, the eastern branch being related to the Tons River and the western branch being related to the Sutlej River. The two branches formed the Ghaggar–Hakra–Nara valley system through which the Saraswati River flowed. Based on the data available in the literature, Valdiya conjectures that the river disappeared because of drainage reorganization that involved river piracy caused by tectonic-induced landscape changes. Chapter 2 by Amal Kar has focused on the mapping of the river system by the early explorers, besides providing a synoptic account of the satellite data-derived maps of the palaeovalleys and the palaeochannels. This synthesis provides the precise location of the large ancient valleys in the Yamuna–Sutlej interfluve and the Thar Desert. Chapter 3 by A. K. Gupta attempts to trace the early courses of the river through the Thar Desert. This study also highlights that the Saraswati Nadi of Haryana, with many associated archaeological sites, is a significant tributary of the Vedic Saraswati. Chapter 4 by Rajiv Sinha and others reinforces the hypothesis of non-contemporaneity of the Saraswati River and the Harappan Civilization, as advocated in an earlier study by some of these authors. They suggest that none of the two Himalayan-fed rivers, i.e. the Yamuna and the Sutlej, were contributing in a significant way to the Ghaggar–Hakra valley during the Harappan Civilization; according to them, the Yamuna had shifted away to the east by about 18 ka and the Sutlej had avulsed to the west by about 8 ka. Chapter 5 by Rana Chatterjee and K. C. Naik deals with, in contrast to the other studies, the present-day groundwater conditions in the palaeochannels of northwest India. These authors recognize several multi-aquifer systems in the palaeochannels of the Quaternary alluvial deposits of the region. Water levels in these aquifers vary from 10 m to 30 m, besides having a better quality of water than the aquifers in the surrounding region. They go on to indicate that because of the poor lateral connectivity of these aquifers, the natural recharge is very slow. Artificial recharge of the palaeochannel aquifers is recommended by them as the transmissivity and the storativity characteristics of these aquifers confirm their groundwater potential. Chapter 6 by R. S. Bisht and V. N. Prabhakar is a study of the human occupation of the Saraswati and Drishadwati riverscapes. According to them, human settlements existed in the valleys as clusters since the fourth millennium BCE. These cultures are classified as 'Hakra' (~3700–2800 BCE), 'Early/pre-Harappan' (~2800–2600 BCE), Mature Harappan (~2600–1900 BCE), 'Late Harappan' (~1900–1300 BCE) 'Painted Grey Ware' (~1300–700 BCE), and 'Rangmahal' (early historic). During the Mature Harappan Phase, the Harappan Civilization had six large cities – Mohenjo-Daro on the Indus, Harappa on the Ravi, Ganewariwala on the Saraswati, Rakhigarhi on the Drishadwati and Dholavira in the Great Rann. This study has shown that the Drishadvati settlements were abandoned well before those in the Saraswati Valley, and that the Late Harappan settlements were located in the upstream segments of tributaries closer to the Himalayan foothills. Chapter 7 by Gwen Robbins Schug has attempted a bio-archaeological assessment of human health and social processes during the Harappan Civilization in the Saraswati River basin. This study is based on human skeletal remains that were examined at Rakhigarhi, Harappa, Kalibangan, and Mohenjo-Daro amongst other sites to find out the trauma and disease at the societal level. These palaeo-pathological investigations have shown that, like in urban centres in other civilizations, violence and disease did impact the major cities of the Harappans. Besides highlighting and rebutting the misconceptions and narratives that surround the Vedic Saraswati River, chapter 8 by Michel Danino offers a synthesis of the new scientific data that has become available in the past decade and a half. Through the synthesis of the new data, he has proposed five main stages for the Saraswati palaeodrainage, which are as follows – a mega river before 10,000 or 15,000 BCE with major contributions from the Yamuna and the Sutlej; the second stage of a river receiving Higher Himalayan contributions up to 4000 BCE; the third stage of a monsoon-fed river that was supplied by a stronger monsoon allowing it to flow up to the Cholistan at least; the fourth stage of the river involving a decline in the Mature Harappan times (the third millennium BCE) in response to increasing aridity; and the fifth stage about 1900 BCE by which time the Mature Harappan sites are abandoned in the central basin of the Ghaggar.

This volume, along with the expanding literature based on the Saraswati palaeodrainage system that has become available in the past two decades, has assimilated new knowledge that shows convergence affirming the presence of a large river system that flowed in the Ghaggar–Hakra–Nara valley at least up to 8 ka, with the possibility that some part of the Sutlej was still contributing to the water discharge up to the initial centuries of the Mature Harappan Phase. These conclusions are based on detailed geological investigations along with observations from more than two centuries of field mapping by the Survey of India and other agencies, and about half a century of mapping with the aid of satellite-derived data. Despite the progress that has been made, the causes for the decline in the discharge of the Saraswati River are yet to be fully understood, and its chronologically constrained multi-stage avulsion history from the Yamuna–Sutlej interfluve still eludes the scientific community.

The present volume is a laudable effort by the Editors towards providing an up-to-date synthesis of the many studies that have been undertaken in the first two decades of this century in conjunction with a summary account of the progress that was made in the latter half of the previous century. This volume will serve the purpose of a reference volume for all those who are engaged with the Saraswati palaeodrainage system and its linkages with the different phases of the Harappan Civilization.

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