

Prehistoric River Saraswati, Western India: Geological Appraisal and Social Aspects. K. S. Valdiya. Springer International Publishing AG, Gewerbestrasse 11, 6330 Cham, Switzerland. 2017. xv + 136 pages. Price: 114,39€.

The book, *Prehistoric River Saraswati*, is a synthesis of data from geology, geophysics, tectonics, geomorphology, topography, sedimentology, space science and archaeology, with greater emphasis on the reconstruction of the geological history of the Saraswati basin. K. S. Valdiya initiated his studies on the Saraswati river about fifty years ago with a popular article in *Dharmayug*, at that time a widely circulated Hindi weekly. His periodic forays into the fundamental issues of the Saraswati river reflect on his unrelenting commitment to resolving the myth and reality surrounding the sacred river. A cursory look at his publications on this subject during the last fifty years reveals his abiding interest and commitment culminating in *Prehistoric Saraswati*. He says: 'I felt the urge again to write on the geological aspects of the river that was the lifeline of the people... Enormous evidence that archaeologists have gathered points to the Harappan Civilization being nourished by the life sustaining Saraswati.' Though the book is a small tome yet it makes a comprehensive effort to providing a complete story of the mighty river Saraswati in a manner hitherto not attempted by scholars. The text is well illustrated with excellent maps and colour illustrations and includes an exhaustive list of references. He is an unrivalled authority on the geodynamic history of the Himalayan orogen and through this work he forays into the pre- and protohistory of the Saraswati

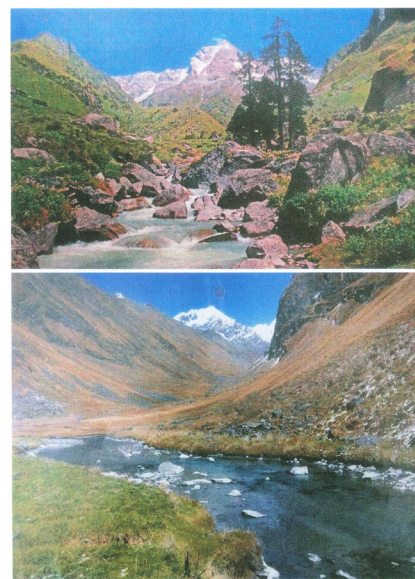
Basin and presents his findings on man-land relationships in the arid lands of northwestern subcontinent. He provides an unquestionable interpretation of the convulsive geotectonic features, both on land and subsurface, during the Neogene and Quaternary to explain the behaviour of fluvial systems that formed the lifeline of inhabitants of the region, especially the Indus-Ganga Plains.

The book is divided into eight chapters. Absence of Index is conspicuous and standardization of spellings, as there is a mix up of both American and British spellings, different authors have spelt the name of the river differently. The chapter heads reveal the multidisciplinary framework of investigations into the origins, prognosis and the role the river Saraswati has played in shaping the destiny of India's first civilization. I feel chapters 6 and 7 could swap their positions in the order of chapters allowing for the continuity of discussion on the history of the river. There is such a wealth of authentic information making it difficult to write a routine review. For want of space brief summaries of select chapters are considered here, as well as insights from more recent studies in the region. The first chapter sets the stage for synthesis of multidisciplinary data to establish the Himalayan origin of the Saraswati and explain the cataclysmic vicissitudes of its history and eventual drying up of the river, with greater focus on the Holocene time period. With equal facility he describes the social context of the river Saraswati and the benefits of its revival for human development in the arid Indian desert.

The northwestern part of the Indian subcontinent is drained by the largest network of rivers, and presents itself as the most well-watered regions that harboured the emergence of one of the first civilizations across the world. Among the three large basins, the Indus, Ganga and Brahmaputra, of the extra Peninsula the Indus Basin, covering the entire region of Pakistan and the modern Indian states of Jammu-Kashmir, Haryana, Punjab, Himachal and Rajasthan, is the largest in its catchment and is densely populated, despite the fact that one third of the region is covered by the Great Indian Desert, the Thar. The region is replete with evidence of human settlements of all ages, since the Palaeolithic. And the well-known Harappan Civilization settlements are widespread not only

along the rivers but also along the palaeochannels of dried up rivers. This particular relationship between the paleochannels and ancient settlements necessitated the study undertaken by Valdiya. These factors came to be observed and documented from the early part of the 19th century, thanks to colonial administrators, military officers, surveyors, geographers, Indologists, geologists and later day desert and fluvial geomorphologists, climatologists and archaeologists.

The first documentation of the former existence of the Saraswati river was made by colonial administrators from the folk tradition of Rajputana (modern Rajasthan), early on around the 1820s. Subsequently, surveyors and geographers began to map a network of channels, dry canals at the time of mapping, and mentioned their notice of abandoned settlements buried under the desert sands. Continuing archaeological and climatological studies in the region have placed the Saraswati river at the forefront of multidisciplinary investigations, particularly the absolute chronology of its appearance and disappearance has been the focus of investigations to be able to explain the rise and fall of the Harappan Civilization and the life history of the river itself (see chapter 4). A large body of data are now available for generating models of interpretation as well as



Har-ki-Dun nestling on the southern flank of the Great Himalaya is the source of the eastern branch of the Saraswati – the Tamasā, today known as Tons.

formulation of new theories and their validation.

In the Indian tradition the rivers are deified as goddesses, be it the Ganga, Yamuna or Saraswati. The Saraswati is the most revered river according to the Hindu tradition and was the lifeline of the Vedic Aryan settlements. A large number of settlements of the Harappan Civilization has been documented along the dry channels of a former mighty river, that has been identified as the Lost Saraswati (modern Ghaggar and Chautang rivers), in the region to the west of the Yamuna and to the east of the Satluj. Some scholars consider the river Ghaggar represents the former course of the Satluj and Chautang the former course of the Yamuna. In my opinion, the search for typical Aryan settlements is still on and that archaeologists are yet to reveal one to one correlation between tradition and archaeology. Although I firmly believe this is a possible scenario, but it is as yet a working hypothesis. I am convinced this could have been easier had the archaeologists were successful in deciphering the Indus script, identified the language of the people and had established the presence of higher density of Mature Harappan sites along the Saraswati and associated rivers. Documented data reveal higher number and density of Late Harappan sites over the Mature Harappan. It is to be noted that material remains of the Mature phase reveal both pre-Vedic and Vedic elements. Undoubtedly the river had acquired a 'powerful image of Vedic symbolism' and as an 'inspirer of hymns' (see chapters 4 and 6).

Frequent references to sanctity and reverence to the Saraswati are found in the *Rig Veda Samhitas*. Not so frequently in the later Vedas and Puranas, where it is listed as one among the many flowing down the Siwalik Subhimalaya. The river re-emerges in its importance in the *Mahabharata*. However, there is no direct reference to it in the *Ramayana*. Folklore is as stimulating as the traditional literature. In the *Rig Veda* the river Saraswati ranks superior among other rivers flowing between the Yamuna to the east and the Indus to the west. It was regarded as the most tempestuous and a limitless and unbroken river and that it was the 'mother of waters or of rivers'. The *Brahmanas* and the *Mahabharata* locate the source of the Saraswati in the Subhimalaya. This was also suggested by

some modern-day researchers. The first reference to the partial disappearance of the river occurs in the *Brahmanas* itself and is tagged as a discontinuous river. This is also echoed in the *Mahabharata* as well. Some of the literary texts since the turn of the Common Era to Medieval times also refer to the river Saraswati and its periodic appearance and disappearance and eventual disappearance into the desert.

During the last more than fifty years there have been a series of independent lines of investigations into the history of the lost river. The river has attracted the attention of explorers, geographers, surveyors, archaeologists, climatologists and geologists during the last more than one hundred years. The dead river, the living desert, multitude of abandoned channels and associated settlements and the most densely populated desert in the world presents a perplexing and complex web of natural and cultural features which can only be addressed through integrated multidisciplinary investigations to arrive at a coherent picture of evolution and history of the region formerly drained by a through flowing Saraswati river. However, during the last decade three very significant studies¹⁻³, on the lost river Saraswati have seen the light of day, each one of them shed fresh light on the history of the river and its place in our understanding of the see-saw of its appearance and disappearance. Unlike the rivers Ganga and Yamuna, the Saraswati river presents a complex web of issues relating to (a) when and where it originated, when and why did it disappear, reappear and again disappear?, (b) who were the first settlers along its course(s)?, (c) when these settlements appeared and were abandoned? and (d) why such natural and cultural vicissitudes occurred? For long these issues have been eluding a definite or conclusive answer. However, it is gratifying to note that these issues are well addressed in these works by marshalling a vast body of data culled from multidisciplinary investigations as well as the application of modern methods of geochronology.

Danino¹ has carried out an exhaustive study of a vast variety of literary sources, cartographic documents, remote sense data, folk traditions and archaeology and presents an integrated account making it a storehouse of authentic knowledge of historicity, tradition and myth of the river Saraswati. *Prehistoric Saraswati* is

an elaboration of Valdiya's 2013 article in *Current Science*, Dave *et al.*³ refute the role of monsoon either in the rise or decline of Harappan Civilization and place the end or death of the through flowing Himalayan river at 40 ka (contra Valdiya, this book). On the other hand, Valdiya refutes the role of Holocene fluctuations in the monsoon regimes causing the drying up of the river. In their study, Dave *et al.* refrain from making explicit reference to the name Saraswati, which is popularly linked to the present Ghaggar in Rajasthan and refer to it as the former course of the Satluj, and to the Chautang the former course of the Yamuna, which have shifted westwards and eastwards respectively.

Each one of these studies provides new perspectives that enrich our understanding of the history of the river, its role in the decline of the Harappan Civilization and its place in the religious traditions of Early Historic India. A perfunctory look at the multitude of investigations and the emerging findings leaves us wondering whether one can arrive at a full or conclusive story.

Chapter 2 provides an earth scientist's insights into the history of the river Saraswati that once flowed continuously through distinctive geological terrains: The Great Himalaya (Himadri), the Lesser Himalaya, the Foothill Belt, Floodplain in the Middle Reaches, the Lower Reaches in the Desert Terrain and the Coastal Belt. The source of the river is traced to two rivers (a) the Satluj (Shatadru), the western branch originating at Rakshastal, a glacier lake, south of Mount Kailas and (b) the Tons (Tamasa) an eastern branch originating at Hari-ki-Dun. Both are located in the Greater Himalaya (Himadri), which lies between the Tethys Himalaya to the north, and the Lesser Himalaya to the south, with an altitudinal range between 3000 and 7500 m amsl.

The *Prehistoric Saraswati* underscores the relevance of our understanding of the geological, sedimentological and tectonic framework of the terrain traversed by the river Saraswati and the effect of periodic tectonic activity in the delineation of its history and how these events impacted the human activity in the region between the Indus to the west and the Yamuna to the east. Chapters 3 and 5 reveal the command of the author on the hard-to-digest data from diverse disciplines. In the upper reaches the river drains

through three tectonic subdivisions of the Himalaya between Tethys Himalaya to the north and the Siwalik Front to the south. The Himalayan Central Thrust, the Main Boundary Thrust and the Siwalik Frontal Thrust demarcate the three broad geotectonic subdivisions such as (a) Great Himalaya, (b) the Lesser Himalaya and (c) the Siwalik Subhimalaya. The Siwalik Front separates the Subhimalaya from the Indus-Ganga Plains.

Within these geotectonic zones there are a series of strike and dip faults, terrane defining thrusts, transverse and slip faults. These were active during the Neogene and Quaternary as evidenced by faults and shear zones, older rocks riding over the younger Quaternary formations, stream capture, beheaded rivers as well as tilted and uplifted Quaternary river terraces. The presence of palaeoseismites in the lakes is a good evidence of earthquakes. These have been dated to 40–20 ka, 20 ka, 18 ka and 13 ka. In the Siwalik sub-province, the rivers Tons, Ghaggar, Markand and Satluj flow through entrenched valleys. In this region there is abundant evidence of drainage deflection, channel shifting, beheading and palaeoseismites.

To the south of the Siwalik Frontal Fault these rivers enter the alluvial plain of Punjab, and further into the desert plains, which has concealed the geotectonic structure of the basement rocks. In this region the drainage pattern of the rivers has governed the formation of human settlement patterns since the Pleistocene and more so during the Mid–Late Holocene. Occurrence of perennial water bodies on the surface in the form of lakes, ponds and river discharge was crucial for sustenance of human settlements. Undoubtedly, the stability of the drainage network and the associated hydrological regimes were crucial for long-term continuity of human activity. Hence delineating absolute chronology and the frequency of subsurface geotectonic activity, both in terms of magnitude and scale, is critical to delineation of the processes responsible for waxing and waning of the rivers, be it Saraswati or the network of rivers draining down the Siwalik Frontal Fault. Geophysical surveys have revealed subsurface ridges, faults, lineaments, strike slip faults, etc. Most earthquakes that have epicentres in this region are attributed to activation of faults along the subsurface ridges. A number of water bodies are seen along

the distal end of fans and formation of some of the linear lakes is attributed to Neotectonic activity:

‘The Siwaliks subprovince and the foothills belt have been repeatedly affected by tectonic turmoil in the later Pleistocene to Holocene times. Quite a few faults and thrusts had become active, registering sideways (strike-slip) and up-and-down (dip-slip) movements again and again. As a consequence some parts of the land sank, others rose up, and some other parts were dislocated. Under this condition the stream and rivers were forced to change their courses; some were deflected and some others were robbed of their waters. As the tectonically resurgent Aravalli orogenic belt very slowly rose up, the Saraswati and their tributaries shifted progressively westwards’ (pp. 103–104).

In the Thar desert existence of grabens has been established. These have been filled up by Quaternary lacustral, fluvial and aeolian sediments. It is inferred that reactivation of faults along these grabens led to reorganization of the Saraswati channels and formation of palaeochannels. Further subsurface data from the Jaisalmer region has attested the existence of faults that are continuously reactivating prominently indicated by the straight courses of the rivers and that the Saraswati channels were controlled by these faults. These changes may have occurred abruptly or gradually. They can clearly be seen in the Luni and Saraswati valleys. Subsurface lithostratigraphy of Quaternary sediments between the Ghaggar and Chautang comprising fluvial sands, fluvial silts and aeolian silts are inferred to indicate *repeated migration of the river channels and variability in river bedload through time, linked presumably to hydrologic change*³.

Additional evidence for the Himalayan source of the Saraswati comes from the provenance studies of clastic sediments buried under the desert sands and isotopic studies, especially in the region of the Ghaggar and Chautang valleys. The subsurface fluvial sediments have been chronologically well constrained by the OLS method³. These studies have shown that the Late Pleistocene clastic components of the basal gravels have their source in the Himalaya and that younger

loamy sands and clays have their source in the Siwalik.

It is of great interest to archaeologists to note that subsurface aquifers were large reservoirs of fresh water for sustenance of life in the desert. These reservoirs were filled by buried channels draining from the Himalaya and not by meteoric waters. In the region of the desert the importance of these aquifers needs no emphasis. Electrical resistivity surveys have revealed the existence of freshwater sandwiched between layers of brackish water. The possibility that fresh water table was much higher before the onset of drier conditions, under the influence of tectonic convulsions leading to drainage disruption of through flowing rivers originating in the Himalaya and the Siwalik belts is discernible. The frequency of tectonic convulsions causing dramatic impact on the drainage patterns as well as human settlements have been clearly documented *from* both buried geological stratigraphy and cultural strata of Harappan sites (e.g. Kalibangan in Rajasthan).

Chapter 6 deals with the characteristics of the Harappan Civilization in all its ramifications and constitutes a well informed chapter on the pre and proto-historic cultures and man–land relationships: ‘The Harappan settlements in the Saraswati domain are restricted to rather narrow tract on the two sides of major water courses implying that the people depended heavily on the river water in the atmosphere of prevalent aridity’ (p. 111). According to Valdiya the Saraswati nurtured the Harappan Civilization till its disappearance during the Late Holocene, though not under the influence of increasing Late Holocene aridity but because of river capture of the branches of the Saraswati by the Ganga and Indus as a consequence of crustal upheavals and river piracy.

Despite more than one hundred fifty years of archaeological investigations and developments in the subdiscipline of geoarchaeology archaeologists in India tend to map the location of pre and proto-historic settlements along the banks of the rivers as they are seen today. There is a complex web of palaeochannels in the region of Ghaggar and Chautang rivers (now they are ephemeral streams) along which numerous Late Harappan sites have been documented. These streams have been identified as Saraswati and Drishadwati. Contrary to Dave *et al.*'s

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findings³, these rivers are considered perennial systems at the time of expansion of urban settlements in the area.

It is to be noted that in the vast majority of archaeological studies in India very little attention has been paid towards reconstructing dynamic behaviour of the rivers or the landforms with which the sites are intimately associated (in other words changing hydrology, denudation, etc.), tectonic framework of the river basins and ground water resources. Of these, the latter is more important for interpreting the patterns of settlements and human exploitation of natural resources. On the southern Indian Peninsula there are several hundred Neolithic settlements, (contemporary with the Harappan Civilization), perched on tops of granite hills (granite inselbergs), surrounded by rolling pediments devoid of channelled drainage network. Hence surface fresh water resources under monsoon precipitation were short-lived shallow water holes on the pediment surface, in the form pools and ponds (now in the form of patches of black soils around the granite inselbergs) under the prevailing Late Holocene monsoon regimes in the largely rain-shadow region of the mid-Indian or Deccan Peninsula. Clearly without perennial water resources human settlements could not have lasted for long. An explanation to 'why the settlements are located where they are' could not be based on the occurrence of surface fresh water resources alone. Our geoarchaeological investigations in this landscape led to identifying extinct springs on the sides of the hills, that were active during Late Holocene despite the lowered ISM and that the groundwater depletion occurred under anthropogenic pressure during transition from the Iron Age to Early History. Despite numerous proxy records showing the onset of Late Holocene dry phase under decreased monsoon precipitation these settlements continued to be on hilltop during 2300 and 800 BCE.

With reference to the Harappan settlement patterns locating the settlement: (a) 'The natural choice of was the banks and floodplains of rivers and streams. The tool makers of hilly and rocky terrain thus descended on to the flood plains of the river systems of the Saraswati in the East and the Sindhu in the west' (p. 76), in the context of transition from Neolithic to the urban way of life; and (b) 'The decay of the culture seems to be related to environmental stress that

the death of the once benevolent river brought about. This happened in the face of aridity that prevailed over the entire Sindhu-Saraswati land. A resilient culture that not only withstood the stress of aridity but flourished despite dryness over a thousand years... finally crumbled when the life-giving Saraswati itself became lifeless' (p. 99), need to be reconsidered in the light of more recent studies.

According to Dave *et al.*³ the documented linear settlement patterns of settlements along the banks of both palaeochannels and major living river need not necessarily indicate perennial flow of the rivers at the time of the rise of settlements during the mid- to Late Holocene and wonder whether the migrating channels would have sustained the permanency of the settlements, both urban and rural³. They cite the example of Kalibangan which: 'survived and flourished without a perennial water source. It seems reasonable that the large urban centres utilized groundwater, as evident from the presence of wells at Kalibangan, and that people in these settlements practised water harvesting and followed agricultural practices sustainable under a limited and seasonal supply of water' (ref. 3; p. 234). This situation is not unique to Kalibangan, also repeated at Mohenjo Daro, the largest city of the time, sustained on ground water utilization. A ring well in every alternate house has been documented, especially in the lower town during Mature Harappan period. More than 700 wells are known and Mohenjo Daro has been called the city of wells.

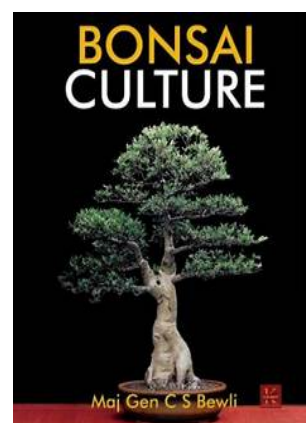
The main conclusions of Valdiya are (a) the Saraswati was not a monsoonal fed river, (b) it did not originate in the Outer Siwaliks and its foothills and (c) the river got lost as a consequence of tectonic upheaval in the foothills of the Himalaya. Obviously, these conclusions are a result of rigorous evaluation of all inferences and surmises 'on the anvil of the principles of geodynamics'. And asserts that the 'Saraswati was not a fantasy. It was a reality'. It is no exaggeration that the theme of the book is as formidable as the reputation of K. S. Valdiya. The book is a masterly synthesis of multidisciplinary data and successfully brings to the fore the potential of the region drained by the Saraswati and its associated rivers for a better understanding of the history

of the river and its relation to the rise and fall of Harappan Civilization.

1. Danino, M., *The Lost River: On the Trail of the Saraswati*, Penguin Books India, New Delhi, 2010.
2. Valdiya, K. S., *Curr. Sci.*, 2013, **104**, 42–54.
3. Dave, A. K. *et al.*, *Quat. Geochron.*, 2019, **49**, 230–235.

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Bonsai Culture. Major Gen C. S. Bewli. Kalamos Literary Services LLP, Delhi. 2018. 240 pages. Price: Rs 595. ISBN-10: 938778018X, ISBN-13: 978-9387780187.

The book under review is a creative articulation that deals with the aesthetic art and science of miniaturizing a tree. For Major Bewli bonsai is not a dwarf species or a young sapling shaped as a tree but an artifact coming out of love and hard work that is put over the years to create a piece of living art, resembling a mature, balanced and an aged tree in nature.

Going back in history the monograph talks about the origin of bonsai in *Yajurveda* (an ancient Indian scripture) and how it travelled through the Buddhists to China and Japan where the art flourished. The fashion of alluring bonsai was soon recognized globally as it not only reduces the stress at work places, but also contributes in making the area oxygenated giving an impressive mini landscape. The monograph reports the