The Conundrum of the Ancient Indian Civilization
Part 3 – The Enigma of the River Saraswati

Dhrubajyoti Mukhopadhyay *

The Vedic River Saraswati

The river Saraswati occupies a very important position in the historiography of ancient India. Rigveda, the oldest of the Hindu scriptures speaks eloquently of *Ambitame, naditame, devitame Saraswati* — the best of mothers, best of rivers, the best of goddesses). The Saraswati is described as the "purest of the pure", "the bestower of food", "most powerful among rivers". It surpasses "in majesty and might all other rivers", it "comes onward with tempestuous roar", "bursting the ridges of the hills with its strong waves", and has a confluence with the samudra (ocean or large inland lake).

But the Saraswati is not the only river mentioned in the Rigveda; it talks of *Sapta Sindhava*, the seven rivers. A verse in *Nadistuti sukta* says," Oh Ganga, Yamuna, Saraswati, Shutudri (Sutlej), Parushni (Iravati, Ravi), follow my praise! O Asikni (Chenab) Marudvridha, Vitasta (Jhelum), with the Arjikiya (Haro) and Sushoma (Sohan), listen!" While many of the Rigvedic rivers can be identified among the present day rivers the most important of them, the naditame Saraswati, remains an elusive enigma. Later works like the Brahmanas and the Mahabharata talk of *Vinashana* or disappearance of the Saraswati in the desert. With time the Saraswati came to attain a mythical character, and so strong was the influence in the psyche of the people that an unseen Saraswati is thought to join the confluence of two rivers to form a Triveni Sangam at Allahabad, and several rivers in different parts of India are given the name Saraswati.

Hence it is a legitimate endeavour to investigate whether a river named Saraswati existed in the past and where it was located. Ancient religious scriptures or mythologies are not history, but these have a substratum of history and geography. They are great imaginative works produced by great minds, and they appeal to us even today for their beautiful literary content. Historical truth has to be extracted from these literary works, but this is to be done using scientific methods and rational analysis. Personal beliefs or unsubstantiated speculations have no place in this exercise. We have before us the example of how the existence of the mythical city of Troy described in Homer's Iliad was established by excavations in Asia Minor by Frank Calvert and Heinrich Schliemann during 1871-79. Almost a century later a geologist, John Kraft, from USA joined hands with a classics scholar from Ireland, John Luce, to identify the geographic and coastal features described in Homer's Iliad. They started work in 1977 and published their findings in 2001 after nearly 30 years of work.[1]

For more than a century scholars from far corners of the world and from diverse dis-

*Prof Mukhopadhyay is an eminent geologist, a former Professor of Geology at the Calcutta University, and the President of *Breakthrough Science Society*

ciplines like, archeology, linguistics, philology, Indology, anthropology, earth sciences, mathematics. engineering etc. have tried to locate the Vedic River Saraswati. But they could not come to a unanimous conclusion. For example, some archeologists contradicted the conclusions arrived at by linguists; even within one discipline scholars radically disagreed with each other. The disagreements are partly due to the fragmentary and inconclusive nature of the evidence and partly due to subjective interpretation of the evidence. At times insufficient evidence is produced in support of a point of view. The distinguished linguist Hans Heinrich Hock made a sobering discussion on how some pieces of evidence cited in this controversy can be interpreted in different ways.[2] Hence a discerning scholar must have an open mind. Unfortunately the Saraswati issue has become entangled with political overtones in recent years. Discussions and exchanges have become emotional, polemical and strident.

The Ghaggar-Hakra : Present and Past

The subject is truly interdisciplinary; evidence from different disciplines have to be integrated to arrive at the truth. We must also keep in mind the aspects of both space and time. As far as the location of the old Saraswati is concerned, there have been two contrasting views from the very beginning and both were first published in the 19th century in the Asiatic Society Journal.[3]

In one view, which is subscribed to by a majority of the later scholars, the Rigvedic *Nadistuti* verse quoted above has been interpreted to imply that the Saraswati must lie between the Yamuna and the Shutudri (Sutlej). The Sutlej-Yamuna interfluve is not currently drained by any major river, but the present day stream Ghaggar with its tributaries flows in this region. It is an ephemeral river mainly active during the monsoon period. The Ghaggar originates in the Siwalik hills, flows in a SSW'ly to SW'ly direction and is met by the tributaries Kaushalya, Dirang, Markanda, Sarsuti (Figure 1). Further downstream it flows in a WSW'ly to SW'ly direction through Sirsa and Kalibangan (Figure 1) and enters Cholistan in Pakistan and here the dry river bed is called the Hakra. Westwards it disappears in the desert sands in Cholistan (Figure 2). However it has been joined through buried channels in the desert with the Nara river to the south (Figure 2) which is now a distributory channel in the Indus delta and debouches into the Rann of Kutch. Thus according to this view there was a continuous channel independent of the Indus river from the Siwalik hills in Haryana through Cholistan to the Rann of Kutch (Figure 3). This fluvial* system has been equated with the Vedic Saraswati.[4,5,6]

The other view is that the early Rigvedic description refers to a time before the Vedic people settled in the Indus valley, and the Saraswati is to be equated with the ancient river Harakhwati (old Avestan name, phonologically equivalent to Saraswati) in the Helmand river basin in Afghanistan, which was in the migration route of the Aryans. Rajesh Kochar opines that the Saraswati mentioned in the Rigveda refers to two rivers; the Saraswati in older compositions of the Rigveda, the so-called family books, described as *ambitame, naditame, debitame Sraraswati*, is the Helmand river in Afghanistan, while the Saraswati of the later part of the Rigveda, e.g., in the *Nadistuti*, or the *Vinashana* Saraswati refers to the old Ghaggar.[7,8] Both groups have quoted slokas from the Rigveda in support of their hypotheses.

*For the meanings of the technical terms, see the Glossary at the end of the article

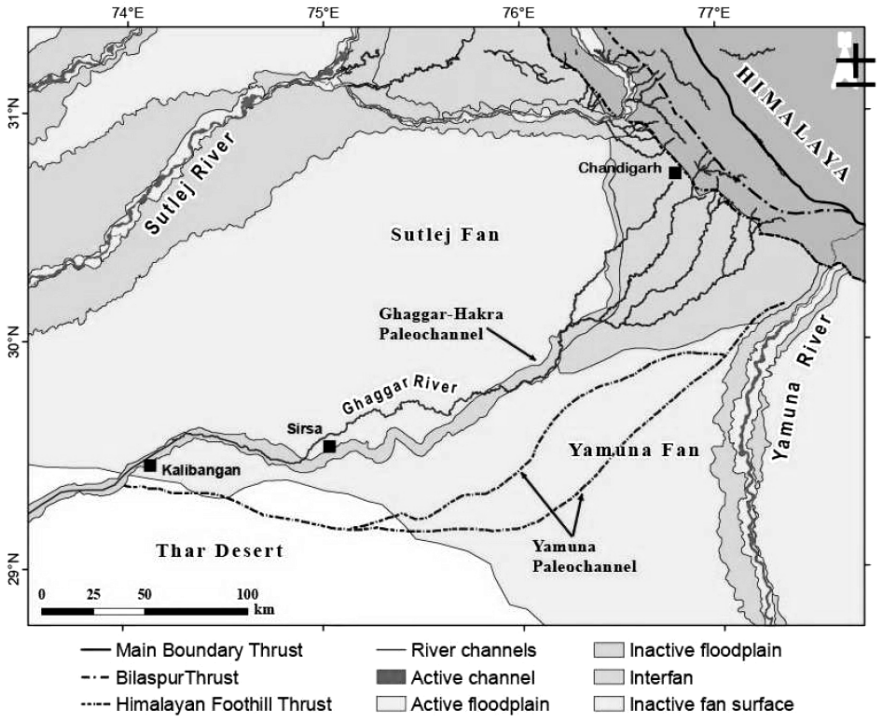

Figure 1: Ghaggar-Hakra river and the upper Ghaggar tributaries. The wide palaeochannel of Ghaggar- Hakra and two palaeochannels of the Yamuna are marked. Note also the nearly N-S Shatadru palaeochannel joining Ghaggar palaeochannel. (After Sinha, Singh and Khan, 2020)

The problem with the first hypothesis is that while the Vedic Saraswati is a mighty, roaring river, the Ghaggar-Hakra is an ephemeral stream and the channel is dry over long stretches and during a large part of the year. The dried out river bed is 3 to 10 km wide suggesting that once it was a large river. Moreover the Rigvedic description suggests that the source of the Saraswati is in the snowy mountains of the Himalayas, while the Ghaggar of today is sourced in the Siwalik hills and is rain-fed. The problem with the second hypothesis is that the other rivers mentioned in the Rigveda in conjunction with Saraswati have no counterparts in Afghanistan.

Meanwhile, many Harappan (Indus Valley Civilization) sites were discovered along the Ghaggar-Hakra or the inferred Saraswati River course, which led to the proposition that the civilization should be called Sindhu-Saraswati civilization. Some even proposed that the Rigvedic people are the Harappan people. The Harappan archaeological materials could be accurately dated as follows: Pre-Harappan — 5050-3250 BCE, Early Harappan to Mature Harappan — 3250-2550-1950 BCE. Late Harappan — 1950-1250 BCE (Part 1 of this article). Older dates have also been reported, for example, at Bhirrana the Mature Harappan is older by about 500 years. Post-Harappan dates as young as 800 BCE have been obtained from several sites. The pre-Harappan people are described as pastoral to village farming community, mature

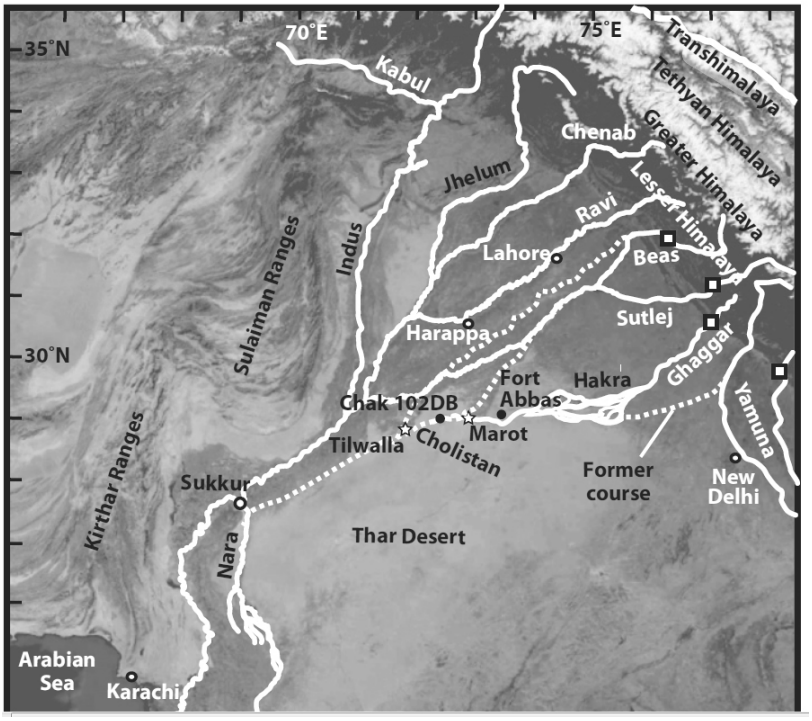

Figure 2: Ghaggar-Hakra-Nara linked channel (hypothetical Saraswati) extending from Siwalik Hills to the Thar desert. Palaeochannels of Sutlej and Beas join Ghaggar-Hakra in Cholistan, (After Clift et al., 2012)

Harappans were highly urbanized, and they built large cities. In the declining stage the cities decayed and smaller villages and isolated farms were established. There is an overall cultural continuity over the Harappan time span, but some cultural changes took place during and after the Late Harappan stage. It is interesting to note that during the Late Harappan stage, that is during its decline, the sites migrated towards the Himalayan piedmont and the western part of the Ganga basin, along the Yamuna and the Yamuna-Ganga interfluve area.

The first hypothesis, the Ghaggar-Hakra hypothesis, received a boost when Landsat imagery analysis revealed the location of a large number of palaeochannels in the Haryana plains and beneath the Thar Desert[9,10] (Figure 4). The Hindutva proponents with political support from the BJP-led Central and State Governments started propagating that science has proved the existence of the ancient Sarasvati river. They equated the Vedic people with the Harappan people and proposed that the great civilization that developed on the banks of the Sarasvati be called the Sarasvati-Sindhu civilization. Some claimed that the river is still flowing underground from the Himalayan foothills to the sea in Kutchh. The State governments of Haryana and the Himachal Pradesh made grandiose plans to revive the Sarasvati, and a Sarasvati Heritage Development Board was constituted.

Satellite imageries revealed, along with

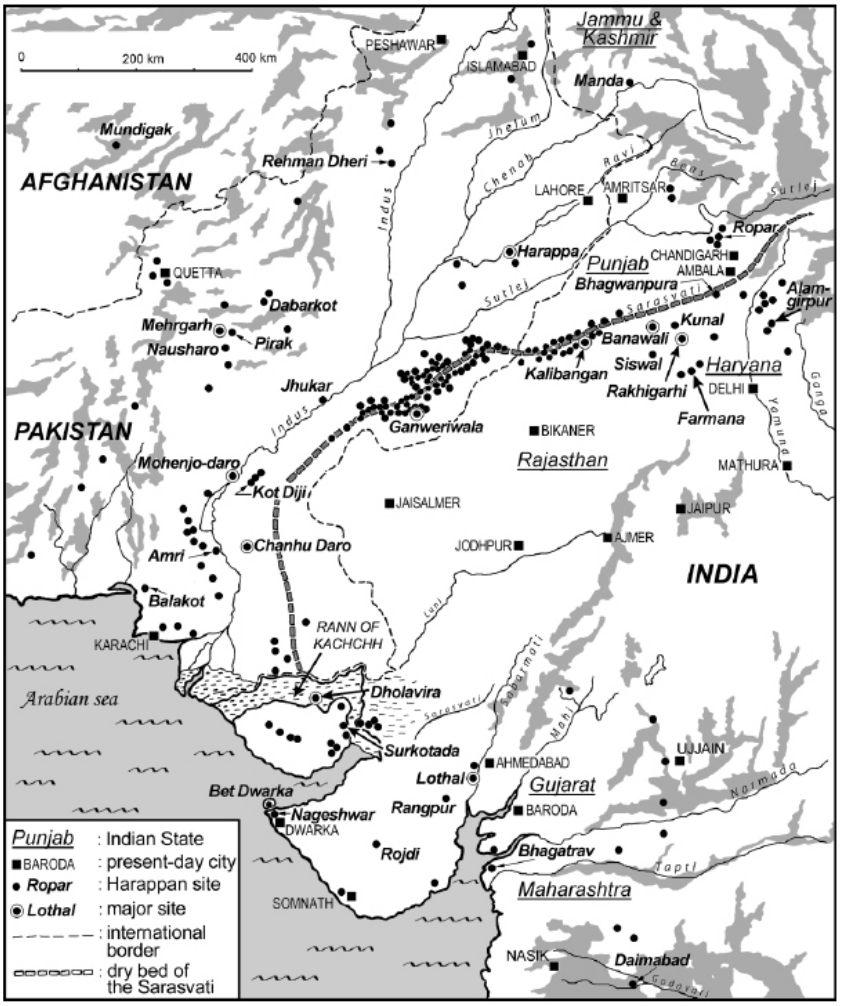

Figure 3: Reconstructed full course of the postulated Saraswati river along with the Mature Phase Harappan sites. (After Danino, 2010)

several palaeochannels in the Indus-Yamuna interfluve, the presence of a 5-6 km wide sinuous palaeochannel of the Ghaggar-Hakra which represents an incised valley that has eroded several metres into the surrounding plains, and which can be traced from Cholistan to the upper Ghaggar plains (Figures 1 and 4). In the ancient time, the eastern-most palaeochannel of the Sutlej joined the upper Ghaggar channel and from there the united channel extended from the exit of the Sutlej at the Himalayan mountain front to the Thar Desert[11] (Figures 1 and 4). Then the waters coming down from the High Himalayas flowed down the Ghaggar-Hakra Channel. Later the Sutlej avulsed westwards to its present channel. One of the westerly palaeochannels of the Sutlej and a palaeochannel of the

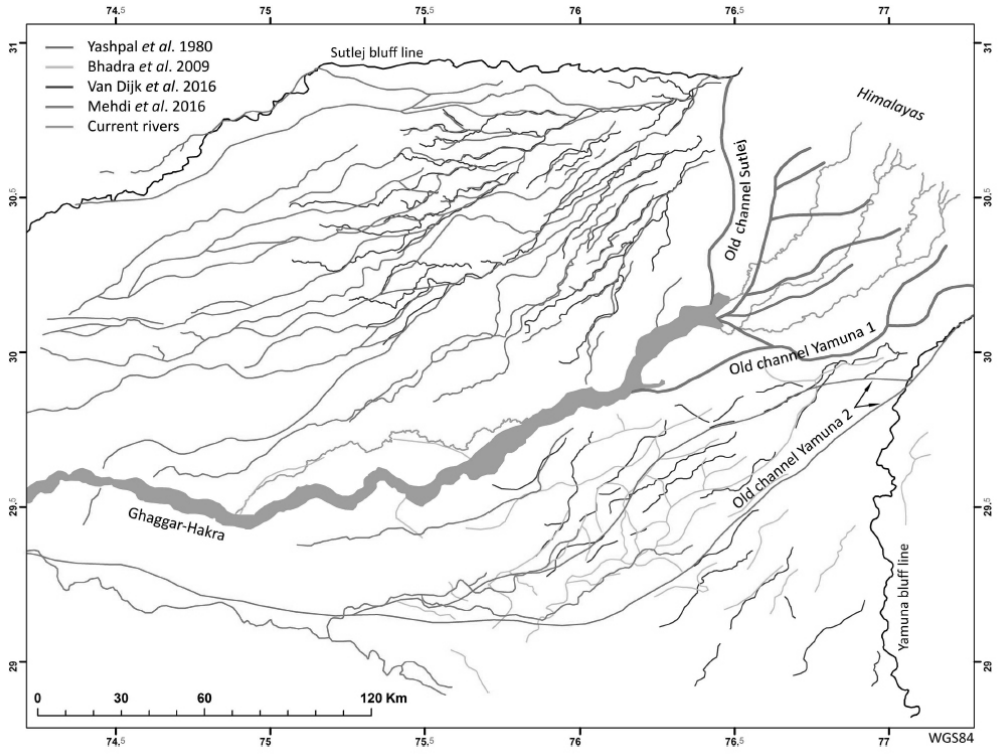

Figure 4: Palaeochannels traced by different authors in the present day Sutlej-Yamuna interfluve. Note the palaeochannels of the old Sutlej and old Yamuna joining the Ghaggar-Hakra palaeochannel (After Orengo and Petrie, 2017)

Beas joined the Hakra in the vicinity of Cholistan[12] (Figure 2). Similarly, once upon a time Yamuna was westerly flowing and at least two palaeochannels (Y1 and Y2 with two branches) of the Yamuna joined the Ghaggar-Hakra 9 (Figures 1 and 4). Y1 palaeochannel of the Yamuna is along the Markanda river[13] and the Y2 palaeochannel is along the present day Chautang river which some have identified as the Rigvedic Drishadwati river[14,15]. Y1 palaeochannel joined the Ghaggar palaeochannel in its upstream portion and Y2 joined the latter downstream from Kalibangan (Figure 1). The above palaeochannel configurations led to the hypothesis that in ancient times the Sutlej and the Yamuna drained into the Ghaggar-Hakra and formed the large river Saraswati. If the Sutlej and the Yamuna donated water to the Ghaggar-Hakra the ancient Saraswati would indeed have been a mighty roaring glacier-fed river. Subsequent avulsion of the Sutlej to the west and of the Yamuna to the east to their respective modern courses led to drying up of the Saraswati river and its degradation to a seasonal stream, the present day Ghaggar-Hakra.

However, it is not enough just to locate the paleochannels. Unless a time frame can be placed on when the ancient fluvial system was active, the information would remain inconclusive as far as the identification of the Saraswati river is concerned.

Chronology

Satellite imageries delineate only the surface traces of fluvial channels; they tell nothing about what lies underneath. Recent researches involving analysis of satellite imageries have been combined with drilling, trenching, geophysical surveys, and radio carbon (RC) and optically stimulated luminescence (OSL) dating to provide information on the chronology and palaeohydrology of these ancient rivers. Such studies have proved the existence of major sand bodies having width of 3-6 km and thickness of 10-50 m with distinct channel geometry below the modern alluvial surface.[11–16] These sand bodies represent buried channels under the surface trace of the palaeo-rivers (palaeochannels) pointing to the existence of a large long-lived fluvial system in the region.

There is now an impressive array of OSL dates and also some radiocarbon dates from the subsurface sand bodies, which have put some time-constraint on the past fluvial activity.[11–22] The channel sands overlie dune sands which are >150000 years old. In Cholistan, that is in the lower reaches of the Ghaggar-Hakra, the wide channels date back to 49,000 years ago, but were also active 4,900 to 7,500 years ago (2,900 to 5,500 BCE) and the channels stopped delivering flow to Cholistan after 4,500 years before present (2,500 BCE)[12]. Saini et al. (2009)[16] reported that in the middle reaches of the Ghaggar palaeochannel, the main fluvial activity involving glacier-fed rivers happened at 26,000 to 28,000 years ago (24000 to 26000 BCE), and a much weaker fluvial activity at 6000 to 3000 years ago (4000 to 1000 BCE).

Study of the sedimentary columns and OSL dating at different sections of the middle to upper reaches of the Ghaggar–Hakra palaeochannel have brought out the presence multistoried sand bodies 30 m thick and laterally continuous for over 8 km.[11,14] The oldest of these is 86,000 years old and the youngest are 15,000, 12,000 and 8,000 years old (13000, 10000, 6000 BCE) in different sections. In the upstream side the Ghaggar-Hakra palaeochannel is connected to the Sutlej palaeochannel (Figures 1 and 3). The upward termination of the sand bodies marks the cessation of the major fluvial activity triggered by the withdrawal of the Sutlej from the Ghaggar.

Singh et al. (2017)[11] and Sinha et al. (2020)[14] concluded that this cessation started at 12,000-15,000 years ago (10000 to 13000 BCE) and was completed shortly after 8000 years ago (6000 BCE). Reduced water supply and low energy fluvial activity (ephemeral or perennial rain-fed rivers) continued as late as 3000 years ago (1000 BCE).[17] Saini et al. (2009) 16 and Saini and Mujtaba (2010)[18] reported fine grained fluvial deposition between 6000 and 4300 years ago (4000 to 2300 BCE), after which there was an upward fining of sediments representing a decline in fluvial competence; the channel was finally abandoned 3400 years ago (1400 BCE).

From a different study Chatterjee et al. (2019)[19] inferred that the major high energy fluvial activity existed till about 20,000 years ago (18000 BCE) when it was transformed to a low energy domain. This change-over coincided with the peak aridity of the Last Glacial Maximum. However, the sedimentary logs suggest that there was a rejuvenation of the river during 9000 to 4500 years ago (7000-2500 BCE),19 probably due to intensification of the Indian Summer Monsoon 9000 years ago (7000 BCE) accompanied by melting of the Himalayan glaciers.

Subsequently the river declined and the change-over from a perennial to ephemeral phase roughly coincided with the beginning of the Meghalayan Stage (4200 years ago or

ca. 2200 BCE). Giosan et al. (2012)[20] is of the opinion that the Ghaggar-Hakra existed as a perennial monsoon-fed river during the urban Harappa phase, 5400 years ago (3400 BCE) in Cholistan, and 4300 years ago (2300 BCE) in upper Ghaggar-Hakra interfluves. A declining fluvial system at even younger ages up to 3,000 years ago (1000 BCE) has been reported by Saini and Mujtaba (2010)[18]. The Intensity of the Indian summer monsoon also influenced the volume of water in the channel.[20]

In the Ghaggar-Yamuna interfluve two paleochannels of Yamuna were marked as Y1 and Y2 (bifurcating and rejoining)[9] (Figures 1 and 3). Trace elements and the Sr-Nd isotopic signatures suggest that 57,700 to 3,100 years old (55700 to 1100 BCE) sediments in the Markanda valley were derived from the sub-Himalayas, and hence the Yamuna, which brings down sediments from the High Himalayas, was not linked to the Ghaggar-Hakra river system through the Y1 channel at least for the past 50000 years.[13] Late Holocene (3.8-3.9 Ka) palaeoflood deposits along the Markanda valley represent larger flooding of foothills rivers that could have sustained flows in the downstream reaches of the Ghaggar-Hakra palaeochannels during Late Harappan civilization.[21]

Yamuna was linked by the Y2 palaeochannel with the Ghaggar–Hakra and the confluence was at the lower reaches of the Ghaggar palaeochannel, downstream of Kalibangan (Figures 1 and 4). Y2 palaeochannel follows the course of the Chautang river (Rigvedic Drishadwati), and the bottommost subsurface channel sediments indicate existence of a large glacially-fed Himalayan river 41000 years ago (39000 BCE).[22] After these sediments, aeolian deposits with intermittent alluvial deposits were formed by strong monsoon events (seasonal flooding) are recorded at 24000 years (22000 BCE). This change from Himalayan fluvial phase to aeolian phase took place between 41,000 to 24,000 years ago, probably close to 40000 years.[22] Aeolian activity continued till 12,000 to 16,000 years ago when seasonal flooding was resumed triggered by strengthening Indian Summer Monsoon and increased winter rainfall.

Giosan et al. (2012)[20] pointed out an important feature that in Punjab channel sedimentation ceased in the Indus tributaries about 10,000 years ago and the rivers started to incise, while in the Sutlej-Yamuna interfluve, the Ghaggar has a wide channel, but remarkably there is no Holocene incision in the river channels in this region. According to them this suggests that glacier-fed rivers did not flow across the Ghaggar-Hakra region during the Holocene, only monsoon-fed rivers were active in the Ghaggar-Hakra channel.

Provenance studies are important for palaeohydrology reconstructions. Zircon age distribution pattern in the sediments dating back to >49,000 years ago in the lower reaches of the Hakra palaeochannel in Cholistan (Pakistan) have similar zircon population as modern Yamuna river sediments and between 49,000 to 7,300 years old (47000 to 5300 BCE) sediments have zircon age population similar to the modern Sutlej sands; younger sediments ~7000 years old (5000 BCE) have zircon age population similar to modern dune sands.[12]

Further downstream, sediments between 44,000 years and 5,000 years age have zircon population similar to the modern Beas river sands. This would suggest that the Beas, Sutlej and Yamuna were all connected to the Hakra palaeochannel (Figure 2). However, chronological data indicate that the withdrawal of Yamuna from the Y2 channel likely occurred after

49,000 years ago and before 10,000 years ago, that is, before the Holocene.[12]

In the middle and upper reaches of the palaeochannel near Kalibangan and further upstream the subsurface channel sands 86,000 years to 12,000 years old (84000 to 10000 BCE) have detrital zircon age population similar to that in modern sands of the Sutlej river with High Himalayan crystalline and Lesser Himalayan source indicating that during this period the Ghaggar-Hakra palaeochannel was fed by a river like modern Sutlej. 40Ar-39Ar age of detrital mica in the buried fluvial deposits of the Ghaggar-Hakra palaeochannels also identify the catchment area of the Sutlej river in the High Himalayas as the source of these.[11,14] Signatures of sources in the Higher Himalayas are absent in the bronze age (3300 to 1200 BCE) sediments along the Ghaggar-Hakra channel indicating that the river no longer had its sources in the high mountains.

Saraswati and the Indus Valley Civilization

The cumulative evidence shows that a major river flowed along the Ghaggar-Hakra channel from as early as 80000 years ago. It was fed by the old Sutlej and old Yamuna rivers and was then a glacially fed river evolving from a braided stream through a wide valley with floodplains and channel shifting to an incised meandering river. [23] There was probably a reduction in the water flow, and transition from a high energy domain to a low energy domain at about 20000 years ago due to the peak aridity associated with the Last Glacial Maximum. The disorganization of the fluvial system started due to the withdrawal of Yamuna through avulsion to the present easterly channel at about 18000 years ago and withdrawal of the Sutlej river due to westerly avulsion at 12000 to 8000 years ago.[14] The river degenerated from a High Himalayan river to a rain-fed river with source in the Sub-Himalayas.

It is to be noted that the acme of the Ghaggar-Hakra river was attained in the Pleistocene period, much before the appearance of human civilization and when its decline started the Harappan people had not yet settled in the region. Palaeoclimatic data retrieved from stable isotopes in lake sediments, in animal teeth and bones from the Harappan sites and in foraminifera from the Arabian Sea indicate that the region was quite wet in the late Pleistocene times (40,000-60,000) years ago. Afterwards aridity set in and reached its peak during the Last Glacial Maximum (about 20,000 years ago), but there was intensified monsoons at 7,000-9,000 years ago (5000-7000 BCE).

A rejuvenation of the river took place during 9000 to 4500 years ago,[19] probably due to this intensification. This was the time when the Pre-Harappan to Early Harappan settlements were established along the Ghaggar-Hakra river. Afterwards the monsoons started to weaken from 7000 years ago (5000 BCE), and reached its minimum 4000 years ago (2000 BCE). The river became ephemeral; during heavy monsoons it might have been swollen with water, rest of the time it might have been dry or had very little water. This was the Mature Harappan period when large cities were established; thus civilization thrived along a declining river. It was probably perennial at some stage, but as the monsoon weakened it became a seasonal one.

The ultimate disruption of flow coincided with the beginning of the Meghalayan Stage (4,200 years ago) aridification event. By 3,900 years ago (1900 BCE) the Harappan people started abandoning their urban settlements in the Ghaggar valley and moved eastwards to the Yamuna interfluves and

northwards to the Himalayan foothills. The urban civilization collapsed, but small rural settlements persisted for many centuries. Painted Grey Ware (about 1000 BCE) sites have been discovered in the river bed and not on the banks suggesting that the channel was dry by that time.

Final Words

As we discussed in the second part of the article the earliest parts of the Rigveda were composed about 3,500 years ago (1500 BCE). By this time the Ghaggar-Hakra or the Sarasvati river had declined to a rain-fed ephemeral stream. This does not fit with the Rigvedic description of the Saraswati as a mighty river roaring down from the mountains. This is the enigma about the Saraswati river. The river was indeed once upon a time a mighty Himalayan river, but that was 80,000, 60,000, 40,000 or 20,000 years ago. Its decline started with the withdrawal of the Sutlej and the Yamuna from the Saraswati channel due to westerly and easterly avulsion respectively. This fluvial disorganization was caused either by tectonic activity or aridification due to climate change. No palaeoseismic data have yet been marshaled to link the fluvial disorganization with tectonic activity. Palaeoclimatic changes during this period have already been discussed.

Alternative solutions to the enigma of the Saraswati have been suggested by different scholars working on ancient Indian history and culture. A few of these are listed below.

(a). The Vedic civilization and the Harappan civilization are to be equated, or the latter is to be considered as the continuation of the former and the two together should be designated as Saraswati-Sindhu civilization. Some regard the Vedic civilization to be much older than the Harappan civilization and the Vedas to be as old as 6000 to 10000 BCE. The Vedic people saw the Saraswati when it was a major Himalayan river. This is the hypothesis aggressively put forward by some of today's Hindutwa proponents. However, the linguistic and genetic evidence indicate that the Vedic people appeared after the Harappan people. There is also the evidence of absence of the horse in the Harappan civilization, and its preeminent presence in the Vedic civilization. Moreover there is a profound difference in culture, life-style and social structure between the urban Harappan people and the pastoral Vedic people. So the two civilizations cannot be considered to be one and the same.

(b) The second idea is that the description of the mighty river in early Rigveda refers to ancient Harakhwati in Afghanistan and the later Rigvedic Saraswati, the Vinashana Saraswati, refer to the Ghaggar-Hakra. However, the other rivers which are mentioned in the Rigveda have no matching counterparts in Afghanistan; on the contrary they can be identified with the existing rivers in NW India. It is questionable to selectively take one river out of many and place it in Afghanistan setting.

(c) In an earlier article that came out in Breakthrough[24], before the new data on the subsurface sediments and chronology were published, the author, Ashoke Mukherjee, supported the idea of some historians and archeologists that the term Saraswati is an adjective meaning 'full of water', and suggested that the name referred to the Sindhu (Indus) river. This argument is difficult to accept, because several Rigvedic verses refer to Saraswati and Sindhu separately and individually; Rigvedic sapta sindhaba includes Sindhu, Saraswati and five other rivers.

Thus, there is no universally acceptable solution to the Saraswati enigma. It is possible that when the Vedic people settled in this region the Ghaggar-Hakra (Saraswati)

was a rain-fed river with a wide channel. By this time the Harappan people had already left this area to small rural settlements in the Yamuna interfluves. The river was prone to floods during heavy monsoons. The Vedic people must have witnessed the floods and been affected by them. In fact the verses describe Saraswati as 'mother of floods', and some *suktas* are supplications to save them from destruction by floods. Can the Rigvedic description of such a river be considered as poetic license?

We suggest that though we now know many details about the Vedic and the Indus Valley civilization, for finding answers to the many questions about this critical period of ancient Indian history — decline of the Indus Valley civilization and advent of the Vedic civilization — we have to wait for more archeological and archeo-genetic information, and decipherment of the Indus Valley script. □

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Glossary

Aeolian: pertaining to the action of wind

Avulsion, avulse: rapid abandonment of a river channel and formation of a new channel

Channel sands: sand deposited in a river bed. Commonly has coarse grain size

Competence of a river: refers to the largest particle size a river can transport. A high energy river carries large size particles; sedimentation in low energy rivers is of fine clay or silt

Fluvial: pertaining to river

Holocene: geological time unit extending from ca. 12000 years ago to present day.

Incised valley: valley cut deep by the river into its own floodplain or the underlying rocks, so that during food the water does not go over the banks

Interfluv: region between two rivers

Meghalayan stage: a division of time starting about 4200 years ago

OSL dating: a method of dating which measures the time since the sediments were buried and shielded from exposure to light.

Palaeochannel: ancient channel of a river

Palaeoseismology: study of ancient earthquakes

Pleistocene: geological time unit extending from ca. 2.5 million years ago to ca. 12000 years ago

Piedmont: area at the foot of a mountain

Provenance: source region from where particular sediments originate