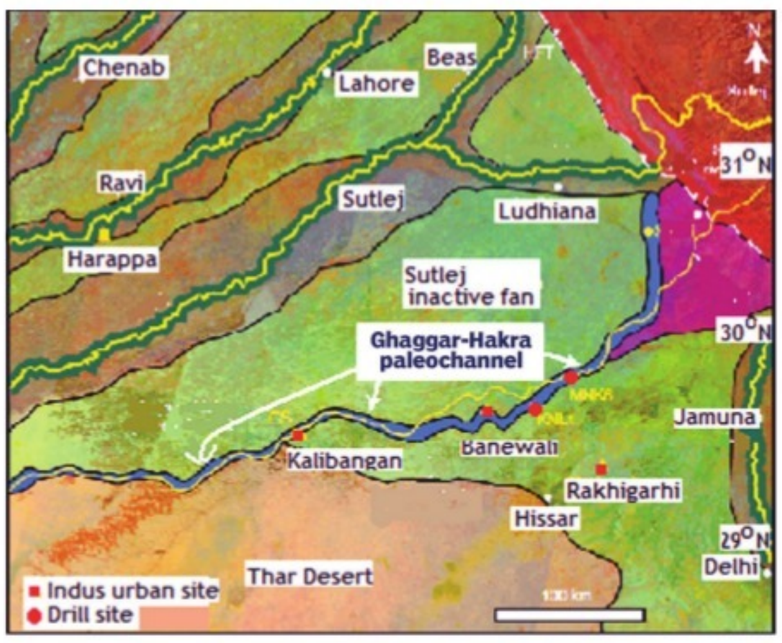
Missing river stays hidden

Detective work on the rivers of prehistory has negated an idea that the Saraswati flowed in the Indus Valley during the Bronze Age

S ANANTHANARAYANAN




The Kalibangan site today


The Ghaggar-Hakra

The great civilisations and urban centres of the world have all risen on the banks of rivers. This is evidently because river valleys are well watered and fertile, apart from the facility of transport and communication. The discovery of urban remains at Mohenjo Daro and Harappa was evidence of sophisticated civilisation, 4,600 to 3,900 years ago, of the same antiquity as those of Egypt and Mesopotamia, clearly nourished by the river Indus.

A good many sites belonging to the same ancient urban civilisation, however, have been discovered within the belt between the Indus system of rivers to the west of the Indian subcontinent and the Gangetic plain, to the east — a region that is not served by a river system. This contradiction appeared to have got resolved with the discovery of a now-defunct river bed, the Ghaggar-Hakra ancient river channel, along the line of the urban civilisation sites. The discovery suggested that there was a Himalayan river that flowed through this channel and supported these settlements, which were abandoned when the river dried up or changed course.

Work by Philippa J Mason, Alexander L Densmore, Andrew S Murray, Mayank Jain, Debajyoti Paul and Sanjeev Gupta, of Imperial College and University of London, Technical University and Aarhus University of Denmark, Universities at Glasgow, St Andrews and Durham, UK and Indian Institute of Technology, Kanpur, India, however, reveals that the river that flowed along the Haggar-Hakra channel moved away long before the Bronze-Age civilisation that prospered in the region. The study, published in the journal, *Nature Communications*, finds that it was the relict, underfilled topography of an abandoned valley of the Himalayan Sutlej River, rather than an active Himalayan river, where several ancient urban centres grew. This suggests that the stability of a region from which a river had migrated, rather than the unpredictable course of an active Himalayan stream, could also support productive human settlement.

The map of the Indo-Gangetic plain shows the system of the Indus and its tributaries on the west and the Jamuna and the Ganga to the east, with a less watered region, including the Thar Desert, in between. While the sites of Mohenjo Daro and Harappa are along the course of the Indus, those of Kalibangan, Banawali, Bhirana and Kunal and a host of others are away from Himalayan rivers. Late in the 19th century, the *Nature Communications* paper says, traces of an ancient, defunct river bed that swept through this region were discovered. Surveys in the region have also uncovered ruins of several urban-scale settlements, associated with this river-bed trace and dated to the same period as the Indus valley civilisation. Further study identified this trace as the course of an ancient river that flowed from the Himalayas in Himachal Pradesh, down through Rajasthan and through to Pakistan.

The ancient channel has been considered as the path of a Himalayan river that once supported Indus Valley period settlements, including the important ones of Kalibangan and others. The ancient river has also been linked with the mythical Saraswati river, which has been mentioned in the Vedas and is believed to join the Jamuna and the Ganga at their confluence through an underground passage. The channel, however, is now only a flow of water during the rainy season, known as the Ghaggar, in India and the Hakra in the part that lies in Pakistan.

It has been believed that the drying up of the river that once flowed through the channel led to the decline of the settlements that the river supported and may have led to the collapse of the Indus urban system. While it has been suggested that the river dried up because sources were diverted owing to movements in the earth's crust or climate change, there is no evidence of such events and there have been no detailed studies to establish the role of rivers in the rise and fall of urban centres in this region, the paper says.

The team of researchers hence undertook a study of the ancient channel by means of satellite imaging and then analyses of deposits recovered by "coring", or drilling into the earth, and lifting out a column of accumulated and consolidated silting. The satellite survey consisted of mapping the radiation in the infrared emitted by the Earth's surface. The damp conditions along the ancient channel affect the extent of IR emission, which is different in drier regions, and the trace of the channel shows up in the IR emission map.

The picture shows two main swathes, called the "fan", of deposits along regions which have fed the river over eons, the green areas in the picture. These areas, however, are now not related to the flow, which has consolidated its course. And then, there is a five to six km-wide channel, shown in blue, in the Sutlej fan, extending from where the Sutlej emerges from the Himalayas and till the Thar Desert. The satellite image suggests that the blue portion represents a cooler and less reflective surface, or sediment with greater moisture content. The researchers interpret this damp and sinuous feature to represent the trace of the Ghaggar-Hakra ancient drainage system.

Now to test the idea that the Ghaggar-Hakra channel was the relict of a Himalayan river and related to the decline of the Indus Valley urban settlement, the composition of the consolidated sediment was investigated along the channel at various depths. Five cores, going down to more than 40 metres, were drilled near the site of the urban settlement at Kalibangan in Rajasthan. The result of the operation was to obtain samples of sediments indicating the surface activity at various times in the past, extending to many thousands of years before the present.

It was found that the sediment at greater depths was of the kind that is dropped on the bed of Himalayan rivers, which indicated that a major river flow did exist over the Kalibangan area. The change in the character of the sediments, as one moved upwards, suggests, that the flow reduced from normal river flow till it was nearly stagnant and pond-like. To confirm whether the transition indicated cessation of river flow, and hence the decline of settlements, particularly of the Indus Valley epoch, the group estimated the age of the different core sections.

The method used is called Optically Stimulated Luminescence and works because certain minerals collect energy from cosmic radiation and then give up this energy in the form of radiation. The minerals in buried sediments, however, keep absorbing energy and do not radiate. Hence, they store energy, which they release by radiation, when exposed and illuminated by light of the appropriate colour. The nature and extent of the radiation, or luminescence, then indicates how long the sample has been storing cosmic radiation, and hence its age.

The result of the investigation was that while there was a river flowing over these areas in ancient times, the flow stopped well before the Bronze Age settlements of the Indus Valley were at their zenith. And there was evidence that it was the Sutlej that followed a course more to the east, till it changed course, well before the Indus Valley period, and settled into its present, stable river valley.

The flourishing urban settlements in the region hence arose not adjacent to an active Himalayan river but in the comparative stability of the abandoned valley. Himalayan rivers tend to frequently change course, often coming back to the course they followed earlier. The Sutlej, after it moved to its present path, some eight thousand years ago, has stayed trapped in an "incised" valley. The stability this gave to the Ghaggar-Hakra region was the environment for productive social evolution that marks the Indus Valley civilisation, the *Nature Communications*, paper says.

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Not just something to swat

They spread disease, damage crops and don't mind eating decomposing bodies but is having trillions of flies buzzing around the planet such a bad thing?

JAMES GORMAN

For each person on Earth, there are 17 million flies. They pollinate plants, consume decomposing bodies, eat the sludge in your drainpipes, damage crops, spread disease, kill spiders and hunt dragonflies. Some have even lost their wings so as to live exclusively on bat blood, spending their lives scuttling about the fur of their hosts, leaving only to give birth to a single larva — usually.

"That's why I love them. They do everything. They get everywhere. They're noisy. And they love having sex," said Erica McAlister, a curator of Diptera — flies to the rest of us — at the Museum of Natural History in London.

McAlister has captured her affection for the Diptera *in The Secret Life of Flies* — a short, rich book, by turns informative and humorous — both a hymn of praise to her favourite creatures and a gleeful attempt to give readers the willies. Her book is also the source of the 17 million number, which, she pointed out, is just an estimate. Like other fly writers before her, McAlister has more than fun in mind. She wants to remind the world at large of the importance of flies to humanity, and to the planet. They are not just something to swat.

Without them, to take just one example, there would be no chocolate. McAlister herself hates chocolate, but she is fond of the kind of flies that pollinate the cacao plant — a variety of biting midge. The midges are tiny, mostly blood-feeding insects, but the chocolate midges like nectar and carry pollen from one plant to another.

Biting midges are, in fact, part of McAlister's specialty. She is fond of all flies, but focuses on those that are included in the lower Diptera, which include mosquitoes, black flies and, as she puts it, "everything that's bitey, stabby, nasty". Her life among flies involves both museum work and field research. For her, this is a dream job. She recalled the first time she went behind the scenes at the museum, as a student, before she actually worked there. "I'd been let into a building that had 34 million insects. I said, 'Oh hello, I quite like you'," she said.

McAlister's fascination began in childhood. "I used to catch the fleas off the cats," she said, inspecting them with a microscope her parents had given her. But she soon gravitated toward more gruesome insects. Decomposing carcasses of small creatures, also courtesy of the cats, were treasure troves of maggots, which she still delights in. "I quite like the darker side of nature," she said, just before discussing the lives of spider-killing flies.

The larvae "hurl themselves at spiders" in order to land on them and burrow into the abdomen. They then eat the spider from the inside out. But if the spiders are immature, the larvae may go to sleep for a few years until the spider grows into a bigger meal.

Many flies do an enormous service for us and the planet by cleaning up all sorts of the biological world's detritus, from dead wood to the slime in drainpipes. Drain flies, or sewer gnats, are actually cleaning up human mess. Occasionally, however, they may have a population boom that sends the adults into the air, which is annoying; if the bodies disintegrate into tiny particles in the air, they are potentially harmful to human health.

And, of course, there are the flies that feed on dead bodies — the 1,100 species of blow flies, favourites of forensic detective shows. The maggots of these flies, like the very attractive bluebottle larva, devour corpses of mice and men and everything else.

Knowledge of which species lay eggs at which stages of decomposition can help determine how long ago a person turned into a body. (If it's Tuesday, it must be a bluebottle.) There are 160,000 known species of fly, and entomologists can only guess at the number we do not know — it is somewhere between hundreds of thousands and millions.

Within science, flies are one of the great subjects of laboratory study. Or rather, the fly: *Drosophila melanogaster*, commonly known as the fruit fly — although McAlister points out it actually belongs to a group called the vinegar flies. They are easy to work with and share the same basic DNA as all life. Historically, they have provided much of the foundation for modern genetics. And now they may provide deep insights into neuroscience and other fields.

Scientists at the Salk Institute in California, US, have reported that their studies of how the fly brain works can improve Internet search engines. At the Howard Hughes Medical Institute's Janelia Research Institute in Virginia, US, the search is on to develop a wiring diagram of the fly brain, and then figure out in the greatest detail how they think.

And they do think, according to Vivek Jayaraman, who runs a lab there, in the sense that flies do not just react instinctively. Their brains make decisions based on several different inputs — smell, memory, hunger and fear, for instance. And that whole process is what he hopes to decipher, neuron by neuron. "You can go end to end, potentially, in the fly," he said.

McAlister said that her work and her book have bemused and pleased her relatives, including an aunt who is quite delighted to have an author in the family. "My parents were a bit confused to start," she said. "But I was a middle child and they let me do my own thing." Eventually, she said, they realised, "Oh, she's done all right."

Flies can be startling in their appearance as well as their behaviour. One Middle Eastern fruit fly has patterns on its wings that look something like spiders. No one knows why. Another fly, *Achias rothschildi*, must swallow air to inflate its eye stalks when it first emerges as an adult.

There are, McAlister notes in her book, limits to even her affinity for flies. Houseflies, for instance, may be affected by climate change. According to one projection, the population could increase by 244 per cent by 2080. "That's a lot of flies," she writes, "even for my tastes." Presumably, many flies will also suffer with climate change. A recent paper looking at all insects reported an apparent decline that may already be linked to global warming.

There are countless mysteries remaining in the fly world — big ones, like how many species of flies there really are, and more limited ones, like the insect with the big orange head, the bone skipper fly. It eats carcasses, but only ones that have been picked over, and comes out at night in the winter. It was thought to be extinct until it was rediscovered a few years ago.

McAlister is doing her part to recruit a new generation to solve these puzzles and others by appealing to the same instincts in young people that led her to seek out the spoils of hunting house cats. "I was telling some kids about maggots and decomposing and why they're fun," she recalled. One of them later persuaded his father to leave a rotten chicken in the yard and to plant an iPhone nearby to make a video as it pulsed with the energy of its consumers.

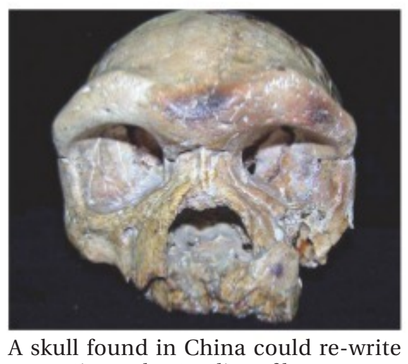
Helpfully, father and son sent McAlister the video. She looks on the bright side, "Hopefully, by inspiring that little kid to have a rotten chicken in his garden, we can spark their interest."

On such outreach rests the future of dipterology.

The New York Times / The Independent

PLUS POINTS

Shared evolution?



A skull found in China could re-write our entire understanding of human evolution. That's according to scientists who have examined the important, ancient head and say that it proves the existing theory of how humans came to be is wrong.

Most anthropologists believe that our species came about in Africa around 200,000 years ago — and that one group left around 80,000 years later before spreading across the world. But instead of humans purely coming out of Africa, the new research suggests that important characteristics of humans actually developed in East Asia.

In fact there might have been times of intense intermingling as those early humans in Asia moved out of and back into Africa, with no single event when modern humans came into being. That means that modern humans are made up of the DNA of ancestors from both Asia and Africa, if the researchers are correct.

The story is a development of a theory that has been widely dismissed by mainstream academics for decades, some of whom suggest that it is being made up to emphasise the role of China. But if the new claims are true, it might prove that the long-ridiculed theory is actually correct.

The important head, known as the Dali skull, was found 40 years ago in China. It was once a member of the early species — and our ancestor — the Homo erectus. It is surprisingly intact, with scientists still able to see the face and brain case as it would have been when its owner was living around 260,000 years ago.

It has strange similarities too with modern Homo sapiens. And the new research suggests that it has far more than expected in common with specimens found in Morocco.

Taken together, the research suggests that humans might not have evolved in Africa and then left, as has long been thought to be the case, researchers Xinzhi Wu of the Chinese Academy of Sciences and Sheela Athreya of Texas A&M University told the *New Scientist*. The similarities suggest that the early modern humans might not have been isolated in one place as their characteristics evolved, the scientists say, instead sharing characteristics across the world.

The independent

Coral transplant

Coral bred in one part of the Great Barrier Reef was successfully transplanted into another; Australian scientists said last Sunday, in a project they hope could restore damaged ecosystems around the world.

In a trial at the reef's Heron Island off Australia's east coast, the researchers collected large amount of coral spawn and eggs late last year, grew them into larvae and then transplanted them into areas of damaged reef. When they returned eight months later, they found juvenile coral that had survived and grown, aided by underwater mesh tanks.

"The success of this new research not only applies to the Great Barrier Reef but has potential global significance," lead researcher Peter Harrison of Southern Cross University said, "It shows we can start to restore and repair damaged coral populations where the natural supply of coral larvae has been compromised." Harrison said his mass larval-restoration approach contrasts with the current "coral gardening" method of breaking up healthy coral and sticking healthy branches on reefs in the hope they will regrow or growing coral in nurseries before transplantation.

The chief scientist of the Great Barrier Reef Marine Park Authority, the government agency that manages the area, said there was a need for such efforts amid the accelerating impacts of climate change.

The straits times/ann