

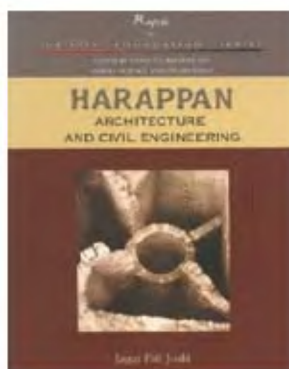
## BOOK REVIEWS

tioned in the book is vital today for India. I think this must be taken up seriously so that one can have a clear picture of protecting the future using the present data to make sure that we live in a healthy world tomorrow.

The book is a good introduction for those who do not know much about pesticides.

K. M. APPAIAH

*Central Food Technological Research  
Institute,  
Mysore 570 020, India  
e-mail: aqcl@cscftri.res.nic.in*



**Harappan Architecture and Civil Engineering.** J. P. Joshi. Rupa & Co, 7/16 Ansari Road, Daryaganj, New Delhi 110 002. 2008. Price not mentioned. 218 pp.

Discovery of the ancient cities Harappa and Mohenjodaro followed by Kalibangan, Dholavira, Lothal and several other settlements, big and small, opened up a new chapter in the history of Indian Civilization. The story is still unfolding with the future of India's past still hidden below the ground. Nevertheless, what is already known about the Harappan, also known as the Indus Valley Civilization (IVC) or Sarasvati-Sindhu Civilization is amazing. The IVC was essentially an urban phenomenon, spread over some one million square kilometres, between rivers Indus and Sarasvati (Gaggar-Hakra), reaching present-day Kashmir, Uttar Pradesh and Maharashtra. Archaeologists recognize three temporal phases of the IVC, known as pre-Harappan, mature Harappan and the decadent stages, covering roughly the period 3500–1500 BCE. But, who were these people, what were their beliefs, re-

ligion, language and script? These are yet to be figured out. However, the material evidence unearthed about their cities and infrastructure facilities is fascinating.

The most remarkable feature of the IVC was its skill in town planning, including water supply and sanitation facilities to its citizens. The drawings of the excavations show considerable forethought and deliberate planning in the founding of the IVC cities. They were unlike some of our present-day cities that have grown by simply absorbing nearby villages, without advanced planning. The boundaries of the IVC cities were well marked with fortifications. Long main roads paved with burnt bricks were neatly intersected by smaller streets at right angles. The streets of Mohenjodaro divided the city into square or rectangular blocks. Every block had residential houses with narrow lanes, each lane having a public well, sometimes with chutes for carrying water into a storage tank. It has been estimated that Mohenjodaro had 700 wells, approximately one in every third house. Waste water from the houses flowed into a covered public drain in the street, which in turn led to larger drains – horizontal and vertical – with inspection chambers and soak pits. The elaborate drainage system, roads, fire pits, kilns, residential, industrial and storage buildings can be recognized among the ruins even now. The architecture appears to be functional rather than what may be called elaborate or decorative. However, the flooring tiles found in Kalibangan are ornate and look sophisticated in the geometric patterns etched on them. No monumental or religious buildings have been unearthed or identified so far. This is not to say there were no big structures. The Citadels, the Great Bath in Mohenjodaro, the granary at Harappa and the retaining wall at Dholavira are remarkable for their size. There are some special structures, such as the eighteen circular brick platforms at Harappa, the purpose of which has not yet been deciphered. Dholavira was founded between two rivers on Khadir Island surrounded by a sea in the present-day Rann of Kutch. Water was stored in a rock-cut artificial lake. In addition, they had several storage wells to harvest rain water. Water inlet works were fashioned by erecting check dams on the seasonal rivers, the remains of which exist even after 5000 years. The dock yard at Lothal could be considered a marvel of ancient engineering. Jansen (*World Archaeol.*,

1989, 21, 2) analysed the water supply and sewage disposal systems of the Harappans to conclude: '... the inner-urban water supply and effluent disposal systems stand out as major achievements of the mature Harappans. Here, for the first time in the history of mankind, such waterworks were developed to a perfection which was to remain unsurpassed until the coming of the Romans and the flowering of civil engineering and architecture in classical antiquity, more than 2000 years later'.

This pre-Iron Age society was prosperous, as can be inferred from the size of the cities, skill in non-ferrous metallurgy and great care in water management. The surplus economy was sustained on agriculture and external trade until due to unknown reasons, it collapsed leading to the end of the urban phase of the IVC. Wright *et al.*, in their analysis of water supply in the Harappan region (*Antiquity*, 2008), found that the waters of the rivers in the upper Indus in the Harappan region increased around 3500 BCE, implying flooding and replenishment of soil for agriculture. But this decreased around 2100 BCE. Reasons as diverse as earthquakes, floods, extraterrestrial impacts, change in topography and climate change have been adduced for the collapse of the IVC.

The level of civic sense exhibited by the city planners, builders and dwellers highlights the civil engineering knowledge and practice that the IVC possessed during its peak period. The book under review captures the status of civil engineering of the IVC mainly through photographs, drawings and sketches. However, to understand and appreciate the motivation, methods and systems evolved by the IVC, one has to go beyond photographs of the excavations into the analysis of the exposed data. This is conspicuously missing in the book.

The book is written in ten chapters. The first four chapters describe the excavations with a view to provide the background for what is to come in the remaining chapters on engineering. There is a wealth of information presented to differing standards with many repetitions. The unexplained archaeological jargon is sure to put-off many interested in the subject. For example, under the subhead 'nomenclature' (p. 8) the phrases, 'pre-defence phase', 'cemetery R-37' and 'cemetery-H' are taken for granted as understood. The list of undefined technical words is

too long to be listed here. Chapter 2 on the pre-Harappan period (7000–3000 BCE) is informative. One of the early interesting structures of this period is the Edith Shahr Complex (p. 21) for which no engineering drawings are shown, nor its location marked on a map. There are two small figures (1.4 and 1.5), which cannot be called maps, marking some of the places mentioned in the book. Surprisingly, for none of the locations the latitude and longitude are given and hence a lay reader will be left wondering where to find places like Nausharo, Mehrgarh and Rojdi. Even the famed River Sarasvati referred to many times, somewhat hesitantly, is not marked in the figure. Since the book is about S&T skills of the IVC, it is natural to expect rigorous engineering drawings. But, in several places, the author is satisfied with a verbal description (e.g. p. 25, describing a stone revetment).

It is incorrectly claimed in several places that the Harappans strictly followed the cardinal directions (p. 27; 29; 77). Even a cursory glance at the city plans is sufficient to convince the reader that the alignment is slightly off the cardinal directions. What could have been the reason for this? Under a German project on Mohenjodaro (Interim report on field work, 1984, vol. II), Wanzke investigated this question fairly convincingly. It would appear that *c.* 2000 BCE the Mohenjodaro city axis was aligned to match with the bright star 'Rohini' (Aldebaran) setting slightly north of the cardinal west, behind the Kirthar Hill ranges. Did they have night-sky observation abilities? Ekka Maula from Finland (Interim report on field work; 1984, vol. I) investigated the great wavy ring stones with peculiar surficial depressions, found in Mohenjodaro, to propose that they could have been used as calendar stones for observing the stars. Thus, there is a strong case for invoking archaeoastronomy to appreciate the layout plans of the IVC cities.

Chapter 3, four pages long, could have been combined with chapter 4 for easy reading. Some elementary information about the sites like the area excavated are provided, with no estimates of the population density or critical analysis of the habitat development pattern. The description of Rakhigarh (p. 38) reads, 'The pits were aligned north-south (bigger) and east-west (smaller) over has been found the floor'. With no errata at the end of the book, it is hard to follow what the au-

thor likes to convey with such statements. On p. 39 is mentioned the existence at Padri of a large square house measuring 12.5 m<sup>2</sup>, having 9 rooms. What the author perhaps means is that each side of the square is 12.5 m in length. On p. 50, one finds mention of a vaulted culvert in Mohenjodaro, without any details. Since Harappans used corbelling extensively (p. 174) and the true arch was not known, a figure of the vault with dimensions would have been of engineering interest. On p. 56 describing the site of Kalibangan, the author refers to Chapter 3 for details of a Harappan citadel, which is not found in the book. There are too many such unconnected statements, making one feel that materials written on different dates, for some other purpose, might have been brought together in book form without sufficient care.

The titles of chapters 5–10 are: Town planning, Hydraulic engineering, Religious architecture, Burial architecture, Building technology and deurbanised Harappan settlements. These give an idea of what the author proposes to present as civil engineering and architecture of the Harappans. Town planning of the IVC is covered in chapter 5; the longest in the book with 40 pages. There are many interesting details in this chapter. The photographs of the entrance to Harappa, brick drains in Kalibangan, drainage network in Lothal and analysis of house models in Mohenjodaro by Anna Sarina draw the reader's attention. The isometric views of the houses give an idea of the living style of the Harappans. Typically rooms were constructed around a central courtyard, a style which has continued to the present day in many parts of India. The author is fond of quoting others, rather than presenting his own considered conclusions, which would have been more valuable. On p. 71, the author quotes Thapar, who in turn refers to Giedion and Masson to substantiate his own views. The book does not even list these two authors in the bibliography, but gives an impression that the Harappans imitated the Ziggurats of Mesopotamia in fashioning their citadels, notwithstanding the local origin of the similar-looking Edit Shahr Complex (p. 23) of the pre-Harappan times. However, on p. 90 the author quotes Fairervis to mention that city drainage and sewage system is the Harappan contribution to the world. According to Fairervis, the drainage system in the Mesopotamian town of Eshunna

was copied from Mohenjodaro, and that too poorly. While there may be explanations for these seemingly contradictory engineering developments, it would have been worthwhile for a book supposed to trace the origins of Indian engineering to dwell on possible interactions between the Harappans and the Sumerians.

Chapter 6, contains some excellent photographs of water engineering structures, presenting a good picture of the ancient achievements. The well at Kalibangan with radial stiffening (cover page and pp. 116–117) captures the essence of the ingenuity of the Harappans in protecting their water resources. The check dams and rock-cut reservoir at Dholavira, and the dockyard and water-inlet works with gates at Lothal are remarkable engineering achievements with locally available building materials.

Chapters 7 and 8 called respectively. Religious and Burial Architecture, are mere formalities for presenting the excavations rather than bringing out any engineering aspects of the IVC. In the absence of any serious discussion on the religion of the Indus people, the figures may be at best called religious geometry. At Mundigak, Afghanistan, a palace building is supposed to exist as shown in figure 7.2 (p. 133). With no discussion of this figure in the text, it is not possible to connect this structure with the IVC religion. The evidence presented points to the existence of fire altars and bathing platforms in several Harappan sites. This is certainly interesting, since fire worship and religious congregational bathing have continued in India to the present day. This reviewer feels that the baths, platforms and altars unearthed deserve better analysis. Do they reflect any relation with the Vedic religion? As is known, some Vedic altars were governed by the principle of equivalence of areas even though they were circular, square or semi-circular. The author could have done well to report the dimensions of the altars with good line sketches to understand their geometry. On p. 141, five altars are reported. The first three are circular with decreasing diameters (50, 40 and 30 cm). The next two are rectangular and oval, but no dimensions are given. Reporting the distance between the altar and the wall as 4.65 m does not serve any purpose in the text. The exact spatial and temporal relation between the Harappans and the Vedic people is still an open question. Hence the statement on

p. 145, 'Rao has been singularly lucky in getting complete evidence of a fire altar, apparently following the Vedic tradition, along with some of its accessories at Lothal', is too simplistic in its approach for discussing the religion of the IVC people. The author seems to imply that the IVC people followed the Vedic tradition. Chapter 9 aims at describing the geometry, tools and materials used by the engineers and masons of the IVC. There is nothing worth calling geometry discussed in the book. It is difficult to follow (p. 158) how a seal with engraved squares, of which no sketch is given, be considered a representative of the high geometric knowledge of the IVC, even though Harappans might have had such knowledge. The ratio 1 : 2 : 4 : 5 in the construction of buildings is mentioned (p. 158) without any background or discussion. The statement that follows this piece of information is disappointingly disjointed as it reads: 'The intersecting circles give the idea of diameter; the Indus people were knowledgeable about the angles'. Continuing with the description of the instruments of the Harappans, the author quotes Vij (p. 161): 'the Indus Civilisation certainly knew the relictically "exact" value for the ratio Pi and hence the measured dimension of the circumference of the earth was within their technological capability'. It is embarrassing to read such ridiculously emotional outbursts aimed at glorification, in an otherwise scholarly effort at presenting the engineering achievements of the Harappans. Among the instruments described, the terracotta hour glass (p. 166) is quite interesting. With no photograph, the verbal description remains unimpressive. The connection between the emptying time of the hour glass, said to be ten seconds, and the muhurtha of the Vedanga Jyotisha is at present a speculation.

The strong point of the book is its breadth of coverage. The quality of the figures and photographs is good. The weakness of the book is its lack of uniformity in style and absence of coherence between different parts of the text. There are too many mistakes or errors in presentation. On pp. 91–93, the figures are exceptionally impressive. But references to the figures in the text are hopelessly mixed up. The style of referring an author in the text should have been standardized. Some are given honorifics: Sir, Major, Brig, Rear Admiral (Retd), Ms; some are cited with initials and quite a

few are left high and dry with only their names and no mention of their works in the end reference. On p. 114, a well in Mohenjodaro is said to be of diameter 2.146 m × 1.479 m. On p. 166, there is a surprising superscript for Vedanga Jyotish! On p. 209, what work of Sharma, Dr (2006) is supposed to be listed? Apparently, copy-editing has not been taken seriously. The foreword mentions appendices summarizing two interesting articles on Harappan architecture and civil engineering, hard to find in the western libraries. The book contains neither an appendix nor summaries of the two articles. It is sincerely hoped the next edition of the book will be free from the present limitations that are too conspicuous to be overlooked.

R. N. IYENGAR

*Raja Ramanna Fellow,  
Department of Civil Engineering,  
Indian Institute of Science,  
Bangalore 560 012, India  
e-mail: aareni@yahoo.com*

---

**Annual Review of Nutrition, 2007.** R. J. Cousins *et al.* (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA94303-0139, USA. Vol. 27. 441 pp. Price not mentioned.

---

This volume lives up to its reputation with a wide-ranging collection of in-depth and authoritative reviews. The prefatory autobiographical chapter by Nevin Scrimshaw is a capsule of his influence on so many facets of nutrition and international development, in particular his role in developing INCAP in Guatemala, and in creating one of the finest centres of human nutrition at MIT.

The role of glutathione (GSH), the most abundant endogenously produced antioxidant, is of central importance from a nutritional viewpoint, since dietary sulphur amino acid intake, and now selenium intake, may be relevant. Oxidative stress has been implicated as an important factor in the pathogenesis of many human diseases, including human immunodeficiency virus (HIV) infection. HIV infections are characterized by low intracellular concentrations of GSH, suggesting that the increased oxidant stress is due, in part, to a reduction in antioxidant capacity<sup>1,2</sup>. For example, low GSH levels favour increased production of the proin-

flammatory cytokines, which have been implicated in the increased HIV expression and the protein catabolic state of HIV-infected individuals<sup>3</sup>, while *in vitro* studies have demonstrated impaired T-cell function with low GSH levels<sup>4</sup>. Further insights into the role of GSH in the redox process linked to disease are provided in the review of the regulation and function of glutathione peroxidase-1 (GPX-1), where interesting linkages of the alteration of GPX-1 activity are hypothesized to be associated with susceptibility to the development of AIDS in HIV-infected individuals, possibly linked to selenium status, through the prevention of loss of helper T-cells<sup>5</sup>. The linkage of GPX-1 to other chronic diseases, including cardiovascular diseases and diabetes is also particularly relevant to the Indian scenario.

The new WHO/FAO/UNU report on amino acid requirements has recently been published<sup>6</sup>, and the daily requirement for several indispensable amino acids (IAA) have been revised upwards by about 2–3 times. This puts the dietary intake of IAA as an area of interest. The chapter on food intake repression in IAA deficiency is illuminating, since chemosensory areas in the brain have been identified to detect IAA deficiency and to change animal behaviour linked to food intake<sup>7</sup>. Moreover, studies with lysine seem to suggest a kind of 'lysine-stat' mechanism that makes animals look for alternatives to lysine-deficient diets. Lysine is the limiting amino acid in Indian cereal-based diets<sup>8</sup>, but it is unlikely that significant lysine deficiency occurs in India, due to the intake of complementary foods such as lentils. However, it is worth speculating whether, in dietaries that are mainly cereal-based, the drive for satisfying lysine intake may be 'lysine-stat'-based. Certainly, there is no adaptation through a diminished lysine requirement in undernourished Indians<sup>9</sup>. Then, with lysine-deficient food (cereals), one would have to eat more to obtain the requirement for lysine; however, the amount of energy ingested may be inappropriate to the individual's needs. Could this possibly be a reason for the large cereal or energy intake, linked to obesity, despite low physical activity or energy demand? Staying with dietary energy intake, it is thought that the degree of encephalization in *Homo sapiens* is paid for by a greater energy dependence of the brain; this is also thought to be linked to