

Mohenjo-Daro, city of the Indus Valley

Michaël Jansen

The Harappan civilization, the world's fourth great civilization after those of Egypt, Mesopotamia, and China flourished in the valley of the Indus three thousand years ago. As yet little is known about it, but one enormous town – Mohenjo-Daro – has survived. This has been only partially excavated and has yielded just a few scraps of information which have provided the basis for some fanciful theories. The author of this article had developed an interesting new approach. Combining a re-examination of the documentation that has accumulated over the past 50 years with an investigation of the actual remains, he has obtained some exciting results which shed new light on the overall planning, architecture, and development of the town over the centuries, thus providing a fresh understanding of the Harappan civilization itself.

The Harappan civilization (from Harappa, the first city discovered) flourished as an urban society in the Indus Valley between around 2400 and 1800 BC, and represents the culmination of the process of colonization of the rich alluvial soils of the Indus system. Human settlements can be traced to the neolithic and chalcolithic (copper) ages in the Baluchistan foothills from the 7th millennium BC and in the Indus Valley itself from the 4th millennium [4]. Huge neolithic and chalcolithic settlements have recently been excavated in the plain of Kachi, 200 km north of Mohenjo-Daro, the largest city in the Indus valley area, revealing the emergence of techniques in architecture – mainly terrace construction – and in the crafts and farming which were used later in the Harappan cities. But the 3rd millennium BC is also marked by increasing contact and trade between the Indus Valley, Baluchistan, the countries of the Persian Gulf, eastern Iran, and Central

Asia: from 2500 BC Mesopotamian texts refer to the importance of trade with eastern regions such as Dilmun (the Persian Gulf) and Meluhha (almost certainly the Indus Valley). We may thus assume that this pattern of trade and contact favoured the emergence of urban societies in the Indus valley and elsewhere, as borne out by the appearance of large settlements in Central Asia (Namazga-Depe and Altyn-Depe, where objects produced by the Harappan civilization have been found.

Although the Indus Valley lies at the heart of the Harappan civilization, sites have been discovered as far away as the frontier with Iran (Suktagen Dor); with the Soviet Union (Shortugai, near the Oxus River); in the valley of the Ganges near Delhi; and in Gujarat, north of Bombay. However, cities like Suktagen Dor were probably more like distant colonies than frontier posts of an immense Harappan empire. Nevertheless, the Harappan civilization covers a very large area. It was materially very homogeneous with relatively little regional variation, although its uniformity has been overemphasized.

It is not known whether there was ever a Harappan empire controlled by a fixed, centralized political organization. The large Indus Valley cities have left no clues (pictorial representations, monuments, inscriptions or archives like those of contemporary Egypt and Mesopotamia, pointing to a political and religious force anxious to give its power tangible expression. The only objects which appear to be emblematic are the seals, unearthed in their hundreds, depicting animals (including unicorns) and bearing inscriptions in a script which has so far never been convincingly deciphered. The diversity of the inscriptions, which often include numerical symbols, suggests that the seals, found as far afield as the Persian

Gulf and Mesopotamia, often together with the stone weights which were a feature of the Indus Valley system of measurement, were used in trade. Some seals, however, are more complex in their imagery, and some have an obvious religious significance – humans are depicted surrounded by animals, while other seals show groups of worshippers around a deity in a tree.

The Harappan civilization was outstanding mainly for its technological achievements, as revealed by the early excavations at Mohenjo-Daro and by the present research programme of Aachen University led by the author. The quality of the buildings and of the public and private drainage systems – in particular the Great Bath on the Mohenjo-Daro citadel – are quite remarkable for the third millennium BC. The work of the Italian researchers directed by Maurizio Tosi, together with that of researchers from Aachen University has shown that crafts were practised on a large scale in what amount to industrial zones on the edges of the residential areas. The spacious houses with their drainage systems in the lower town of Mohenjo-Daro suggest the existence of an urban class whose economic and political standing no doubt helped to shape the civilization's unique character, its taste for producing things which were useful, and its preference for small-scale art rather than monuments and large statues.

The Harappan civilization in its mature form appears to have come to an end around 1800 BC. The discovery of scattered groups of skeletons in the ruins of Mohenjo-Daro seem to lend weight to a theory that the inhabitants were massacred by invaders. It now appears, however, that not all the skeletons date from the final period of occupation. Moreover, as M. Jansen has pointed out, the signs are that the

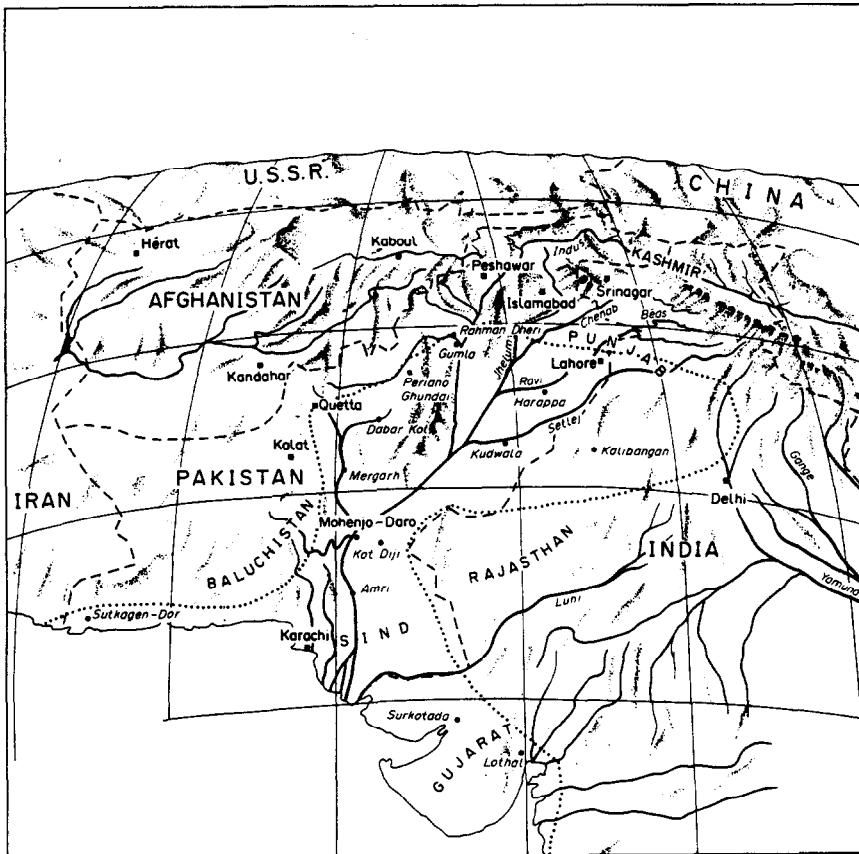
Michaël Jansen, M.A., Ph.D.

Is Director of the research project on Mohenjo-Daro at the University of Aachen.



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Figure 1 A great urban civilisation arose in the valley of the Indus during the 3rd millennium BC. The dotted lines of the map show the broadest spread of the Harappan civilization at this time, with the main archaeological sites shown in italics. The biggest city of the Indus Valley was Mohenjo-Daro, discovered in 1922 beneath the ruins of a Buddhist shrine which still towers above the ruins of the city.

city went through a period of decline before being abandoned. The cities of the Indus Valley may have been affected by the international trade crisis referred to in the Mesopotamian texts which, from around 1800 BC, no

longer mentioned eastern regions like Meluhha. It is probably no coincidence that the populations of the large cities of Central Asia were dwindling at the same time. The figures of horses and riders discovered at Pirak on the edge

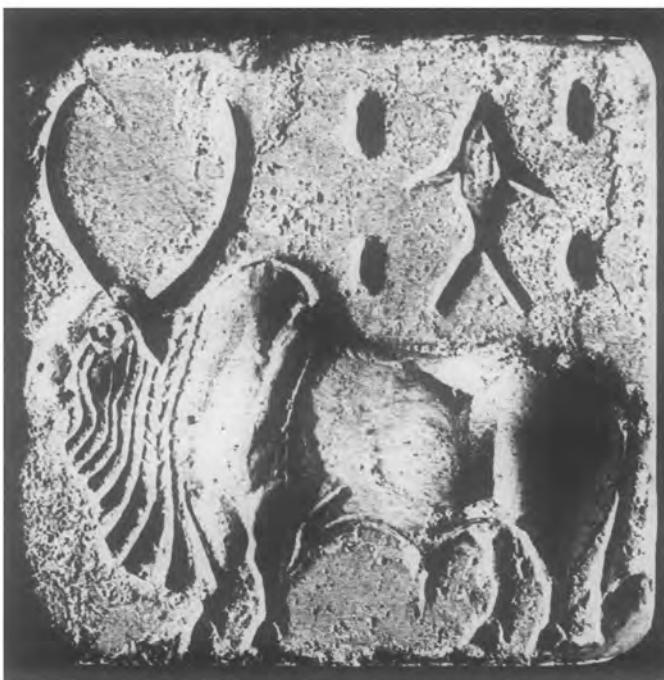
of the Indus Valley system and dating from around 1700 BC point to population movements which may have contributed towards the upheaval characteristic of that period. But the Harappan cities did not come to an end, as is still widely believed, at the onset of a period of economic decline. On the contrary, spectacular advances were being made in farming – the winter cereals, wheat and barley, which formed the staple diet of the Harappan civilization, were supplemented by summer cereals such as rice, millet and sorghum, which appear to have been unknown in the Indus Valley in the third millennium BC. All these changes, brought about by a variety of factors, helped to shake the very foundations of Harappan society. Numerous aspects of Harappan material culture did, however, survive during the second millennium in many settlements in the Indus Valley and in the valley of the Upper Ganges, near present-day Delhi. Thus, the Harappan civilization was not, as is so often thought, completely annihilated. It contributed, in modified form, towards the development of ancient Indian culture in the second and at the start of the first millennium BC.

It is against this general background that we must consider one particular facet. This is the current research being conducted at Mohenjo-Daro – the Mound of the Dead – in Pakistan, a city which dates back some 5000 years (figure 1).

Now, only sixty years after its discovery, the city is literally falling to pieces in front of our eyes. It is threatened by mineral salts, in particular sodium sulphate, which are eating away the brick walls of which the city is built. This threat existed long before excavations were started, since analysis of the bricks reveals that the salts were already present when Mohenjo-Daro was last occupied. However, the buildings unearthed over the past fifty years have been deteriorating more and more. This means the loss not only of a major tourist attraction but also of the most important site of the Indus valley culture left to us since the city of Harappa, discovered at the same time as Mohenjo-Daro, was irreparably damaged in the 19th century by railway workers who used the bricks as ballast for the Lahore-Multan railway line.

For this reason, the site has been protected since the 1960s by UNESCO. At the same time, however, two research programmes have been launched by the Pakistan Department of Ancient Monuments, the University of Aachen (Federal Republic of Germany), and the Institute for the Middle and Far East (ISMEO) in Rome. Research has necessarily been conducted

(a)



(c)



(d)



Figure 2 Some quite remarkable objects were unearthed when Mohenjo-Daro was first discovered. These were the steatite seals, characteristic of the Harappan civilization, showing various figures and a script which is still undeciphered. Most of the animals depicted are cattle (top left), but there are also rhinoceroses (top right) and unicorns (bottom left). The last seal (bottom right) is an unusual representation of a horned deity on a seat whose legs resemble cattle hooves. These objects appear to have had an emblematic function. They were often found together with stone weights used in the Indus Valley system of measurement and may have been used in trade. (Photos: G. Helmes).

in a novel way because excavation work at Mohenjo-Daro has been forbidden since 1964 in order to preserve what is left of the site. Thus, with only a fraction of it excavated, we are obliged to continue the investigation by gleaning as much information as we can from the excavations carried out since 1922 and by devising other archaeological techniques [1]. The

programme which I direct on behalf of the University of Aachen (RWTH) relates to the architecture and planning of the city, while the joint RWTH-ISMEO programme directed by Tosi is concerned with crafts. The aim is to find out how the people of Mohenjo-Daro spent their lives and how the city developed and changed in the course of its long history.

To do this, we made a thorough re-examination of the documentation (drawing photographs, reports, and excavation notes) which had accumulated since 1922 with a view to analysing the architecture and general layout of the city. We worked on the assumption that an analysis of the architecture which was not confined to purely technical details ought to shed light on the

organization of the city, its various districts and individual buildings. Maurizio Tosi is carrying out a surface investigation of areas not yet disturbed, using his experience of finds from the same period in Iran and Turkmenistan (between the Caspian Sea and the Oxus) to locate, study, and analyse sites of craft activity [2]. Our investigations should result in a fuller understanding of urban planning and the inhabitants' social structures and daily activities, and will make use of recent discoveries on the Indus civilization a subject on which ideas have changed considerably since 1922.

A 'bewitched' mound concealing an ancient civilization.

In 1922 R. J. Banerji, the director of the western archaeological district based in Bombay was on a routine visit to a large mound on which stood what appeared to be a brick tower, thought by local tradition to be scarcely more than 400 years old. The mound was said to be bewitched and the Indus fishermen thought that anyone who climbed it would turn blue. It was therefore left undisturbed, and in fact showed no sign of human habitation or even of any Islamic tombs near the surface.

Banerji soon established that the tower was the remains of a plundered *stupa* – a Buddhist monument. The robbers had penetrated into the heart of the building to steal urns and relics so that, nothing remained but a cylindrical brick structure with a hole in the middle, like a tower, on top of the mound (figure 1). Soon the rectangular base of the monument was uncovered, followed some time later by the sub-foundations of the surrounding monastery. Treasure in the form of coins from the Kushana period was also found, which made it possible to date the structure to the second century AD.

Digging more deeply, Banerji discovered objects which he found completely baffling, in particular seals 4 to 5 cm long with animal engravings beneath symbols of a kind which were then unknown (figure 2). The seals were found together with flint knives, but there were no other objects dating from any known period. He was forced to conclude that the finds were very old, representing a new civilization dating from a period in history which was still unknown. Almost at the same time, and independently of this first discovery, a second site was excavated at Harappa in the Punjab and identical objects discovered.

When Sir John Marshall, Director General of Archaeology in India, first published an account of these discoveries in the *Illustrated London News* in 1924, the seals were compared with

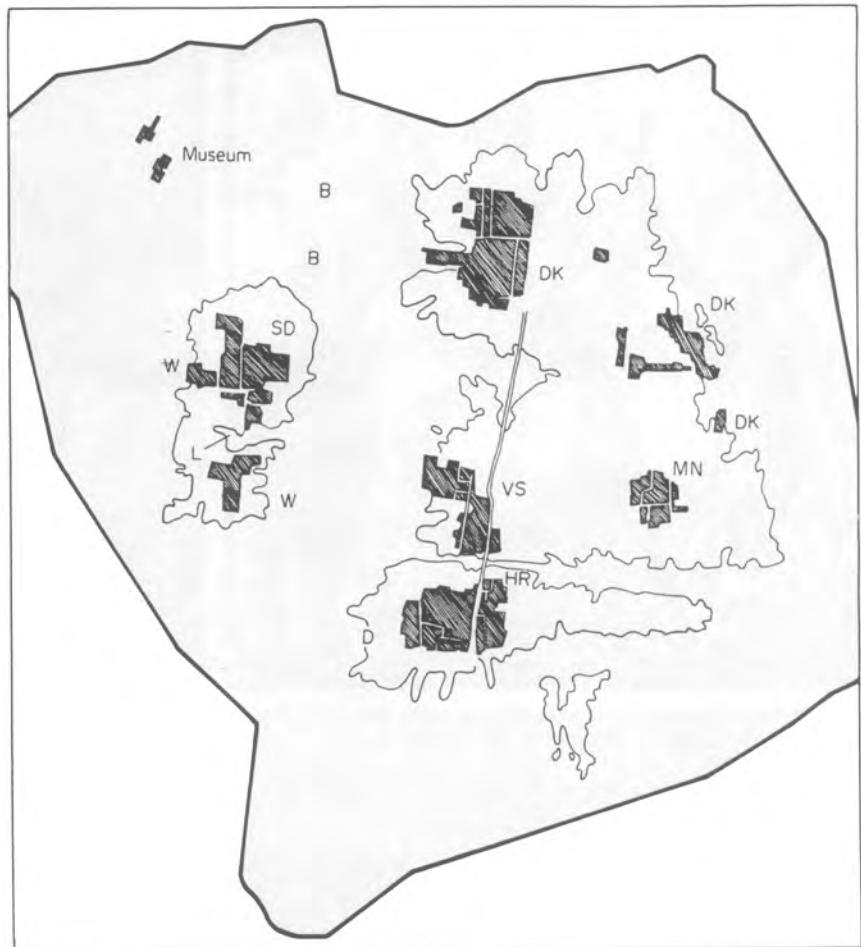


Figure 3 Mohenjo-Daro covers an area of approximately 80 ha. The excavated areas are marked on the map with the initials of each of the dig leaders. The plan shows the layout of the city with the upper town (the 'Citadel') to the west and the lower town to the east. Also very clearly visible is the thoroughfare crossing the lower town from the north (sector DK) to sector HR in the south, although it is not possible to trace its course accurately. This plan and the alignment of the streets and alleys suggest that the theory according to which the town was built on the basis of a gridiron plan is not entirely accurate, since the streets tend more to follow a zig-zag course. Two slightly different alignments are also distinguishable: the upper town and sector HR on the one hand, and the remainder of the lower town on the other. This suggests that the city may have developed in two phases, with the two different alignments being superimposed.

similar seals found at Ur, thus making it possible to date the Harappan civilization to the third millennium BC. It thus became the fourth great civilization after Egypt, Mesopotamia, and China. There was considerable excitement, and in the weeks that followed numerous articles on the same subject appeared in that magazine.

From 1924 to 1925, Marshall, convinced of the extraordinary significance of his discovery, set virtually his entire organization to work at Mohenjo-Daro. In all, five digs were started in different parts of the 80 ha site, each headed by one of the Directors of the Archaeology Department. Their initials are still used to identify the different digs – HR for H. Hargreaves in the southern part of the town; VS for M. S. Vats to the north of the HR dig;

DK for K. N. Dikshit; SD for A. D. Sidiqi in the citadel sector; and last DM for B. M. Dhamma (figure 3). Helped by several hundred workers, each of these carried out excavations in the winter of 1924–25, quickly clearing vast areas.

Today, one may be critical of the archaeological methods used at that time. Nonetheless, results were obtained over the entire site, culminating in the publication of two lengthy reports which are still our main source of reference material [3]. One of the main criticisms which may be made concerning the methods then used is the lack of interest in any detailed study of stratigraphy; that is, the chronological succession of different layers of strata representing different periods of occupation. This method was intro-

duced and applied on a wide scale only much later by Sir Mortimer Wheeler, the last Director of Archaeology in India, who excavated at Mohenjo-Daro in 1950.

At Mohenjo-Daro excavations continued until 1964, but work carried out since the 1920s has not yet been published. The findings of Mortimer Wheeler and George Dales, the last archaeologists to excavate the site, have not yet been published.

Were the cities 'imported' or original?

Since their discovery, Mohenjo-Daro and Harappa have excited the imagination and interest of many archaeologists. Because of their size and location, the two cities have been virtually regarded as the twin capitals of a theocratic kingdom governed by priest-kings. Since the cities appeared to emerge suddenly, many archaeologists have thought that the concept of town planning in the Indus valley was the result of outside influence, or, as Wheeler wrote as recently as 1968 in his 'Cambridge History of India', an 'idea imported from Mesopotamia at the height of the Sumerian civilization and adapted in the Indus valley by the local populations. This theory was based on the apparent lack of any connection between the two cities and the known neolithic villages in the area. How could the sudden emergence of a city in the Indus valley be explained other than as the result of external influence if the site was not previously occupied?

However, this view has been seriously challenged over the past twenty years or so, mainly as a result of the work of American and French archaeologists, who have raised questions which cannot be answered on the basis of such an inflexible and simplistic theory.

Recent excavations by Jean-Francois and Catherine Jarrige (of the CNRS) at Mergarh in Pakistan at the mouth of the Bolan pass linking the plain of the Indus to the Quetta valley in Baluchistan, and beyond that to Afghanistan, have shown that the Indus civilization forms part of a long regional development originating in a neolithic phase dating from the 7th millennium BC [4]. This culminated in a great period of urban development at the end of the 3rd millennium, represented by Harappa and Mohenjo-Daro, and accounts for the uniqueness of this civilization. The Indus civilization did have links with Mesopotamia, but only in the form of trade by land and sea.

This reappraisal of the Indus civilization has meant that increasing importance has been attached to Mohenjo-Daro, a city which, because of its size

and the fact that a great deal remains to be discovered, should provide the answer to some unanswered questions. That is why, in 1978, Aachen University submitted the present project for documenting the city's architecture to the Government of Pakistan. This is the first attempt to investigate the site systematically, earlier excavations having been rather inconsistent. Instead of exploring the site stratigraphically, we set out to establish how the city was organized socially and economically. We decided to use the earliest documentation dating from the 1920s as the point of departure for our investigations. In order to amass as much information as possible. Singling out individual reports or publications would have meant ignoring certain data, and it was therefore considered essential to use all the early documents. The joint Aachen ISMEO programme launched in 1983 by Maurizio Tosi and myself will add to the documentation, since the first phase was an overall survey of the site on the basis of indirect examination. By carefully examining the aerial photographs, observing erosion patterns, and measuring the electrical resistance of the ground, we should be able to pinpoint remains still buried and discover any extensions of the site beneath the alluvial soil of the present plain. All these methods are slow and costly, but will not result in any further deterioration of the site and yet will enable us to form an impression of living conditions 5000 years ago.

What does Mohenjo-Daro look like?

On arrival at Mohenjo-Daro by air from Karachi, one is immediately aware of the vast site, for the little airport is situated barely 200 m away. The two sections of the city, which is built on a clay platform and aligned from north to south and east to west, are clearly distinguishable. To the west, extending over about 400 m, is the upper town, also called the 'citadel' where, according to the first excavators, the city's élite used to live. The upper town contains large buildings unearthed in 1950 by Wheeler: he called these the Great Bath and the Granary [5]. He thought that the upper town was the seat of the authorities responsible for constructing the public buildings (figure 4).

To the east of the citadel is a strip of open ground about 200 m wide dividing the upper from the lower town, where the residential areas were located. This division was a characteristic feature of the cities of the Indus civilization and is also found at Harappa and Kalibangan [6]. The lower town is on a mound shaped like a parallelepiped, its sides now eroded. 1 km long and 700 m wide. Very clearly visible is a large

thoroughfare crossing the lower town from north to south (figure 3). To the south, the mound is traversed by two deep depressions running from east to west and creating two rounded hillocks. Marshall thought that these had been created by the Indus. Excavated sectors are easily recognizable with numerous walls aligned north-south and east-west and a network of houses criss-crossed by streets and alleys. The highly complex arrangement of streets in the lower town is not really based on a grid iron plan, as Wheeler suggested, comparing the system to that used for the camps and cities of the Romans. Here the streets seem rather to follow a zig-zag pattern. It is also worth noting that large houses are found side by side with small ones, with no real evidence of a social class structure. The entire city was built of bricks: – baked bricks for the foundations and bases of walls, since they had to be damp-proof, and mud bricks for the upper sections. For this reason there is no possibility of finding any wall decorations at Mohenjo-Daro, if indeed there ever were any, since mud brick walls have to be rebuilt each generation.

Measuring every wall in the city

We decided to measure and carefully catalogue, over five winter periods of 120 days each, an immense area of over 100 000 m² containing over 300 dwellings. It was intended to draw up a comprehensive plan of the city, with each dwelling precisely measured.

The problem was how to complete this task in the short time available. The idea of making a detailed brick-by-brick drawing of the walls was rejected at the outset, since this would have been too time-consuming. We calculated that it would take two days to survey each dwelling, and this simply could not be done using conventional methods. We needed a method which was accurate, fast, and efficient and permitted immediate reference to all the data at any time. The only suitable method was to photograph all the structures and use photogrammetry to interpret the results.

The next stage was to check the plans drawn in the 1920s. The topography of the remains appears to have been accurately surveyed, and the most difficult task was to measure as accurately as possible all the walls and their openings, together with any changes. Fortunately, the baked bricks are of a standard size, approximately 7 × 14 × 28 cm corresponding. It was, therefore, sufficient to know the height of a wall and the average heights of a row of bricks to determine the position of any point on the wall. Since the bricks provide a grid pattern, an ordinary photograph was sufficient. All the



Figure 4 The 'Citadel' sector was excavated by Sir Mortimer Wheeler. In the background is the Buddhist stupa and in front of this are the two large structures discovered by Wheeler which he named the Granary and the Great Bath. Wheeler thought that wagons loaded with grain entered the citadel from the west and were unloaded in front of the Granary. Recent research has shown, however, that the upper section of the Granary does not date from the same period as the lower section which is older. It is thus probable that Wheeler's theory is incorrect and that the building had a different function. (Photo: Research Project Mohenjo-Daro).



Figure 5 A number of aerial photographs of the site were taken from a hot-air balloon. This was the main technique used in making the photogrammetric survey of the city's architecture. This photograph of the 'Great Bath' was taken from a height of about 100 m. The north-south/east-west alignment of the architecture is clearly discernible. The streets which originally surrounded the building would have enabled processions to walk round it. (Photo: Research Project Mohenjo-Daro).

houses were measured using this method, each building being simply photographed from the outside.

15 000 photographs were taken, an average of 50 per house. When each photograph was filed and transferred to a plan, each part of a house could be very quickly examined. However, this system could not be used in sector DK-G in the northern part of the lower town, since the walls were too high and too close together. We therefore used a remote-controlled hot air balloon carrying a camera specially designed for photographic surveying which systematically covered the entire sector (figure 5). This method proved highly successful because of the ease with which the balloon could be used and the high quality of the photographs taken.

These first investigations provided some valuable information [7]. Firstly, it appears that the chronology traditionally ascribed to Mohenjo-Daro is wrong and must be completely recalculated. The early excavators thought that the very large differences in level between certain groups of houses had some chronological significance. This conclusion was reached after the discovery of the highly sophisticated network of drains in the two, but the same drain can in fact serve dwellings on very different levels.

However, a systematic analysis of

the layout of the city and its architecture indicates that houses connected to the same drain date from the same period regardless of their respective levels. More importantly, after enabling us to establish the relative ages of certain groups of dwellings, the drains also made it possible for us to achieve an absolute dating. A drain which was still full was found to contain carbons which could be dated.

The layout of the city points to a highly complex urban development. Architectural development differed from one part of the city to another. Some parts near the edge were neglected, while the more central areas were constantly renovated. In the lower town, proximity to the main north-south thoroughfare had a considerable bearing on the type of renovation. The remotest districts were completely demolished, while districts near the thoroughfare were to some extent renovated house by house.

As we have seen, large and small houses were found side by side in the lower town with no apparent class distinction. An architectural analysis of the houses also shows that all were of high quality, even the smallest. Unlike houses in the Middle East, they are all of complex layout, with numerous rooms and various entrances.

To analyse the architectural features

of the house we developed a process whereby it was possible to compile quantitative (that is, comparative) data. Such processes had already been applied in the analysis of pottery, for example, but not for architecture.

Each house was analysed on the basis of several features – means of access, the purpose of each room, and the size and shape of each room (figure 6). By analysing the means of access to each dwelling it is possible, for example, to establish that all houses in the same group to which there is joint access date from the same period, and also to investigate how a group of dwellings grew.

By determining the type and number of access points to a house it is also possible to establish the purpose of individual rooms and to find out which were for public or for private use. Each room is then referred to a diagram representing a typical house. On the basis of the size of a house and of various features such as wells, terraces, and staircases, it is possible to establish a definition of the 'typical' house (figure 7). Then, by including in the diagram all the objects found in the house, we can find out what each room was used for. We have already established that there were several types of houses, but before we can draw any sociological conclusions we shall have to compare numerous plans.

Old photographs re-examined

If we compare present-day plans with those of the 1920s we find that Mohenjo-Daro is no longer in the same state as it was when it was discovered. The topographical changes which have taken place since 1925 provide a useful pointer to the changes in the land resulting from excavation, and knowledge of the changes is very valuable for the purpose of preliminary surveying.

However, the buildings have also undergone changes, some of them considerable. Excavations carried out since 1925 have revealed new structures, while others have disappeared as a result of erosion; many walls have been knocked down or restored, while others have been modified by restoration work. The walls of Mohenjo-Daro

are, therefore, no longer in their original state, although they are still extremely important to archaeologists and students of the history of architecture. We therefore compared the present layout of the city with the exceptionally good photographic documentation produced in the 1920s – about 5000 photographs held in Karachi, New Delhi, and Mohenjo-Daro. Not until this documentation had been subjected to critical reappraisal did we proceed to analyse the city's architecture and overall layout. On the basis of this reappraisal we were able, for example, to establish that Wheeler's theory concerning the grid iron layout of the city was not archaeologically well founded.

We were also helped in our analysis of the city's buildings by the discovery

in 1981 of an inventory of 36 000 objects found during excavations. This inventory, which is now being fed into a computer, materially adds to the existing documentation. Thus, we are now in a position to interpret all existing archaeological data, which will help us to resolve the many questions still unanswered concerning Mohenjo-Daro and its history.

The life and death of a city

Despite all that has been done, our knowledge of Mohenjo-Daro is actually very sketchy. For example, nobody knows the location of the city's cemeteries. Moreover, we know nothing about the city's relations with its hinterland. According to W. Christaller's theory, central places are surrounded by 'outpost' cities, each linked to smaller towns, and so on [8]. He writes that the 'city' was probably the centre of a hierarchical network of towns which supplied it with food and used its services.

This theory has been verified for Mesopotamia by H. J. Nissen (Berlin) and R. M. Adams (Chicago) [9], but what about Mohenjo-Daro? There are several possibilities; for example, the cemeteries and the 'outpost' towns may have been covered by sediment from the Indus, and the rise in the groundwater level would make excavation impossible. If this is so, it will be impossible to verify this theory; and if not, the sites must first be found.

This is a highly important question which raises another equally important one – that of the development and sudden demise of Mohenjo-Daro. What exactly do we know? Mohenjo-Daro is built on a platform of brick which provide protection against flooding in the valley of the Indus, whose yearly sediment deposits have raised the level of the river plains. We also know that the groundwater level has risen and is at present at a height of 45 m a.m.s.l. What we do not know is how much the level has risen: opinions differ widely, ranging from 15 m to no more than 3 or 5 m.

Many questions and theories have been formulated concerning this point. The first excavators at the site thought that the rising groundwater had obliterated the deepest, and therefore the oldest, remains, thus making it impossible to trace the earliest stages in the building of the city.

This was a major drawback, especially considering that these archaeologists believed that the city had originated as a result of Mesopotamian influence. Some years ago deep boreholes were drilled in the hope of finding these earlier remains. Kiln-fired pottery was found at depths of between 16 and 20 m below surface, which seems to

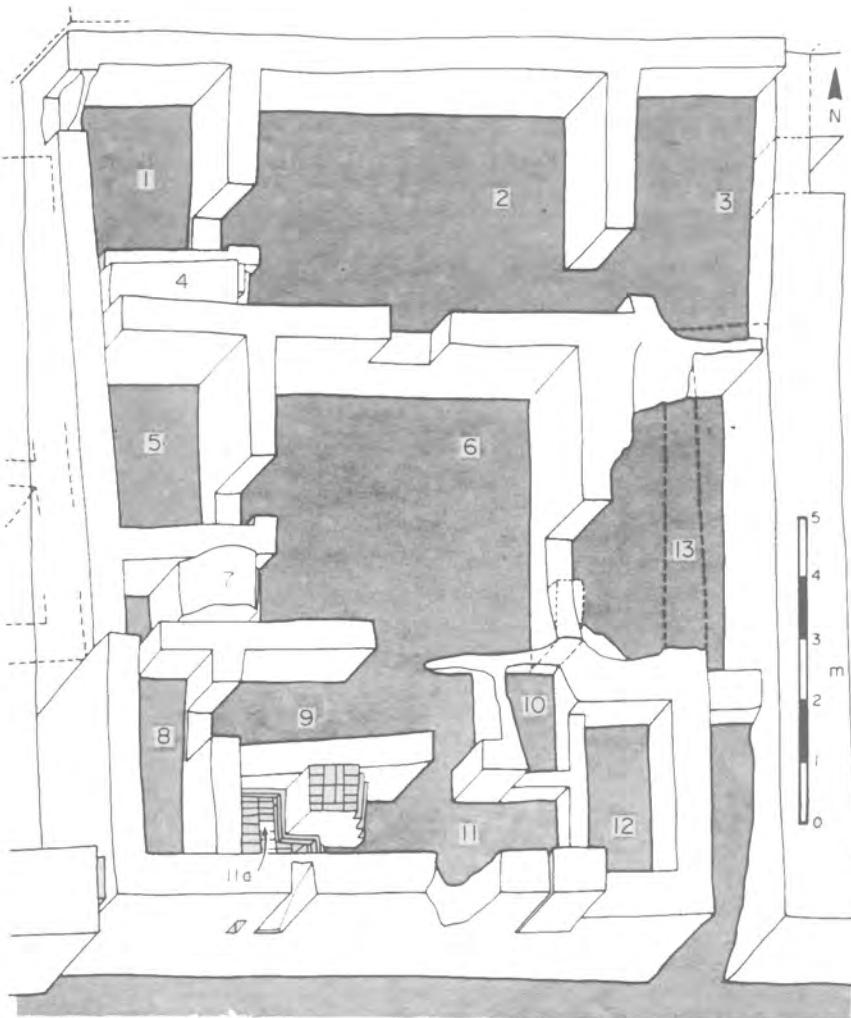


Figure 6 Each house was analysed on the basis of several criteria: access to the rooms, and their size, shape and purpose. Several types of houses were then identified. This house has its entrance to the south (11) opening on to a central courtyard (6). Room No 5 is characteristic of this kind of house and is always the same size and has the same proportions. There is also a bath in room 11a, which can be approached by a small staircase near the entrance and the street. The used water was drained into the street via baked clay pipes through the hole in the wall. These analyses underline the quality of buildings and of the interior fittings of all houses irrespective of their size. It is also possible to trace the architectural development of a group of houses and of the various alterations.

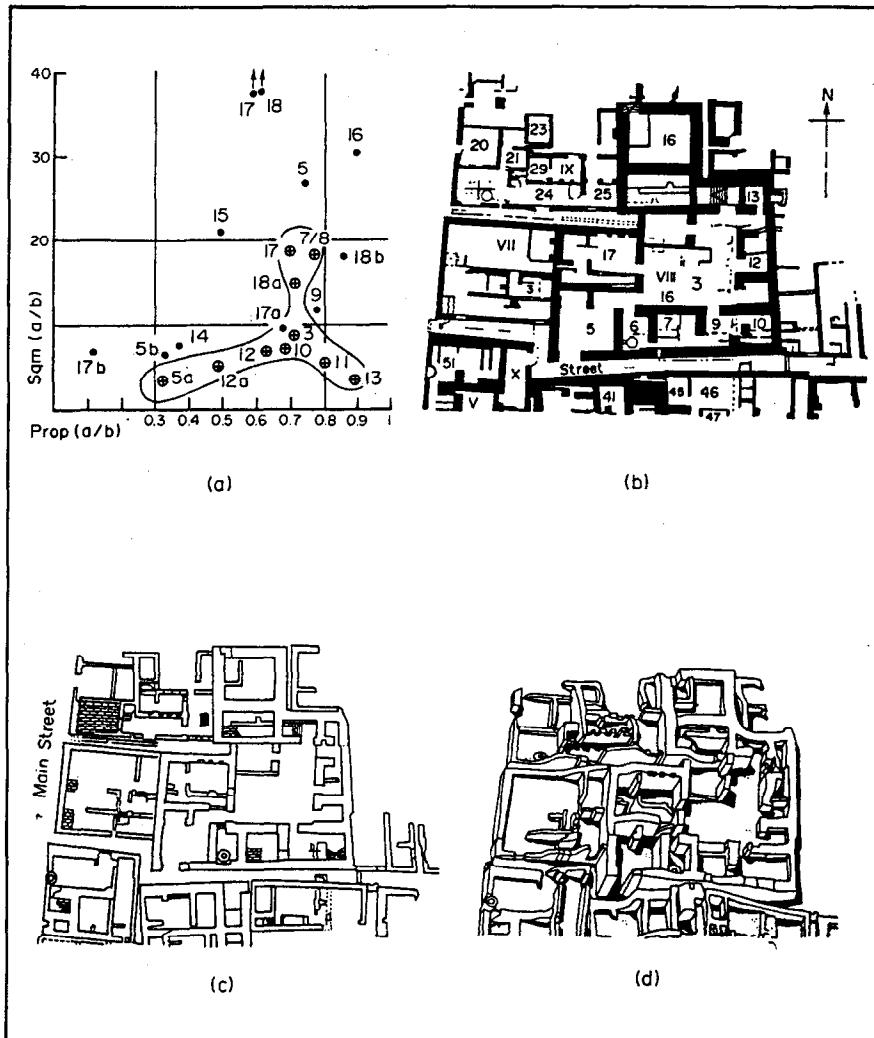


Figure 7 Four mutually independent approaches were adopted to describing and analysing the architecture of Mohenjo-Daro. The first was to draw a diagram taking account of the area of each room and of its length/width ratio (a). All the rooms in a house are thus represented. Here, the diagram shows that many of the rooms in the house are between 3 and 10 m² and that they are oblong. Diagram B shows the various means of access to a house and the way in which the rooms were connected. It is thus possible to determine whether a room was for public or private use. In this case all rooms are reached from the central courtyard. It will also be noted that the well in room x could be used both by the public and by the private sections of the house. Drawings C and D show the house as it is today and give an isometric impression of the present height of the walls. On the basis of these four observations it is possible to identify the type of house, taking account of the various alterations, which should make it possible to analyse the architecture from a sociological viewpoint.

lend weight to the early theory of Marshall. We take a different view. To construct the platform on which Mohenjo-Daro is built, a large amount of clay was needed: a platform 5 m high would have required 3 million m³. This would have meant digging about 60 ha of trenches 5 m deep. If the clay had been extracted in the immediate vicinity of the site, a practice still carried out today in Sind, the city would be surrounded by such trenches and the difference in level from the lowest part of the trench to the first layers of dwellings would be around 10 m (figure 8). Such trenches are

often used as rubbish dumps.

Pottery found at a great depth may simply have been thrown into the trench. To settle this question, cross-cutting, drilling, and geophysical analyses would be required. However, we have already obtained promising results since the surveys carried out by Mauro Cucarzi from Turin, the geophysicist in our team, has enabled us to unearth part of the 600 m-long platform to the south of the city. The platform could in fact be at a higher level than the ground from which the clay was extracted.

Some very elaborate theories have

also been propounded concerning the disappearance of the city. In 1964 R. Raikes suggested that it had disappeared beneath a sea of mud following the bursting of a natural dam on the Indus [10]. As evidence he submitted an analysis of clay deposits taken from the citadel area – that is, the upper town – in which he found what he considered sediment from the Indus. In fact, a granulometric analysis of the clay indicates that it was used for building.

The Indus valley is, moreover, a wide, flat-bottomed valley in which the catastrophe described by R. Raikes could have been caused only by movements in the earth's crust. Flooding would have had to be very severe for the upper town to be inundated.

Here again, the early documents and the surveys being carried out by our Italian colleagues should provide the answers to these questions. Although it is still rather early to draw any definite conclusions, since surveying has only just begun, some significant results have already been obtained concerning the city's development.

Mohenjo-Daro – one of the earliest examples of town planning

Neither the general outline nor the exact size of the city have been determined, although, as we have just seen, a promising start has been made by Mauro Cucarzi. In another field we can also put forward new theories: on examining the street plan of the lower town we noticed that the north-south thoroughfare deviates 6° from its main axis. This deviation is most clearly visible in sector HR (figure 3), in which all the streets are aligned somewhat differently. We regard this as evidence of an earlier phase of development. Moreover, the alignment of the streets in the upper town corresponds to that of the streets in sector HR. If this is indeed the result of the earlier stage in the city's growth, we have in Mohenjo-Daro a very ancient example of town planning. After the initial step of founding the city, the different alignment in the later town plan indicates a major change in orientation.

Work on the city's housing has also produced interesting findings concerning the final stage of occupation of the site. In general, the density of construction on the lower levels was no doubt the result of land shortage, due either to a city wall, as Wheeler believed, or to the elevated platform. According to Marshall the city was overpopulated in its final period of occupation, since the large houses appeared to have been sub-divided. Houses in fact became more spacious and are surrounded by open ground.

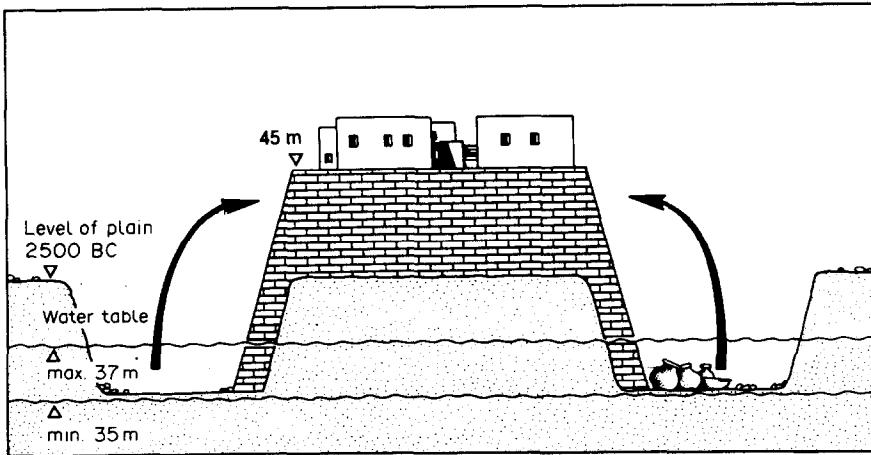


Figure 8 Pottery was discovered at depths of between 16 and 20 m as a result of drilling carried out some years ago, suggesting that the earliest stages of occupation have not yet been reached. Michaël Jansen has a different explanation. To construct the platform on which Mohenjo-Daro is built, the clay needed was dug from deep trenches all around, as depicted by the arrows in the diagram. These ditches may then have been used as rubbish dumps by the inhabitants, which would explain why pottery was found at that depth. The depth of the ditches may have been governed by the lowest groundwater level in winter. The ditches may then have been filled either by the rising groundwater level or by rain, as is still the case in the Sind villages. The surveying work now in progress may provide a clue to one of the most important questions concerning Mohenjo-Daro how did the city originate?

This was in all probability due not to an increase in land for housing but to a decline in population, a return to provincial village life and the disintegration of the city's cohesive structure, even though the influence of Harappan culture was still felt. This disintegration may be seen in the citadel sector, where such important buildings as the Great Bath and the Granary were covered by other buildings in apparent ignorance of the upper city's ancient function. Surface surveys have shown that craft activities were carried out there. Were the goods produced intended for the élite who are supposed to have lived in the upper town, or is this a sign of the degeneration of the political structure, with the economic infrastructure surviving in a more primitive form?

It is still rather early to make any statements concerning this economic infrastructure, as geophysical surveying of sectors not yet excavated is only just beginning. One of the main difficulties inhibiting such work is the fact that certain sectors have been drastically altered. By systematically comparing the topographical survey made in 1927 by A. Francis with the present-day map of the area, all changes in the terrain can be noted and located. It was impossible to carry out any surface investigations in most areas near the digs, since such areas were often used as dumps for excavated earth. J. M. Kenoyer (University of Berkeley) and

Massimo Vidale (ISMEO) have discovered near the Indus to the east of the city's workshop in which bracelets of gastropod shells were made. At other parts of the mound, vast stretches were covered by small, fire-blackened clay fragments, which led an American writer, David Devenport, to conclude that Mohenjo-Daro must have been finally wiped out by a nuclear explosion! The clay fragments in fact come from a huge pottery producing area dating from the late Harappan culture. Indeed, this year S. Pracchia (ISMEO) located some of the pottery's double-chambered kilns. In other sectors which were little affected by the digs M. Vidale discovered workshops where semi-precious stones were fashioned and chalcedony pearls produced. Everything is still there – the stone tools, the splinters and shavings, the waste, and the semi-finished and finished products.

All our findings clearly underline the importance of this type of research when the results of earlier excavations have to be re-interpreted. Such an approach is all the more necessary because large-scale excavations are becoming increasingly costly and archaeologists have been banned from some countries for political reasons. Using the methods described above it is possible to re-investigate ancient sites and to find out a great deal more about them.

Owing to the size of the site a large

amount of work remains to be done but we intend to continue our surveying systematically to trace remains which are still undiscovered. We also intend to scour those areas already excavated with a view to collecting sedimentation containing organic material which can be dated and used for zoological and botanical study.

By combining all these approaches we shall be able to develop a new programme of research taking account of results already obtained. Now that we have identified the main problems, we can set about solving them. To illustrate this aspect of our work we are intending to organize, in collaboration with UNESCO, an exhibition which will open in June 1987 at Aachen and then begins to travel round the world, thus giving the general public an impression of the still largely unfamiliar Indus civilisation in Pakistan.

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