History of Environment and Man in the Thar Desert

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The Thar Desert of western Rajasthan occupies an area of nearly 200,000 sq. km., and has a human population of over 10 million. Most of the land surface is covered by high and long sand dunes and sand sheets. The rainfall is very scanty, ranging from about 500 mm per annum in the east, near the Aravalli hills to 100 mm in the west, and it is highly uncertain. There are neither river channels nor flowing water. In fact, on the drainage map of India the vast region between Ganganagar and Jodhpur and between Ajmer and Indo-Pakistan border appears totally blank. Because of scanty rainfall and absence of surface water, irrigation facilities are virtually non-existent, and for this reason no agriculture is possible during winter and summer months. Whatever cultivation is done is confined to the monsoon season when crops like bajra, moth, til and gowar are raised. Because of inadequate agriculture, the population depends mainly on sheep, goat, cattle and camel pastoralism for its sustenance. Increasing livestock is also denuding the vegetation cover, and so is the increasing demand for fuel and timber. The result is that bereft of vegetation cover the sand dunes get destabilised, and the sand starts moving by high velocity summer winds and enchroaches upon arable land. This phenomenon creates a scare among people that the desert is expanding toward the east. The delicate balance between man and environment established several thousand years ago is being steadily upset.

However, if we are to harness the limited resources of the desert to
satisfactorily support the growing population, and at the same time also prevent the further deterioration of the environment, we must have an accurate body of information to answer such questions as: when and how did the desert come into existence? Have the environmental conditions in the desert remained uniform throughout its history or have they changed? How long has man lived in the desert, and how has he adapted himself to the desert environment? What has been the role of man in the creation and expansion of the desert?

An understanding of the environmental history of the desert is also important from another point of view. It is now well known that our planet has experienced drastic climatic changes during the last one million years or so. In high latitudes these changes consisted of alternating cold and warm periods. In low latitudes the cold periods probably coincided with aridity and warm periods with humid conditions. It is now widely feared that the earth is heading for another Ice Age. If that turns out to be true, the arid zone of India will experience accentuated dryness which in turn will adversely affect agricultural production. To meet that eventuality we must have a reliable picture of the climatic changes in the past so that we can forecast the future changes with some degree of accuracy and plan measures to meet the challenges created by these changes.

Our knowledge to answer these questions so far has been very meagre. In the absence of reliable scientific data many theories have been advanced with regard to the origin and antiquity of the desert. To answer some of these questions the Department of Archaeology, Deccan College, Pune launched a modest project funded by the U.G.C. (University Grants Commission) five years ago. It is a multi-disciplinary project in which the main participants are Prof. V. N. Misra (Prehistorian) and Dr. S. N. Rajaguru (Geomorphologist and Environmental Archaeologist) and several research fellows and students from the Deccan College. Besides, scholars from several leading national and international institutions are participating to help solve special problems.

The main aspects of our work during last five years are as follows:

1. We have carried out several extensive reconnaissances of the desert to collect archaeological and geomorphic data. We have located nearly fifty new stone age and other sites on sand dunes and in fluvial sediments. We have studied dunes in many areas to understand their morphology, distribution pattern, and weathering profiles, and examined several hundred wells, tanks (nadis) and quarries to study the nature and stratigraphy of fluvial sediments and locate archaeological sites in them. Every village has one or more nadis the digging of which has thrown up buried sediments and along with them stone implements in large numbers.

2. We have carried out excavation of several stone age sites at Jayal and Didwana in Nagaur district. These have revealed, for the first time, evidence of occupation of this part of our country by Lower Palaeolithic (Early Acheulian) Man, dating to about half-a-million years ago. These are the first excavations of Palaeolithic sites carried out in the desert. Until this work was done, it was believed that the desert came to be inhabited by man only during the Middle Palaeolithic times, some one hundred thousand years ago. What is even more significant is that we have been lucky to locate primary archaeological occupation sites where the stone tools lie buried in fine sediments exactly where they were manufactured, used and discarded by stone age man, and where they get buried in fine sediments deposited in sluggishly flowing water or in lakes and pools. This discovery of undisturbed living sites of Palaeolithic Age is considered very important in prehistoric research.

3. We have dug a 16 m. deep trench through a fossil sand dune at Didwana to recover the stratigraphy of various dune phases. This trench has revealed three major lithounits and at least four palaeosols. These lithounits differ from one another in the texture of the sand, colour, degree of compactness, mode and extent of calcium carbonate leaching and segregation, and humus content. In this 16 m. vertical profile the climatic history of the last 60 to 70 thousand years can be read like an open book, and even a layman cannot fail to see that environmental conditions during the period of dune formation were not uniform throughout, but were marked by considerable changes. It is for the first time that a fossil dune has been intentionally sliced open to recover climatic history. Earlier attempts at building the chronology of the dunes and of climatic fluctuations were based only on surface observations of dunes and were, it now turns out, highly erroneous. What has made our excavation in the fossil dune even more significant is the recovery of stone implements on two horizons. We now know on the basis of solid and unequivocal evidence that man had lived in the desert during the arid period which lasted from roughly 70 to 10 thousand years and when extensive and high dunes were formed. During this long and generally dry period there were short intervals of increased rainfall when dune surfaces acted as open land surfaces which were subjected to weathering and stabilization on which stone age hunter-gatherers camped. It is for the first time in India that stone artefacts older than the
Some 100 million years ago the Indian landmass was very close to the Equator, and the area now comprising the Thar enjoyed a warm tropical climate comparable to that of Kerala today. The major portion of the Thar was occupied by sea, and the Aravalli mountain acted as a great water divide for the Indian sub-continent. Owing to movements of earth’s plates India shifted towards north, and the Western Ghats and the Himalayas came into existence some 30 to 40 million years ago. The great Sindhu sea receded from the Thar and the climate of the region became dry and continental. The Himalayas attained their present height due to continued epeirogenic movements, and the monsoon system got firmly established in the area around two to three million years ago.

The Thar was watered by mighty streams comparable in size to the Indus and the Ganga about one million years ago. Geomorphic evidence for the existence of such powerful streams is preserved in the form of relic bouldery beds from near Ladvun in Nagaur district in the east, to Phalodi in Jodhpur district in the west. These beds are best developed near Jayal in Nagaur district where they attain a width of some 10 km and a height of nearly 75 m above the surrounding ground level. When these beds were being formed, the Thar was certainly enjoying a much higher rainfall than today. Due to tectonic movements in the area the powerful drainage system got disorganised and was replaced by less powerful and meandering streams around half-a-million years ago. It is during this period that man first appeared in this area. Stone age hunter-gatherer groups camped on the shores of lakes and pools in the floodplains of these shallow rivers. We have unearthed campsites of Lower Palaeolithic man at a number of places around Didwana in Nagaur district. The archaeological evidence for the existence of man in the area is found in the form of stone implements like handaxes, cleavers, choppers, chopping tools, polyhedrons, etc. which are found embedded in the soft loamy sediments of lakes and pools and scattered on the surfaces of the bouldery beds of an earlier age. Early man selected suitable rocks and boulders of quartz and quartzite for making his tools from nearby hills and from the river beds which are now buried under sand dunes. The large number of sites located by us and the density of artefacts on them shows that the region was densely populated in Lower Palaeolithic times and must have had good vegetation cover and ample animal life. These pioneering colonisers of the Thar lived by hunting and collecting wild vegetable foods. Although no bones have been preserved in the sediments, from the faunal remains associated with stone tools of

Mesolithic period have been recovered from the body of the dune.

4. Prof. D. P. Agrawal and Dr. A. K. Singhvi have dated numerous carbonate, sand and lacustrine sediment samples by using Radiocarbon and Thermoluminescence dating techniques. They have applied for the first time anywhere in the world Thermoluminescence dating technique to the dating of dune sands. The results of this experiment are quite encouraging, and with increasing refinement of technique are expected to give us a larger number of dates to build a detailed chronology of the complex phases of dune formation and the weathering and stabilization of dunes during episodes of increased rainfall.

5. We have carried out detailed laboratory studies of ancient sediments and soils by using sophisticated techniques like X-ray diffraction and Scanning Electron Microscopy as well as mechanical and petrological analysis to understand the processes involved in the formation of these sediments and soils.

6. In 1980 we dug a 7.50 m. deep well in the deepest part of the Didwana salt lake bed to recover the stratigraphy and samples for sedimentological, palynological and radiometric analyses for the period before 10,000 years, as the climatic history of this lake for the last ten thousand years had already been worked out earlier by Dr. Singh. We already have a radiocarbon date of about 13,000 years from an upper horizon of these deeper lake beds. Dr. Singh is now working on the pollen analysis of these sediments, and Dr. R. J. Wasson and Dr. S. N. Rajaguru have completed detailed chemical and mineralogical studies of these sediments. Once the results of these analyses are available, we hope to have a fairly detailed picture of climatic fluctuations and their durations for the last 20 to 25 thousand years. Meanwhile, Dr. Kajale has started work on the palynological analysis of sediment samples from Tal Chhapar and Bap Rann Salt lakes.

7. We are collecting information from Survey of India toposheets, aerial photographs and LandSat imageries to supplement information collected from surveys on ground for reconstructing ancient landforms including palaeo-channels.

As a result of this multi-disciplinary, collaborative research effort it has become possible to trace the evolutionary history of the desert over the last one million years or so, to understand the complex processes of climatic and hydrological changes involved in the formation of the desert, and the history of human adaptations to the changing environmental settings of the desert. The fascinating story that emerges from this sustained research effort can be summarised as follows:
comparable technological stage in the Narmada and Godavari alluvium, we can say that the Acheulian inhabitants of the Thar hunted large herbivores, and had adequately developed social organisation to permit coordinated group hunting. The discovery of a few quartz crystals in association with stone tools in our excavations at Didwana may suggest one of the earliest uses of semi-precious stones by stone age man in India.

The Acheulian people occupied the area for several hundred thousand years. During this long period they continued to refine the techniques of their tool making. Their later tools are more symmetrical in outline, thinner and have more even surfaces. These tools which we call Late Acheulian have been found in large numbers in the dug out loam of a tank at Jankipura, a few kilometres west of Didwana. With the passage of time some of the old tool forms were given up and new ones like scrapers and points were introduced. These tools were smaller and were made on small flakes carefully detached from large pieces of rock known as cores. The working edges of these small flake tools were strengthened by removing small shallow flakes from the margins, a process archaeologists describe as retouch. These later stone age people also used, alongside quartz and quartzite, fine-grained rocks like chert and chalcedony for making their tools. By around 100,000 years ago both the forms of tools and the techniques of making them had undergone sufficient transformation for us to designate them as belonging to a new stage of culture known as Middle Palaeolithic.

Around this time the Thar also began to experience changes in environment, the consequences of which were dramatic. Rainfall began to decline and the rivers started shifting their courses to the west, perhaps in response to tectonic movements in their headwater region. By around 70 to 60 thousand years ago the complex and well-integrated drainage of the earlier times had become totally defunct. The reduced rainfall and considerably lowered water table must have very adversely affected the vegetation growth. Strong winds started lifting up sand and silt particles from thickly alluviated surfaces which were parched for water and denuded of much of their vegetation cover, and began depositing them elsewhere. In this way much of the land surface of western Rajasthan was eventually covered by thick and large sand dunes and sand sheets. This arid climate, however, did not remain uniform throughout the long period of dune formation. Instead the aridity was interrupted on several occasions by short periods of increased rainfall. During these wet intervals the dune surfaces formed open land surfaces on which vegetation grew and animal life flourished. The dune surfaces were stabilised and hard calcareous soils developed on them. Man reappeared in the area during these periods of congenial climate. The deep trench cut by us in a fossil dune near the Didwana salt lake has exposed a sand profile in which the several climatic fluctuations during last 70,000 years are beautifully preserved. There are three distinct lithounits representing three major phases of dune formation and at least four palaeosol horizons representing four wet episodes.

The onset of aridity in the region resulted in the decline of vegetal and animal food resources and forced Middle Palaeolithic populations to migrate to the southern part of the Thar where the Luni continued to flow due to good rainfall in the Aravalli hills. However, whenever conditions ameliorated in the northern part of the Thar due to increase in rainfall, hunter-gatherer bands reappeared in the area. In our excavations in the fossil dune at Didwana we have found stone implements at two horizons, at depths of about 10 and 6 m. from the surface. These implements include, besides scrapers and carefully struck thin flakes, symmetrical blades, suggesting considerable advancement in stone working technology. On the upper of these two horizons we discovered to our surprise a very small, thin and symmetrically shaped oval handaxe which is a masterpiece of stone age man’s craftsmanship. This horizon has been dated by radio-carbon method to around 24,000 years ago. This handaxe therefore will be the youngest tool of its kind in the world, and probably the only one to be found in a sand dune. We have collected sediment and soil samples from the lower levels of the dune cutting for dating by radiocarbon and thermoluminescence techniques. But pending the availability of these dates, we can extrapolate the age of the older dune deposits from the already available dates from the upper levels of the dune. On that basis of these dates we can say that dune building activity began about 70 to 60 thousand years ago.

The history of arid climate preserved in the dunes is corroborated by the sediments deposited in the salt lake at Didwana. In the past many theories have been advanced regarding the origin of the salt lakes of Rajasthan. On the basis of the stratigraphic and sedimentological data collected by us from Didwana and several other lakes we can say with certainty that these lakes came into existence due to the disorganisation of the drainage system in the Thar. Lake sediments dated to before 10,000 years consist of alternating bands of sands, clays and evaporites, representing periodical filling and drying up of the lake. During periods of increased rainfall the lake was carrying fresh water, and it is during
these periods that the hunter-gatherer groups settled on the nearby dunes. During periods of reduced rainfall the lake turned saline, and sands were deposited in it, and halite and gypsum bands developed in these sandy layers.

The harsh dry environment of the Thar probably came to an end around 7,000 years ago. Due to considerably increased rainfall the lake started carrying abundant fresh water. In these deep waters of the lake clayey sediments were deposited which are preserved in the form of thin laminated bands. These clays are of dark black colour and because of their apparent likeness to kajal (collyrium) are known as kajalia. In these clays pollen grains have been preserved in rich quantities which help us in reconstructing the vegetation and climate of the period. On the dunes this wet climate is reflected in the form of a deeply weathered brown layer in the youngest dune phase. As a consequence of the luxuriant growth of vegetation which must have naturally followed increased rainfall and which is attested by the pollen record of the lakes, the dunes got stabilised all over the desert. This period seems to have been very congenial to human populations. Hunter-gatherer populations flourished in large numbers all over the desert. Their archaeological remains are found in the form of microlithic tools on numerous dunes. These microliths were made from tiny, slender, parallel-sided bladelets by steeply blunting one or more margins. Their shapes are often geometric like crescents, triangles and trapezes. A series of these tiny tools were hafted in slotted wood and bone handles and shafts to make spears, arrows, knives and sickles. There is definite evidence from Central Indian rock paintings that microliths were used to tip and barb arrowheads. Bow and arrow came to be regularly used for hunting in this period. Also for the first time shallow grinding stones began to be used for the preparation of food. These innovations in technology coupled with increased food resources which must have been generated by higher rainfall were probably responsible for the dramatic rise in human population in this period. The widespread and often dense distribution of microlithic tools on dune surfaces all over the desert shows that the Thar region must have thrrobbed with human and animal life during this period. Rich faunal remains recovered from the excavation of the sand dune site of Bagor in Bhilwara district on the eastern side of the Aravallis show that the Mesolithic hunter-gatherers had taken to sheep/goat and cattle pastoralism around six-and-a-half thousand years ago. This pattern of subsistence based on a combination of pastoralism and hunting and gathering must have diffused to the Thar region as well around this time. It proved to be an ideal adaptation to the semi-arid and arid environment of the desert, and has persisted to this day. Farming-based life did not appear in the area until about two thousand years ago. With the introduction of farming clearing of vegetation began which in turn led to a decline in wild animal life. Consequently the role of hunting in the subsistence economy steadily declined and pastoralism became more and more important. Nomadism was characteristic of this pastoral-hunter-gatherer way of life. When around 4000 years ago rainfall began to decline again, the trend toward nomadic way of life must have been accentuated. This is the beginning of historical period in India.
What is it that we have when we go on a vacant site or plot of land—an existing environment at the disposal of a designer and user to modify it. There are various undercurrents in that existing environment—like the site characteristics, the climate, the economy, the energy, the society, the available technology and so on. A designer has to modify the environment by making the most of these prevailing environmental criteria (under-currents). His building has to positively respond to the environment so as to avoid clashes with the prevailing under-currents.

There are various types of possible environmental responses. Let us very briefly go through some of them.

A) The physical environment (The site & its surroundings) response

A thorough study of the site and a sensitive approach will enable the designer to use the existing site characteristics to the best of their advantage viz.

- The site contours e.g.—on a large site of a campus a depression could become a natural water catchment area creating a small beautiful lake and a water reservoir. Building according to the contours is economical and saves building resources. A sloping site could also give the first-floor inhabitant a patch of land (garden) as a rear yard. Creating terrace gardens on a sloping site prevents soil erosion.