PRINCIPLES AND METHODS OF ARCHAEOLOGY

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PREFACE

This book is designed as a concise introductory handbook on the principles and methods of archaeology for the university students and the general reader interested in the discipline of field archaeology. It presents the latest trends and theories on the subject in an easy and intelligible manner to the students and the non-specialist reader. Besides providing practical guidance for the field archaeologist, it covers the syllabus prescribed for the subject in the universities of India. The subject of archaeology is becoming more complex as it draws more and more from other scientific disciplines for the improvement of its field techniques and interpretative skills. It is also becoming more popular among the students and the general public but, unfortunately, the books on the subject have not kept pace with the growing interest. It is with the intention of presenting the recent developments in field strategies and interpretative skills in a concise manner that this volume is brought out. The author, besides drawing from his own field experience, has consulted the valuable works of several archaeologists and, to stimulate the interests of the students for further study, a select bibliography is added at the end. The author wishes to thank Shri N. Hariharayana, Director of Museums, Government of Tamilnadu, for his valuable suggestions regarding conservation of antiquities and other scientific aspects. The author also thanks the Parthajan Publications, Madras, for the keen interest shown in the publication of the book.

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K. V. RAMAN
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CHAPTER 1

DEFINITION, SCOPE AND VALUE

Section 1

Definition and Scope

Archaeology studies the story of man's past through his material remains. The word archaeology comes from the Greek word *Archaia* - Ancient or *arche* - beginning and *logos*-theory or science. According to one definition, "archaeology is essentially a method of reconstructing the past from the surviving traces of former societies". It is a branch of learning that is concerned with the material vestiges of man, "everything made by human beings from simple tools to complex machines from the earliest temples and tombs to palaces, cathedrals and Pyramids". Though the original connotation of the word archaeology implies the study of the past, its scope is considerably widening. It is a continuing story "which begins with the first appearance of man on earth and will only end with the final extinction of the species" (Leonard Cottrell). There is no rigid time limit for archaeology. The earliest stone tools made by man two million years ago, the primitive houses of the Neolithic folk or the copper axes of the Chalcolithic people, the Megalithic tombs, the coins of the medieval times, the palaces and fortifications of the 18th century, kings are all part of the archaeologists' study. As Glyn Daniel has put it, archaeology "deals with everything from Boliths to
time capsule and covers such an enormous field that much of it is dealt with specialist studies such as history of art or architecture”.

Archaeology and History

Both archaeology and history are concerned with the study of the human past. But history is dependent on the written records and therefore, its field pertains to that part of the human past for which there are written documents. Archaeology, on the other hand, is able to probe farther back and study human history even prior to the time of the written records. Gordon Childe points out that the period covered by written records “is at best one hundredth part of the time during which men have been active in our planet. Archaeology surveys a period a hundred times as long”. As another authority has put it: “About one percent of human past can be studied through written documents. The remaining 99 percent has left no written records and this is outside the bounds of documentary history. The 99 percent of human past is the main subject matter of archaeology”.

Archaeology presents another method of approach to history, a study of the human cultures through the material remains. As a method, it can be applied to any period however recent. Even for the period for which written records are available, archaeology provides useful supplementary evidence and serves to fill in the gaps. For example, more information is available about the Roman contacts with South India or Greek contacts with North West India from archaeological sources than the scapy evidence contained in literature. Many more instances can be cited to show the immense utility of archaeology for historical period. Archaeological excavations done in Nagarjunakonda (Andhra State) have provided new and spectacular
evidence about a less known dynasty that flourished in the beginning of the Christian era. Thus, for historical period too, archaeology serves as an important supplementary evidence.

The greatest achievements of archaeology have been in the study of pre and proto history where it is the sole source of knowledge. In recovering information about the origins of mankind and of cultures, archaeology has revolutionised man’s understanding of himself and his history.

Archaeology and Culture

Although both the historian and the archaeologist are interested in the study of past cultures, the archaeologist focusses his attention on the material aspects of culture. The archaeologist includes in his purview the culture of non-civilised or pre-civilised societies too that are outside the boundaries of history. For archaeologists, material culture consists of such tangible forms as tools, pottery, burials, house-patterns, ornaments and art. Archaeologists call the smallest cultural unit as an artefact. An artefact is a product of human workmanship. Tools, weapons, vessels, art-objects, houses, buildings, monuments, burial tombs and the like are all artefacts. Even a refuse pile or a kitchen midden, though not an artefact, often contains many artefacts like broken tools, vessels, fragments of bangles or beads which convey information about the method of manufacture, nature of raw materials etc. A collection of artefacts of one category at a site is called an industry. The potteries of a site can together be called as ceramic industry of the site. Similarly, terms like bead industry, stone-tool industry are often used. Such industries found in close association with each other constitute an assemblage. Several similar assemblages found in several sites and covering a reasonably full range of human
activity constitute a *culture* according to the archaeologists. As Gordon Childe observes:

"An archaeological culture is an assemblage of artefacts that recurs repeatedly associated together in dwellings of the same kind and with burials of the same rite....Artefacts hang together in assemblages not only because they were used in the same age, but also because they were used by the same people, executed in accordance with techniques, rites or styles prescribed by a social tradition handed on by precept and example and modifiable in the same way".

The archaeologist has to document, classify, analyse and interpret the artefacts he studies. He has to place them in their historical and environmental contexts. But the artefacts, important as they are, do not tell the full story unless they are studied in relation to Man. In the words of Mortimer Wheeler: "The archaeologist is digging up, not things but people, the bits and pieces with which he deals should be alive to him. Archaeology is a science that must be seasoned with humanity". Glyn Daniel echoes the same view when he says: "Archaeology is a technique by which facts are obtained for the construction of history and pre-history; and pre-history, like history, is humanity-a way of looking at man and his work".

**Archaeology and Environment**

The archaeologist studies the artefacts in their environmental contexts. He seeks to understand man’s inter-relationship with his surroundings. Environmental study is very vital as the economical and social life of the people was directly related to the human ecology or environmental setting including floras, faunas, soil, climate etc. This is a recent development in archaeology and this study is often called Palaeo-ecology.
Earlier archaeologists did not pay due attention to these factors but were content to document the artefacts only. But today, the archaeologists realise that the non-artefactual remains like the soils, seeds, bones, water source etc. are equally important as they provide the environmental background for the site. This would show the environmental advantages and disadvantages under which Man had to work and adapt himself. The importance of this approach particularly for pre-history has been brought out emphatically by Karl W. Butzer in his book *Environment and Archaeology*. This new outlook has made a valuable contribution to the study of many problems. For example, the decline of the Harappan civilisation was in no small measure due the extensive, de-forestation, decline of rainfall and the aridity that had set in. For the study of palaeo-ecology, the archaeologist takes the help of other scientists like the botanist, zoologist, oil scientist, and the geographer to identify and analyse the remains of the plants, animals, soils, rocks, bones and other factors. It is an interdisciplinary study and the archaeologist has to integrate the varied data and reconstruct the ecology of the past societies. This is also called the ecological approach to archaeology which has come into greater focus in the recent decades. This method is more useful in the excavations of pre-historic sites than the historical sites. This study has its own inadequacies and may lead to the trap of "economic determinism" (See the next chapter for a more detailed discussion).

**Archaeology and Natural Sciences:**

According to one view, when the archaeologist is studying culture in the anthropological sense of the term, he has moved from the area of humanities with their historical or fine arts frames of reference into the realm of the social science or the natural sciences. Gordon Childe regards archaeology and
anthropology as twin branches of a single science. Childe has argued that aided by archaeology, "history with its prelude pre-history becomes a continuation of natural history". Glyn Daniel objects to archaeology and anthropology being called "sciences" except perhaps as social sciences. While anthropology, in some of its branches, looks towards sciences like human biology, "archaeology can only be called a science by a very special use of the term". He concludes that archaeology, like history, is humanity. Though archaeology uses extensively the methods, the techniques and the results of the physical and biological sciences, it is not a natural science. Some would consider it as "half science and half humanity". Sir Mortimer Wheeler emphasises the twin aspects of an archaeologist - a fact finder and a humanist. To consider an archaeologist purely as a technician and scientist, according to Wheeler, marked a useful reaction from the romanticism of the past century. But it hardly does justice to the archaeologist who is essentially a humanist. "Archaeology increasingly and very properly adopts and adapts the methods of natural science and unblushingly seeks its aid. It is not on that account itself a science in the class room sense of the term". Wheeler agrees with Crawford's view that archaeology is an art which employs scientific technique. But those who consider it as a science point out that apart from the scientific techniques and methods used in archaeology, the discipline of archaeology has built up a body of organised knowledge representing a crystallisation of the experience of the archaeologists. Based on the knowledge, a few generalisations and even predictions about the broad stages of cultural evolution are possible for wider application. For example, wherever one finds the impact of Neolithic culture, one can find the evidence of agricultural practice; the Megaliths are
associated with the cult of the dead; the Palaeolithic sites can be found on the river terraces where quartzite or flint is available etc. Similarly, by field experience, the archaeologist knows that wherever a particular type of pottery and other artefacts are found, they are invariably associated with a particular culture or a group of people. So, generalisation and prediction with a fair degree of probability are possible with regard to the general stage of culture and its main component, but there would be always local variables which cannot all be anticipated. For example, the site at Lothal (in Gujarat) yielded all the predictable components of the Harappan civilisation, but in addition, it had a vast dockyard, the presence of which was not anticipated. Research in the field goes on and hypotheses are tested, rejected or confirmed, revised and replaced by more correct generalisations in the light of new findings. In other words, archaeology as a body of knowledge, is based on the critical examination of facts. But in spite of these features, which archaeology shares with science, it cannot be called science because of the unpredictable variables in human behaviour and his response to environment. Archaeology is at best an inexact or soft science. It is an interdisciplinary science drawing freely upon various other disciplines like geology, anthropology, physics, chemistry, zoology etc. Basically, it is concerned with the history of mankind and therefore deserves to be placed in the category of human science. Archaeology like history deals with human beings and their activities whereas science deals with nature, and its phenomena. As regularity is a feature of nature, general laws can be evolved and future events predicted. Scientists can forecast rain or eclipse. This is possible only in a limited sense in social sciences and particularly in history and archaeology. For instance, the diffusion or decline of a culture may be due to different causes at different places and therefore cannot be
generalised exactly. Archaeology and history can however analyse these happenings and indicate the causes for the decline in general. Moreover, the method adopted by science is inductive whereas that of archaeology is deductive.

The relation between archaeology and science, can be summed up as follows: Considering the differences between social sciences and physical sciences in respect of their viewpoints, subject matter and theory, it becomes evident that in calling archaeology a science, one does not mean to accord it the same degree of exactness as that found in physical or natural sciences. Archaeology can lay claim to be a science because it employs the scientific method in its study. Its exactness, the capacity to lay down general laws and predict are comparatively less than the physical sciences in view of its unique subject matter; but it can, despite these factors, be called a social science since it fulfills many requirements of a science. According to a scientist, "it is the approach rather than the contents that is the test of science". According to another scientist "science is a way of investigation". Archaeology employs scientific methods like observation, recording, classification, generalisation and verification. Like physical sciences, its subject matter are facts and not ideals. Archaeologist searches for the cause-effect relationship and seeks to formulate general valid laws regarding the cultural process. So, archaeology can be called both a science and an art. In the words of Wheeler:

"It is abundantly clear that Archaeology is increasingly dependent on a multitude of sciences and is itself increasingly adopting the methodology of a natural science. As a science, it is pre-eminently a synthetic process; if we prefer to regard it as an
art, or even as philosophy we must still affirm that it is an integration of scientifically observed and dissected phenomena relating to man; it is still a synthesis”.

New Archaeology

In the last twentyfive years, a school of archaeologists led by Binford and David Clark has been strongly championing the cause of archaeology as a scientific discipline. This approach goes under the name “New Archaeology”. In his book entitled *Analytical Archaeology* (1968), David L. Clark has tried to demonstrate how with the improved methods of data retrieval, analytical taxanomy, classification, integration and synthesis, archaeologists would be able to devise models or hypotheses and transmit these models to experimental aspects for further testing and modifications. Gradually, the hypotheses may be elevated to theories and ultimately, theories elevated to synthesising principles. According to this school, the impressive progress that archaeological methods have made would enable it to make a departure from the purely historical or descriptive nature and enter into the field where it can formulate general theories. In the words of Clark, “Archaeology is a discipline in its own right because it alone provides the conceptual apparatus for analysing this peculiar data, different from that required for the study of history in its limited sense”. There are, however, criticisms against this school one of which is that it has a limited validity applicable only to prehistory and that there are variables in the human behaviour etc. (For a more detailed discussion see chapter II).

Kinds of Archaeology

Since archaeology seeks to study a wide variety of artefacts or material remains of mankind from the earliest to the recent
times, no one archaeologist can cover the whole range in time and space. There are many branches of archaeology classified on the basis of geographical areas, periods, subjects and methods. Thus, on the basis of geographical or territorial divisions, we have branches like the classical or Mediterranean archaeology to denote the archaeology of Greece and Rome; the archaeology of ancient Egypt which is also known as Egyptology; Archaeology of America, India and so forth. On the basis of periods or chronological context, we have divisions like pre-historic, proto-historic and historical archaeology. The aspect of archaeology that deals with the past of man before he learned to write has, since the middle of the 19th century, been referred to as pre-history or pre-historic archaeology. For this period, archaeology is the sole source. Historical archaeology deals with the period for which written records are also available. Proto-history is the study of people who were living after history began, but who themselves did not have writing. Graham Clark describes proto-history as "secondary pre-history" because it is studied in relation to the history of contemporary civilization. Today, there are separate chairs of professorship for pre-historic, proto-historic and historic archaeology in many of the Universities in Europe, America and India. Historical archaeology is further divisible on the basis of periods such as Medieval Archaeology, Industrial Archaeology and the like. Archaeology can also be classified on the basis of the subject matter or the problem of study or even the perspective, as for example, Economic archaeology Ethno-archaeology or even Buddhist or Temple archaeology (to study Buddhist sites and monuments, and temples respectively).

Economic Archaeology

Closely related to the environmental study is economic archaeology. As in history, so in archaeology, more and more
attention is paid to the economic motives and compulsions of the past societies. The growth of economic archaeology has been significant in the last twenty five years particularly in the field of pre-history. Aspects regarding production, distribution and consumption of commodities; trade and exchange system, management of natural resources, population density and growth, agriculture, irrigation and animal husbandry etc. receive great emphasis. There is now a "shift in the study from culture to community and from chronology to behaviour". There has been tremendous improvement in the data retrieval techniques which enable the excavator to document minute evidences about the floral and faunal remains and tool and food residues to reconstruct the economic history relating to plant and animal resources, subsistence economy etc. A variety of flotation techniques has been developed that help the excavators to collect rich data on the archaeco-botanical wealth and related aspects like types of crop system, storage and consumption. Admirable advances have been made in the study of the origin and development of agriculture in the pre-historic periods and the process of evolution from hunting and gathering to farming. Another area on which the economic archaeologist has been bestowing attention is the subsistence strategies of the prehistoric societies. Factors like the migration of prehistoric communities in response to the fluctuations in food resources are now being studied closely. But as pointed out by Robbin Dennel (1980) economic archaeology suffers from a few weaknesses. It tends to overemphasise the effect of physical environment and neglect the social environment of the prehistoric society. In the economic model, all social and cultural changes are seen as the consequence of factors like population pressure or environmental fluctuations. While these economic and ecological factors are undoubtedly important and influential, all transitions in the human development need not be the result of them. Recent studies have shown that population growth is as often a consequence as a
cause of change. Similarly, as pointed out by Andrew Sherratt (1980) all social changes need not necessarily be related to man's quest for living but they are often the by-products of other changes. A variety of factors were often responsible for such changes of which economic were also one.

Ethno-Archaeology

This is part of the socio-anthropological approach to archaeology. This study involves the study of social and cultural customs, practices and the material equipment (artefacts, house patterns, burial methods) of the present day tribes or inhabitants of a locality as a guide to the understanding of the patterns and remains found in archaeological contexts. The observation and study of the tools and other artefacts of present day tribes or the village folk besides their techniques have often provided clues to a better understanding of the artefacts from the excavations. Lewis Benford's study of the Eskimos is one of the best known studies in ethno-archaeology. This method was also adopted for a few Indian prehistoric or proto-historic sites by scholars like H. D. Sankalia. But caution should be observed in this approach also since some tribes have been influenced by the urban centres in the recent years and to that extent, there have been changes in their practices and tool equipment. This mistake can be avoided if the study is extended to larger areas for a wider comparison of the primitive tools and practices. This would provide necessary corrective to any hasty conclusions based on observations of limited or urban-influenced ethnic groups (also see chapter VI).

Regional basis

The basis for classifying archaeology is sometimes the locality within a country-archaeology of a natural region or a state or a site. For instance: Archaeology of Gujarat or the Archaeology of the Ganga valley, Archaeology of the Ramayana sites and so on can be distinguished.
Under-Water Archaeology

On the basis of the methods adopted also, we can differentiate a few more kinds of archaeology. There is what is known as under-water archaeology as distinct from the archaeology from the earth. It needs special equipment and skill to undertake under water archaeology either in a lake or a sea. Particularly, in the shallow waters of the Mediterranean, numerous wrecks of ancient boats which were once carrying goods of the classical world were accessible to divers. After the invention of the aqua lung, the under-water salvage work has become considerably simpler. Better techniques of recovery and recording of the sunken materials have been developed and increasingly used with good results. The warship of the Tudor King Henry VIII, which sank in Solent off the south coast of England in 1545 has been excavated using the latest techniques of marine archaeology. A Byzantine ship of 6th century carrying Roman goods was excavated off the Turkish coast.

Aerial Archaeology

This term is used for the aerial survey of the sites through study of the aerial photographs and preparation of maps and plans based on the survey. With the aid of crop marks and shadow marks visible in the photographs, clues are obtained regarding certain old landmarks and plans of ancient cities or walls or embankments are identified. This is discussed in greater detail in the third chapter.

Salvage Archaeology

This particular kind of archaeology has assumed importance all over the world in the wake of many developmental programmes and constructional activities. In India, several huge river-valley projects, water-reservoirs and dams are being constructed which would inundate vast areas and hundreds of ancient villages, temples and other monuments.
The Nagarjunasagar Dam in the Krishna valley and the Srisailam Hydro-electric project both in the Andhra Pradesh, the Kangasawati project in Bengal can be cited as a few examples. Here, the archaeologists are often called upon to do something to rescue the archaeological sites and monuments from total destruction in a short period. Often, this kind of work involves the transplantation of the ancient monuments to safer areas. The world famous Nubian monuments in the Aswan dam project in the Nile valley in Egypt belongs to this category. Another spectacular instance of transplantation of a variety of Buddhist stupas, chaityas and other monuments is provided by the remarkable work done in the ancient city of Vijayapuri on the banks of the Krishna in the giant project of Nagarjunasagar excavations in Andhra Pradesh. In such contexts, the archaeologists have to work under pressure of time and therefore, sites taken up have to be selective with greater emphasis on clearance and recovery of antiquities without prejudice to the scientific methods. This is indeed a difficult task and the results may not be cent per cent technically sound; but it is the best that could be done in the circumstances. In recent years, archaeologists have developed sound methods and techniques of survey and excavation work in salvage operations.

**Functions of an Archaeologist**

The work of an archaeologist is complex and arduous. It involves many systematic skills and technical know how. First, he has to survey, explore and discover ancient archaeological sites and mounds, then undertake excavations on scientific lines, document the artefacts carefully classify and analyse and interpret them. Each one of the functions enumerated above is elaborated in the later chapters. Suffice it to say here that field archaeology demands considerable planning, organising capacity and ability to choose the right priorities. It includes many items of work such as the identification of problems, selection of suitable sites for
excavation, setting up of excavation camps with competent technical field staff and equipment, direction and supervision of the diggings with diligence and care, documentation and preservation of the antiquities recovered from the excavations.

But his job does not end with the collection of the materials. He is not a mere fact-finder. He has to place the material remains in their proper historical and cultural context correlate and then with the literary evidences, wherever available, and interpret the discoveries in a wider perspective and a conceptual framework. As has been observed by Wheeler: "He is primarily a fact-finder but his facts are the material records of human achievement, he is also by that token, a humanist and his secondary task is that of revivifying or humanizing his materials with a controlled imagination that inevitably part-takes of the qualities of art and even of philosophy". The practice of archaeology calls for the exercise of the technical know-how and scholarship, love for field work, judgement, perseverance, organising skill and above all a capacity to comprehend the human behaviour and responses in relation to his environment for a proper interpretation of the past. As he depends on many other branches of sciences, he should have the ability to integrate their findings to formulate the general frame work of cultural sequence and synthesis. Thus, his functions are many: he is a discoverer, a technician and a scientist in so far as his field-search for facts is concerned. But he is also a historian with all the nuances of that discipline in interpreting the facts.
Section 2
VALUE OF ARCHAEOLOGY

As a Primary Source

Pre and Proto-historic archaeology: The value of archaeology as a source of the history of mankind can hardly be exaggerated. As pointed out earlier, it serves as the prime source of knowledge for the long saga of man in the pre-historic times. It is only due to the sustained efforts of archaeologists that the antiquity of man on the planet could be traced back to about 500 thousand years. Pre-historic archaeology has revealed the various stages in the evolution of human cultures in the different parts of the world. By the systematic and arduous field study of the remote geological deposits and river terraces and the human tools and fossils embedded in terraces, we are able to see the nature of man’s habitat, his implements of defence and offence, the tool-techniques and his ways of life. The environment of the Stone Age Man and his responses and adaptations to the climate, the flora and the fauna have all been meticulously reconstructed with the help of the fields like geochronology, stratigraphy, carbon dating and Thermoluminescence techniques. Archaeology provides us with a systematic framework of cultural and chronological sequence besides the technological advancement from age to age. A comprehensive treatment of the dating techniques adopted to the archaeological artefacts is presented by Prof. Zeuner in his admirable book *Dating the Past*.

Moreover, archaeology has unravelled the distribution or diffusion pattern of the different stages in the human evolution in various parts of the world, so that human response to the environment could be studied on a world-wide basis. Pre-history of Europe, Africa, Asia, and America has revealed strikingly similar techniques, equipment and responses with a wide variety
of local adaptations and changes. Brilliant exposition of the archaeological discoveries and their bearing on cultural and technological progress of man can be seen in works like Gordon Childe’s *What Happened in History* and *Man Makes Himself* and J.G.D. Clark’s *World Prehistory*. How the archaeologists were able to reconstruct the stages in the tool-making techniques of the Stone Age can be seen in the fascinating works like Oakly’s *Man the Tool Maker* and M.C. Burkitt’s *Old Stone Age*.

Thus, archaeology is able to delve deeper into the origins of mankind and the roots of culture and civilizations and revolutionise man’s understanding of himself and his past.

For the proto-historic period, we have some records but still largely depend on the archaeological evidence to give us a coherent account of the life during that period. The discovery of the extensive Indus Valley Civilisation in North Western India and the excavations at Harrappa and Mohanjodaro can be cited as an outstanding contribution of archaeology to the history of Indian civilisation. Till the discovery of these sites in 1920s Indian Civilisation was considered to date back to the Vedic times. Archaeology has helped to push back the antiquity of Indian Civilisation to the middle of the third millennium B.C., almost contemporary with the Egyptian and Sumerian Civilisations. More and more information is forthcoming in recent years about the Harrapans, their origins, wide distribution, town planning, trade contacts, religion, burial practices and the scripts. This great civilisation of the Indo-Pakistan sub-continent has been proved to have covered a much wider area than did the Nile Valley Civilisation in Egypt.

Similarly, what was happening in India between the end of the Indus Civilisation and the beginning of the historical times? Archaeology has shed new light on this problem of Dark Age. Several viable culture groups such as the Copper Hoard
culture, Painted Grey Ware culture in the Ganga Yamuna valley, Neolithic-Chalcolithic culture in Central India, Rajasthan, North Deccan, South India etc. have been discovered which have helped unravel many problems like the introduction of agriculture, the use of pottery, metals like copper and iron, the house patterns, the domestication of animals and the burial practices. This is cited as an example to show Archaeology's vital role in bringing to light new and hitherto unknown sets of evidence that have revolutionised our estimate of the pre and proto historic cultures.

Similarly, the spectacular discoveries of Schliemann, Sir Arthur Evans, Petrie in the Aegean and Egyptian countries have opened a new vista in the study of history of the ancient world. Until Schliemann dug at Mycenae and Arthur Evans in Crete, no one could guess that there was a Minoan civilisation. In the words of Sir Leonard Woolley: "The whole history of ancient Egypt has been recovered by archaeological work in astonishing detail; I suppose we know more about ordinary life in Egypt in the fourteenth century before Christ than we do of England in the fourteenth century A.D. To the spade, we owe our knowledge of the Sumerians and the Hittites, the great empires whose very existence had been forgotten, and in the case of other ancient peoples, the Babylonians and the Assyrians, the dry bones of previously known facts have had life breathed into them by the excavation of buried sites". With justifiable pride and optimism he adds: "It is a fine list of achievements and it might be greatly expanded; all over Europe, to Central America, in China and in Pakistan. Excavation is supplementing our knowledge and adding new vistas ...." (Digging up the Past).

In the pre and proto-historic investigation, the archaeologists' contribution lies in two aspects-one in bringing to light the material remains of the extinct civilisations like the monuments, artefacts, scripts, houses etc. and the other in interpreting the
evidence and seek solution to certain problems. The first aspect was given greater importance by the earlier archaeologists; while the second one, that is the interpretative aspect, has gained importance in more recent times. Discoveries as those of Tutankhamen’s Tomb, or the Palace of Minos in Crete, the Clay tablets at Ur, are by themselves impressive and profoundly move the public imagination. They emphasise the material qualities of the civilisation - art, architecture, technology etc. Today, the excavated artefacts together with their social and cultural setting also serve as invaluable source - materials for solving many riddles in the history of mankind like the origin of farming or agriculture, domestication of animals, use of pottery, origin of metallurgy, the attitude towards the dead, social behaviour, dress, customs, urbanisation and the like.

2. Historical Archaeology: Supplementary Source

The role of archaeology for the historical period has also gained importance in the recent years. It serves as a valuable supplementary source for the period. It fills in the gaps that are found in the records of written history. To cite a few examples: the excavation of the defence and palace remains of the Mauryas at their capital city of Pataliputra (in Bihar State) has given us an illuminating insight into the layout, the building materials, the designs of the pillars and such other facts, thus adding a new set of evidence to the Mauryan history. The discovery of the Buddhist sculptures in the Greek style in the Gandhara region has given a tangible and incontrovertible evidence for the Indo-Greek contacts. The extensive excavations done in Nagarjunakonda in Andhra Pradesh can indeed be called a landmark in the historical archaeology of India. The information that was available about the Ikshvaku dynasty that ruled sometime in the first two centuries of Christian era was extremely scrappy and incidental. But, the excavations have brought to light the entire lay out of their capital city of Vijayapuri, the royal
complex, the picturesque secular buildings like the amphitheatre, a variety of religious monuments like the asvamedha-yoga altar-complex, the Buddha Viharas, Chaityas etc; Several valuable inscribed slabs, exquisite sculptures, gold ornaments, coins and the like. In short, the whole gamut of life of different strata of society of the ancient city has been laid bare by the spade adding a new chapter to the history of South India of the early centuries of Christian era.

Two other excavations that have yielded outstanding results in the field of historical archaeology of South India can be cited: Arikamedu (1945) and Kaveripumpattinam (1962 to 1972). The former helped identify an Indo-Roman trading centre on the Coromandel Coast of the early centuries of Christian era. The Tamil literature of the period, generally known as the Sangam literature, contains quite a few cryptic references to the trade contacts with the Romans (Yavanas). The works of the contemporary Greko-Roman writers like Ptolemy and Pliny also refer to Indian ports and articles of trade. But the Arikamedu excavations brought to light the tangible remnants of the Romans—their clearly indentifiable pottery like the Arretine ware, the Rouletted Ware, their typical amphorae wine jars, the Roman intaglios which Wheeler called a “remarkable assemblage of Mediterranean origin”. With the help of these firmly datable Roman antiquities, the contemporary indigenous materials like pottery, structures etc could also be dated. As Wheeler rightly claimed, Arikamedu site will go down in the history of South Indian archaeology as that from which the classification of ancient South Indian cultures effectively began” (Archaeology from the Earth p 143).

Kaveripumpattinam, the Kaberis Emporion of Ptolemy was a flourishing port-city of the ancient Cholas situated on the mouth of the Kaveri river where it joined the Bay of Bengal. It is eulogised in the ancient Tamil epics and other literary works for
its busy Wharfs, Buddhist and Hindu establishments. The literature also refers to its submergence in sea due to the wrath of the Goddess of the Sea. It was long believed to have been irretrievably lost to the sea. But here, archaeology played a useful role in identifying several spots which once formed part of the city. Brick-built monuments of outstanding importance going back to that period were laid bare: a large brick jetty which formed part of a Wharf, the facade of a water-reservoir, a vast Buddha Vihara complex. Besides these, Roman pottery, early Chola coins of the first century A.D. beads in different stages of manufacture, terracottas etc. have also been discovered which constitute a striking assemblage of artefacts bearing eloquent testimony to literature. In short, archaeology which is sometimes accused of being dry as dust has enlivened the study of an obscure period.

We will close this section by mentioning a few important excavations which have enriched the study of history in the northern parts of our country. Excavations done in several important places associated with the Buddha such as Sarnath, Bodh Gaya, Kausambi, Rajagriha, Kapilavastu have yielded remarkable and interesting material evidences which have enriched our knowledge about the history of Buddhism. For example, at Kausambi (in U P ) within a huge fortified wall of the city, the palace of king Udayana, a contemporary of Buddha, was discovered as well as the famous Goshitarama Vihara where the Buddha stayed. What greater joy can there be for a historian than to discover the very building in which the great teacher lived? Similarly, the great Cyclopean walls built by the Mauryas in their first capital Rajagriha as well as the monastic complex have been discovered. Recently, at Kapilavastu, archaeology has helped successfully to locate the stupa in which a portion of the mortal relics of the Buddha were interned by the members of his Sakhya Clan.
Archaeology has revived interest in the famous university site of Nalanda (Bihar), which was in ruins and forgotten. Excavations here have laid bare the layout of the vast structural complex comprising of the stupas, Chaityas and Viharas. Exquisite sculptures of the classical period of the Guptas who were great patrons of Nalanda University have been discovered. Several impressive Buddhist establishment have been brought to light in places like Udayagiri and Ratnagiri in eastern India, Devnimori in Gujarat, Amaravati, Salihundem, in Andhra State. These have given us new insights into the ancient and medieval centres of Buddhism in India; Their monastic establishments, religious affiliations, forms of worship, architecture, iconography have been brought back to life, as it were.

Instances can be multiplied to show the value of archaeology. But the foregoing brief account would be sufficient to show the increasing role of archaeology in serving as a valuable supplementary source of history.

3. Common Man's History

Another valuable aspect of archaeology that is worthy of special emphasis is the amount of materials it provides for reconstructing the common man's history. While many of the historical documents or inscriptions might pertain more to the higher classes and the heroes and the leaders of the society, the excavations often bring to light the day to day household objects of the common folk. Especially, where a village site is excavated one gets a good picture of the rural folks with their simple dwellings and equipments like handicrafts such as the terracotta beads, spindle-whorls, glass bangles, wooden combs, iron sickles, knives, bone tools, gamesman which throw much light on the arts and crafts of the villagers. The excavations in Harappa and Mohenjadaro exposed the presence of two parts of the city - the acropolis where the rulers and the higher class lived and the lower
city where the craftsmen and other common people lived. At Lothal, the entire workshop and the equipment of the bead-makers was laid bare. At Nagarjunakonda goldsmith’s workshop with all his gadgets and tools of the first two centuries A.D. was unearthed. Thus, 'archaeology’s range includes the peasant and the potter, the priest and the prince. “The archaeologist supplies the material for a social history of a sort that could never have been undertaken before” (Leonod Wooley).

4. Rescue of Historical Relics

This aspect of archaeology has already been discussed under Salvage archaeology. Here it is mentioned only to show how the techniques of archaeology serve to rescue and document the monuments and other historical relics of an area threatened by submergence or dam construction. In these days of increased constructional activity, the need for archaeological work assumes greater importance. Archaeologists play a vital role in the excavation and documentation of the sites and also in their transplantation and conservation.

5. Scientific Outlook

The study of archaeology helps to develop a scientific approach to the past as against a romantic view of history. Since archaeology provides stratified account of the artefacts and human material achievements with allied chronological sequence, we can have a fairly correct assessment of the progress of technology and material culture. Imaginary or exaggerated view of the material progress of past societies can give place to a more factual account of the tempo of progress. For later periods, literature often gives a glorified picture of the material prosperity of an ancient town or a race and archaeological work may act as a corrective to such an account. But a drawback in archaeology is that while it aids to reconstruct the material culture of the past, it is apt to miss the spiritual or intellectual aspirations or attainments of Man unless
they are reflected in the excavated remains. But even this deficiency may be only partly true because excavated remains and artefacts often do reflect the beliefs, the rituals and the behaviour.

6. Understanding of our Heritage: Humanism

An invaluable contribution of archaeology is that it enables us to have a better understanding of our cultural heritage and social traditions. As has been aptly observed by Martha Jowkowsky: "The essence of archaeology is that it makes our world much more meaningful. Through archaeological finds, many things that we have taken for granted begin to mean something. The past is not really "dead" and therefore irrelevant as some people think. It lives on, in words, customs and attitudes. Archaeology deepens our understanding of humanity and society. We are fascinated by the study of archaeology not only because it informs us, but more importantly because it orients us to our own environments and commitment to ourselves". Scholars like Sir Mortimer Wheeler have laid special emphasis on the humanistic value of archaeology. As Wheeler has observed "Man is not only the author or vehicle of culture trend, he is also a personality. The struggle towards civilization has been the struggle towards the fuller development and more ample expression of that personality". The study of archaeology is the study of the human struggles, efforts and triumphs not only of one country or one society but different parts of the world and diverse types of societies. This broad-based study leads to a more universal thinking and helps a better appreciation of the social and cultural traditions of different nations. Archaeology serves as a bridge across several countries and can contribute to universal outlook and liberal humanism.
CHAPTER II

HISTORY OF ARCHAEOLOGY

Section 1

General

Scientific archaeology is a modern development but treasure-hunting was a very old pastime. Curiosity to know about the past and its remains can be traced back to the classical times. The Greeks were interested in the problem of origin and development of man. They tried to know about the ancient civilizations of the Egyptians and Persians. The classification of history of civilization into five stages like the Age of Gold, the Age of Silver, the Age of Bronze, the Age of Epic Heroes and the Age of Iron with the corresponding characteristics of the people of the respective periods is found in the writings of Hesiod. The writings of Plato and Aristotle also contain speculations on the development or evolution of human cultures in stages.

Such interest in the past and speculation on the ages are found in the works of Roman writers like Tacitus. Roman philosopher Lucretius propounded a shrewd analysis about the existence of several technological stages in the evolution of society. He held that man used his hands, nails and teeth and then stones, wood, fire and lastly iron. His conclusion was based on speculation and not on any experiment or excavation.
The Chinese historians of second century B.C. (earlier than Lucretius) had formulated a four-stage sequence of technological evolution which remarkably anticipated that of Lucretius mentioned above. They were: the age of weapons made of stones for cutting trees; the age of weapons of jade, building houses and digging; the age when weapons were made of bronze for making canals and lastly, the age when they were made of iron (Jason W. Smith).

The earliest record of excavation and search for antiquities goes back to the times of Nobonidus, the king of Babylon (555-538 B.C.) He was deeply interested in the past culture of Babylonia and conducted excavations in the temple of Shamash and Sippar, found many earlier relics and even arranged for their display in a museum (Glyn Daniel). Instances of treasures hunting and robbing of tombs for treasures was known even in ancient Egypt and Ur. This interest did not continue in medieval times.

15th to 17th Centuries

In the 15th and 16th centuries, in the wake of the Renaissance movement in Europe, there was a new wave of interest in the classical world. Scholars looked back upon the glories of Greece and Rome. It became a fashion with the affluent people to furnish the home with ancient art treasures and antiquities. They sponsored excavation in the ancient sites. These men of Italian Renaissance were known as dilettanti, those who delighted in the fine arts. The art collection made by these people later on enriched many of Europe’s leading museums. The dilettanti in their own way were the fore-runners of the archaeologists.

In the 16th and 17th centuries England, there was a different trend which has been called “antiquarianism” distinct
from *dilettantism* of Italy. Interest in visiting and studying the monuments and other objects of antiquarian interest gained popularity. Many detailed studies of historical monuments were made by men like John Leland and Camden. The latter published his book *Britannia* in 1586. The former was appointed king's Antiquary in 1533, which marked a sort of official recognition of the new interest.

18th Century

In the 18th century, several important developments took place which laid the foundations of new approaches and study of the past. As has been pointed out by Glyn Daniel, the study of antiquities was invigorated by three things—the rediscovery of Greece, the Romantic Movement and the development of natural science. English scholars turned towards Greece, learnt the classical languages, visited these lands and made notes, drawings and excavations. Painter James Stuart and architect Nicholas Revett spent several years there and published the famous works *Antiquities of Athens* (1762) with detailed drawings. Similar field studies like *Antiquities of Ionia* (1769) *Ruins of Baalbec* (1757) were published on the monuments of Asia Minor, Syria and Egypt. According to M. L. Clarke, the expedition to Greece of Stuart and Revett mark the beginning of scientific archaeology. The antiquities brought by them also formed the nuclei of several museums in England. The sites excavated included were Pompeii and Herculaneum.

The second important development was the *Romantic Movement*. English scholars began to turn their attention to the antiquities and monuments of their own island. They began to glorify and romanticise their own history and historical relics like stone-henges, forts etc. A keen interest to excavate the monuments and find out their contents was widespread. Several
excavations were undertaken in the later half of the 18th century by persons like William Stukeley. Prof. Stuart Piggot would attribute the origin of the British pre-historic archaeology to the Romantic Movement.

The third important development that facilitated the growth of archaeology was the growing interest in natural science and history. Many societies like the Royal society, London (1666) the Society of Antiquaries of London (1718) were functioning actively. Thus, it is rightly concluded that the antiquarians, the Romanticists and the natural historians laid the foundations of archaeology.

19th Century Developments

The 19th century witnessed further impetus to the growth of archaeology. Besides the classical world, other countries like Egypt, Palestine, Mesopotamia received great attention. Egyptian archaeology practically began with Napoleon Bonaparte's invasion of Egypt in 1798. He took with him scholars and draughtsmen who set to work recording the archaeological remains of the country. The results of the work were published in the work entitled Description de Egypt (1808-25). The famous Rosetta stone was one of French collections which came into the hands of English later on. In 1822, Francois Champollion deciphered the ancient Egyptian writing. It was a great breakthrough for Egyptian archaeology which paved the way for more systematic excavations in Egypt by several agencies. The Egyptian Museum at Cairo was founded by the Frenchman Auguste Mariette.

Similar important discoveries were being made in other parts of the Near East and Meditarrenean countries like Nineveh
and Babylon in Mesopotamia, and the Aropolis in Athens. Another important landmark of this period was H.R. Rawlinson’s decipherment of the Persian text of the trilingual inscription of Darius I of Persia, which led to the decipherment of the Neo-Babylonian Cuneiform script. But the excavation techniques were still backward and did not differentiate occupation levels. In many cases, the excavations were no more than mass destruction and loot of the treasure. The British and the French archaeologists vied with each other to get the largest number of art objects in the shortest time possible. Excavations at the Assyrian capital Nimrud and Nineveh can be cited as two of the numerous examples of such ransacking of the ancient sites and tombs. They had no knowledge of how to preserve the priceless objects like frescoes or inscribed clay tablets. Belzoni’s large scale excavations in Egypt done in the beginning of the 19th century have attained notoriety for their “outrageous and audacious loot”.

But certain new developments were taking place which had their impact on the concept and technique of archaeology. The development of scientific archaeology has been rightly attributed to the three such developments: a geological revolution, an antiquarian revolution and the doctrine of evolution (Glyn Daniel)

The revolution in the field of geology is to be seen in the discovery and demonstration of the principles of uniformitarian stratigraphy by the geologists like William Smith and Charles Lyell. Before that period, the Biblical account of creation of earth in 4004 B.C. was the only theory of the origin of the earth which was widely accepted in Europe including the geologists. They proposed a uniform view of casual forces and rejected the Biblical view of a series of floods or catastrophes. The discovery
of genuine stone tools of man in certain datable strata demonstrated that man had been in existence long before 4004 B.C. Man's prehistoric past was established with the help of geological strata.

C. J. Thomsen established in 1836 the Three Age System in the classification of the artefacts in the Danish National Museum. He grouped them on the basis of the three successive ages of Stone, Bronze and Iron. His successor Worsae showed the correctness of the classification by stratigraphical evidence found in the Danish peat bogs and barrows. Excavations in the Swiss lake dwellings confirmed the succession of technological stages. This is termed as "antiquaraian revolution" by Glyn Daniel.

Theory of Evolution

Charles Darwin's theory of evolution of man propounded in his Origin of Species, emphasised the long past of man and also the idea of human evolution. His theory gave a new stimulus to the scientific world and, in particular, gave a new meaning to the study of man's pre-historic past.

The three new developments mentioned above created a climate of thought in which archaeology could flourish and make further advances. In the later half of the 19th century, the study of pre-history made rapid strides. Remarkable Palaeolithic sites were discovered in France and Spain including La Madeleine, Le Moustier and also the cave paintings at the famous sites of Altamira (Spain) and Les Eyzies in France and Lascaux. John Lubbock wrote his book Pre-historic Times (1865) in which he subdivided the Stone Age into old and New periods (Palaeolithic and Neolithic).
Henrich Schliemann (1822-1890)

By the end of the 19th century, there was a change in the emphasis and outlook of archaeologists who brought to bear on the work a historical perspective, recognised the value of the texts and looked for inscribed materials which had to be carefully dug out and preserved. An outstanding example of an excavator who had this new orientation of archaeological objectives was Henrich Schliemann. He was a German who became a citizen of U.S.A. He made a fortune in business and spent enormous amount in excavating the sites in the classical world. He knew many languages including Greek and Latin. He rejected the traditional view that the Iliad and the Odyssey were works of fiction and he argued that the poems described the real people and events. He wanted to corroborate Homer by finding out Troy. In several seasons of excavations between 1870 and 1889, he successfully located the City of Troy in the mound of Hisarlik in Asia Minor. He kept careful day to day notes of the progress of work and the location of finds. He was the first to recognise stratigraphy in the Near Eastern tell. He also found the remains of pre-historic Greek life at Mycenae and opened a new world of classical scholarship. Schleimann opened the eyes of the world to the possibilities of excavation directed towards solving problems rather than solely to the recovery of objects of art. "Modern phase of archaeology begins with him for he had shown what immense light an excavation of an entire site can throw if it is planned intelligently". He set the tone of what is still being done.

Pitt Rivers (1827-1900.)

The excavations of Pitt Rivers in the last quarter of the 19th century constitute a distinct advance in the technique of excavation and recording. He was a military general, known as General Lane Fox, before he assumed the name Pitt Rivers. He
was deeply interested in anthropology and archaeology and was particularly influenced by the theory of evolution. Sir Mortimer Wheeler gives the following assessment of Pitt Rivers's work: "His whole approach to archaeology was from a modern angle and for twenty years he explored the ancient sites with a science and scholarship that half a century of subsequent work has supplemented rather than superseded". He fully realised the value of the three-dimensional recording of the antiquities which is the essence of modern excavation. He was personally present to supervise the diggings and insisted on recording of the antiquities in such a way that every object could be accurately re-placed in the findspot on plan and section. His excavations were also well organised with regular and trained assistants. He attached importance to all antiquities however trivial they were, and classified them on typological basis. He also compared them with contemporary ethnographical material. His excavations were models of scientific digging based on stratigraphical observation supported by accurate plans and sections. He carried out his excavations with precision, thoroughness and discipline of a military operation. He brought anthropological and sociological approach to the study of pre-historic artefacts. As aptly observed by Glyn Daniel, "Pitt Rivers and Petrie were mainly responsible for the transformation of the archaeological outlook from one of curiosity to one which was frankly sociological". Pitt Rivers explained his approach in several notable lectures like *The Principles of Classification; The Evolution of Culture; Primitive Warfare and Early Modes of Navigation*. A part of Pitt Rivers's vast ethnographic collections was set up in Oxford and another part housed in a museum built by himself at Farnham.

**Sir Flinders Petrie (1853-1942)**

Sir Flinders Petrie was an Englishman who did yeoman service to Egyptology as well as to the techniques of field
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archaeology. He was a painstaking and imaginative researcher who laid emphasis on four important aspects viz. care for monuments, care in excavation and collection and description of everything found; accurate planning of excavation and publication of the results. He explained these principles in great detail in his classic book *Methods and Aims in Archaeology*. He was one of the first few to appreciate the value of pottery for chronological purposes. He developed the technique known as *sequence-dating*, a form of *seriation* by which he could give relative dating for materials which were entirely undated otherwise.

Thus, as pointed out by Glynn Daniel, the last quarter of the 19th century "archaeology came of age" and its essential technique had taken shape. The foundations of modern scientific archaeology were securely laid which were later developed and improved in the 20th century.

20th century developments

World Archaeology:

Archaeological work has developed into a well organised and systematised discipline with tremendous improvement in quality, quantity and methodology. There was extension of archaeological work into other areas of the world like India, China, America etc. Stone Age has been studied throughout the world. L S.B. Leakey's discoveries of stone tools and skeletal remains of early man dating back to two million years in Olduvai Gorge in Tanzania (Africa) are the most remarkable ones of this century. Similarly, new light has been thrown on the early Neolithic sites at Jericho in Palestine, Hassuna and Iraq. Remarkable evidence for the origins of agriculture in the Near East has been discovered. Sir Arthur Evans's memorable excavations at Palace of Minos, Knossus in Crete which had
reconstructed the rich Bronze age culture of Minoan, and an earlier Neolithic civilization constitute "one of archaeology's greatest achievements" (Casson), Evans published his discoveries in four volumes entitled *The Palace of Minos at Knossos* (1921-35).

Very important discoveries were also made in Egypt like those of Tell el-Amarna, the tombs of Yuwa, and the tomb of Tutankhamen. A sequence of the cultures of Egypt was also built up as can be seen from the works like Childe's *New light on the most ancient East* (1935) and Elice J. Baumgartel's *The Cultures of Pre-historic Egypt* (1947).

In Mesopotamia several scientific excavations were conducted by the Germans, the Americans and the English. Many Universities like Pennsylvania, Chicago and the British Museum, London, participated in the excavations. The most sensational excavation was that of the Royal Tombs at Ur by Sir Leonard Woolley in 1926. He published the results of his excavation in his works like *The Sumerians*, and the *Ur of the Chaldeans*.

Other sites excavated include Teppe Hissar, Shah Tepe, Tepe Sialk and Persepolis. Thanks to the excavations and the painstaking explorations of Sir Aurel Stein in east Iran, our knowledge of Middle Eastern Prehistory increased enormously.

**Biblical archaeology**

Archaeology in the Biblical lands of Palestine and Syria has added a great deal of details to the brief references found in the Bible to places, people, customs and historical events. The work was started even during the middle of the 19th century by persons like Edward Robinson who published the *Biblical*
Researc hes in Palestine (1852). Important places connected with the Bible like Jerusalem and Jericho were excavated. The history of Jericho settlement has been traced back to 7000 B.C. and its destruction by the Egyptians to 1500 B.C. At Ras Shamra, hundreds of clay tablets bearing texts in Cuneiform script and datable to 15-14th centuries B.C. were found. The language was closely related to the Phoenician and Biblical Hebrew. The Dead Sea Scrolls found in 1947 provided the oldest known Bible Manuscripts.

Indus Valley:

The discovery of the great Indus valley civilization at sites like Harappa and Mohenjodaro was an outstanding achievement of this century. More about this will be said in a succeeding section. But what has been described above, though brief, would clearly show the spectacular progress of archaeological studies. Glyn Daniel rightly observes: “It is a splendid story stretching back into the late nineteenth century to the heroic days of Petrie and Schliemann in Egypt and the Aegean to the north-west India and Transcaspia there emerges the tale of what Childe calls the Most Ancient East, the tale of the development of peasant village communities in the sixth and seventh millenium B.C. and the development of the great urban pre-historic or proto-historic civilisation of Egypt, Palestine, Syria, Anatolia, Mesopotamia, Iran and the Aegean. It is this great story which Breasted described as the New past of man”.

European Archaeology also made remarkable advance during this period. This can be briefly stated as follows: An indepth study of Palaeolithic cultures and classification of its successive stages of development. More and more specimens of palaeolithic art were discovered such as those at Lascaux (1940);
clear picture and identification of the Mesolithic culture and Neolithic cultures of Europe emerged in the period. Graham Clark's valuable works on Mesolithic culture of Britain and Europe were published. Similarly, much new work was done in the Bronze Age and early Iron Age culture of Europe. Archaeologists like Fox, Grimes, Crawford, Childe, and Piggott made substantial contributions. The Roman vestiges in Britain and other parts were also discovered and studied. For example, R. E. M. Wheeler's *Prehistoric and Roman Wales and Rome Beyond its Frontiers*. Mortimer Wheeler developed further the methods of Pitt Rivers and emphasized the vertical site record and statigraphy. He also infused a rare trait of vigorous military discipline and scientific precision to archaeological excavations. For him, excavation was a veritable military campaign characterized by thorough planning, orderliness, hard work and dedication. He showed the remarkable results of such an approach in his famous excavations like Maiden Castle and Verulamium in England and Harappa and Arikamedu in India. More about Wheeler in a later context.

**Scientific excavations:**

In the present century, field archaeology has become highly systematic and inter-disciplinary. It is with the aid of the techniques drawn from sciences like Geology, Physics, Botany, Chemistry and with the proper application of the background of History, Economics, Anthropology and Sociology that the archaeologist now studies the environment of his ancestors.

**Scientific aids in explorations:**

The sophisticated photographic technology, aerial photography, underwater photography and other scientific and remote sensing aids have all improved the equipment to a level far beyond that of the earlier archaeologists. These scientific aids
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help us in locating ancient sites and also scientifically uncover their secrets. In other words, the methodology in field archaeology has improved tremendously.

**Precision in chronology:**

Similarly, scientific dating methods like Carbon-14, Dendrochronology, Thermoluminiscence, archaeo-magnetism have lent precision to the chronological assessment of ancient cultures. All these aspects will be discussed in greater detail in a later chapter.

**Archaeological Theories:**

One other development in the archaeological studies is the conceptual interpretation of the archaeological discoveries. It started even in the 19th century but considerably expanded in the 20th century. This related to the formulation of certain general theories regarding the developments of human culture. We can appropriately discuss here the various archaeological theories.

We have already referred to Thomsen's "Three Age system" by which he showed that people had used stone, bronze and iron successively. The idea of evolution of human technology and culture was implied in this theory. Evolution implied an epochal idea of prehistory i.e. the development of culture in a certain sequence or stages automatically all over the world. According to this theory, everywhere in the world, the same cultural stages or epochs were gone through. This was also known as "the law of similar development". Lewis Henry Morgan (1818-1881) an American lawyer laid the theoretical foundations of the anthropological science. He studied more than one hundred societies throughout the world and compared them on the basis of kinship terminology they used. His research led him to analyse
the evolutionary stages through which man had passed. In 1877, he published his famous book *Ancient Society* in which he presented the human evolution "from Savagery through Barbarism to Civilization". He contended that the "history of human race is one in source, one in experience and one in progress".

Against this theory of evolution of culture from stage to stage by its own innovation was the theory of diffusion already propounded in the 19th century but considerably improved and in the first half of this century. According to this theory, development of culture is attributable to the "stimulus diffusion" coming in the wake of the arrival or invasion of new people or indirect influences of new ideas percolating through contacts. One school of diffusionists held the extreme view that all culture spread from Egypt. Elliot Smith and Perry were the champions of this Egypto-centric culture diffusion. The former expanded this idea in his book *The Migrations of Early Cultures* (1915). But, the discovery of earlier cultures in other parts of the Near East have disproved this theory.

In the first half of this century, new orientation marked the study of human culture. It was a change from the purely geological-epochal to historical and anthropological attitude to the culture study. Detailed archaeological researches in many parts of the world have demonstrated that the so called cultural stages or epochs often co existed. They were found to be not necessarily successive but contemporary phases of a culture. Archaeologists began to see that though there was a general increase in technological efficiency in prehistoric times, culture did not everywhere go through precisely the same stages in the same way. This new historical and anthropological or cultural approach to pre-historic cultures was ably presented by Gordon
Childe in his work *The Dawn of European Civilization* (1928) and *The Danube in Prehistory* (1928) etc. This “new European pre-history” in the words of Glyn Daniel “used geology as a framework for relative and absolute chronology of its cultural sequence but it conceived its sequence in terms of historical and anthropological concepts, in terms of civilizations and cultures”.

**Gordon Childe (1892-1957)**

One of the most prolific and influential writers on the new interpretation of cultural history was Gordon Childe the famous Australian born British archaeologist. He was successively Professor at Edinburgh and London. His understanding of old world pre-history was unparalleled and his analysis of the dynamics of social change was penetrating and masterly. His works like *Man Makes Himself* (1951), *Social Evolution* (1951) *What Happened in History* (1954), *The Dawn of European Civilization* and the *New Light on the most Ancient East* have established him as a great social thinker whose influence on the archaeologists of this century was indeed profound. Childe described culture-history in terms of major technological and social advances or ‘revolutions’ that enabled man to make better use of his environment. For Childe, man’s social evolution was dependent on his technology and the material culture was largely a response to an environment. He recognised that each society responded to its own peculiar environment and evolved its distinctive processes and devices. But these “inventions and discoveries” were not confined to their region alone, societies migrated to regions which in turn evoked other responses in those societies. “The migrant society does not throw away its traditional equipment; more usually the immigrant and the native traditions blend”. In other words, Childe recognised the divergence of responses and cultural traditions and the impact of diffusion of ideas from one society to another. He demonstrated
that culture grows more and more diversified through the differentiation of societies in response to special stimuli, geographical, technical or ideological. But at the same time, due to interchange and interaction between societies they began to come close.

He observes: "If the streams of cultural tradition go on multiplying they nevertheless tend to converge more and more and flow into a single river....cultures are tending to merge into culture" (What Happened in History p. 23). According to him, the historical process was marked off into several phases or stages by a series of revolutions.

In the first stage, which he calls "Palaeolithic Savagery" (sometime between 500 to 250 Thousand years ago), man lived like any other beast of prey, a parasite on other creatures and gathering food from nature. Archaeologists would call this period as the Old Stone Age or Palaeolithic and the geologists as "Pleistocene." The "Neolithic revolution" took place about 8,000 years ago when food producing economy was ushered in with its features like cultivation, domestication of animals and other accessory equipment. This would correspond to Morgan's classification as Barbarism. This was followed by what he calls the "Urban revolution" which ushered in the "Civilisation". This took place about five thousand years ago in the alluvial valleys of the Nile, the Tigris, the Euphrates and the Indus. It witnessed the transformation of riverside villages into cities. The farmers had to produce a surplus of food stuffs over and above their requirements and use the surplus to support "a new urban population of specialised craftsmen, merchants, priests, officials and clerks". Writing was a by-product of this urban revolution which ushered in "Civilization" and historical records started from this period. Childe subdivides this period of urban
civilization into many stages. The first two thousand years, according to him, coincide with the Bronze Age because copper and bronze were the only metals used for tools and weapons. They were scarce and expensive and the advantages concentrated only in the narrow circle of priests and officials, but the discovery of Iron around 1200 B.C. marked the Early Iron Age and popularised the metal equipment which was used more widely. The invention of an alphabetical script and introduction of coined money facilitated commercial transactions. Then, a chain of events like the wide distribution of surplus production among the merchants, financiers, and capital formers which ushered in the Age of Feudalism, settled agriculture and increased productivity and development of trade promoted the growth in the European population. Finally, the discovery of the New World and sea ways to India and the Far East opened a world market which was followed by the Industrial Revolution. Gordon Childe was a leading exponent of the diffusionist theory which interpreted all major developments in terms of the spread of the people or ideas from the Near East. He also laid emphasis on the study of the local development—a study which is now called “processual archaeology”.

Robert J. Braidwood: Ecological Approach

A leading archeologist from the University of Chicago U.S.A. who contributed much to develop the ecological approach to archaeological interpretation by demonstrating the productive results of cooperation with the natural scientists and value of their data for a better understanding of the prehistoric record was Robert J. Braidwood. His Iraq-Jarmo expedition 1954-55 was conceived of not as a simple site excavation, but as an attack on the ecological problem of the origins of plant and animal domestication. A geologist, botanist, zoologist and
ceramic technologist were employed to study and analyse their sub-systems with the general ecological framework. Remains of early forms of domesticated plants and animals were discovered and attempts were made at palaeo-environmental reconstruction. The results of his studies were published in his work *Prehistoric Investigations in Irawit Kurdistan*, 1960, which he wrote in collaboration with Bruce Herve and others. This approach has become very popular particularly among the American archaeologists and anthropologists who have variously applied and refined it. Similar multi-disciplinary study was undertaken by J.G.D. Clark in north-east England, using pollen analysis of peat deposits to reconstruct a Mesolithic camp site. One criticism against the ecological approach is that it might lead to underestimate the social and human factors and view all the changes as the result of environmental changes. If this model is not used with caution i.e. making due allowance for other factors that influenced the societies, it may lead to the fallacy of environmental determinism. But it can not be denied that this approach has provided new insights in to the understanding of prehistoric societies, their ecological constraints and man's adaptations. As P. J. Watson *et al* observe: “The ecological view of culture has already achieved widespread acceptance and is more readily applicable to archaeological data than the more general systems theory. Its real contribution is the perspective it gives to research. Through it, the investigator views man and nature as participating in a series of dynamic and interacting systems. This concept of interpretation of culture and environment leads to productive and testable models” (*Explanation in Archaeology*, 1971, p. 107).

Recent trends in Archaeological Theories: New Archaeology

As pointed out in the I chapter, the main thrust of research in archaeological field in the last twentyfive years has
been a quest for theory building and linking theoretical work with empirical observation. This goes under the name “New Archaeology” which has a number of proponents, chief among them being Lewis Binford, David Clark, K. V. Flannery, Frank Hole and others. The ultimate goal of scientific archaeology, according to this school, is to formulate general theories to explain and predict major transformations, cultural processes and human behaviour. Binford asserts that though the archaeologist’s data is mainly the material remains of a culture, he can infer even the non-material aspects and indeed the cultural system by studying “the entire range of determinants which operate within any socio-culture system, extinct or extant...”. According to him, the limitations of our knowledge of the past lie in the inadequacy of our research designs and methods, not in the archaeological record. The behaviour pattern of the people of the past can be investigated by hypothetico deductive method of science because archaeological remains and their spatial relationships are empirically observable records of that patterning. These archaeologists are also often referred to as processualists or even “progressives” (P. J. Watson et al). They want to adopt a scientific framework as the basis of investigation and study of extinct cultures. Scientists of other disciplines provide various models demonstrating how the methods may be applied. Anthropology or ethnology oriented framework is one such model. Two other important explanatory frameworks are the systems theory and the ecological approach which are discussed in detail in the book Explanation in Archaeology—An explicitly Scientific Approach by Watson, Le Blanc and Charles L. Redman (1971). We need not go through the elaborate arguments put forward by the various proponents of this new approach. A few points may however be mentioned briefly.
The Systems Theory Approach

A group of researchers known as general system theorists have in the recent decades built a body of laws and methods to help investigate systems of all types. Their basic assumption is that there are “systems so basic in nature that they can be seen operating virtually in every field” (Flannery 1967) and that they can be usefully applied to prehistoric cultural systems by the archaeologists. The systems-oriented archaeologist focuses attention not so much on the artefacts or activities in themselves but seek out the way this system behaves in a given environment. The traditional analytical technique for studying relationship has been to isolate pairs of variables and to study their behaviour. This is considered inadequate because in most systems pairs of variables do not act in isolation.

Systems theory emphasises the “connectedness” of the subsystems and of the variables within each of them. “Positive feedback occurs when subsystem stimulates another which in turn stimulates the first one. It is a self stimulating link that leads to growth and change (morphogeneses). Negative feedback occurs when one subsystem restraints another (homeostasis) so that things remain as they are (Ian Hodder). Kent V. Flannery has explained the attempts to utilize various aspects of Systems theory to explain a cultural process. He examines the transition from food collecting to sedentary agriculture in terms of a series of “procurement systems” of specific plants and animals. According to this systemic view, one excavated site represents a single example of one type and does not reflect the whole settlement system. Different forms and functions of settlements during each period as well as their configuration and demographic parameters should be taken into consideration. Clustering and grouping of artefacts into, ‘types’ is useful and necessary procedure for some
kinds of analysis but not for systemic analysis. It might be better to measure all of the relevant variables independently before clustering into types. This gives the researcher more than one dimension along which to measure artefact variability. Binford advocates this type of procedure when he suggests that technical, morphological and decorative dimensions of artefacts be compared separately. It helps to focus attention on the multiple causes of change. Binford says: "Culture is multivariate and its operation is to be understood in terms of many casually relevant variables which may function independently or in varying combinations. It is our task to isolate these causative factors and to seek regular, stable and predictable relationships between them". P. J. Watson et al. sum up thus: "The greatest contribution of systems theory to archaeological research is the formulation of testable models of human behaviour. The central purpose of a theoretical model is to aid the researcher in the selection of relevant variable and significant hypotheses from an infinite number of possibilities."

Various other models based on analytical and inductive statistical techniques, seriation techniques, computer simulation mathematical models, information and communication theory are being tested to evolve general theories. Some mathematical models have been put forward mainly emphasising the set of quantitative relationships that are considered to hold among the variables. They have been variously applied to study the problems connected with the location and spacing of sites, spatial distribution of artefacts on a site etc. The clusters of sites are identified and possible reasons of the cluster are analysed such as, for example, water source, raw materials, climate etc. Within a site, the clustering and patterning of artefacts are taken to reflect the behaviour of the people in a settlement. One criticism against this approach is that many other factors would have also caused
the disturbance of artefacts during or after deposition in which case the so called the "spatial patterning" would have been accidental and not deliberate (M. Schiffer, *Behavioural Archaeology*, 1976). However, certain general conclusions can be arrived at if the investigation is done on a wider scale. Different categories or hierarchies of sites are also sought to be distinguished and theories like the central place theory have been put forward (I. Hodder and C. Orton, *Spatial Analysis in Archaeology*). For example, the pattern of Roman walled towns in Britain has been analysed in this manner.

A good example of locational model based on analytical archaeology is that of D. L. Clarke on the distribution of structures, clay floors, hearths and artefacts on the Iron Age marsh settlement at Glastonbury in England and he has presented modular unit showing the organisational and functional components occurring throughout the history of the site (*Models in Archaeology*, 1972).

The New Archaeology has come in for considerable criticism not only at the hands of the traditional archaeologists but also by younger archaeologists. The former feel that this approach de-humanises archaeology. Mrs. Jacquetta Haukes one of the authors of the UNESCO’s *Cultural History of Mankind* (1968) has observed that all our exact measurements and statistical analyses are of no avail if the archaeological discipline loses its "humanity". Bruce G. Trigger (1968) does not think archaeology need be or should be explicitly scientific but rather emphasises its historical and descriptive aspects. There are archaeologists who consider the recent emphasis on explicitly scientific or theoretical archaeology as a "rehetorical flourish", "a terminological fad" while the actual work of the archaeologist,
like that of the historian, is to describe what happened. Robert Adems (1968) raises the question whether anthropologically oriented archaeology should indeed be explicitly scientific. Some archaeologists accept the value of all scientific methods in the exploration, excavation techniques, data collection and analysis, but have reservation regarding the formulation of general laws and predictive theories. This debate is going on between the nomothetic or theoretically-oriented and the ideographically oriented archaeologists, between the generalists and the particularists. Many archaeologists like Trigger emphasise the value of the ideographic or historical aspects of archaeology i.e., primary concern is to describe and explain the particulars, and infer the general laws of human behaviour and cultural process.

P. J. Watson et al. point out that the nomothetic approach is still in its experimental stage and it has to go a long way; but emphasise that archaeological data provide the only means for investigating culture process for a long-time periods and that they are potential source of independent evidence for testing a number of hypothetical laws. They rightly conclude that both the approaches, nomethetic and ideographic, are essential. They are complementary and not conflicting. Scientific framework is necessary for an adequate historical description and explanation of particular events.
Section 2

ARCHAEOLOGY IN INDIA

The immense epigraphical, architectural and sculptural wealth of India, not to speak of its hoary religious centres, were always subjects of reverence for Indians and curiosity for the foreigners who visited India as traders, travellers and rulers. Respect and interest for preserving the old objects and records is ingrained in the Indian mind. We come across interesting instances of renovation of ancient temples undertaken with due care to preserve older inscriptions. Some inscriptions of the Chola period expressly tell us that before older structures were pulled down for rebuilding a shrine, the inscriptions on the walls were copied out and re-engraved on the walls of the new structure. In one instance (near Pudukkottai), it is stated that the renovators who could not read or understand the old inscription took care to re-engrave it in the new wall. These instances would show their interest in preserving the older records though, we do not get evidence for any effort having been undertaken to decipher or study them.

Generally, the interest in the collection and preservation of old objects seems to have been a royal pastime. The royal palaces of the numerous princely states in India had rich collections of old jewels, sculptures and paintings and other antiques. More enlightened among them looked at them as cultural objects and took steps to study and understand them. The valuable collections of MSS and other curios made by the scholarly Mahratta ruler Sarabhoji in his famous Saraswati Mahal in Thanjavur can be cited as an example of the royal efforts in this direction. The old royal collections have often
formed the nucleus of the later day museums, for example: The Salarjung Museum, Hyderabad and the Ramnagar Palace Museum, Varanasi.

Foreign rulers and visitors in India though impressed with Indian monuments and art objects made no real attempt to understand the historical background of the culture of the people among whom they worked. As rightly pointed out by Prof. A.L. Basham, "They accepted that culture at its face value as very ancient and unchanging and their only studies of India's past were in the nature of speculations linking Indians with descendents of Noah and the vanished empires of the Bible". A few Jesuit and other missionaries learned Sanskrit and other ancient languages of India like Tamil; but their interest remained largely linguistic. From the last quarter of the 18th century, officers of the British East India company began to take interest in the antiquarian wealth of India. In 1784, under the initiative and guidance of Sir William Jones, a Judge of the Supreme Court and a linguistic genius, the Asiatic Society was started in Calcutta for "enquiring into History the Antiquities, Arts, Sciences and Literatures of Asia". Jones found in Charles Wilkins (1749-1836) a kindred soul who had a good knowledge of Sanskrit and a passion for Indian classics. They had the blessings of Warren Hastings, the Governor General at Calcutta. The establishment of the Asiatic Society and the publication of its journal *Asiatick Researches* in 1788 gave a fillip to Indological studies. Jones and Wilkins translated several Indian classics like the *Bhagavad Gita*, *Hitopadesa*, and *Sakuntala* into English and, in the beginning, their interests were mainly literary. But these served as the first steps in revealing India's past to the outside world. Archaeological work was indeed limited to the preparation of notes on monuments which were rather unscientific. But, Charles Wilkin's work proved
important and provided the key to the decipherment of the Gupta script. Explorations done by H.H. Wilson in Afghanistan and Francis Buchanan in Bengal and Mysore brought to light many interesting finds like temples, coins etc. Many East India Company’s surveyors brought back reports on temples, caves and inscriptions. James Fergusson conducted an architectural survey of the country for eighteen years (1829-47) and systematically classified the monuments. It was remarkable work which remains still a classic. In 1838, James Princep an official of Calcutta Mint and a gifted amateur deciphered the Brahmi script in which Asokan edicts were written. This opened a new vista in the historical studies in India and provided a sheet anchor for Indian chronology.

**Alexander Cunningham (1861)**

—The father of Indian Archaeology

Alexander Cunningham was an army engineer who worked in the spare time with Princep in his work on the decipherment of Brahmi script. He took keen interest in the study of ancient monuments and sites of India and impressed upon Lord Canning, the Governor General, the need for a systematic exploration. Accordingly, in 1861, Canning established the Archaeological Survey of India with Cunningham as the Archaeological Surveyor. He took up the work with single minded devotion and abiding interest and surveyed extensive areas in north and eastern India. He followed the accounts of the foreign travellers like Fa-Hien and Hiuen Tsang and tried to identify the ancient routes and places. He and his surveyors visited several monuments and remains and published reports with photographs and drawings. He identified the chief cities and sacred places of ancient India such as the city of Taxila, the fortress of Sangala
(connected with Alexander); Sankisa, Sravasti, Kausambi, all intimately connected with Buddha; the Great Stupa of Barhut, dated inscriptions of Asoka; new rock edicts in Bactrian characters. His publications and bulletins stand as testimony to his untiring efforts, dedication and respect for Indian cultural heritage. Though his exploration techniques were not advanced during his times, he and his enthusiastic assistants had a passion to explore and unravel India’s past. “After Sir William Jones, Indology owes more to General Sir Alexander Cunningham than any other worker in the field” (Basham).

Fleet And Hultsch

Other important persons who can indeed be called the pioneers may be mentioned here briefly. John Faithful Fleet was appointed Government Epigraphist in 1883; Hultsch served as the Epigraphist for South Indian inscriptions. Hultsch was well versed in Sanskrit, Pali and Dravidian languages. They did remarkable job in bringing to light valuable inscriptions and publishing them with their scholarly notes.

Medows Taylor

Of the early pioneers who have made a lasting contribution to Indian archaeology not only by the volume of work and their absorbing interest but also adopting scientific methods of enquiry were Medows Taylor and Robert Bruce Foote, the former an administrator, the latter a geologist. Meadows Taylor was in service of the Nizam of Hyderabad. He is known by his famous work *The confessions of a Thug*. He excavated a number of Megalithic tombs of Central and Southern India with meticulous care for details which he recorded and published in the *Journal of the Bombay Branch of Royal Asiatic Society* (1851) and *Antiquities*
(1862). The drawings of plan and sections that he drew clearly indicate that he differentiated between the layers and presented a sequence of the deposits. Wheeler is right in stating: “Medows Taylor was the first man, so far as I know, to hint implicitly at the true function of an excavator and recorder. His works show an acuteness of perception and technical competence far advance of the time. His achievement stands out as a landmark in the annals of archaeology.”

Robert Bruce Foote

Another important figure who did remarkable pioneering work in pre-and proto-historic archaeology of India was Robert Bruce Foote. He is acknowledged as the “Father of Indian Prehistory”. He served in the Geological Survey of India from 1858 to 1891 and spent a good part of his service in the Madras Presidency working with William King and after retirement worked in Baroda and Mysore states. He made valuable contributions to the study of the geology of peninsular India and took been interest in archaeology and was looking for traces of early man. In 1863, he discovered the first palaeolith at Pallavaram near Madras and then for the next 43 years explored different parts of South India and discovered numerous Palaeolithic, Neolithic and Megalithic sites. All his collections were deposited in the Madras Museum. In 1914, he published two volumes on his collections, The Foote collection of Indian Prehistoric and Proto historic Antiquities. It is a remarkable publication containing numerous photographs and drawings of the prehistoric tools, pottery, iron objects etc. with excellent descriptions. Being a geologist, he had a good idea of stratigraphy and sequence of cultures.

James Burgess

James Burgess who succeeded Cunningham made many notable contributions. He started the publication of Indian
Antiquary in 1872 and Epigraphia Indica. He published the results of his elaborate surveys in twenty monumental volumes entitled Archaeological Survey of India, New Imperial Series. Even though he was not himself a trained excavator, he insisted on professional control of excavations and took measures against indiscriminate digging.

Lord Curzon (1899-1905)

"After the retirement of Burgess, archaeology suffered a setback which was removed only after the arrival of Lord Curzon as the Viceroy. Though known for his imperialist ambitions, he had sympathetic attitude for the preservation of ancient cultural relics and archaeological researches. He had a comprehensive view of the archaeologist’s work. In his famous address to the Asiatic Society of Bengal in 1900, he observed: "It is equally our duty to dig and discover, to classify, reproduce and describe, to copy and decipher and the cherish and conserve". In other words, his programme included exploration, excavation, research, epigraphy, publication and preservation of monuments. The Archaeological Survey was reorganised and enlarged. A young archaeologist (26 years of age) John Marshall was appointed as the Director General in 1902.

Sir John Marshall (1876—1958)

During his tenure (1902-1928) archaeology was placed on permanent footing with defined policies to guide it. Hundreds of monuments and sites were declared protected and brought under the newly enacted Ancient Monuments Preservation Act (1904). Several circle offices and branch offices were formed to look after the monuments. Marshall gave much importance to excavation and, during his period, several Buddhist and other historical sites were excavated such as: Sarnath, Rajgir, Sanchi, Sravasti,
Kusinagara, Nalanda, Pataliputra (Patna) and Texila. All these excavations yielded very interesting antiquities like sculptures, inscriptions, seals, coins etc besides impressive structures. Remains of the Mauryan palace were discovered at Pataliputra and a fine town planning system under Indo-Parthians at Texila.

The greatest triumph of Indian archaeology during the period was the discovery of the Indus Valley civilization at Harappa (Punjab) and Mohenjo-daro in Sind. The earlier works were done in these sites by Daya Ram Sahini and R.D. Banerjee in 1921 and 1922 respectively, but later extensively excavated by John Marshall assisted by Hargreaves, K.N. Dikshit and M.S. Vats. The discoveries were indeed startling which John Marshall rightly compared with Schliemann’s discovery of Troy and Mycenae. The results of these excavations were published by him in three fine volumes, *Mohenjodaro and the Indus civilization*. These discoveries created widespread interest in archaeology in India and gave a fillip to further work. Systematic exploration and excavations done by Stein, Majumdar, Hargreaves extended the horizon of the chalcolithic Indus civilization into Sind, Baluchistan and sites like Chanhu-daro, Amri and Jhukar, were excavated.

Other important excavation works done during this period were: Urn-burial site at Adichanallur in Tirunelveli district of Tamilnadu by Alexander Rea; the early historic city and Buddhist centre at Nagarjunakonda by A.H. Longhurst.

In 1939, the distinguished British archaeologist Sir Leonard Wooley was invited to advise on the future policy on exploration and excavation. He criticised the excavation techniques as outmoded. He pointed out that the Indian archaeologists had not kept in touch with the latest techniques adopted in Europe
and America. According to him, there was very little attempt to establish the sequence of cultures based on stratigraphy. In fulfilment of this objective, Mortimer Wheeler was appointed the Director General in 1944.

**Sir Mortimer Wheeler (1890-1976)**

The appointment of Robert Eric Mortimer Wheeler as the Director General of Archaeology in India in 1944 was a landmark in the annals of Indian archaeology. Wheeler brought to India the scientific methods of archaeological excavation which he had developed in England from the earlier techniques of Petrie and Pitt Rivers. He reorganised the Department of Archaeology and expanded its activities in several branches like excavations, museums, technical, research etc. He trained a band of young archaeologists in modern methods of excavation and conservation. He also invited the scholars from the universities to participate in excavations. He conducted well planned and problem-oriented excavations at Taxila and Harappa in north west India and Brahmagiri and Arikamedu in South India. They yielded significant results which he published in reports which are models of precision and masterly interpretation. He also started a new series of publications such as *Ancient India and Indian Archaeology* which continue to hold an important place among the archaeological publications of India. Mortimer Wheeler has left a profound impact on the Indian archaeologists by his spirit of discipline and the strict observance of rules in field work. Himself a Brigadier, he introduced military discipline into archaeological camps and succeeded in projecting archaeology as a serious profession. He was the founder of the Institute of Archaeology in London University. He realised the need to train young scholars in the field archaeology, conservation and other branches and started the training camp at Taxila where a few...
selected Indian scholars were given training. This was continued for several years and later on (1960) culminated in the establishment of the School of Archaeology, New Delhi. Wheeler recognised the useful role to be played by the Universities and the State departments in the field of archaeology and museums. Indian archaeologists were also sent abroad in order to have contacts and learn latest techniques. In short, Wheeler brought Indian archaeology in line with the best international standards. From the time of Wheeler, the Archaeological Survey of India is practically manned by Indian archaeologists, many of whom were trained under him.

The establishment of the School of Archaeology in 1960 in New Delhi under the Archaeological Survey of India is a fulfilment of Wheeler's stress for a Central Institute of archaeology for training and research on a national level.

The Departments of archaeology of several states and the Universities in India have made valuable contributions to the progress of archaeology. Even prior to Independence, the princely states of Mysore, Travancore, Cochin, Pudukkottai, Hyderabad, Gwalior, Baroda, Jaipur had each a department of archaeology which did fairly good work especially in the fields of epigraphy and museums. Small scale excavations were also conducted by them. In the recent years, almost all the states have separate department of archaeology. Many universities in India have departments of Ancient History and Archaeology which offer post-graduate degrees and research facilities for Ph. D. degrees. A large number of young scholars are trained in different branches of archaeology including explorations, excavations, art and architecture, numismatics etc. Some of the large-scale excavations like those of Maheshwar, Kausambi, Atiranjikeda,
Kanchi T. Nasipur, Takkalakotta, were done by the University departments. There are also research institutes like the Deccan College Post-graduate and Research Institute, Poona, Jayaswal Research Institute Patna which are doing valuable work. Significant work in prehistory and excavations have been done by the Deccan College, Poona under the dynamic leadership of the doyen among Indian archaeologists, H. D. Sankalia and his colleagues like S. B. Deo and others. A number of Indian scholars have done significant work in the post-Independent era like A. Ghosh, V. O. Krishnaaswami, B. Subba Rao, B. B. Lal G. R. Sharma, K. R. Srinivasan, M. N Deshpande, B. K. Thapar, N. R. Banerjee, R. Subrahmanyan, S. R. Rao, K. V. Soundararajan, R. V. Joshi, to mention only a few.

Recently, environmental archaeology and scientific dating methods like Carbon-dating, Tree ring method, Pollen analysis, Thermoluminescence, etc. have assumed great importance. There are several institutions which have developed special infrastructure facilities for carrying out these investigations. The Tata Institute of Fundamental Research, Bombay and Physical Research Laboratory, Ahmadabad and Birbal Sahini Institute of Palaeo-Botany at Lucknow are doing excellent work and helping the departments of archaeology in getting their data scientifically analysed besides publishing their own technical reports. The Archaeological Survey of India has also its conservation and scientific wings where facilities for chemical cleaning preservation methods are undertaken. Other departments like those of the Anthropological, Botanical, Zoological Survey of India etc. undertake collaborative work with the archaeological departments and make valuable contributions to pre-historic and other archaeological studies. Thus, archaeological studies have made notable progress in India in all branches since Independence. Necessary scientific facilities
are available in our country to undertake works connected with conservation of antiquities and monuments, exploration, excavation, environmental archaeology, scientific dating, etc. Almost every major museum has its own scientific unit to attend to the needs of conservation. Some beginnings have also been made in underwater archaeology by creating an archaeological wing in the Institute of Oceanography, Goa. It has undertaken some preliminary work in the ancient port towns of Dwaraka and Kaveri-pumpattinam. Seeing the progress of archaeological work, Sir Mortimer Wheeler observed even in 1956 “Today no part of the world is better served in archaeological matters than is the Republic of India”.
CHAPTER III

SURFACE EXPLORATION-NATURE METHODS EQUIPMENT AND RECORD

Section 1

Nature and Objectives

Location of an ancient site or a buried monument or an artefact is one of the important first steps in archaeological investigation. This initial discovery may be casual, accidental or deliberate. Many of the archaeological discoveries of 19th century were accidental. During the digging of a canal or laying of a track or ploughing of the land, ancient structures or burials might come to light. Many of the Roman coin hoards of South India were accidental discoveries by the plough. The discovery of the site of Mari on the Euphrates was the result of a chance discovery by the local people. The site was excavated later on. Londoners discovered ancient Roman walls during the clearance done after the German raids in World War II. An outstanding example of an accidental but sensational archaeological discovery was that of the famous site of Harappa in Montgomery District of Punjab in 1921. Ancient brick structures were encountered there when the area was being cleared for laying out railway lines.
Chance discoveries will continue to play their part in bringing to light the hidden treasures of the earth, especially in the wake of increased tempo of activities like extension of cultivation, the laying of new roads or railway lines, extensive house building activities and the like. An archaeologist has to take note of such discoveries and utilise the data in his field investigation, though he does not depend solely on them.

Certain natural agencies like floods or river and sea erosion would suddenly uncover the presence of ancient sites and settlements. The river erosion would often expose the sections of the tool-bearing terraces and help the prehistorian to identify the tools and the geological sequence. It is a common sight in the places like the Vaigai river bed near Madurai to see people actively picking up old coins soon after the floods recede. Even buried brick structures would be exposed by the river erosion. The archaeologist should take advantage of these exposures by the natural agencies by visiting the suspected sites soon after the floods and erosions.

The search for ancient sites and antiquarian remains can however be organised in a systematic and meaningful way by the professional archaeologists. In fact, one of the primary tasks of an archaeologist is to explore an area or a site for its archaeological potentialities before he undertakes excavation. Site survey is a preliminary study of the field data available on the surface of a site or an area. Just as the geologists do prospecting for minerals or oil, the archaeologist searches for the ancient sites and antiquarian remains. The process of locating, recording and study of archaeological sites on the basis of their surface features and without recourse to excava-
tion is known in England as "field archaeology". Terms like "Site Survey" or "reconnaissance" are used in the United States. The term exploration, is used in India to distinguish preliminary site survey from excavation. Crawford would call it "archaeology without digging".

Surface explorations have a vital role to play in bringing to light the nature and the distribution of artefacts or cultures not only in a site but also over a wider region. Sir Aurel Stein's explorations in Central Asia in the 1920s and 30s enabled him to record an extraordinary amount of archaeological material from Iran and Baluchistan. His discoveries formed the basis for several important excavations in the area. Similarly, the survey of Chingleput District in South India conducted by V. D. Krishnaswami in 1940s helped plotting nearly 200 sites with different types of the megalithic tombs in the area. This has formed the basis for excavations in several such sites which have yielded a substantial evidence of the Megalithic culture of South India. So, field exploration helps us to enlarge our knowledge about the archaeological materials of an area and acts as a good indicator of the nature of the sites or cultures that one could expect in an area. It enables us to collect various surface finds such as tools, pottery, coins, terracotta figurines, seals, beads etc. and recognise or reconstruct the different cultures and periods represented in the collection. Exploration in a wider area will also enable us to study the distribution pattern of such cultures or industries and assess their impact on a larger space. Since excavations are expensive and time consuming, they can at best be done in selected sites. Surface exploration, though not a substitute for excavation, is of great value for an archaeologist.
to plan his excavations in selected sites, on the basis of surface exploration, many interesting facts like the distribution pattern, interspacing of sites, factory and seasonal sites can also be identified. This has undergone great improvement in recent decades especially in U.S.A.

Objectives

A site survey can be undertaken for different objectives depending upon the nature of the problem taken up by the explorer. The areas to be inspected, the land features to be observed, the nature of artefacts to be collected, and, in short, the strategy to be adopted in the field depends largely on the objectives of survey. The objectives of the survey may broadly be classified as follows:

(1) Survey of Pre-Historic Sites

An explorer may be a specialist in pre-history and would like to study the Palaeolithic, Microlithic and Neolithic sites of a region. Yale Cambridge expedition to the Sohan Valley was solely organised to study the Pleistocene archaeology. Prof. Zeuner’s survey of the Teri sites of Tirunelveli (Tamilnadu) would also come under this category.

(2) Survey of Proto-Historic and Historical Sites

As an example of the former, the survey of the Indus valley sites in Rajasthan, Gujarat etc. in the post-partition period can be cited. As an example of the latter, exploration of the sacred Buddhist sites of India may be cited. For historical sites, we have the literary and epigraphical references also to go by. For proto-historical period, we may or may
not have these reference. There are no literary references
evidence available for the existence of the Indus Valley
Civilization.

(3) Survey for a Specific Problem:

A field survey is sometimes undertaken to get
information on any specific problem, prehistoric or historic.
Survey of the Megalithic monuments of South India undertaken
by V. D. Krishnaswami can be cited as an example of this.
The main purpose of the survey was to study and classify
different types of the Megalithic tombs found in South India.
Archaeology of the Ramayana sites will also fall under this
category since the exploration is limited to the sites mentioned
in the epic. Exploration to find out a lost city mentioned
in ancient literature or inscriptions would also come under
this category. Other examples of problem-oriented surveys
are: archaeology of Roman sites in Britain and India;
monumental survey of any one style or period such as the survey
of Pallava cave architecture of Tamil Nadu done by
K. R. Srinivasan.

(4) General Survey

A site survey can also be undertaken to assess all the types
of antiquarian remains of an area in general. That is, it may
include the pre-historic, proto-historical items cited above.
Usually, when an archaeologist once goes to the field to
undertake the site survey work, it is better to include as
many items as possible in its purview. In such a survey, all
items like stone age sites, mounds, burials, habitation sites,
forts, temples, sculptures, inscriptions etc. are all documented. In India, such a type of exploration is often referred to as "Village to Village Survey antiquarian remains" since there are thousands of villages having ancient landmarks of one kind or the other.

SECTION — 2

Methods of Site Survey

As pointed out earlier, the methods, the strategy and, to a certain extent, even the personnel depend largely on the objectives of the survey. If it is purely pre-historic exploration, the explorer’s concentration would be on the study of geological factors like the river terraces, gravel deposits, the nature of rocks and soils, fossil remains, stone artefacts and the like. He should be familiar with the past geological and climatological changes or cycles that have occurred in the area and the corresponding land forms and the human remains therein. The preliminary documentation for pre-historic sites would differ in some respects from the one required for historical sites. Whereas, literary epigraphical and traditional data would be available for the latter category, nothing of that kind would be available for the former. Nor will there be any local tradition or guidance available for the pre-historic sites. Only in some rare cases, local people would be able to point to some caves in the hills nearby without knowing their true significance. The explorer should visit such caves which could turn out to be pre-historic ones. Except in such cases, pre-historic exploration is based on the study of the geology and palaeontology of the area rather than local enquiries and
traditions. With such differences between pre-historic and historic explorations kept in view, let us review the important requirements to be attended to for a successful archaeological prospecting.

1. Map Reading

There are many useful maps available in India which can be of great value to the explorer in our country. Apart from the State maps, there are the District, Taluk and village maps prepared by the Survey of India. Particularly useful are the "one inch topo sheets" prepared by the Survey of India which are more detailed since the scale adopted in them is

\[ 1" = 4 \text{ miles} \]

These maps provide us with important information on the cities, towns, villages, hamlets, major highways, minor roads, cart tracks, railway lines and stations. This would enable the explorer to plan his trip and cover the area by jeep or foot. Rest houses or Travellers Bungalows or old Chatrams (Dharmasalas) are also marked which would provide useful resting place or night halts. Similarly, temples, mosques, churches are also marked.

Maps are also very useful for the explorer as they provide details regarding the physical features of the area - like the hills, rivers, lakes, springs and forests. Since the human settlements owe their position in many cases to their surrounding water sources, it would be reasonable to expect vestiges of old human settlements on the banks of the rivers or lakes. Particularly, many ancient civilizations flourished on the river valleys such as the Nile and the Indus. Explorers of Palaeolithic sites have mainly to study the gravel beds and sections of the rivers to identify the tools and fossils. The maps give us the present day configuration
of the rivers and older courses have to be searched for, located and studied in relation to their present bed.

Maps, one or more centuries old, may show features which are today completely buried or unrecognisable in modern maps. We have cases in South India where, in the older maps, certain areas are marked as "archaeological poromboke" (the usual local name for the Magalithic sites) are now shown in the present day records as cultivable lands, a clear case of encroachment into the ancient site. So, the study of maps and village field records are extremely useful for the archaeologist from many points of view.

2. Study of Physical Features

Apart from the location of hills, plains, rivers, lakes, forests and the like, there are also other aspects of physical features which are important and worthy of note for an explorer. Maps may not provide that category of data such as the distribution of rocks, minerals, soils, the flora and the fauna. But geological maps or reports would provide this kind of data. The District Gazeteers and Imperial Gazetteer of India prepared several decades ago and in many cases revised now, are an invaluable source of information. Here, we can list out some of the significant physical features that an archaeologist has to take note of:

(a) Hills

Often, the area surrounded by high hills would be an area of relative isolation and to a certain extent free from external impacts. On the high ranges, one could expect the tribals living
in splendid isolation e.g. Pulaiyars of Anaimalai and Todas of Nilgiris, who might provide a good scope for ethno-archaeological studies.

Low rocky hills would often have natural rock shelters or caves which provided the abode for pre-historic people e.g. Gudiam cave near Attirampakkam and Hoshangabad rock shelters. Castellated hills in the Deccan and parts of Lower Karnataka have been found to be associated with Neolithic settlements. Hills provided the source for the necessary raw material for the Neolithic folk.

(b) Passes

Passes served as corridors through which movement of people and ideas trickled through. The Bholan and the Khyber passes served as the passage for several foreigners to enter into the Indian sub-continent (like the Greeks, Persians, Scythians, Kushans, Hunas, Turks, Mangols etc.). The Palghat pass in the Western Ghats had acted as an active cultural link between the Kerala coast and Tamilnadu. Similarly, a number of passes in Vindhyas provided a corridor between North India and the Deccan. With their help the ancient routes could be plotted.

(c) Rivers

Rivers provided the perennial life-giving water source and hence important for human settlement from pre-historic times. All major river basins of India were once inhabited by the pre-historic people. The explorer has to study the old river terraces and gravel beds to locate the Palaeolithic tools and fossils in relation to the geological deposit in which they are lying.
Rivers continued to be a major attraction for the people's settlement even in proto-historic and historical times. The Indus basin supported an impressive and far-flung chalcolithic cultures in the second millennium B.C. Several urban centres belonging to the 1st millennium B.C. have been located in the Indo Gangetic plains. Huge archaeological mounds which marked the ancient townships or settlements have been discovered such as those at Hastinapura, Kosambi, Ahichchatra etc., the ancient cities mentioned in the Mahabharata. Ancient and historical cities are to be found on the banks of all the major rivers of India. To mention only a few: Indraprasta on the Yamuna; Ujjain, the capital of Avanti on the R. Sipra; Dhanyakataka (Dharianikota and Amaravati) the capital of the Satavahanas and Vijayapuri the capital of Ikshvakus on the River Krishna: the city of Vijayanagar, on the banks of the Tungabhadra; Uraiyur the capital of the Cholas on the River Kaveri, Madurai' the Pandyan capital, on the River Vaigai and so on. From this selective list itself one can understand the importance of rivers and the valleys for the study of the ancient sites and human settlements.

River mouths often served as the ideal spots for the port towns such as the Chera port Muziri in the mouth of the Periar on the west coast, Kaveripumpattinam, the Chola port at the mouth of the Kaveri and Tamluk or ancient Tamralipti in the mouth of the Ganga.

d. Lakes

Lakes formed another important water source. Some of the lakes are very old and even belonged to the prehistoric
period while some others belonged to later periods. Lake dwellings in the Switz lakes belonged to the Neolithic period. They have furnished very important evidence regarding the settlement pattern of the neolithic folk of Europe. Microlithic sites known as the Teri sites have been noticed on the banks of old lagoons in the coastal tip of Tamilnadu. South India was well known for tank irrigation system and there are a number of lakes, many of which might go well back to the beginning of iron age. It has been noticed that the Megalithic sites and burials are found clustering around the ancient villages nearabout the lakes eg. Sanur near Madurantakam lake and Kunrattur near Sembarambakkam lake. According to some scholars, tank irrigation system was started by the Megalithic people in South India.

e. Rocks, Minerals and Metals

Study of rocks is another important aspect of the physical features. The importance of rocks for the study of stone age sites can hardly be exaggerated. Rocks supplied the raw materials for making the pre-historic tools. Palaeolithic man preferred the quartzite stone for his tools and hence, he was sometimes referred to as the “Quartzite Man”. So, the availability of quartzite stone in an area may serve as an indicator for locating the palaeolithic sites. Similarly, the Microliths were made on silicious materials and semi-precious stones like jasper, chalcedony, agate etc. The Neolithic folk of South India went after the black basaltic dyke rock to make their shapely axes and adzes. The neolithic sites are found to proliferate in such areas where this kind of stone is found in plenty (e.g. Deccan and Karnataka).
The architecture of megalithic monuments was largely determined by the kind of stone available in the area. The monuments of purely latertic zone like parts of Kerala differ from those of granitic zones. So, by studying the nature of rocks in an area, the explorer can almost anticipate the type of monument he could come across there. Similarly, knowledge of the nature of metal and minerals available in an area would be helpful to locate the bronze and iron age sites.

3. Ethnographic Data

In undertaking exploration in pre-historic sites especially in areas where the hunter-gatherer and simple agricultural groups still exist, an ethnographic study of the local inhabitants may be necessary. A study of their material equipment, social organisation will be useful to know their settlement patterns and their traditions, for comparative study. The importance of ethno-archaeology is discussed elsewhere (see Chapter I).

4. Historical Literature

Before exploring an area or an ancient city, the explorer would do well to acquaint himself as fully as possible with all the available historical literature about them. It may be in the form of ancient and medieval literature or inscriptive references to the places. This data is not required for purely pre-historic explorations since no literary reference would be found for the pre-historic sites, but it is very essential for the exploration of ancient historical sites. Familiarity with the Biblical literature becomes indispensable for the explorer of the Biblical sites even as familiarity with the Buddhist literature is
essential for undertaking exploration in the Buddhist sites. In many cases, literature gives valuable details regarding the ancient names by which a city or a village was known, its lay-out like fortification walls or gateways, its architectural landmarks and the field archaeologist could explore the potential areas and select a site for excavation according to its importance. In some cases, the exact location of an ancient city would be in doubt since all memories of it would have been lost and it has to be established by correlating the literary data with the field data. The location of the famous site of Troy was a matter of dispute until Schlieman identified it in the light of Homer's *Iliad* and the *Odyssey*, local traditions and inscriptions and later confirmed by his excavations.

Often, the foreign travellers or ancient geographers' accounts help us identify ancient towns. The accounts of the Greko-Roman writers like Pliny, Ptolemy and Strabo have furnished valuable data regarding the ancient ports and capitals of peninsular India in the early centuries of Christian era. Some of the places mentioned by them still await precise identification while many others tally well with other local evidences available in the sites. *Megasthenes' description of Pataliputra city* has been remarkably confirmed by the excavations done there.

Similarly, the accounts of the Chinese travellers Fahien (4th century A.D) and Yuan Chuang (7th century A.D) are of great use for archaeology of the Buddhist sites of India. Cunningham identified many forgotten Buddhist sacred places with the help of these travel accounts. Not only the towns and cities but also within them some ancient landmarks like
the stupas, chaityas, temples or palaces can be located with the help of literature for detailed excavation.

The explorer should also be familiar with the epigraphical data available in the area to be explored. Old inscriptions attest to the antiquity and historicity of a place or a monument. The royal edicts like those of Asoka were often put up on the highways or junctions. With their help we could locate the ancient trade routes of the Mauryan times. Inscriptional data also helped in the identification of the Chola port-town of Kaveripumpattinam.

5. Previous Works

The explorer of an area or a site should also get to know about all the previous archaeological work done in the area—either in the form of exploration or excavation. This would serve as a valuable guidance and help avoiding duplication of work. This data would be available in the form of published works or unpublished notes or site cards prepared by the explorer. Casual finds are most likely to be found in the local state or district museums. A visit to the museum and examination of the antiquities found previously in the area would be of great help. An outstanding example of a published exploration report is Robert Bruce Foote's famous work *Pre and Proto historic Antiquities of Madras Presidency*. Such a meticulous description of the sites and their antiquities can hardly be seen anywhere during the second half of the 19th century. Bruce Foote had trekked a vast ground and visited even remote places in those times when there was no jeep or car. An explorer, especially in the pre-historic archaeology of South
India, can not omit to consult it. Robert Sewel's book *Antiquarian Remains of South India* is a useful work for the historical and field data it contains. Cunningham's notes on his exploration and discoveries are of great value for the explorer in North Indian sites, though the methodology or techniques available to him were not upto the mark and his enquiry was limited in scope.

The explorer would do well to consult the old *Annual Reports of the Archaeological Survey of India* and its successor *Indian Archaeology- A Review* which report all the explorations and discoveries made in India every year by various agencies. Before Independence, several princely states had their own small departments of archaeology which published their discoveries in their annual reports eg. Mysore, Travancore and Cochin states had their own archaeological reports. The publications by the State Government and the University departments of archaeology on the work done by them should also be consulted.

6. Local Traditions

Local traditions have their own value in reconstructing regional or local history. They often preserve old memories of the long forgotten facts about cities or towns and even about some particular landmarks within the town. This memory may be preserved in the form of legends or folk songs which would mix up facts with fiction. Local people would often be able the point out certain spots as the places where the ancient place or temple stood or as the place where a battle
took place and the like. This would often help the excavator to choose the spot of his excavation within a site.

Enquiries with the elders and the knowledgeable of the locality are found useful in many other ways also. They would be able to tell us about some chance discoveries of old structures, burials, treasure trove or coin hoards made in the locality some years back. All these have to be carefully recorded by the explorer as they would serve as good guidelines for further investigation. It has been the experience of the author, that the villagers would point to certain localities now under cultivation as the place where the old village stood. Such places were usually called "Nattamedu" or "Nattakkollai". When we inspect the spot, we would invariably find vestiges of habitation like the postherds and coins. At the ancient site of Kaveripattinam, local people could show the spots wherefrom they had dug and removed bricks (from the buried ancient structures) and re-used them in their present houses.

Staff:— No hard and fast rule can be laid down on the strength of the staff for exploration work. The team may consist of one, two or more archaeologists, one of them preferably a specialist in pre-history and geology, and one a specialist in historical archaeology who is familiar with the historical sources of the area including literature, inscriptions, architecture etc. Though the explorer himself can do photography it is better to have a specialist photographer to document important mounds, river sections, monuments, sculptures, inscriptions etc. It is found useful to take a few student trainees in the exploration work. They are found helpful in making local enquiries and also collecting antiquities from the sites.
Besides, they can learn the methods of exploration from the experts. Persons knowing the local language should be included in the team.

**Exploration Kit**

The preliminary exploration kit should not be too heavy. It should consist of only the minimum, since the party would be moving from place to place. The following items may be found useful:

1. Knapsack with shoulder straps for carrying equipment.
2. Pottery cloth bags for collecting specimens like stone tools or potteries.
3. Antiquity packets to collect smaller antiquities like beads, coins etc.
4. 100-foot cloth tape for taking measurements of sections or monuments.
5. A few excavation knives to scrap the exposed sections for finding the stratification.
6. Small entrenching shovel and pick axe for any emergency small scale excavation or clearance work.
7. A few brushes for cleaning the objects before photography.
8. Pocket compass to know the direction.
10. Site notebook or site cards to record the field data for every site explored.

11. Sundry items like drawing sheets (to make rough plans and sketches), pencils, pens, geometry box etc.

12. Binoculars are found useful in surveying the objects or suspected monuments from a distance eg. Megaliths on hill slopes.

13. First aid box.


Though the survey work has to be done mostly on foot, a jeep may accompany the party wherever possible as it is often found useful in many ways. It can carry the heavier exploration materials and tools or lunch packets from distant places. From the camping place to the workspot and also making local contacts it can provide transport and avoid unnecessary walking. The antiquity collection may also swell as the exploration progresses and particularly the stone tool collections would be heavy and they can be carried in the jeep back to the camping place.

**Field Observation and Ceramic Survey**

Surface exploration needs training and experience. First, the sites have to be recognised and carefully examined. The explorer must walk over the area with his eyes and mind open to all the possibilities. This would give a preliminary idea of the nature, importance and the probable date of the site. An archaeological mound or site could yield the following
objects: broken pottery, stone or bone implements, structures, tombs or burials, coins, beads and the like. There may be rain gullies or partial exposures of the mounds due to erosion by a river or a deliberate quarry of the earth by the villagers as a result of which a section of the mound would reveal the successive habitational strata of the mound. A trained eye can recognize the ancient potteries or other antiquities of known association and date the various strata and form a general idea of the antiquity of the mound and the cultural phases represented therein. The scientific study and classification of ancient pottery has assumed importance in archaeological investigation as they serve as reliable clues and type fossils for various periods and also indicators of the diffusion of cultures. The pottery assemblage of the Indus Valley sites for instance has distinctive quality, type, colour and designs about them and an explorer who goes in search of Indus sites should be familiar with their pottery and other allied artefacts like their inscribed seals and sealings. Therefore, ceramic survey has become an important feature of archaeological exploration. It is important to note that the presence of Kiln-baked pottery presupposes a sedentary life. So, ceramic records of the explored sites should be prepared with care for future reference.

Recording of Exploration Data

The field data thus collected and features observed on the site should be accurately and adequately recorded in a suitable way such as it would be available for consultation later on. The data can be recorded under classified sub-divisions. It should be supported by photographs, sketches or rough
plans. The “site card or sheet” should normally contain the following items of information.

1. Site Name and Location

Any site including the open uncultivated one normally belongs to a nearby hamlet or village. The name of the main village should be given first and that of the hamlet next. The Taluk or Tashil, the District and the state should be indicated. Usually, in India every field bears a revenue survey number. This should be mentioned. If the particular land or site belongs to any individual or institution, the owner’s address is to be noted.

2. Approach to the Site

Here, the nearest Railway station or bus station and the direction to reach the exact spot should be given. Halting facilities if any may also be indicated.

3. Topographical Features

Features including elevation, any river side or hill slope, rocks and the nature of soil or vegetation as deemed relevant may be given. Whether the site is under cultivation or fallow may also be mentioned.

4. Archaeological Importance of the Site

Pre-historic or historic or medieval; habitation site or burial site; important surface finds like pottery types or coins, terracotta figures and their cultural importance should be briefly stated. Important observation regarding the stratigraphy
and approximate date may be recorded. Selected illustration with photographs or sketches should be given. A list of significant artefacts collected on the surface may be given.

5. State of Preservation of the Site or Monument

Here, any river erosion, or quarry of earth or construction of buildings and such other disturbances in the site that have threatened the site or the monument may be recorded.

6. Reasons and Possibilities of Excavation

The explorer can give his assessment of the site and state why further investigation like excavation is necessary. Any potential area in the site for excavation can be suggested with reasons.

7. Owner of the Site

If the particular site belongs to an individual or an institution, the owner’s address should be noted. This will facilitate getting his permission to excavate.

8. Published References

Reference to any account of the site in historical or archaeological publications should be given.

9. Date of Visit and the name of the explorer should be recorded.

10. Illustrations and Antiquity Register

The number of photographs taken on the site and their register number in the Photographic Register should be cited for
any future reference. Small size positives can be pasted in the site card. Similarly, reference to the register of antiquity bags should be given.

SECTION - 3

Scientific Aids in Exploration

Apart from the physical methods of prospecting described above, some scientific aids like the magnetic and electricity resistivity methods are also found extremely useful. They would register certain types of abnormal surface disturbances or anomalies indicating some features below the earth which cause them. They provide valuable clues to the archaeologist as to the presence of structures or metal objects below.

(1) Magnetic Survey

The Proton-Magnetometer is a highly sensitive apparatus which has been found useful in detecting buried iron kiln sites and certain kinds of soil. It detects anomalies or differences between the general magnetic field of an area and the one above or near a buried iron object or kiln. The spots where the anomalies are registered can be taken up for excavation. One disadvantage in this instrument is that since it is highly sensitive it will register the anomaly even if there is any small iron object or rocks with large iron content near the area—for example iron fence or electric post on the field. But used with caution, it can play an important role in archaeological exploration. Proton-magnetic survey of certain suspected areas covered with sand was done at Kaveripattinam and Madurai in South India but its use was rather limited in scope.
The use of the proton-magnetometre involves setting up of a line of electrodes a few inches into the ground at the intervals of 30 cms. Anomalies between the electrodes can then be plotted. A team of three people would normally suffice to cover several acres in a day.

2. Thermo-Remnant Magnetic Survey

By this method, the existence of burnt clay artefacts, burnt brick structures and sites which experienced extensive conflagration could be detected. The objects cause magnetic disturbances which are recorded.

3. Electricity Resistivity Survey

The resistivity meter is based on the fact that the ground can conduct electricity. Different soils or rocks conduct differently. Electrical conductivity of the soil depends on its nature viz. whether it is filled-in pit, ditch or wall or a uniform deposit. They will show wide divergence in their resistivity which is clearly registered in the Instrument. This method was used by the geologists and civil Engineers to study the layer of the earth but first applied to detect buried archaeological structures by R. J. C. Atkinson in 1946. This kind of survey is especially suited for problems connected with the tracing of the extent of a wall or a road. Negative resistivity anomaly would show a ditch or pit and conversely, positive anomaly would indicate a structure of high resistance such as a wall, floor etc. By this method a Roman road of limestone rubble was traced at Crawley, oxon. and a neolithic ditch traced at Dorchester. The special instrument, the Megger Earth Tester, is used to record and plot the variations in resistivity in graph model. This can also be operated by
a team of three people and the equipment is also easily obtainable. If the soil is very wet or dry, the electrical resistance may be uniform throughout the strata and in such cases, the results of the survey may not be satisfactory.

4. Probe Survey

This is done with a simple apparatus of an iron bar with a tapered point and a T-handle and used as a probe across a suspected wall or pit at convenient intervals. "When the probe penetrates any stratum different in texture from top soil this can both be felt as a difference in resistance and heard as a different sound. A single line of probings can therefore discover a buried feature and a series of parallel lines one metre apart can define its whole shape" (J. Alexander)

5. Augur Survey

Used by the geologists, the augur survey is adopted for archaeological sites. Hand augurs are used to take out samples every 3 cms. The samples of soils and pottery pieces or other antiquities can be studied. The strata accumulation over the bedrock and their content can be known. Its use is rather limited in hard soil.

6. Drills

In oil prospecting and geological survey, power-driven augurs and drills are extensively used as they can penetrate to great depths and reveal the nature of the strata below. In archaeological sites, this can be used with advantage as preliminary survey. They can be used especially to probe the
strata lying buried below flood deposits and sand accumulation. This was used by the Archaeological Survey of India in 1968 in and around Cranganore in Kerala to find out if there were cultural strata below the huge sand accumulation deposited by the Periar river. This probe proved useful to assess the antiquity of the habitation in the area in relation to the deposits.

The drilling equipments are rather unwieldly and expensive. They have to be hired from special organisations like the Geological Survey of India or the Oil and Natural Gas Commission.

7. Exploration by Sound

Sometimes tapping the ground at various spots would emit differential sound. Depending upon the compactness of the soil or structure below, the sound from the natural or undisturbed soil would be different from that of the disturbed one or artificially accumulated one. This method is not always a sure guide but combined with other methods it will be found useful.

8. Geo-Chemical Method

The soil of ancient settlements often contains high concentration of phosphates from organic refuse; thus, the soil near Cairo has long been taken by the local cultivators for use as fertiliser. Here in India also, earth from ancient sites and mounds serve as fertilisers. On the basis of this kind of soil analysis, archaeologists were successful in defining sites in Denmark, Italy and England. Near Copenhagen, the lost site of the village of Stockkerup was found in this way by
taking 250 soil samples from a depth of 14 to 30 Cms. over an area of 30 hectares and analysing them in order to find the high phosphorus pentoxide content. "In regions where the vegetation and terrain are unhelpful to air photography the method can be used with advantage to sample wide areas" (John Bradford).

9. Aerial Survey and Photography

As pointed out by Kathleen Kenyon, the value of air photography is two fold; firstly, it enables us to have a bird’s eye view of the ancient town or settlement as a whole which is impossible from the ground. This will give us a total view of the shape and the outline of the ancient city. Secondly, the aerial photography shows up certain features which are not visible to the naked eye.

One has only to see the beautiful aerial photographs of the ancient cities of Taxila (now in Pakistan), Sisupalgarh (Orissa) to realise the importance of aerial photographs. The whole lay out of the ancient cities, the criss-cross roads and streets, the alignment of houses, the stupa and the Vihara complexes therein, have come out boldly giving us a vivid picture of the town planning in ancient India. The excavator can, by close observation and correlation of the photograph with the site proper can pick and choose the important areas or part of the alignments, depending on his objectives. If it was fortified city, the outline of the fortification or the defensive wall surrounding the city can be identified as well as the entrance gateways and such other landmarks.
Shadow Marks

Certain features in a site like the covered-up ditches or low walls or low banks, obscured ancient roads or tracks may come out sharply in air photographs in different ways such as the shadows, crop marks or soil marks. Slight variations in levels and the mounds can be detected by the shadow marks found in the photographs taken obliquely.

Crop Marks

Differences in vegetation and the consequent crop marks and colour contrasts are brought out clearly in photographs. Over the buried structures, the growth of crop will be less sparse than the surrounding areas. Similarly, over the filled-in ditch, the growth would be comparatively more if not luxuriant. Thus, the variations of the crop marks shown in the aerial photography serve as good indicators of the buried buildings or ditches.

The development of air photography was one of the blessings of the world wars. Initially developed for mapping military targets, it was applied to different purposes. It was used for archaeological purposes as early as 1915 by Leon Rey in Macedonia and Lt. Col. G. A. Beazley in Iraq in 1919. The latter and G. O. S. Crawford were chiefly responsible for using the method more systematically as can be seen in their respective publications viz. Surveys in Mesopotamia and Air Survey and Archaeology (1924). With the aid of air photographs, Crawford mapped out the ancient Celtic and Saxon remains in England. Air survey was done in the old bed of the
River Ravi in the state of Jaipur, India. Father Poidebard made further technical improvements and surveyed the desert regions of Syria. He was able to plot the whole system of ancient roads and fortifications of the Syrian desert. He used horizontal lighting as well as counter-lighting methods to achieve excellent results. John Bradford, an army officer working with air photos in the Second World War, has in his valuable work *Ancient Landscapes* (1957) discussed the contributions made by "air archaeology" to the discoveries in the ancient cities of Rhodes, Carthage, Etruscan burial mounds, the ancient field systems in Greece, Italy etc. Hitherto unknown sites have been revealed by soil, shadow and crop marks using the techniques of pin point, vertical and oblique photography. The method of horizontal lighting of the morning or evening exaggerates the undulations aided by the variations in the colour of the field. This method was perfected in 1930s. The buried ruins of the frontier zone of the Roman empire buried over a vast distance in Syrian desert could be plotted by air photographs. From 1939, stereoscopic examination of large areas was developed. For indications on the ground which are revealed by the shadows, oblique photographs were preferred while vertical photographs were taken to get comprehensive plan of a site or to show up differential vegetation. In the stereoscopic technique, "a series of vertical photographs of the area or the landmarks, each having an overlap of 60% in common with the next in the direction of flight are taken and portions common to both are placed under stereoscope and the twin views of the feature to be examined are arranged immediately beneath the lenses. After some practice, the two images should fuse optically into one in full relief". (John Bradford)
Photogrammetry: The technique of transforming aerial photography into a scaled plan is an important and fruitful development which helps us to get a graphic and enlarged view of the site. This process or technique is called Photogrammetry. This has enabled archaeologist to get rapid and accurate method of map-making. In the course of a single flight for a few hours, the plan of several ancient sites can be obtained. As observed by John Bradford, “Aerial mapping can telescope years of work on foot into span of weeks.” Though aerial survey is expensive, it has come to play a vital role in archaeological reconnaissance all over the world. It has almost justified Crawford’s claim in 1923 that “the invention of air camera is as valuable to archaeology as that of the telescope to astronomy.”
CHAPTER IV

EXCAVATION - STAFF AND EQUIPMENT

Excavation is an elaborate process involving time, money, labour and equipment. The services of different technical persons are needed at different stages of excavation - selection of site, setting up of the camp, laying out of the trenches, excavation proper, documentation of the evidence, sorting out of the excavated objects and then preservation and transport of the materials back to the headquarters, and preparation of technical reports and publication of the results. Let us have an idea of the personnel and their respective duties, functions and equipment.

SECTION - 1

Excavation Staff and their Functions

1. Director:

Director is the captain of the excavation team and he has to give the right lead throughout the expedition from the choosing of the site to the publication of the results. Not only should he be a scholar well versed in the subject and its related disciplines but also be familiar with the different branches so as to be able to coordinate and regulate the works of other technical staff.
He should be an experienced field archaeologist having worked in a number of excavations and undergone long apprenticeship to learn different skills required. Theoretical knowledge should be combined with practical skills. Being the brain behind the campaign, he plans the general scheme and the strategy, distributes the work to various technical persons and coordinates their activities towards his objectives. "If archaeology is a craft, the Director should be a master craftsman. The conscientious director must not only know and practise all the current techniques of his craft but must always be on the look-out for new ones. To do this, he brings to his work a much wider knowledge than his predecessors" (John Alexander).

The director must be prepared to deal with a very wide variety of periods and types of evidence, each of which will have own problems. The success of an excavation lies in the Director's relationships with other specialists and in their ability to produce a final synthesis of all the kinds of evidence. Apart from academic skills and field experience, he should have the skills of men and money management. He has to choose the workmen of experience and intelligence and assign them the right job. He plans the budgeting and funding for the excavation. He has to contact other scientific organisations for any assistance or collaboration. The director is responsible for all the legal aspects of the excavation, obtaining the permission or license from the concerned authority to excavate, negotiation with the owner of the land for an agreement, fixation of the compensation amount for the owner if any etc. He is also responsible for the public relations - informing the local public or the visitors about the importance of the work and need for their cooperation. He
also briefs the press about the highlights of the excavation as and when it is called for and at the same time avoid sensationalisation which may lead to distortion and controversy. Sober assessment and factual information would be better appreciated than tall claims and hasty theorisations.

Probably, the most important responsibility of the director is the publication of the results of the excavation in the form of a monograph or a bulletin. He has to collect all the evidence and reports of other specialists and consolidate and synthesise them into clear, concise and intelligible form.

2. Assistant Directors

The Director should have able assistants who closely work with him and understand the problems and strategies. It may not be possible for the Director to be at the site all the time or attend personally to all the branches of activities. It is better to have an able and experienced Assistant Director to take the command in the Director’s absence and to act as coordinator. In a University department, a senior member like the Reader or Lecturer can act as the Assistant Director. He can also look after the administration and management of the camp, and problems relating to accommodation for staff, supply of equipment, accounts, supplies, health care etc.

3. Excavation Assistant:

Also called Technical Assistant, he works closely with the Director whom he assists in many ways - from setting
up of the camp to its closure. He should be qualified and well trained archaeologist. The number of Excavation Assistants can be increased depending on the size of the excavation and the number of trenches. He is responsible to keep all the records like the Antiquity Registers etc.

4. Site Supervisors or Trench Recorders:

They need not be full-time employees. Even the student trainees can do this. They should be trained to record the excavation of strata and the antiquities put up the labels, and separate the pottery to be sent to the pottery yard. They would also do the three dimensional measurement for the antiquities (See Chapter V) and preserve them in separate covers with suitable markings. They supervise the digging and maintain discipline in the trench under the care of the Excavation Assistant and the Director. They write the Record note-book, keep the sketch plans, sections and record the antiquities.

5. Pottery Assistant:

Since excavations yield enormous amount of potteries of different types, it is better to have an Assistant to attend to them. He should mainly work in the pottery yard where he attends to the classification of the potteries according to the trench and strata, have them cleaned and labelled. He attends to the selection and packing of the pottery after the excavations are over. He should have an intimate and thorough knowledge of the potteries found in a site and in the region to make a comparative analysis. At the headquarters,
he will be incharge of the Pottery section where potteries from different sites are kept under classified cabinets for ready reference and study. He should be assisted by a Marker.

6. Antiquity Assistant-Cum-Curator:

In large-scale excavations (like Nagarjunakonda or Lothal) it is essential to have a person or two to collect the antiquities coming from the excavations, and maintain records of them according to the trench, stratum, materials etc. He attends to the cleaning and the preservation of the antiquities, arranges for their photography and drawing in consultation with the Director. At the headquarters, he is incharge of the antiquity section and its related records for ready reference and study. He should prepare a card index to all individual objects. He is personally responsible for accurate record, correct marking, display and storage.

7. Photographer:

He is incharge of the photographic documentation of the excavation at every stage. His duties include: Taking photographs of the site before excavation; of the sections, structures and other landmarks during the excavations and of the classified antiquities, and potteries after the excavation.

It is his duty to prepare the subject for photography with the help of the Excavation Assistant, choose the correct timing and light, improvise the scaffolding or any other suitable elevation for his camera and prepare readily accessible dark room for cleaning the film the same day to be seen by the Director. Though it is the Director who decides the
subject to be photographed and details he needs, it is the photographer who executes the idea. The value of an excavation report depends on the quality of its photographic illustrations. In the words of Wheeler: "An intelligent and experienced photographer is a Sin-qua-non. Like a doctor, the photographer must be available and be prepared at a moment's notice and at all times (Wheeler).

The photographer may be assisted by a photo printer. As the former will be fully engaged in outdoor work, the latter can assist him in the dark room and also in the preparation of prints, maintenance of the album, cataloguing of the photo prints and negatives in orderly fashion for ready reference for scholars.

8 Surveyor

A qualified surveyor has an important role to play in an excavation. He is responsible for the preparation of a general and contour plans of the site. In the former, he would locate a general plan of the site or mound and its environs, and mark the excavated trenches so that the exact location of trenches in relation to the other landmarks could be known. He prepares a scale drawing of the entire mound and shows the excavated trenches. The shape of the mound itself gives some important clues with regard to the plan of the town, its central and peripheral parts. He also prepares the general map of the site and its environs so that relative heights of the parts of the mound are clearly brought out. Marked undulations, depressions and elevation would come off well, indicating the nature of the plan of the site.
The Surveyor also helps in the preparation of elevation of the structures and in laying out the trenches for excavation.

The Surveyor should go to the camp site in advance and prepare the preliminary contour plan of the site which would help the Director in selecting the area to lay out the trenches.

9. Draftsman

The services of a draftsman are equally essential for an excavation work. The preparation of measured drawings of the plans and sections of the excavated trenches and structures besides general maps and the numerous potteries and other antiquities that come up in the excavation are his primary responsibilities. The draftsman's work is complementary to that of the photographer, and is quite important right up to the publication stage. His plans and drawings form the bulk of the illustrations that go with the publications. Regarding his qualifications, Wheeler points out that the draughtsman should thoroughly understand the technique of line-block production to employ lines of the right thickness and firmness, having regard to the extent of reduction required in publication... Clear hard lines and clear hatching entail sureness of hand and that combined with experience, are his primary qualifications. The usual items that are attended to by the draftsmen are:

1) Drawing of plans, sections and elevation of the excavated structures.
2) Section drawings - showing the layers, pits, structures etc.,
3) Pottery-drawing including sections, elevations, designs, graffiti etc.

4) Drawing of antiquities.

5) If he is also a modeller, he should prepare scale models of sites, or sections or other interesting objects if necessary.

10. Marksman:

He attends to the marking work in different stages. While laying out the trenches, he does the peg marking with black (Indian) ink. During excavations, he works in the pottery yard and attends to the cleaning and marking of the potteries. He should mark the locus (Site and Trench number) layer number etc. After sorting and packing are done, he marks them with the suitable labels before they are being transported and assists the Pottery and Excavation Assistants.

11. Foreman-Cum-Store Keeper:

He is an important figure in an excavation. He is in charge of all the materials like the Camp equipment, excavation tools and plants and the like. He maintains stock register of the articles, issues them to the staff and receives them back after the work is over. Technical equipments like the Survey materials or Photo equipment are kept under the custody of the respective technicians but the other general excavation materials are under the custody of the store keeper. He is primarily in-charge of transporting the materials to the camp site and setting up of the camp and arrangement of other camp facilities. In some of these duties he may be assisted by the Excavation Assistant.
Foreman maintains the roll call of the labourers working in the site. He should also assist in running the mess in the camp.

12. Field Chemist:

The presence of a chemist would be desirable to attend to the work of conservation of excavated objects including giving first aid attention to fragile objects, consolidation, transport and preservation—for example, consolidation of bones before their removal, cleaning of coins etc. But often his services are requisitioned as and when necessary. So also the services of an Anthropologist, Zoologist, Botanist are borrowed when necessary.

13. Labourers:

Unlike in Western countries, Indian archaeologists employ casual labourers to do all the mechanical work. It is comparatively cheap and useful. Men are employed to do the harder work like digging, carrying earth etc.; while women do the lighter work like washing the potteries, cleaning etc. An average labourer, though uneducated, is shrewd enough to pick up the essentials of his work. He can be trained in the process of excavation fairly quickly. He has to be taught how to dig slowly and carefully with the sharp edge of the pick so as not to damage any object, to stop digging if he encountered new soil or loose soil or a structure, flooring or an object, and in keeping the sections of the trench trim, vertical and tidy. Labourers should realise the importance of the antiquities for which the archaeologist is searching. After the
digging, the labourers, along with the Supervisors, examine the earth to locate the antiquities and inform the former for recording the measurement. Some credit in the form of "tips" or "bonus" can be given to the workmen who find valuable antiquities. This would act as an incentive for further discoveries. They should be instructed to abide by the discipline of the field work and should in no way impair or cause damage to the sections, trenches etc. They are found useful in helping to set up the camp and the tents, providing water supply and help the photographer, the Surveyor, the Draftsman, the Storekeeper and the marksmen in various ways. A disciplined and intelligent labour force is a boon to the expedition.

SECTION 2

Tools and Equipment

A. Camp equipment

Excavation being an elaborate process involving many technical personnel like the Surveyor, Draftsman, Photographer and the like, the tools and plants required by them are quite numerous. Usually, excavations are to be conducted in out-of-the way places, in rural areas where amenities for stay may not be available. The excavation party has often to set up its own camp close to the site and this would require camp equipments.

1. Tents

Tents of different sizes may be necessary. Tents of smaller size where two persons can stay, besides two or three
bigger tents can also be fixed up - one to serve as a camp office one to store the tools and plants and the camp materials and one for the excavated antiquities. Some time, a bigger tent can serve as a common dining hall for the staff. In India, the camp kitchen is usually made of thatched palm leaves which is quite inexpensive.

2. Tent Equipment

A variety of tools are necessary to pitch the tents like hammers, nails of various sizes, iron pegs, ropes etc. Coir mattings or Dharis for the flooring. two or three cots can be accomodated in each tent for the staff members. Light furniture of a small foldable table and two chairs for each tent are found useful for the staff to do reading and writing notes.

Lighting: In many of the villages it is possible to get electric connection for the camp. Otherwise, gas or petromax lights and hurricane lights would be necessary for every tent as also in important places of the camp site.

3. Water facilities

Drinking water is to be provided in each tent preferably by keeping a small pot or jug with tumblers, and tubs or buckets of water with a mug for washing purposes.

Camp Kitchen

It is usual in India to have a common kitchen and a dining place in an excavation camp so that the field staff
need not go outside for breakfast or food. It is needless
to say that this requires the necessary vessels like plates,
cups, pans etc. Facilities for supply and storage of drinking
water should be taken proper care of.

Furniture like folding chairs and tables, camp boxes
to keep books and records and atleast one small sized steel
almirah to keep cash and other valuables would be essential.
A bell is necessary to keep timings and alert the staff at
appointed hours.

4. Transport

Transport of camp material from Headquarters to the
camping site and back is usually done in trucks or lorries. A
jeep or station wagon is absolutely necessary at the camp for
local trips and transport.

B. Draughtsman's Equipment

1. Tripod Stand
2. Plane table
3. Drawing board
4. Metallic tapes
5. Bubble level
6. Steel tape
7. Architectural scales
8. Folding scale
9. Parallel ruler  
10. Protractors  
11. Set squares  
12. T. squares  
13. Drawing papers  
14. Drawing pins  
15. Drawing pencils  
16. Paper clips  
17. Strings  
18. Iron pegs  
19. Wooden pegs  
20. Indian Ink and Pen  
21. Survey Umbrella  
22. Graph sheets  
23. Nails.

C. Surveyor's Equipment

All the items mentioned above for the draftsmen are also required by the Surveyor. In addition, the Surveyor needs the following items:

1. Theodolite  
2. Dumpy level
3. Levelling staff
4. Prismatic campus
5. Survey levels
6. Survey Chains
7. Small notebooks

D. Photographer's Equipment
1. Field Camera full size with camera stand
2. Quarter size camera like Linhof is found very handy and effective.
3. A Camera of 120 size like Rollicard or Rolliflex
4. A 35 mm. camera for preparation of slides
5. Cut films.
6. Film rolls
7. Lenses (normal, wide angle, close up and telephoto).
8. Filters (Green, yellow and red)
9. Scales of different sizes 50mm, 1 mm, 2 mm
10. Bubble level
11. Exposure metre
12. Plastocine to fix the small scales
13. Black velvet cloth to serve as background for taking photographs of the antiquities.

E. Excavation Equipment

The number and variety of tools and implements employed in an excavation is virtually limitless. The bare minimum tools required are listed here:

1. Pick Axes - small, medium and long sized for digging. The pointed edge is invariably used for better control and minimise damage to antiquities. They are found very useful in Indian sites.

2. Shovels - long-handled to remove the excavated earth or thick deposit of sand.

3. Short handled shovel *mammatis* - very popular in South India

4. Bale or turf cutter with 'T' handle for trimming and straightening the sections.

5. Crow bars - which are used in a limited way to dig very hard deposit or to make deep narrow holes to plant the pegs.

6. Iron pans or baskets to remove the debris and the excavated earth and to carry the potsherds to the pottery yard. They are also useful during the washing and storage. So, a substantial number of them, say about 100 would be necessary.

7. Trolley: Small two wheeled trolley is found useful to transport earth away from the trench,
8. Excavation knives - for scraping the section and examining the layers and the earth for antiquities. It is an essential tool for the site supervisors. It is especially useful in marking layers and examining the deposits on the floorings, pits, burials etc.

9. Angle measure - with bubble level fixed on the two arms, each one metre long and divided into centimetres. This is an important item for three dimensional measurement of antiquities.

10. Brushes of various types and sizes - coir brushes to clean the surface, paint brushes for removing the dust and cleaning the delicate objects and wire brushes for harder surfaces. They are essential during the preparation of the subjects for photographs. Brooms can also be used for sweeping the floors and pavements, walls and the trenches. Small camel hair brushes and tooth brushes are used for delicate cleaning.

11. Scissors - big sized scissors to cut the rootlets in the excavation trenches and small sized scissors for other uses.

12. Pen knife

13. Tapes

14. Plumb bob

15. Labels to mark the pottery bags and also the layers on the section.

16. Cloth mounted antiquity envelops - to keep the small antiquities.
17. Pottery cloth bags to pack the selected potteries and some bigger antiquities.

18. Wooden pegs to demarcate the trenches. They are faceted so that names of the trenches can be marked on them. The bottom is pointed for easy planting in the earth.

19. Nails of various sizes.

20. Black and White paint and steel pens for painting the trench numbers on the pegs and for marking the potteries.

21. Plaster of Paris for making models

22. Quick fix, wax etc for first aid to antiquities.

23. Essential chemicals as preservatives

24. Tin foil and plastic covers for collecting soil samples and C-14 dating samples.

25. Antiquity Record Book with plain and graph sheets.

26. The hand bellows: They are useful in blowing off fine dust

27. Small and big ladders: Helpful in going up and down the trench.

28. Sceve: to sceve the excavated earth to save the smaller antiquities that would be missed by the human eyes.
CHAPTER V

EXCAVATION - PRINCIPLES AND TECHNIQUES

Section 1

PRINCIPLES

Excavation follows exploration. In the previous chapter, the importance of field reconnaissance and its utility were shown. Once the ancient sites or mounds have been spotted and the field data about them collected, the archaeologist can choose the most important and interesting among them for excavation. While surface exploration would give only an idea about the general nature and the broad cultural overview of the site, it is through excavations we can get a comprehensive picture of the succession of cultures as well as the material contents of the site. For a better understanding of a detailed history of a site on a sequential basis excavations can be undertaken to know (i) the vertical dimension of a site i.e. the total thickness of the cultural accumulation of a site from its earliest inception - from the virgin soil upwards (ii) the different periods or phases in its history - including the different occupation levels and building levels and (iii) the horizontal dimension: the material contents of each period like the lay-out of the town, the house patterns, nature of buildings and a host of human artefacts throwing valuable light on the material culture of the people.
Simply stated, Excavation is digging of the earth and removing the buried soil and, in its very nature, it is a destructive process. But, archaeological excavation differs from ordinary excavation done for digging a well or laying foundation for houses. In the latter cases, the digger is not interested to know if there were occupational layers, or cultural deposits or human artefacts. The well digger is only interested to get to the water level at the quickest possible time. He simply throws out all the excavated earth till he reaches water level. But the archaeological excavator is interested to know every inch of the soil he digs below the earth to find out if it is part of an occupation layer, or if it contains any vestige of human activity. By its nature, archaeological excavation is a slow, systematic and planned digging to study the nature and the contents of the occupation layers in the reverse order in which they were laid down, gradually uncovering each successive stage in the history of the site. The main characteristics of an archaeological excavation are: (1) it is done with great care and planning so that every artefact - be it a building or a bead - is laid bare and preserved (2) its position in relation to the layers of deposits in which it is found (stratification) and in relation to other objects (associated finds) is documented in records for verification at any time; (3) the data relating to the environmental factors like flora, fauna, soil are recorded and studied to know the ecological setting and (4) the record of the excavation is made known to the public through publication. Because of the methodical and scientific nature of the work involving special techniques and well tried principles, excavation should be undertaken only by the well trained and experienced archaeologists with a team of experts.

As already pointed out, excavation was for a long time considered merely as a method of collecting antiquities "a
glorified treasure hunt". It was Pitt Rivers in Britain and Petrie in the Near East who first placed emphasis on the context in which they were found i.e. the layers in which they were found and their relation to the other layers and objects. Another factor that was neglected in the past is the chronology of the site as a whole. But today "no excavation can be considered satisfactory unless the excavator can make a reasonable assessment supported by evidence, of the period and circumstances of laying down of each deposit and the construction of each feature, and of their general correlation. In other words, he must ascertain what was done there, when and by whom" (Graham Webster). So, the context, the cultural sequence and chronology are important in an excavation and after some trial and error, the stratigraphical method has been envolved to obtain these requisites. Let us first examine the methods of dating.

Absolute and Relative Dating

In archaeology, as in history, though in a lesser degree, the time factor is quite important and relevant to know the correct sequence of events or cultural movements and their interrelation. Time factor also becomes necessary when we compare the same cultural stage in two different countries or different areas within the same country. For example, the Megalithic tombs are found in different parts of Asia and also Europe and all of them do not belong to the same period. Some belong to the Iron Age and some are clearly pre-iron. If we know the earliest occurrence of a particular cultural trait we can know something about the possible source of diffusion. Similarly, within a country or a cultural zone, the time of occurrence of a particular trait like the use of iron, or the use of wheeled
pottery or the invention of a script becomes vital in order to build the sequence of techniques, types and cultures and trace the tempo of human progress in a given society. In the words of Sir Mortimer Wheeler "First, without an absolute chronology cultures of different regions can not accurately be compared, their interrelationship can not be assessed; the vital causative factors of human progress can not be authoritatively reconstructed and may be widely misunderstood. Secondly, the fluctuating tempo of human achievement can not be estimated" In historical archaeology, we often get evidence for absolute dating with the help of a datable objects like coin or inscription or textual correlation. Example: An avamedha sacrificial site excavated at Jagatgram (in U.P.) had an inscription mentioning the king Silavarman who built it. But in the pre-historic and proto historic-sites we have to depend on relative dating only based on the stratigraphic sequence, typological comparisons etc. But even in these sites, it is possible to arrive at absolute datings (with some possible marginal error) with the help of a number of Geochronological and other scientific methods of dating such as Radio-Carbon, Thermo-luminscence, Dendrochronology etc. These dating methods are described in another chapter and so are not elaborated here. Here, we will confine our attention to the archaeological method of dating alone, which largely depends on stratigraphy supplemented by typological comparisons.

Typological Method

In this method, artefacts are classified according to their form or shape and their relative antiquity assigned on the presumption that the main criterion-simple to elaborate, poorly preserved to well preserved, crude to refined-is correlated with
age. In every arfact, we can have 'type series' indicating a particular form or shape and the date and further finds can be described simply by reference to the types already recognised. The distribution of the types in space and time would indicate the diffusion of a culture. This is a logical evolutionary arrangement constructed by the archaeologist and this is called Seriation. Independent dating of two or more stages in the series would help us date the series relatively. The typological method has come in for much criticism in recent years; but Atkinson and Clark have shown that, with corroboration from the evidence of associated finds, the method can be verified. Wheeler also observes: "Their (typological classification) values are liable to be local rather than universal and must be established afresh and objectively for every first locality. With this proviso that may be of great use". The typological classification when applied in corroboration with stratigraphic method serves as a very useful tool to understand the different forms and traditions in the manufacture of different classes of artefacts. It also serves to link artefacts of distant areas and gives scope for comparison and contrast. For example, the close similarity seen between the handaxes and cleavers found in South India and South Africa or the Neolithic shouldered axes of South East Asia and Eastern India would open up possibilities of ethnographic links and even pre-historic migrations.

Stratigraphical Method

This method was first used by William Smith also called "Strata Smith" in 1816 for geological stratification with the help of fossils. This was adapted for archaeological investigations also later on. This technique has now been universally adopted by excavators and extended to the exploration of cities and
burial sites. The nature and importance of stratigraphy has been vividly portrayed by Wheeler in the following words: "The human occupation of a site normally results in the accumulation of material of one kind or another on and about the area occupied. Objects are lost or discarded and become embedded in the earth. Floors are renued and old ones buried. Buildings crumble and new ones are built upon the ruins. A flood may destroy a town and deposit a layer of alluvium upon its debris, and later, when the flood has subsided, the levelled site may be occupied. Sometimes, the process is in the reverse direction deposits may be removed by the digging of a pit or a burial. In one way or another, the surface of an ancient town or village is constantly altering in response to human effort or neglect; and it is by interpreting rightly the evidences of alterations that we may hope to reconstruct something of the vicissitudes of the site and its occupation." Stratigraphical method of excavation is the surest method of determining the order of succession of events and cultures in a given site and hence, it is a major tool for archaeological interpretation of a site. One of the first tasks of an excavator is to understand the principle of stratigraphy. Wheeler has aptly compared the strata of a site to the pages of a book and each stratum is a link in the cultural sequence of a site.

This method implies the recognition of occupation or habitation layers as well as the layers formed naturally in an excavation so as to determine their sequence of formation. The law of superposition states that the upper layer must have accumulated later in time than the lower one which in turn should have formed later than the one below it. Archaeological layers are deposits of materials laid down by man. It can also be called as occupation layer or level and may consist of artefacts used and
left by man such as pottery, charcoal, coins etc. Stratigraphical
evacuation means excavation layer by layer, keeping all the
artefacts from each deposit in separate groups. The procedure is
to peel off the successive strata in conformity with their bed lines
ensuring the accurate isolation of structural phases and relevent
artifacts. The excavation should “proceed in precisely the
reverse order of deposition” i.e. the last laid deposit must be
removed first and the earlier ones successively until the natural
soil is reached. This will give us a good idea of the earliest
culture at the site and the later cultures that came up successively
until the latest represented by the uppermost layers. This is
known as the sequence of cultures built on the principle of
stratigraphy. Stratigraphic excavation ends at the layer where
there is no longer any trace of human handiwork i.e. when
bedrock or natural soil is met with.

Let us examine what is meant by layers or strata. Layers
are deposits differentiated by variations in colour or texture or
content. It is with some practice, observation and experience
alone that one learns to distinguish the strata correctly. The
change of the colour of the surface of the layer can often be
detected as the digging proceeds. But when it is difficult,
scrapping the vertical sides or sections of the excavated trench
with the help of excavation knife and sometime by clean
vertical cut by bale would help in detecting the finer lines of
separation of one deposit from the other. The variations
in colour, compactness and composition would be visible in
sections. As the excavation knife runs on the vertical section, it
can feel the differences in the texture as well as the contents.
Different kinds of soil depending upon the cause of the deposition
natural or human, like the layers of sand, clay, silt, gravel
or lime (chalk) can be identified. If there was any flooding by
the rivers on the settlement, it would have left a layer of sand and silt. Regarding the contents of the layer, we usually encounter layers containing ash or charcoal, gravel or pottery pieces, layers of brick bats etc. Depending on the contents, the texture of the layer may be loose (if it is sandy) or hard (if it has gravel or pebble). Within the layers we may find some local patches—a patch of plaster or lime-flooring which need not confuse us. Such local patches may look like layers especially if the area of the dig is small but when extended they may be found to terminate at short length and be part of a layer. So, within a layer there may be many smaller laminations or patches. Natural layers should be differentiated from man-made or cultural layers. Layers deposited by natural agencies like the wind, floods etc. may easily be recognised because they will be bereft of human artefacts, and usually called “sterile”. The sterile layers would indicated discontinuity in the occupation of the site due to temporary desertion of the site.

In actual experience, the excavator may find some difficulty in detecting the layers especially in the bright sunlight. It is advisable to observe the section in different lights of the day and, if need be, spray water on the section and have a fresh cut of the section. Variations which tend to get flattened out would show up sharply in shade on indirect lights. Colour photography would also be helpful in this examination. Whenever doubts crop up there is no harm in having over-stratification because it is possible to correct them later on. But under-stratification would lead to a mixture of evidence i.e. artefacts belonging to two different strata may get mixed up irretrievably. The artefacts like pottery, coins etc,
extracted from each layer should be kept separately with the layers marked on them so that their place in the cultural sequence or in the chronological and contextual framework is preserved.

Stratigraphy not only provides us with the sequence of cultures or the order of succession of events in a site but also enables us to arrive at some probable dates at least in terms of centuries. To cite an example, the excavation at Brahmagiri revealed three cultural periods: Period I, the earliest being the Neolithic culture followed by the Period II Megalithic (iron age) Culture which was in turn followed by Period III the early historic culture. The third cultural period viz the early historic period was precisely datable to the early centuries of Christian era on the basis of the discovery of the Satavahana coins, and identifiable pottery and other considerations. When we know that the III period is datable to 1st century B.C.-A.D the preceding culture (Period II) can be certainly be surmised to have flourished prior to first century B.C. say C. 300 B.C. Again on the same basis the preceding Neolithic culture should have been earlier than 300 B.C. It is possible to arrive at a near approximation of dates for culture on the stratigraphical basis.

Two terms are often used in relation to a datable object in a stratum—i.e., *terminus post quem* and *terminus ante quem*. Artefacts sealed beneath a floor gives a *terminus post quem* for that floor, since it could not have got there after the floor was laid. Similarly, datable objects found on the floor would give the *terminus ante quem* since the floor should have come earlier than the artefacts found on it. If a coin datable to 100 A.D. is found on a floor, the floor should have been laid out anytime before or during 100 A.D, and certainly not later than 100 A.D.
These reckonings are of great value in dating the layers and building up the chronological framework. Even securely datable pottery or architecture of the excavated monuments or artistic styles of sculptures found will be of great value in getting approximate dates for the layers.

As and when the layers are recognised, it is advisable to mark the horizontal plane of the layers in the section and also affix the label indicating the layer number and a brief description of it like "ashy" or "sandy". The numbering of the layers is done from the top to the bottom i.e., the layer I would be the latest in point of time and as one goes down, one goes backward in time. This method is convenient for separating the antiquities according to the layer in which they were found. But after the entire excavation work is over, and when we classify the materials and distinguish periods or phases of culture represented, we may number them from bottom to the top. Obviously, the cultural period I would be at the bottom succeeded by period II, III and so on.

Disturbance to the Strata

Pits

There are many factors which cause disturbance to the strata and they have to be recognised by the excavators. Any pit dug at a time either as a refuse or storage pit or for a well or as a foundation trench for a structure causes disturbance to the layers that had already accumulated at the spot. The material in the pit would be coeval with the time when the pit was dug and not with the materials found in the layers it had cut through. The antiquities found in the pit-filling should be separated from those found in
the layers. Though they may be found in the same level, they belong to two different periods. Therefore, it is essential to prepare the history of every pit in an excavation indicating the working level of the pit i.e., the period when the excavation of the pit was started; secondly, the layers which it had cut through and, lastly, the layers not disturbed by the pit. The dimensions and the depth of the pits are also recorded and marked in the section and labelled. The pits are all to be numbered serially like Pit No. 1, 2, and 3 as we proceed from the top downwards. The history of each pit has to be reconstructed in the record note book and its purpose determined as it was part of the history of the site.

Post-Hole and Robber Trench

Two other items which often cause intrusion into the strata are the post-holes and robber trenches. A robber trench is generally a trench for removal of stones from an ancient wall for re-use. Post holes are the small pits or depressions on which posts were planted to carry a roof or a fease. All these cause disturbance to the earlier strata and hence they have to be carefully isolated as a separate unit for study.

The contents of the pits and post holes have to be carefully searched for the packing materials or remnants of wooden poles which would be useful for carbon dating.

Bench Level or Datum Line System

The value of the stratigraphical method of excavation can be appreciated better when it is contrasted with the earlier method that was practised in the early decades of this century by some archaeologists in the sites of Egypt and Mesopotamia and also by Sir John Marshall in Mohenjodaro. The emphasis was not on
the recognition of the strata levels in a site, but "the mechanical recording of every object and structure in relation to a fixed bench level". The levelling instruments were set up at the excavation site and the level of each object or structure was recorded with reference to the fixed points. The basic assumption in this method is that all objects and structures found in a level belong to the same period. Mortimer Wheeler has described this system "outworn" and as "the very parody of scientific method". It fails to take note of the changes in soil or strata and the later intrusions to the earlier strata like the pits and blindly puts all
the antiquities and structural phases in the same period because they are in the same level. Stratigraphical method does not go by the sea mean levels but is based on the recognition of the habitation deposits and the process of their accumulation. Mixing up of the earlier and later materials can be avoided in the stratigraphical method.

But this method is not considered as "Outworn" by many other archaeologists. Burkitt is of the opinion that "Where there is no obvious stratigraphy but more than one industry is present, uniform layer 6 to 9 Cms., thick are removed". American archaeologists also do not decry the "mechanical" or metrical stratigraphy. As has been observed by Heizer, "No archaeologist will quarrel with Wheeler's insistence on employing visible stratification. The fact remains that there are many instances where archaeologist finds himself dealing with a deposit which does not contain such stratification....Where the excavator can find the natural stratigraphy, he must follow the strata, but where such evidence can not be observed, he will be forced to collect his material by some sort of vertical graded levels to enable culture stratigraphy to be determined in the laboratory analysis". A few other American archaeologists plead for the application of both the "natural" and "metrical" stratigraphy or arbitrary level excavation.

Section 2

Lay out of Trenches

The lay out of the trench by peg marking is an important first step in the excavator. The excavator should first decide where the trench should be laid in the mound. This should be done not at random but after a detailed study and observation of the site, exposed sections and also the contour plan prepared by
the Surveyor. Normally, the highest point or the most elevated part of the site would be preferable as it would give the maximum accumulation of the occupational strata and therefore, a full cross section of the cultural history from the earliest to the latest phases of its history. But, in certain cases, the excavator may not be interested in the modern accumulation and his main interest might be in the earlier cultural horizons and accordingly, he may choose the slopes or the lower areas of the mound. However, in general, the central portion of a site should not be left out since it would have served as the hub of the habitation and hence important. Nor should the fringes be neglected since very often the outer fortification wall or the gateways might lay buried there.

Different strategies and methods have to be adopted in the excavations depending upon the aims, the area and the time available for excavation. An accurately laid out trench system is essential for precise record because all artefacts and structures found in the excavations are described according to their position within the trenches and to the pegs that outline the areas. The different types of lay out are:

(i) Trial Trenching or Sondages

Trial trenches serve as preliminary sounding before regular excavation and give us some glimpses of the nature, depth and contents of the archaeological deposits in a given site. They have to be considered as exploratory in nature and they are only a means to an end and not an end in themselves. The dimensions may be one meter in width for equal measure of depth. They should be laid out and oriented with the grid so that if they produce promising results the areas can be extended into a square excavation. Indiscriminate trial trenching should be avoided as it
would affect the perspective that would be gained by a fuller area excavation. At any given place, it may serve to give a view of the culture sequence of a site in a short time; but it should be used with caution since the area of the dig is small and hence its value limited. It is not a substitute for a more detailed excavation.

(ii) Rectangular Trenching System or Vertical excavation

One of the popular methods of excavation lay-out is the rectangular trenching method. Wheeler calls it as "Substantive trenches" since they are not tentative cuttings but regular method with definitive objective. This is useful when the area of dig is small and the objective is more to know the vertical sequence of cultures than to have fuller picture of each and every phase. This method is also useful for cross trenching a line of fortification to correlate its stratigraphical sequence with that of the enclosure within. This method was adopted in Harappa to establish the stratigraphical relationship between two cemeteries far away from each other.

![Diagram of Rectangular Trenching System](image)

Fig. 2
Generally, in this system a rectangular trench of say 10' X 8' or 30' X 20' may be laid out lined with two parallel rows of one metre. The pegs on one side may be numbered as O, I, II, III, IV and so on whereas the corresponding pegs on the other side as O\textsuperscript{1}, I\textsuperscript{1}, II\textsuperscript{1}, III\textsuperscript{1}, IV\textsuperscript{1}. If in the course of excavation it is felt necessary to extend the trench backward from Zero, the pegs of the extended sides can be marked A B C D on one side and A' B' C' D' on the other. The pegs should be diagonally planted with a central nail at the top which marks the correct measuring point. The peg line acts as the datum line for all measurements in recording the antiquities. The actual excavation should be done about 50 Cms. inside the peg line on all sides. In fact, the actual area to be excavated should be marked with the string lines all around. Digging should not extend up to the peg line but should stop with the cutting line. This is done in order to keep the pegs and the peg line undisturbed throughout excavations. The pegline is also marked by a running string firmly nailed to the ground. The peg line serves as the datum line for all measurements.

Another important feature in this method is to leave a number of intermediary baulks at regular intervals - say after every 3 metres. This helps having proper control over the digging and correlating the sections besides facilitating access to different parts of the trench for the supervisors and labourers.

Recording the artefacts and other features in the excavations is done by what Wheeler calls as the three dimensional measurement. The three measurements serve to pinpoint the exact location of each object found in the trench and help record the stratigraphical position. Longitudinal measurement records the distance along the trench from the nearest peg. An angle
measure is used in such a way that one arm is held along the
datum string and the other goes at right angles inside and
perpendicular to the object. The vertical or perpendicular line is
obtained with the help of a plumbob suspended over the object.
This provides the lateral or inward distance of the object from
the datum string; and the third measurement records the depth of
the object from the intersection of the inward arm and the
vertical plumbob line. A double purpose would be served if
we attach the plumbob to a measuring tape and suspend it over
the object. It would mark the intersection with the inward arm
as well as indicate the vertical depth of the object. The ultimate
measurement recorded would have three dimensions - the
longitudinal, the horizontal or lateral and the downward or depth.
The measurement of each object can be recorded thus:
V-1.2 X .50 X 2.5. The first unit represents the peg number and
the other three represent the three measurements. The envelops
into which the antiquities are kept or the label thereof should
contain these measurements so that at any time their exact
location and their stratigraphical position can be known without
doubt or ambiguity. With the help of the measurements we can
reconstruct the location of the objects according to the plan and
according to the strata. The same method of measurement is
applied to plot the structures and other features that are
discovered in the excavation.

The trench system described above is suitable more for
vertical excavation than horizontal excavation; one of the defects
in this system is that it does not lend itself for lateral expansion.
Expansion is feasible only on the longitudinal direction. To that
extent the excavator's freedom is restricted. Secondly, the scope
of getting a fuller picture of material culture of a phase is
certainly limited. Its great advantage is that within a comparatively shorter time and with less labour and expense, the excavator can obtain the vertical sequence of culture and also a few glimpses of the material culture. Wheeler has drawn a comparison between the vertical and horizontal excavations and stated:

"Vertical excavation alone whilst supplying a key to the length of an occupation, can not be expected to reveal, save in the most scrappy fashion, the significant environment economic, religious, administrative in other words, it leaves us in the dark as to these very factors which fit a past culture or civilisation." Mohenjodaro could never have taken its high place in history of urban development with its rectilinear street plan, elaborate drainage had it not for the far-reaching horizontal excavation to which it was submitted. But it should be noted that vertical and horizontal excavations are not mutually exclusive but complementary. The former should precede the latter. The vertical dig reveals the stratified deposits and furnishes the sequential framework whereas the horizontal dig reveals the contents of the deposit

(iii) Grid System or Horizontal Excavation: Fig. 3

For horizontal or area excavations two ways of investigation or lay-out are followed-one by the grid system in which a series of squares of uniform size is laid out and the other is stripping complete area without the aid of square divisions or balks. The former method was popularised by the British archaeologists including Wheeler and Kenyon. But the latter method-open stripping has gained popularity in recent years especially in the U. S.
The grid divides the area into a series of exact squares which are parallel to the site baseline (or latitude) and to the datum line (or true meridian longitude). The Surveyor lays out the metric grid parallel to the datum line. This orientation is necessary because it enables the archaeologist to describe accurately any point on the site in relation to the north-south axis. The size of the square boxes will depend on the depth to be excavated. Normally, 5 to 10 metres square will be reasonable. The squares are separated by the balks (unexcavated strips of partition) of uniform width of 50 cms. or 1 mt. depending on the nature of the soil. The balks are to be retained till the end of the excavation work because besides providing access to different boxes they preserve four vertical sections which establish relation between the layers and features. They help the excavator in the correlation of stratigraphy from the different parts of the sites. Ultimately, the balks have also to be removed if necessary as they should never be allowed to obscure or cover any structural features or other important details. Besides the primary balks, secondary balks, wherever necessary, to have a section across the structures within a square, can be had.

Fig. 3
After the grid is laid out and the peg marking done accurately, they can be conveniently named by means of letters on one direction and by numbers in the other. This would enable us to designate and mark the square individually as A1, A2, A3 etc. or B1, B2, B3 and so on. The peg at the junction of four squares will have four different names for its four faces A1, A2, B1, B2.

A great advantage in this grid system is that it lends itself to expansion in any direction without hampering the basic datum line of the sections, as shown in Fig. 3. Therefore, this is a very convenient system to excavate a vast area or a town site and every part of it could be plotted and integrated in the over-all site grid.

(iv) Open Stripping

Some excavators would resort to open stripping method after knowing the stratigraphy of the site. The square unit system and the balks that go with it are avoided. The total stripping is carried out in a single operation or in connected series. Each layer and feature is followed individually and cleared completely. This method is often employed when time is short or where there is a need for emergency excavations. It also helps to clear a large area and save considerable amount of time and effort. It was adopted in quite a few places in England to excavate sites with the timber architecture of the Saxon period and pre-historic farmstead. The main problem in this method is to have proper control over the stratigraphical base and also the movement of people and the disposal of excavated earth in the absence of the balk path ways. Therefore, it demands much skill and caution on the part of the excavator. This is popular in U.S.A where there are no huge mounds or complicated stratigraphy.
(v) Quadrant Method

For excavating a circular mound such as a barrow, megalithic cairn circle or a stupa, the trenches can be laid out in the quadrant method. The mound or the burial is divided into four quarters, each of which is excavated sequentially. This method was introduced in India by Wheeler to excavate the megalithic burials at Brahmagiri and since followed in all the megalithic excavations. The mound is marked out into four quarters by two strings, laid preferably to the cardinal points of compass and over the approximate centre. Opposite quarters are dug leaving a balk of about 50 Cms. to 1 metre wide between the quadrants which provides a complete transverse section across the mound in both directions. Quadrants are numbered or named in the order they are excavated. A line of pegs at 50 Cms. intervals is planted along the lines of the lay-out. They serve as the datum line for recording the artefacts or grave goods or other features in the burial. The balk sections would preserve the stratigraphy of the deposits and features such as the level at which the primary burial pit was cut and the nature of the filling over it. This could be drawn to scale for recording. After recording the stratigraphy revealed by the balk sections the balks can be removed so that the complete plan of the burial is exposed for drawing and photography. By this careful method we will be able to reconstruct the different stages of the burials and also the rituals that were behind them.

SECTION—3

Excavation of a Structure

Structures form an important part of any ancient site especially of the proto-historic and historical times. Right from the Neolithic period, man started devising some sort of primitive
dwellings by raising mud or mud-brick walls. In some areas, timber-architectural remains have been unearthed. In urban centres like Harappa or Kausambi very imposing structures have been brought to light. It is the duty of the excavator

a) to lay bare the plan of the structure.

b) to know the pattern of construction.

c) to expose the successive occupation levels associated with the structure and know its history—its origin, life time and destruction.

d) and to identify its purpose and utility. Let us discuss these points in greater detail.

Plan of the structure

The chief aim of the excavator is to know the full plan of the excavated structure to know its full dimensions-length, width and height besides its shape and form—whether it is circular, square, rectangular. This will enable us to know many useful things such as whether circular or square houses were more popular during a particular period; or whether apsidal structures were confined only to Buddha chaityas or whether they were more widely used etc. This would include the plan of the streets, houses, drainage system, fortification walls, places of worship and their lay-out, orientation in a given town and so on.

Pattern of construction

Ancient structures could reveal the pattern of construction and the engineering skill attained in a particular age. Things like the nature of the super structure, the nature and material of the cementing material and the pattern of the roof are some of the interesting aspects that can be studied. For example, we can find
out whether the header and stretcher arrangement of bricks was followed in raising the walls. We can also find out whether the walls were erected in dry masonry or some cementing material was used and if so, the nature and preparation of the cementing material, clay or lime or any other material.

Another important aspect relates to the nature of the roof and roof materials whether the lintel or the arch or corbelled arch system was followed and whether it was thatched or tiled roof and things like that. There is a general opinion that the true arch system was introduced in India only during the Islamic period and prior to it the lintel system was the prevailing norm though evidence of corbelled arch is available.

The size and nature of bricks is also to be carefully noted. Certain standard sizes in certain periods were in use, for example, large-sized bricks (2 ft. × 1½ ft × 6") are often met with in the early historic period in South India in sites like Nagarjunakonda, Kanchi and Kaveripattinam; bricks of the later period are smaller in size. The nature of the clay and the firing also distinguish bricks of certain periods. Hand-made and moulded bricks are also differentiated. Similarly, the ancient roof tiles differed from the latter day tiles. Long rectangular tiles with hook-like shape at one end were popular in ancient and medieval periods in South India. The concave tiles which are widely used today were of more recent origin.

Careful examination of the structure and the associated debris would reveal many important features of the ancient architectural patterns. The pattern of outer veneering and plastering, and the flooring and the ventilation system all can be known. Fallen plasters, some painted, are often collected in the
debris. Beautiful ornamental or painted mosaic tiles forming the flooring have been uncovered in Roman villas. Other notable features include door and window sills, iron bolts and nails, balustrades, ornamental entrances etc. In short, excavated structures form an important source for reconstructing the history of ancient architecture in any country.

History of a structure

Chronology of the structure should never be neglected. Sometimes, the ancient structures can be dated on the basis of some associated inscriptions or coins or literary correlation. Certain intrinsic diagnostic architectural styles and motifs are also there, for example, the Mauryan pillar capitals found in Kumraha (Pataliputra) excavations. But often, the excavator is not so lucky to get clearly datable structure. Here, the stratigraphical association becomes extremely valuable. The aim should be to expose the successive occupation levels associated with the structure and for this a structure should be related to the adjacent strata. The first important pitfall to be avoided is to attempt wholesale clearance of a wall along its two faces as this would cut it away from all the strata and floors and isolate the structure from its cultural context. The common impulse "to find a wall and follow it" should be avoided. Instead, the trench should be cut perpendicular to the wall face. In the course of an excavation, structures running obliquely may be met with in the trench. In such cases, a section in the form of a balk is to be laid against the structure passing through the centre of the structure at right angles. By this method of cross sectioning, the relationship of the structure to the adjacent stratification of the trench as whole can be retained. This relationship will be destroyed if the whole sale clearance of the wall along its two faces is attempted. Sir Mortimer Wheeler has explained these two methods tellingly with
illustrations of two sections in his book Archaeology from the Earth. According to him the dating or the cultural setting of a building is based on three categories of objects: (i) those supplied by the strata which accumulated before the building was constructed (ii) those supplied by the strata contemporary with the construction; and (iii) those supplied by strata subsequent to the construction. "Categories (i) and (ii) bracket chronologically or culturally whilst category (iii) defines the point within the brackets." In an excavation, one may find structures of different kinds-portions of a palace or an altar or a basement of a temple belonging to different periods or cultural phases. All the structures have to be serially designated A, B, C etc. and the three categories of data given above should be recorded for each one of them. This would clearly indicate the relative chronology or the cultural setting of each structure. Structure A may belong to V cultural phase, B to the IV, C. to phase III and so on, or more than one structure may belong to the same cultural phase.

The questions we should try to answer are: when was this structure built? how long did it survive and when and why did it fall? Particularly, we should note the layer or layers into which the foundation trench of the wall has been cut into. If the structure was not very tall, a shallow trench would have sufficed but if it was a high wall, part of a storeyed building, the foundation trench would have been deeper and more firmly laid with sand filling or rubble footing. Among the layers into which the foundation trench is cut, the top most would mark the beginning of the period of the structure and the layers that have accumulated against the wall were coeval with the wall and mark the working level of the structure, and the debris layer marks the end of the wall. Invariably, we would find the roof material collapsed and forming the debris. The layer that covers and runs
over the debris layer is posterior to the structure. By clearly identifying its stratigraphical position, the chronology or the cultural setting of the structures can be fairly reliably determined. Artefacts like the coins or distinguishable pottery found in the contemporary layers would help us to know the date of the structure. The pre-structural layer and the ceiling or post-debris layer discussed above would provide respectively the lower and the upper limits of the chronology of the structure. In this fashion, the relative sequence of the structural phases in a given village or town site can be reconstructed as was done at Harappa, Lothal and other sites. The section drawing should clearly indicate the stratigraphical position of the structure and interpretation should be based on it.

Floors

One of the easily recognisable features which an excavator can look forward to while excavating a structure like house is a floor level. Often, we may find a series of floor levels formed against a wall. When a floor abuts a wall, it means that the latter came first or the two were contemporary or the floor may be a renewal. When a well or its foundation is found cutting through the floor levels, it means the latter were already there and hence earlier than the well. Floorings of the pre-historic period are comparatively difficult to identify because of their primitive character and close resemblance to the surrounding soil. Mostly, they were made of beaten earth and clay or made up of straw or cow-dung or other organic materials. But the flooring of the historical period, made as they were of solid materials like slabs or tiles are easier to recognise. Mosaic floors paved with decorated tiles were often found in many of the Roman sites. The artefacts found on the floor levels are extremely valuable to determine the cultural setting of a structure.
Robber Trenches

As already pointed out, there are many human agencies which cause disturbance to strata and the ancient structures and one such is the trench cut by the stone or brick robbers. It is well known that many ancient Roman sites in England served as a rich quarry for tiles and stones for later day constructions. As pointed out by Graham Webster, the Great Norman Church at St. Albans was constructed largely of Roman tiles robbed from Verulamium. In India too, bricks from ancient sites are beings robbed by the villagers to construct their houses (eg. Kaveripattinam in Tamilnadu.)

Mud Brick Structure

Excavation of mud and mud-brick structures is rather difficult and therefore, it should be undertaken with extra care. They are usually met with in the chalcolithic and the early iron age cultures in India. Sites like Lothal in Gujarat, Ahar and Gilund in Rajasthan and towns of historical period like Kapilvastu have yielded impressive range of mud brick structures. Since the mud wall or mud-brick wall would closely resemble the surrounding earth in colour, the excavator is apt to mistake and dig the mud brick wall too. But, careful observation and scraping of the surface with an excavation knife before every dig would certainly reveal that the wall portion is harder and more compact. The excavator can spray water on the surface and notice the differential nature of absorption of water. The earth would dry up more quickly in the earth portion than on the brick portion and hence, the outline of the bricks would show up. The thin lines of joints between the bricks can be noticed,
Excavation of Ancient Towns

Excavation of an ancient buried town or city is indeed a challenging task and calls for considerable planning and imagination. Examples of excavated cities that come to our mind are: Pompeii, Athens, Charsada (Pushkalavathi), Taxila, Harappa. These excavations have brought to light cities with massive walls, gateways, towers, citadels, shrines and palaces. But in some of them the stages of their growth or development were lost because of the emphasis laid on the recovery of the valuable treasures and the buildings rather than the historical growth of a city. But the perception has undergone change in the late 19th and 20th century. "Today nobody regards the excavation of an ancient city as the despoliation and dismemberment of an organic entity". Gaston Boissier summed up the new method initiated by Guiseppe Fiorelli in 1863 at Pompeii which are quite relevant even today. "Efforts were directed to reviving a Roman city (Pompeii) that would depict for us the life of bygone ages; that it was necessary to see the city in its entirety and in its minutest details...that knowledge was sought not only of the houses of the wealthy but also of the dwellings of the poor, with their common household utensils and crude wall decoration. Instead of stripping the dwellings of their decorative features and furnishings and penetrating into the buildings and thereby bringing about collapse of the superstructure and facades...Fiorelli was the first to apply the stratigraphic method in this excavation at Pompeii. His procedure consisted in clearing the dwellings in gradual stages starting from the top and working downwards, so as to ensure the conservation in situ of different elements of masonry".

Sir Mortimer Wheeler distinguishes two categories of town-sites—the level site and the other mound or the tell—and prescribes
wo different strategies though the ultimate aim of both is the same. For the level or flat site, he advocates restricted area excavation in the centre of the town since the original civic centre would have been the focal point round which the city had grown and hence likely to yield the maximum accumulation of occupation. The excavation could be gradually extended toward the periphery to have a more integrated picture. The excavations in the periphery may often reveal the presence of the outer defensive walls. This can be probed by cutting trenches across the line of fortification at selected points. These trenches may be continued or prolonged into the town area so as to correlate the defensive system with the successive phases of the occupation of the town. This would help throw light on the historical vicissitudes of the town from its initial foundation to the heyday of its glory and then its decline.

As regards the excavation of a tell, it is not always advisable to start from the top-most point of the mound because the depth to be negotiated would be too much and hence unmanageable—say 15 to 30 m. Moreover, it is also very likely that the top levels would only yield remnants of the recent past about which enough evidence is already available to us. If the mound is not very tall and the upper strata are themselves of the earlier and less-known period, we can start the digging from the summit. But otherwise, it is advisable to resort to step cutting from top to bottom. This method would help negotiate any depth. In this, the earlier strata at lower levels and at the periphery of the mound are more easily accessible to us. The available money and labour can be spent on knowing more about the earlier period and not wasted in the excavation of the medieval or modern deposits.
An ideal excavation of the town site would be a total uncovering of the lay-out and the general plan of the town and to establish the cultural and chronological range of the town. The normal features of the ancient town such as the citadel or the acropolis, the quarters of the common people, the army barracks, the public buildings like the public granary, the temples and other religious centres, the fortification, the gateways, the roads and streets and last but not the least, the burial ground. Typical of this kind are the excavations of the urban centres like Harappa, Lothal, Kalibhangan and Taxila.

Section 5

Excavation of Burials

The method of the disposal of the dead is an important element of the culture of any society. It reflects the attitude towards many aspects such as belief in the life after death, the immortality of the soul, belief in the protective role of the spirits and so on. An analysis of the burial mode and the grave goods would give clues regarding many religious beliefs and ritual practices of a society. Therefore, excavation of an ancient town would be incomplete without the excavation of the burial site. The burials as an important source of historical information can indeed be appreciated when we see the rich and elaborately furnished royal tombs of Ur or the Pyramids of Egypt with a vast array of artefacts and inscriptions or the comparatively simpler but extremely significant burials with inscribed seals found at the Indus Valley sites. The megalithic burials of South India present their own interesting variety of architectural features, grave goods and the graffiti marks. It is very difficult to generalise the burial types since there are so many improvisations and adaptations. Nevertheless, the following types can be distinguished: simple
inhumation burial in fully extended or flexed position, urn burials associated with cremation, jar burials, collective burials, sarcophagus burials, monumental tombs like the pyramids of Egypt, barrows which are usually low mounds above the ground level as those of the Bronze Age barrows of England, chamber tombs, the megalithic dolmens, cairn circles and so on.

Whatever the type of the burials, the general features to be observed, recorded and interpreted are:

i) the location of the burials visa-vis the village habitation. Was there any particular direction set apart for the burial place? The megalithic burials are usually situated on the slopes of a hill in South India while the habitation was at the foot of the hill. In the Neolithic period the dead were often buried in the house itself.

ii) the position of the body-extended position or flexed or crouched; and also the orientation of the body.

iii) the nature of the burial—whether primary or secondary—the latter meaning re-burial of the bones after exposure to nature and removal of the flesh.

iv) the nature of the receptacle—urn, or sarcophagus or stone chamber, rock-cut caves and other architectural features.

v) the stages into which the original burial pit was dug and the fillings made and sealed. This will also indirectly help reconstruct the ritual history. Stratigraphical method in the quadrant or general grid has to be adopted for this.
vi) the nature of the grave goods—pots and pans, weapons and other artefacts interned with the body. They have to be recorded in detail and interpreted. Inscribed seals and pottery would often be very valuable.

vii) Skeletal Analysis.

The excavator should carefully expose the skeletal remains in situ by gently removing and cleaning the dirt by soft brush and needle; do the photographic documentation and the drawing to record the exact position of the skeletal remains and the grave goods. The bones should be chemically strengthened before removal lest they should crumble. If the skeleton is too fragile, it is advisable to lift it along with the surrounding earth by undercutting. The packing and transporting to the laboratory for conservation and study should be done carefully. The bones are referred to the physical anthropologist for identification and study. Various aspects like the age, sex, racial type etc. can be analysed. Pathological study can also be done to extract information on the cause of death, nature of disease etc.

For achieving the objectives set out above, the stratigraphical method of excavation and three dimensional and triangulation methods of recording the artefacts are the best means. For circular burials like the round barrows or megalithic cairn circles, the quadrant method, described earlier, is found suitable. Good example of the megalithic excavations in India are those of Brahmagiri (by Wheeler) Sanur (by N. R. Banerjee and K. V. Soundara Rajan), excavation of urn-burials at Pulkalam, Kerala (by B.K. Thapar) and rock-cut cave burials of Kerala (by Y.D. Sharma) described in detail in the volumes of Ancient India. For flat cemeteries like the urn burials without any stone appendage, the ordinary grid system with adequate sections across the burials would serve the purpose.
Section 6

Excavation of Stupas

Excavation of buried stupas is somewhat complex since it has many architectural features like the outer gateways, circumambulatory passage, the projecting platforms, the central dome besides the relics in the centre. Since it is also a circular structure on plan, the quadrant method of excavation may well be applied to expose the plan as well as the stages of its construction and nature of the fillings. The quadrant method is easier for isolated stupas; but when they are part of a bigger monastic complex full of subsidiary structures like the Chaityas, Viharas, Mandapas etc. it is better to excavate them as part of the usual grid system. The advantage is that a comprehensive plan of the lay-out of the complex will be obtained. This would be quite important for the study of Buddhist architecture and rituals. Good examples of the excavated Buddhist complexes are Taxila, Nalanda, Kapilavastu, Pauni and Nagarjunakonda. In the latter place, interesting plans of the stupa base like the Dharma Chakra and the Swastika have come to light besides the ayaka platforms and pillars peculiar to the Andhra stupas.
CHAPTER VI

ARCHAEOLOGY AND OTHER SCIENCES AND DATING METHODS

It was briefly shown earlier how archaeology is increasingly becoming a multi-disciplinary enquiry and how it depends on many natural and social sciences like Geology, Anthropology, Physics, Chemistry, Botany, Zoology and Palaeontology. As has been rightly observed, "archaeological enquiry has become so diversified that no one can even pretend to be fully conversant with all branches". Broadly speaking, the dependence of the archaeologist on other sciences is seen in four spheres of his activities:

i) explorations and excavations

ii) dating the artefacts and the strata

iii) studying the environmental archaeology

iv) cleaning and preserving the antiquities and monuments.

Of these, the first item viz. the scientific aids used in exploration techniques have already been discussed in the second chapter and the fourth item regarding conservation of antiquities is discussed in chapter VIII. We will examine the other aspects of application of science to archaeology.
1. Archaeology and Geology

Geology is the science which deals with the condition and structure of the earth and the evidence afforded of ancient forms of life. It includes the study of the earth’s crust, its strata and their relations and changes. In simpler terms, it is a study of rocks, minerals, soils, river formations and terraces, past climatic changes and their effects on land formation. The most important contribution of geology to archaeology is the law of stratification which has become a major tool for archaeological interpretation. Its utility and importance in an excavation has been explained in detail in chapter V and needs no repetition here. Similarly, a knowledge of the formation of river terraces, or changes in the river courses, the climatic cycles (like the glacial and pluvial cycles) and their effect on the land formations etc are extremely important for the correct interpretation of pre-historic archaeology. The geological formations or deposits in which the human artefacts like the stone tools are found provide the geo-chronological context in which the makers of the tools lived. A sound knowledge of geology is very essential for prehistoric archaeology as it provides the sequential framework for the deposits in which human artefacts are found embedded. De Terra and Patterson studied the Palaeolithic tools of the Sohan valley in relation to the terraces found there, as well as the geological cycles in the glaciated zones of Europe and presented a sequential picture of the evolution of tool techniques and types. The same method is now extensively used to study the pre-historic cultures in the other river valleys of India as well. The glacial cycles of North India and the pluvial cycles of peninsular India are carefully studied and related to the corresponding cycles in Europe, Africa and other parts of Asia together with their faunal remains.

Geomorphic features like changes in sea levels, glaciers, wind deposits, erosion and deep cutting of rivers, wet and dry
phases—all leave certain recognisable and comparable deposits and the human artefacts or faunal remains found in them help the geologists to cross date them. Thus, geological correlations form a vital link in dating the human artefacts.

Geology helps an archaeologist in many other ways also. Identification of the rocks or minerals of which the human artefacts are made is helpful in knowing the source or origin of supply and also its distribution. A knowledge of the distribution of quartzite in India would help us anticipate the occurrence of Palaeolithic sites even as the presence of trap rock would be an indicator of the prevalence of Neolithic sites.

A special branch of geology known as Petrology is engaged in the study of crystalline structure of the stone. Such a study on the stone axes and similar implements found in excavations has led to the discovery of factory sites and also the ancient trade routes. Dr. H. H. Thomas demonstrated that blue stones of Stonehenge came from Pembrokeshire mountains and it set the archaeologists to search for either the partially coastal route or the more adventurous route round the land. Petrological identification of the rocks helps an archaeologist to know the source of the raw material of the artefacts.

**Glacial Varve Chronology**

This geological method of dating was first evolved by Gerard De Geer. Varve dating depends on the waters that flow down from the glaciated areas. It deposits the rough material in the lakes, but later, in the autumn, drops only the finest silt until all deposition stops in winter and consequently the deposit is thin. Each year a layer or varve is added. These are varied and laminated clays. These annual deposits or cycles of sedimentation are
counted in a series of sections and a time scale is evolved for a region. With the help of additional evidence from the study of moraines and other related features, varves from different regions are correlated for building up a chronology covering larger regions. By his study of varved clays, De Geer arrived at a chronology for the end of the last Ice Age in Northern Europe as about 12,000 years ago. In the lake deposits of Scandinavia and North America, it has been possible to count back to the period immediately after the last retreat of the glaciers.

Soil Science

The importance of the study of soil or pedology for archaeology has been shown by Prof. Zeuner and also by Cornwall (Soil for Archaeologist, 1958). The soil is the combined result of natural weathering forces, decayed plants, and the activities of small animals and insects. Particles of stones, pieces of tile and pottery get buried in the soil below the humus level. In an excavation, the archaeologist may encounter buried natural soils of the past. Such soils are dead and are truly fossils. They indicate a pause, during which the site was subject to natural weathering and growth of vegetation. From them, the environmental factors that led to the desertion of the site may be deduced. Soil scientist can also assist the excavator in interpreting the details of stratification in the sections and explaining the composition of the layer. His tools are primarily mechanical grading of particles and certain chemical testing like the phosphate analysis.

2. Archaeology and Physics

The contributions of Physics to archaeological investigations are many. We have already noted (See Chapter-III) how a physicist can help in the process of archaeological prospecting.
by providing us with the scientific aids in his survey like the Proton Magneto metrical survey to detect buried iron and kiln sites; Thermo-remnant Magnetic Survey to detect buried burnt clay artefacts and brick structures; Electricity Resistivity metric survey to study the buried soils, rocks, pits, etc. All these survey methods, used variously, according to the problems of the area, have contributed substantially to the improvement of the exploration techniques. It is however in devising methods of dating that Physics has contributed significantly.

Radio-Carbon dating (Carbon-14)

This method of C-14 dating was devised in U.S.A. by Willard F. Libby in 1948. Carbon 14 which is radio active heavy isotope of Carbon is present in the earth’s upper atmosphere. The C-14 atmos combine with oxygen to form carbon-dioxide and become mixed in the earth’s atmosphere and enter into all living organisms like plants and animals. All living organisms absorb C-14 (the ratio active carbon) and C-12 (ordinary carbon) in a constant proportion till the moment of death, after which the radio-carbon already absorbed starts decaying at a rate determined only by the half life of the isotope. The Carbon-14 is reduced to half in 5568 ± 30 years. It is possible to determine the age of an organic sample by ascertaining the specific Carbon 14 activity in the sample. The amount of C-14 remaining in the dead organic matter as indicated by its radio-activity is proportional to the time elapsed since death. The dating of an ancient organic sample results from the measurement of its C-14 content and the calculation of its age from the amount of disintegration that has occurred since death. This dating is possible on the basis of the present day C-14 content of living matter and the known half-life of C-14.

"The laboratory procedure consists of burning the sample, reducing it to pure carbon and measuring the radio activity in a specially constructed radiation counter".
The materials that are found suitable for this examination are: wood, charcoal, charred bone, textile piece, leather, hair, skin, antler, tusk, shell, dung, charred grains etc. Care should be taken at the time of sample collection to see that contamination from organic material (like cotton or other fibrous material) of more recent derivation is avoided. Samples should be collected in moisture-free jars or aluminium or plastic foils, labelled and kept with the necessary field data like the name of site, strata etc. recorded. The samples should be sent along with the field data to the analyst.

This method is not without defects. The assumption that the rate of production of C-14 has been uniform throughout the past is now challenged. There are possibilities of error in sampling or calibration of the counter or countering error. In order to correct this error, the final count is expressed by the plus or minus figure appended to a C-14 date. Some recent advances have also been made in evolving correction methods to eliminate contamination.

There are a number of centres in U.S.A. and U.K. having laboratory facilities for Carbon-14 analysis. They are extensively used by the archaeologists. In India too, we have a few institutions undertaking these analyses such as the Tata Institute of Fundamental Research, Bombay, the Birbal Sahni Institute of Palaeo-Botany, Lucknow and the Physical Science Laboratory, Ahmadabad. Thanks to these institutions, we have quite a long list of Carbon-14 dates for different cultures and sites in India which by and large corroborate with the archaeological datings. There are however a few cases where the carbon dating is found to be at variance with the archaeological dating. This is attributed to contamination of the sample. As pointed out by Harold Barker,
there are certain some limitations in the method but he rightly concludes: "One must accept the fact that the method is not able to resolve age differences of less than several hundred years and is therefore more useful in fixing the broad outlines of a chronology rather than the fine detail" (The Scientist and Archaeology (1963) p. 135) " Another writer remarks: "The method has given the first universal means of absolute dating quite independent of archaeological methods."

Thermoluminescence Dating (T L.)

This method is helpful in dating the ancient clay objects like the pottery, bricks and the ceramics. All clays contain crystalline constituents and also traces of radio active materials the decay of which leads to the accumulation of energy at a constant rate within the materials. This accumulated energy is released as a flash of light when the clay material is heated to a very high temperature. This phenomenon is called thermoluminiscence. The amount of light thus emitted is measured by sensitive photo electric equipment. When pottery is made and fired, the accumulated radiation in the clay is released as thermoluminescence. This method involves the measurement of the decay of the radio-active particles in baked clay by calculating the amount of damage to the crystal structure of the material. Therefore, if one takes a sample of pottery and measures the amount of thermolumiscent light emitted on heating, it should be possible to relate this to the time that has elapsed since the pottery was originally fired. There are certain practical difficulties in applying this method widely but attempts are being made to improve it for wider application. It is still in the experimental stage. "Once the method is perfected it will give a valuable check on radio carbon dating for all periods of the past when pottery was in use". 
Archaeomagnetism

A technique has been developed for dating baked structures such as kilns, hearths and burnt clay walls if they have remained in situ. This method is based on the behaviour of iron particles in the clay when it is in plastic state prior to its hardening during the process of firing or application of heat. Any object in which there are bits of magnetic iron is given magnetic power by earth's magnetic field. When a clay object is heated above a certain temperature its magnetism is lost; but it is regained when it is cooled. While regaining it thus, the orientation and strength of the regained magnetism are determined by the earth's magnetic field at the moment of their last cooling, and hence it is called archaeo or remnant magnetism. "Let us take an example of an earthen jar that was hardened near London in a very hot stove and then was allowed to cool. Centuries later, a scientist finds that jar and wants to date it. If he can measure the direction of the remnant magnetic line in the pot and if he knows what year the magnetic lines of the earth pointed in this true direction, he can date the year when the jar was heated in the stove. He will then know how old the jar is." (Lywn and Gray Poole, *Science Dates the Past*, 1964, p. 100).

The instrument for measuring the direction and strength of the remnant magnetism was designed by Profs. Cook and Balsha. It is called magnetometer. With its help, the scientists search the true magnetic north record and discover in what century and almost in which year true magnetic north was pointing exactly in that direction. Then they can arrive at the near date for the object.

The dates obtained by archaeomagnetic methods are very encouraging and agree with the known dates of the objects tested.
This was tested on the objects from the Roman sites in England and the dates obtained tally well with known dates.

Potassium-Argon Dating

This method resembles closely the Carbon-14 method. The earth's crust contains potassium of which Isotope K 40 decays to Argon 40 at a known rate, its half life being 1,300 million years. The date of a sample is determined by measuring both i.e. Potassium-40 and the Argon-40 present. Volcanic ash and basalt which have come out of the volcanic eruption serve as good samples for this method. This method was applied to date samples of Early Pleistocene period in the Olduvai Gorge. This is useful for dating materials 23 to 26 million years old.

Archaeology and Chemistry

Archaeology is indebted to Chemistry in many ways, the most important being in the field of cleaning and preserving the antiquities. Metal objects like iron, copper or silver found in the excavations are to be treated chemically for removing the incrustations, corrosion products and silicious materials and for strengthening and preserving the objects themselves. This applies to other objects also like glass, terracotta, wood, textile etc. Sometimes, the excavated objects may be so fragile that they have to be chemically treated and strengthened in situ before removal. Here, the services of a chemist are very important and almost indispensable.

The services of the chemist also become essential in the conservation of monuments and ancient paintings. There are several problems in the monuments such as the growth of vegetation, moss and lichen on them and salt action on the building
material, which have to be removed carefully without causing injury to the monument. This is best done by chemists who in recent years have developed several useful methods of chemical treatment. The dark covering of moss and lichen on monuments like the Five Rathas at Mamallapuram or the Sun Temple at Konarak has been successfully removed and the monuments brought back to their original beauty by the excellent work done by the chemists of the Archaeological Survey of India.

Similarly, the chemists play a vital role in cleaning, strengthening and preserving the ancient wall paintings. The world famous Ajanta paintings and those at the Great Temple at Thanjavur are outstanding examples of the good conservation work done by the archaeological chemists. At Thanjavur the chemists of the ASI did the difficult job of separating two layers of painting which had been done one over the other and preserving them both.

The bronze icons and coins often found as treasure troves are usually highly corroded or covered with incrustation and they are sent to chemical laboratory for treatment before they are put on display. So, a chemical laboratory is an essential adjunct to a museum. Chemists have devised several methods like electro-chemical and electrolytic reduction for cleaning these objects.

In recent years, preservation of excavated ancient brick structures is engaging the attention of the archaeologists and here too, the chemists are helping by testing several chemical solutions to protect the structures from the effects of weathering, salt action etc.

Let us now see how chemistry helps in dating some of the antiquities.
Fluorine, Uranium and Nitrogen Dating of Bones

The basis for this analysis in the words of Kenneth Oakley is “The fluorine and Uranium content of the mineral matter of buried bones and teeth increases with the passage of time whereas the organic (protein) content measured as nitrogen decreases. Thus, the comparison of the fluorine, Uranium, and/or nitrogen content of bone or tooth of questionable age with the ranges of these elements in other bones or teeth of known age and in similar matrix at the same site, sometimes indicates clearly the relative antiquity of the specimen in question” (The Scientist and Archaeology-p. 111)

Fluorine Dating

The fluorine that is present in the ground water is gradually absorbed by the buried bones or teeth. It replaces the hydroxyl content. The greater the fluorine content of a bone, the greater is its antiquity. But the rate at which this absorption happens, depends on the fluorine in circulation, climate and similar factors and therefore, this method may not be useful in comparing the bones of different areas or hydrological conditions. However, in a given area, the fluorine test will give us the relative age of bone of different geological ages.

The test in combination with uranium content test and radio-carbon test has proved of great value notably in detecting the fake claim of the Piltdown Man and also confirming the Acheulian age of the Swanscombe skull.

Uranium Dating

Like fluorine, uranium is also present in the ground water and is absorbed by the mineral matter of bones and teeth. This uranium content of the bones can be measured and the relative age of the bones determined. The uranium content is
measured by the method known as radio-metric assay which
takes the form of exposing a sample to a Geiger counter and
counting the radiations per minute. This test helps us to
distinguish between fossil bones and the recently introduced
bones in old gravels or sands.

Nitrogen or collagen Dating

Bones basically consist of calcium phosphate, fat and bone
protein or collagen. On death, the fats gradually disappear. The
collagen survives much longer though it decays at a uniform rate.
This can be measured by a nitrogen assay. The rate of decay
depends on physical, chemical and other factors and therefore
cannot be universal, but bones of different dates in a single
deposit can be distinguished on the basis of nitrogen content.
Nitrogen analysis is particularly useful for relative dating of bones
of several ages (preserved in identical conditions) in cases where
they are too recent to be within the range of fluorine or uranium
methods. It is very valuable as a means of cross-checking the
results of uranium and fluorine analysis of the bones believed to
be of the Pleistocene age on open sites.

Chemical analysis of ancient metallic objects gives us
information regarding the technological development of ancient
civilisations. In particular, the methods used in metal casting and
fabrication can often be deduced through chemical analysis and
metallographic examination of the object. Information regarding
the area of provenance by comparison with well-authenticated
objects or with raw material obtained from the area in question
can be obtained. Various physical methods of chemical analysis
such as optical emission spectrometry, X-ray flourescence analysis,
neutron activation analysis etc. have been developed and have
yielded valuable data (E T. Hall, The Scientist and Archaeology,
pp 168 ff).
Phosphate Analysis

Decay of animal and organic matter leaves a residue of phosphates. Chemical analysis can reveal their presence. It has been employed particularly in the study of cave deposits to show human or animal occupation, settlement sites and burials.

4. Archaeology and Botany

It is only in recent years that the importance of the study of flora and fauna for gaining knowledge of ancient environmental setting and human ecology of cultures is being realised. The study of ancient plant remains is called Palaeo-botany. The method of pollen analysis has been found extremely useful in palaeo-botanical studies. They provide information regarding the nature of vegetation, climate, and the history of cultivation in any place and also the food habits of the people in happing it.

Pollen Analysis or Palynology

Pollen grains which are produced in large quantities by plants are almost indestructible and can be identified by their shape when seen through microscope. In a wet site like clay or peat bog or a buried surface, pollen grains are well preserved. Botanical experts or palynologists are able to extract pollen from various strata of a deposit and to examine them under a microscope and identify the genus and even the species to which they belong from their shape, structure and other factors. From this, they can determine the kind of vegetation and the climate which corresponded with each stratum. Even a pollen profile has been reconstructed and it is compared with those from other sites and the relative dating of the deposit is confirmed or denied. The changing composition of woodland of northern Europe since the last retreat of ice has been closely studied and documented by.
pollen analysis and the period subdivided on this basis. These zones numbered I to IX are named according to the climatic condition deduced from the evidence of vegetation. Radiocarbon dating has been used to convert the sequence to an absolute dating giving us a chronological framework. A table of Pollen Zones and their corresponding vegetation, climate, fauna and economy of the late glacial and post-glacial periods has been built up (see the chart-The Penguin Dictionary of Archaeology, pp. 18--) “The technique is invaluable for disclosing the environment of early man’s sites and can even reveal man’s influence on his environment by forest clearance”.

Only small quantities of pollen are required, about a match box full, but care should be taken to keep the samples free from contamination. Samples should be taken from a freshly cut section.

Dendrochronology

Tree-ring counting or Dendrochronology was developed by A. E. Douglass in 1929. All trees form rings each year but they vary in thickness according to the climatic conditions. This would permit comparison and correlation of ring patterns found on cut surfaces of recent and ancient trees. Douglas showed how the variations could be used to date archaeological material. He showed how in one restricted area in U.S.A. having the same climatic condition, he could build up a scale of ring pattern of timbers from the present back to the pre-colombian period.

Growth of rings can be clearly demarcated in trees growing in areas which have regular seasonal climatic changes. Wet springs and summers produce thick rings whereas dry winters produce thinner rings. Tree ring sequences show a rhythmie
variation and such cycles are found to recur every eleven years coinciding with the sun spot cycle. While useful results have been obtained in America, it has difficulties in Europe where seasonal variations are not so clear. Another difficulty is in some trees the same rings vary in thickness in different parts of their circumference. But despite these difficulties, this method has been extensively employed in U.S.A., England and Scandinavia. Attempts have been made to correlate the tree rings over long distances to link the climatic sequences of America, Europe and other continents. The tree rings undoubtedly serve as indicators of climatic oscillations. The method has been successfully adopted for the dating of the prehistoric settlements in south-west U.S.A.

5. Archaeology and Anthropology

a. Physical Anthropology

Anthropology is the science of man and it has two main divisions—physical anthropology and social-cultural anthropology. It is so closely related to archaeology that in U.S.A. archaeological work is carried out as a part of the activities of anthropological departments. Physical anthropology is the study of man's evolution and biological variation and encompass the study of fossil man. It is the study of humankind from a biological perspective. It is concerned, among other things, with the study of racial types among men, their differences and distinct features, their origin and evolution and also the biological processes involved in human adaptation. It involves the study and analysis of human anatomy or anthropometry. Measurement of skulls, jaws, and other parts of the human skeleton for comparative study is an important feature of this study. The value of physical anthropology for archaeological studies can hardly be exaggerated.
All the human skeletal remains from an excavation have to be examined by the physical anthropologist who can analyse the data and help in identifying whether the particular skeletal portion is that of a child or an adult, male or a female and the like. The role of the physical anthropologist is very important in the excavation of burial sites. The skeletal analysis would also throw much welcome light on the physical and racial characteristics of people. Though the concept of pure racial type has been discarded by modern anthropologists, various attempts have been made to classify the races in the world on the basis of the form of the head and face, shape of nose, eyes, hair, proportion of the body etc. Some of the major racial types are the Negroid, characterized by dark skin, woolly or frizly hair, broad flat nose and thick lips; the Mongoloid by coarse straight head, broad flat face with projecting cheeks, a fold covering the eyelid and teeth having shovel-shaped incisors; and the Caucasoids or “European”, characterised by tall stature light complexion and high narrow nose. The distribution of each of these types and sub-types in different parts of the world would certainly indicate racial migration. For example, the largest concentration of the Negroids is found in Africa but related types are also found in the Andaman Islands and the Malaya Peninsula. Again, the Mongoloid race predominates in Japan, Korea, China, Tibet and parts of South East Asia like Burma, Thailand etc. But they are also found among the native American Indians and the Eskimos. The Caucasoids with their subdivisions like the Nordic, the Mediterranean and the Alpine are found in Europe, West Asia, India etc. The study of racial and sub-racial types, behaviour traits, blood group study etc form a complex and growing subject. The study of the racial characteristics of the authors of a civilization would give some clues regarding migration and contacts. For example, the origin and the diffusion of the megalithic burial
practice in South India poses a problem and the analysis of the skeletal or skull remains should furnish some evidence regarding racial stock. The anthropological report on the skeletal remains of the Brahamagiri megaliths "reveal a predominantly Austroloid type and a more or less medium statured, meso-cephalic medium-vaulted, flat-nosed type with powerful upper and lower jaws, probably of Scytho-Iranian stock". In the Adichanallur urn burials, the Proto-Mediterranean types of skulls were found showing links with the present day population of the area. These are cited as examples to show the interesting possibilities of the anthropological studies on ancient skulls and other skeletal remains. Such a study has been made on the important sites of the Indus Valley sites like Harappa, Mohenjadaro, Lothal and Kalibhangan; Neolithic sites like Burzham; megalithic burials at Sanur, Amritamangalam (Tamilnadu) etc. They would certainly give us an idea of the various racial strains or elements that had populated different parts of India at different times. They would also reveal the continuity or discontinuity with the present day population, and migrating trends and racial affinities of different periods. But it should however be said that this study is yet to be undertaken in a systematic manner in India on a wider scale.

Because early men were hunters and gatherers, physical anthropologists study contemporary foraging societies in order to fill in the fragmentary physical evidence left by early humans. In addition to the study of living human groups, physical anthropologists also study living non-human primates (especially monkeys and apes) for clues so that their chemistry, physiology, morphology (physical structure) and behaviour can give us some insights into the understanding of our own species.
b. Social and Cultural Anthropology

This branch of anthropology deals with the social and cultural institutions and habits, customs and traditions of a given society. According to one scholar, "Cultural anthropology studies human behaviour that is learned rather than genetically transmitted, and that is typical of a particular human group. Cultural anthropologists attempt to understand culture in this general sense; they study its origins, its development, its diversity as it changes through time and among peoples...they also want to know how different societies adapt to their environments". In any given society they study language variations, communication, food-getting system, production, distribution, exchange, social stratification, marriage, family, kinship and association, political systems, social control, religious, myths and symbolism, graphic and plastic arts, music, dance, folklore etc. The anthropologist has all these perspectives in view while he studies the present day social group. The archaeologist has more or less the same perspectives while he studies past societies. Archaeology can indeed be called as the anthropology of the past. While the anthropologist can have first hand ethnographic field study and observation of a given society, the archaeologist has to reconstruct these aspects from the material remains found in an old settlement site. In the interpretation of the material objects, the archaeologist can draw upon the experience of the cultural or social anthropologist who is familiar with the objects used by the present day primitive tribes. In fact, the study of prehistoric archaeology owes much to the anthropologists. This specialisation now goes under the name of ethno-archaeology. There are many primitive tribes in different parts of the world who are still in the food-gathering stage and who manufacture stone tools. By observing their tool techniques tool types and other practices, and comparing them with those found in prehistoric sites, we can really get to
know the techniques, the utility of the artefacts and their social relevance, in ancient societies. Knowledge of primitive agricultural implements and practices, weaving and other arts and crafts, dress and ornaments, weapons and primitive dwelling places used by the present day tribals would throw light on the objects found in archaeological sites. For example, the dry farming methods practised by the tribes would illustrate the ancient method of cultivation practised by the Neolithic people. The circular type of huts used by the present day village folk in Bellary District of Karnataka tallied well with the similar ones found in the Neolithic strata at Takalakotta. In other words, the observation and study of the social customs and practices of present day village folk and the tribals will help the archaeologists to understand and interpret the artefacts in their proper historical and sociological perspective. Hence, social and cultural anthropology is closely related to archaeology, particularly ethno-archaeology.

6. Archaeology and Palaeontology

Palaeontology is a science devoted to the study of fossil remains of animals. Human palaeontology is the study of the origins of man himself. By studying the markings and fossils of living things in the stratified rocks, palaeontologists have been able to establish a record of the evolution of life through geological time. The geologist, at the same time, with the evidence of fossils, has been able to study the sequence and the age of rocks. The most concrete evidence for the evolution of man consists of the fossil bones of man-like creatures who preceded us during the past. From the interpretation of fossil bones, ideas are formulated as to how our ancestors looked, stood, walked, used their hands and behaved. Some hundreds of skulls and skeletons and teeth have been discovered in different parts of the world and they
provide the raw materials for study for the palaeontologists or palaeo-anthropologists. "The story of fossil man is incomplete, but every year brings new specimens, new methods of investigation and new knowledge. Gradually, the gaps are filled so that the continuity of human evolutionary change is more clearly seen" (Michael H. Day *Fossil Man* 1972).

Some fossil forms are known both in the Eocene and Oligocene periods. However, during the Miocene period in East Africa, many varieties of primates appeared. They possessed attributes later to become more fully developed among the Hominids. The East African primates left trees and learned to walk upright, gradually adapting their pelvic and leg bones to erect posture. The freeing of the arms and hands opened the way to tool-using and eventually tool-making also. The onset of Pleistocene was marked by increasingly cold climate and by the appearance of Collabrian mollusca and Velliferanchian fauna with elephant, ox and horse species. The oldest form of man had evolved by the Early Pleistocene and cultures classed as Palaeolithic fall within this period. This *australopithecus africanus* first known from South Africa is considered as one of the earliest specimens of human ancestral types dated as between 2 to 3 million years old. In the Lower Pleistocene bed on the Olduvai Gorge, Tanzania, a fossil named as Zinganthropus boisei also called a *australopithecus brisei* was perhaps the earliest tool-maker and with this, this culture of Palaeolithic begins. The Middle Pleistocene witnessed another major step in the evolution of the hominids. The brain was larger than that of the australopithicus, the skull bones were thick with massive ridges, with no forehead or chin. The first specimens were found in Java and hence called the Java Man (*Homo erectus javanesis*). In 1927, similar *homo-erectus* types were found near Peking in China (Peking Man). Neanderthals were found in upper pleistocene
times in Europe, Central Asia and North Africa. *Homo Sapiens* (technical name for modern man) emerged during the fourth glaciation some 35,000 years B.P. They made flint tools of Mousterian type which were technically more advanced than earlier tools and they had also left the oldest surviving evidence of funerary offerings and religious beliefs. According to one set of scholars, the *Homo sapiens* originated somewhere in Asia and moved westwards to replace the Neanderthal man and introduced the new blade-burin technology while, according to others, *Homo sapiens* evolved from the earlier Neanderthals. The above discussion would show the importance of fossil study for pre-historic archaeology. Equally important are the fossils of animals many of which have not survived because of lack of adaptation to the changing climatic and other environments.

7. Archaeology and Zoology

Zoology is the science of animal biology dealing with the structure, classification and distribution of various members of the animal kingdom. A zoologist or a knowledge of zoology can help the archaeologist in many ways. Excavations in prehistoric and historical sites often yield numerous animal bones. The archaeologist is interested to know if they belong to the domesticated or wild variety and whether their presence is accidental or for food or for ritual purposes. Study of the fossil bones of the wild and extinct animals of the past ages comes under palaeontology which has already been considered. In some deposits, animals and molluscan remains are an indication of the climate. Bones of a lemming, a polar bear or a mammoth indicate a cold climate, while monkey, pig, antelope bones indicate mild conditions. From the Neolithic times onwards, man learned to control and domesticate the animals like sheep, goat, dog and the pig. There is evidence of domestication of cattle in Anatolia by
about 6000 B.C. Dog bones are found associated with the Mesolithic remains. The horse was apparently domesticates much later, around the 2nd millenium B.C. In India, there is a controversy whether the horse was first introduced by the Vedic Aryans who performed horse sacrifices (asvamedha) or whether they were known earlier. There is no clear indication of the presence of horse in the Indus Valley culture. Here, the correct identification of the skeletal remains and the species to which, they belong becomes very vital as it is an important component of a culture. Recently, a full skeleton of a horse with all its trappings has been found in a megalithic burial in Maharashtra (S. B Deo). All these would show the importance of the study of the animal bones in an excavation and their correct identification as they would throw light on the man-animal relationship at different times and different places. The purpose may be for meat, milk, hides, fur wool, or cultivation or hunting or assisting as beasts of burden or draught animals or for sacrifices and other rituals. But the correct identification of the species or the domesticated and wild types in a species is not an easy task and often becomes controversial and therefore, it is always to safe to entrust the animal bones to an expert zoologist for careful analysis and report.

8. Palaeopathology

Pathology is a science of diseases. Certain diseases leave their mark on the bones—for example malnutrition, dental decay etc. Palaeopathology is an application of this science to the study of the skeletal remains from ancient sites to recover data about the health conditions of the people, cause for death and the incidence of any particular disease etc. One specialisation of this which is confined to the study of bones alone is called Osteo-archaeology. Such a study was made on the human skeletal
remains at Kalibhangan (1969-70) and many interesting facts were revealed. Evidence of surgical operation (trephining) on a child's skull because it had accumulated too much water in its cells (*Hydrocephatis*) was found. It was also observed that the teeth of the Kalibhagan people (including old people) were very good because "they were at least not vigorous flesh eaters".

9. Metallurgy

The discovery of metal was an epoch-making event in human history as it brought about a significant change in the tool technology and tool equipment. In the Three Age System, the second and third ages are respectively named as the Bronze Age and the Iron Age. Bronze came to be widely used in the old world between 3000-2000 B.C. and in Britain around 1800 B.C. Bronze was the main material used for man's tools and weapons. Bronze is the alloy of copper and tin and they had to be obtained from two different sources. Trade in Bronze led to diffusion of ideas and technological improvements. In the ancient world, centres of bronze working were established in Aegean islands during the Minoan and Mycenaean civilisations. Impressive copper tools and weapons have been found in all the Indus Valley sites; Copper hoards have been found extensively in the Gangetic Valley in India. In Europe, early sites have been found in Spain, Britain and Scandinavia. In Asia the Bronze Age saw the origin of civilisation and in Europe the great folk movements. Scholars regard that the technique of iron-working was not mastered until C. 1500 B.C. by the Hittites. After their collapse, the secret of iron working was leaked out and iron spread rapidly. It replaced bronze for man's basic tools and weapons thus ushering the Iron Age. The history of iron technology in different parts of the world is interesting. Iron accelerated the growth of civilisation. The Vedic
Aryans considered Iron (ayas) a valuable tool in their hands. The megalithic burials of South India have yielded an impressive range of agricultural and domestic objects besides weapons. Other metals usually met with in the excavations are gold and silver in the form of ornaments or coins Analysis of the metals from excavations would throw light on many interesting features such as "the nature of the original metal; the processes employed to make the metal and those employed to fabricate the object; the physical changes resulting in repairs; the chemical changes due to burial which have resulted in the formation of minerals upon the metal" (R. M. Organ, *Analysis and Microscopic Study of Metals*, 1963). These analysis would also give us some clues as to the location of ancient mines, the spread of the techniques and the types, trade contacts etc. The micro-analytical methods applied in the analysis of the metal objects can be handled by expert chemists and metallurgists. Non-destructive methods such as X-ray Flourescence Analysis are also available by the use of which the whole object can be examined. One of the most useful branches of science employed to examine the internal metal structure and to identify the different processes in the fabrication of a lump of metal into an object (like hammering, casting, tooling, spinning, quenching, tempering etc.) is known as 'metallography' while the other is radiography which deals with the examination of objects by X-ray. Besides shedding light on the processes involved in the fabrication and the sources of the trace elements, they provide valuable data on the impurities contained in the ancient metal objects, mineralisation and other corrosive attacks on the ancient metal objects so that suitable methods of conservation can be devised.
10. Statistical method in Archaeology

As in many other disciplines, statistical method is of great value to document archaeological data. Statistical formulations serve as a tool for the easier handling of complex and voluminous data. Artefacts like potsherds can be reduced to a series of measurements, analytically determined values or systematic observations which can be represented as numbers. The distribution of items with respect to these variables can then be studied. The degree of relationship (correlation) between variables may also be calculated. Large number of variables can be treated by Multivariate Analysis.

Statistical analysis of excavated artefacts may lead to interesting results and help in determining the dominant or less dominant cultural traits of two periods or two different sites or two different traditions. The numerical calculation of the artefacts of a particular type or material in different phases in a particular site will enable us to trace the evolution of the artefact in time. It would enable us to answer questions like: What was the most prominent tool type or technique in the Early Stone Age sites at Attirampakkam? when was the painted pottery tradition stronger—in the early, middle or latter phase of the Indus valley civilisation? Of the Roman hoards of coins found in South India, which area has supplied the largest number and which the least? and among them the coins of which period are the largest and which are less common? and so on. Statistical analysis of the relevant data would provide us with some basis to answer such questions. In most of the excavation reports of recent years, a statistical distribution of pottery types, coin types and even other artefacts, in different strata and periods is appended to give us a clear picture of the incidence of the types. Petrie's sequence numbers of chronological placement of Egyptian artefacts repre-
Archeology and other sciences-dating methods

resents perhaps the earliest attempt at frequency of grave goods. Kroeber and Strong's Studies of Peruvian Pottery collections provide later examples.

11. Computer Science

No subject can escape the impact of the computer age and it applies to archeology as well. "The ability of the computer to handle massive amounts of material more rapidly and dependably than any other system is obvious. It is especially necessary for artefact analysis on sites with large numbers of finds, because it allows the control, indexing and storage of large numbers of information including spatial information provided by stratigraphy. The computer also interprets the quantitative and qualitative patterning provided by artefacts themselves" (Martha Joukowsky). A suitable programme system has to be designed that could be applied to the archeological data gathered in the field; spatial information and the data relating to the artefacts or data classified as pottery, stone, biological, chemical etc. Once the system to be fed into the computer is defined, the system can be used for sites with similar assemblages and also for serving to index local material and a tie-up with other seriated assemblages would be made easier. The data is quantified and qualified in computer-convertible terms, the programme is prepared for any computer to process the data easily. Computer input recording format can be derived so as to give a comprehensive body of data for any particular artefact from excavations-ceramic, beads, coins etc. With the number of excavations increasing and thousands of artefacts coming up, it is only the computers which could help us in the storage in a computer memory so that information is immediately available for researches. The advantages have been realised and hence widely used by the archeologists in the West, especially U.S.A. But this is yet to catch up in India. However,
recently some significant results have been achieved in the decipherment of the Indus Script by the computer analysis done by the Finnish, Soviet and Indian Scholars. Computer has also been used to study and analyse the technical and proper names occurring in the medieval Tamil inscriptions by the Japanese and Indian Scholars. The utility of the computers as a tool for analysis, storage and for building up data bank, for ready reference and retrieval is increasingly being realised and there is no doubt that it would become more and more popular with our archaeologists too in the near future.
CHAPTER-VII

DOCUMENTATION AND PUBLICATION

Section—1

Documentation

As already observed, archaeological excavation is a "recorded destruction" and therefore it is but proper that we should explain the nature and importance of the records in an excavation. Records are mainly in the form of photographs, measured drawings of features and artefacts besides field notes and observations.

A. Field Note Book

The field supervisor in charge of a site or a trench should maintain a field note-book containing both plain or lined and graph sheets, the former for recording the resume of the work done, his observations thereon and the latter for the drawings of the sections, features and artefacts. The Field Note Book should reflect everyday’s work and contain a sort of a running commentary on what was done. The Field Note should be superscribed with the site name, grid number, excavator’s name and the year of excavation. The problems faced by the excavator and steps taken by him to resolve them may be recorded. The doubts which confronted him either with regard to the stratification or the
identification of structural phases and his reasonings for his conclusions may also be stated. Apart from these, the field notes should contain a matter-of-fact recording of the findings, including the description of the layers and their contents, the pottery, artefacts and features. Particularly, certain features which are comparatively trivial and difficult to preserve should be carefully noted and recorded. For example, the colour of the soil freshly excavated or contents of a fragmentary flooring or the colour of the pit or post-hole contrasting with the colour of the layers into which it is cut. All the artefacts, big and small, should be serially recorded with the three dimensional measurements in the notebook as well as in the bag or envelope in which they are packed. The cross reference to the envelope number should be noted.

On the graph sheets, the grid layout can be plotted to scale, and the important features drawn on plan. Key sections showing the stratification should also be drawn. This is apart from the detailed drawing prepared by the draughtsman on the tracing cloth.

The purpose of the field note book is to give a day-to-day account of the work done and the discoveries made in such a way that even if there is a change in the Supervisor, the new incumbent can continue the work without difficulty. The Director can see the field notes of several squares in the site from time to time and coordinate and integrate the evidence. The field notes form the basic record for the final publication of the results of the excavations. Therefore, "they should be written so clearly and comprehensively that they can be understood and interpreted even by those who have not worked in the site".
B. Antiquity Envelops

The cloth bags or paper envelopes containing the artefacts should have the following details tagged on to them. These details may even be written under suitable code words in an obscure corner of the back side of the artefact if it is of moderate size; or tagged on to it with a label if it is too small.

1. Serial Number and date: Running number for each antiquity.
2. Site: Name of the village/town and the locality.
3. Designation of the Grid/square or location with reference to the pegs. Three dimensional measurement for the artefact should be recorded.
4. Stratum: Layer Number or Pit Number.
5. Object: Brief description of the object eg. copper square coin or Terracotta bull.
6. Supervisor: Name and Signature of the Supervisor.

The antiquity envelops with the above details are kept safely according to their date and number in the antiquity trays or boxes for being taken to the laboratory for further study and analysis.

C. Antiquity Register

A register of antiquities should be maintained in which all the antiquities are serially numbered and entered with the same details given above. While the recording on the envelops should be done as and when the antiquities are discovered, they may be entered in the Register at the end of each day or subsequently. The Register gives a consolidated picture of all the artefacts recovered in the excavations.
D. Recording of Pottery Evidence

Pottery has rightly been called the alphabet of archaeology. Excavations in the habitation sites yield enormous amount of pottery belonging to different periods. Pots and pans are so essential and so constantly used by the rich and the poor that they form the bulk of the remains in any village or town site. Moreover, because of their brittle nature short and life, they were in constant demand and consequently continuous production and supply were also there. Hence, the enormous quantity of the potsherds found in the excavations. It is a good index of cultural continuity and change. Valuable objects like gold, silver or copper would have been more carefully used and preserved and even melted and re-used by generation after generation and hence they are comparitively scarce in the excavations. But not so the earthen vessels. Once they were broken, they were discarded and nobody took notice of them. The ubiquitous nature and lack of intrinsic value have indirectly helped the archaeologist to obtain the potteries in large quantities. Potteries belonging even to the earliest period of their use, nearly 5000 years ago, have come down to us. Pottery of high and distinctive quality with beautiful designs have been found associated with the sites of the Indus Valley Civilisation of the 3rd millenium B.C. Similarly, very special kind of pottery known as the Painted Grey Ware has been identified with the Aryan settlers in the Indo-Gangetic plains. The Megalithic people of South India were invariably found using a distinctive were called the Black and Red Ware. Imported potteries of Roman origin and known date like the Rouletted pottery, the Arretine ware and the Amphora give valuable clues to the chronology of the local associated wares. Pottery pieces also have sometimes valuable inscriptions or potter’s stamps, graffiti marks or paintings which have considerable historical significance. Hence, the study of pottery is very important for an
archaeologist. It serves as a good indicator of the prevalence and spread of an associated culture in an area. As has been aptly observed by Martha Joukowsky "Pottery probably provides the single most important yardstick for measuring technological and stylistic developments. Because pottery was well within everyone's reach economically, it was in common use: for that very reason it is an index of taste, providing a means by which to judge the aesthetic and practical sense of manufacturers. It is a key to local manufacturing programmes and production; it provides an understanding of an area's internal communication routes and also its foreign contacts".

Pottery Yard

From what has been said above it becomes evident that due care should be taken to document ceramic evidence of a site. During the excavations hundreds of potsherds would be coming up from almost every dig and the documentation of them is not an easy task. The first task of the excavator is to separate the pottery of each stratum as the digging proceeds. This is best done by setting up a pottery yard as an important adjunct to an excavation grid. It is to be located a little away from the excavation trenches preferably in a shady place. The same lay out pattern of the excavation is repeated here also so that all the squares or trenches are also present here not with the same dimensions but in a miniature size. One arm would represent the trench or the square number and the other, the layer number. So, the excavated potteries are sent to the pottery yard with the labels and the same are received by the pottery assistants in charge of the pottery yard and placed in the appropriate square according to their locus and stratum. The printed pottery label or tag should have the columns such as the name of the site, the Locus or the Square number, 

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the depth and stratum and the Supervisor’s name. This would help the Pottery Assistant to place the pottery in its proper place in the yard. Then the potteries are taken up for washing in plain water with suitable brush so that all the dirt is removed and the original fabric of the pot sherds is clearly visible. Fragile pottery which can not withstand the wash may be softly brushed. Similarly, pot sherds with painted designs should be carefully cleaned without causing any damage to the paintings. After they are washed and dried, marking is done on the inner side of each sherd. The code letters indicating the name of the site, trench number and stratum number are written in small letters in Indian ink so that potteries, even if mixed up by chance during study or drawing or photography, do not lose their identity. Then, the potteries can be put into the pottery cloth bags according to the square and the stratum and two labels are enclosed—one put inside the bag and the other tied outside. Detailed analysis and study of pottery with regard to their manufacturing technique, function, slip, designs etc. can not be made at the excavation site and have to be taken up only in the laboratory during the preparation of the report. But preliminary study and brief notes may be prepared for classification. Pottery mending may also be made at the site by the Pottery Assistant and the volunteers. It means the repairing or reconstructing the broken fragments of the sherds into vessels wherever they are possible. Finally, the bags containing the potteries are packed into wooden boxes with suitable padding and transported to the headquarters for further study, preservation and publication.

Pottery Classification and Drawing

There are various methods of classifying the excavated pottery—on the basis of the periods and the strata; or manufacturing technique, typology, colour, fabric, function, designs etc.
Period-wise classification based on the stratigraphical sequence already arrived at would be quite convenient since it would, at the same time, give a chronological sequence of the pottery types in a given site. So, firstly, periodwise grouping of the pottery can be done and among them, further classification on the basis of colour and type may also be done. For example: Red sherds, Black sherds, Black and Red sherds, Grey ware and so on can be separated and under each of these categories, representative types can be taken up for drawing. Pottery types like the bowls, lids, plates, jars, and urns can be identified and grouped. Further subdivision of these types is also possible e.g. among the bowls, we can have shallow bowls, deep bowls, carinated bowls, knife-edged bowls, corrugated bowls and so on. Under such conveniently sub-divided categories, the detailed drawing of the potsherds should be done to scale on the drawing sheets in Indian ink.

The standard method of drawing pottery is to show the section and internal surface on the left hand side and the external surface on the right. The basic measurement is the rim diameter. This can be reconstructed with the help of the rim fragment which can be guaged on a rim scale whose arcs are drawn out in a series of radii. The rim is moved up and down the scale until its curve fits one of them. Once the diameter is determined, the same should be drawn horizontally and bisected by a perpendicular line. The left half is meant to show the details of the section and the right half shows the details of elevation. Full pot can be measured by placing it suitably, against graduated horizontal and vertical rules and taking offsets from them to the pot at various points. Fragments not having rim portions but having features like paintings, designs or inscriptions may be drawn to the size on the sheet along with the
features. Striations and colour variations can be indicated by suitable lines or shadings as the case may be. When all the selected pottery pieces are thus drawn in Indian ink, they can be serially numbered plate-wise and described. The description will give the details about the colour, type or sub-type, the physical profile, manufacturing technique, designs etc.

E. Section Drawings

Graham Webster rightly observes "Structures and features with their stratigraphical relationships are best demonstrated by drawings. The section and plan are the basic forms in which the evidence is represented and the report should be built around them." Neat and accurate section drawings and plans are the most important records which illustrate the sequence of cultural deposits, associated structures and disturbances to the stratification. It was already stated that as the digging proceeds and the layers are laid bare, they are immediately identified and labelled on the sections of the trench. The next task is to draw them to scale on the graph sheet or tracing cloth. This can be done at convenient intervals during the excavations. After the excavation is completed i.e., digging up to the natural soil is done, the entire trench is ready for a comprehensive drawing and recording. Already, the layers, pits, structures, foundation trenches and other features as and when they were encountered were marked first in plan and then marked in the section. Now, a complete picture of the section on all the four sides of a trench are drawn to scale. This would help the excavator to correlate all the sides of the trench and interpret the evidences in the proper stratigraphical perspective. It would provide a measured drawing and an overview of the complete vertical profile of the strata of the site including the inter-relationships of the soils, trench sections, balks and structural features done by competent draughtsmen.
Following is the procedure for drawing a section: Set up a firm horizontal datum line by stretching a string across the section at the top. Also stretch a measuring tape alongside the string. Level the line and the tape with a bubble level to be sure that they are absolutely in line. This should be checked frequently so that any sagging of the string is detected and rectified. Then, take measurements at equal intervals, say at every 20 cms. along the tape with a steel tape and record the strata and the features that are marked and labelled on the section by the excavator. Any suitable scale for measuring can be adopted, depending on the length of the section to be drawn. But a uniform scale is to be adopted for all the sections in a site for easy correlation. The standard scale is 5 Cms. or 10 Cms. for 1m.

Certain conventional symbols are used to distinguish various types of earth strata in the section drawing. The diversity of the deposits—like sand, chalk, clay, gravel, stone pebble, charcoal, compact or loose soil, debris layer etc can be intelligibly drawn by using such symbols. Symbols conventionally used in India are given in Fig 4.

In the final presentation of the section, some archaeologists prefer to show the stratification by marking hard lines demarcating the changes while others would prefer to show the section as it appears to the eye. Differences are shown only by varying the intensity of the shading and stippling. Both the methods have their merits and defects. While the former affords clarity, it has the defect of imposing excavator's subjectivity and the over-emphasis of minor features. On the contrary, the other method is more pictorial and looks more natural but may lack clarity. The best method according to Wheeler and Webster is a compromise between the best characteristics of both the methods. This
would show the demarcation lines and the numbers of the strata marked by the excavator together with the deposits as they actually appear. The section shown in Fig. 1. typifies this method of section drawing.

**SYMBOLS FOR SECTIONS**

- Compact Clay
- Surface Humus
- Burnt Bricks
- Gravel
- Compact Earth
- Muddy Bands
- Loose Earth with Gravel Etc.
- Potsherds
- Loose Earth
- Brickbats Etc.
- Mud Bricks
- Sand
- Loose Clay
- Ash

**Fig 4**

**F. Plans**

Plan drawing is another important constituent of the excavation records and it is indeed complementary to the section drawing. While the section gives the vertical profile, the plan
provides the horizontal picture of the object from top. The successive strata and the features in them have to be plotted on plan to scale. This would provide the relative position of the features in a stratum and would help interpretation of the evidence. Features like room walls, flooring, hearth, soakage pits, doorways, streets and drainage found at a particular level, when plotted, would clearly show the over all orientation and their inter-relationship. Apart from this, plan drawing of all the features has to be prepared to show their length and breadth. The peg points can serve as the datum points for taking measurements by triangulation method. All the features of a structure—the shape or form, the brick sizes, the placement, designs on the flooring, the series of post holes or other similar constituents can be plotted accurately by this method. The details to be plotted in a structure or a burial have already been described in the previous chapter and need not be repeated here. In a burial, the plan drawing will enable us to plot the shape of the pit or the receptacle, the skeletal remains and the grave goods as they were originally interned.

G. Survey Plans and Contour Maps

The importance of the work of a Surveyor in an excavation was explained in chapter IV. It is he who helps the Director in laying out the trenches and the area of excavation and fixing the pegs according to the chosen measurements. Pegs mark the basic datum line for all measurements and so should be accurately and firmly fixed by the Surveyor. The theodolite which is a versatile surveying instrument used for measuring angles is often employed for setting out the grids.

Site Map

A map showing the exact location of the excavated site, the village or town in which it is situated along with the other
land marks in the vicinity like the hills, rivers etc. has to be prepared by the Surveyor. This can be done on the basis of the 1" Topo Sheets prepared by the Survey of India. The details of latitude and longitude are also shown in the map. Supposing the excavated site is within a vast fortified complex with fortification walls, moat etc., the Survey map should show all these details and the excavated trenches set in these surroundings. All these need accurate Survey plan prepared by a competent Surveyor and by following methods like Chain Survey or Plane Table Survey or Level Surveying.

Contour Maps

The site map may also incorporate the contour lines or levels of elevation of the landmarks. The relative heights of the features in a given site can be brought out by the contour plan for which the usual base line is the bench mark showing the mean sea level. The relative levels of the different portions of a city can be indicated as well as a number of other factors like the height of the hills or the gradient of an old dried-up channel. Particularly in the prehistoric sites, the relative elevations of the old river terraces can be plotted in the contour map.

H. Photo-Documentation

Photography plays a key role in archaeological documentation. As pointed out earlier, photographic record is indispensable for all the three stages-pre-excavation field survey, excavation and post-excavation research and publication. The first item has already been explained in chapter III. Coming to the second item, it is to be emphasised that photography plays a pivotal role in recording the different stages in the excavation. It is complementary to the plan and section drawings but its visual impact is more direct, objective and convincing. Good photographs can
speak for themselves and bring before our eyes the different aspects of an excavation. It provides a permanent *in situ* visual record of the strata, structures, artefacts and other features. It is a faithful and trustworthy record of what has happened during the excavations. Photographs, along with the field notes, plans and drawings help "to recreate a comprehensive picture of the excavation".

The photographer has to work in close collaboration with the Director of the excavations. It is the latter who instructs him as to the items to be photographed and also the angle of view; or against a particular section and so on. Since he knows the interrelation of the structures, artefacts and their associated finds, he can instruct the photographer what are to be included in the photograph and what are to be left out. He would also explain what are the items within a structure that need to be emphasised more. The photographer's job is to fulfil the requirements of the excavator and devise an arrangement to bring out the details desired. He discusses with the Director and tries to understand the importance of the finds, takes good quality photographs, keeps a register of them for ready reference and supply whenever required. The following are some of the items of photography in an excavation:

1. The site or the mound before excavation from different angles to show its natural shape, contours and dimension. In certain extensive sites, aerial photography would be necessary.

2. Strata sections of different trenches or squares with proper labels and scales.

3. Plan and section view of structures, floors, pits etc.

4. Artefacts *in situ*. 

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5. Photographs of different kinds of artefacts classified and arranged category-wise eg. separate plates for coins, terracottas, potteries etc. before and after chemical treatment.

The following are the general guidelines for archaeological photography:

1. The subject to be photographed should be cleaned with brush so that it is free from dust; often small roots and rootlets would be seen projecting in the soil section and they should be cut with scissors. The preparation of the subject contributes to the clarity of the picture.

2. Layer and pit demarcations should be clear and adequately labelled.

3. Scales should always be placed near the subject. The size of the scale should be such as not to obscure or obstruct the subject. For bigger subjects, such as a trench or a building, a six feet scale painted red and white alternatively would be appropriate. But for a full plate of small antiquities like coins, a three or six inches scale would suffice. The scale should be placed parallel to the side or the bottom of the frame.

4. Photographs should be taken in soft and subdued light and never in the bright sunlight. In Indian conditions, early morning or evening is the best time for field photography. Sometimes, strong light can be screened off with the help of suitable cloth. Strong light tends to flatten the details of the subject. Therefore, it is advisable to take photographs of the trench sections when they are in shadow. But, colour photography of the sections may need more light.
5. Photographs of minor antiquities should also be done in natural light rather than flash light. Artificial light may be useful in some cases. The antiquities have to be arranged in a balanced composition in a full plate size with a suitable contrasting background cloth and a small scale. Later on, each antiquity can be serially numbered for easy description in the accompanying text. Here also, colour photography of the antiquities like the beads, coins and metal objects would help bring out their original colour though publication of them would be more expensive.

6. Subjects of larger dimension like the structural complexes need wider coverage and hence photography from a higher plane would be ideal to avoid distortions. For this purpose, a foldable wooden photo tower is often kept ready in an excavation. It is usually made of strong wooden frames or scaffoldings with a landing platform at the top and a ladder to climb up the tower. The photographer can conveniently fix the tower in a suitable place and position the Camera on the platform at the top and take plan views of the structures and trenches.

7. All photographs taken during the excavations should be immediately washed and developed to be seen by the Director so that if the result is not satisfactory the subject may be re-photographed for better results. For this, the necessary chemicals and other materials should be ready along with dark room facilities at the camp site. The subject should not be disturbed till the Director is satisfied with the result of the photography.

8. Recent developments in photography should be fully taken advantage of by the Director to obtain the best results. Apart from the sophisticated cameras, a wide variety of lenses
like normal, wide angle, telephoto, and a variety of filters have been devised which help to have wide coverage and high quality pictures. Similarly, fast films are now available which help us to take remarkable pictures of subjects in dark shades. Auto-focus devises and built-in exposure meters have greatly facilitated the photographer's work. Video films with audio recording have added a new dimension to the photographic documentation as we would be able to record the whole range of activities connected with an excavation. This is a definite improvement over the older method of slide projections. The Director can also give a sort of running commentary on the excavations and explain the results. Video cassettes would help in the distribution of the information to the schools, colleges and learned societies.

9. Photo Negative Register and Album

The maintenance of the photo register and album is another important responsibility of the Photographer. Each and every negative should be serially numbered with the date of exposure, and the details of the subject (like site, locus, orientation, description of the object etc.) recorded on the envelope in which the negative is kept. The same should also be entered in the Photo Negative Register. The serial number can also be written in a corner of the negative.

An album containing one print each of all the negatives should also be prepared for ready reference. The same serial number together with a descriptive title is typed and pasted below each print. (eg, Kanchi Excavation 1970 site No. 2, section of a Ring Well).

1. Card Index

Apart from what has been stated above, it is advisable to prepare exhaustive card catalogue to index all the objects
unearthed. It is a permanent artefact record. The details already noted in the artefact envelope like the site, location, object material, stratum are recorded here also. But some more details like the following items may be included:

*Dimension*: Length, width, diameter, thickness, weight etc.

*Place of deposit*: Place, Box No. Bag No.

*Photo & Drawing*: Negative number or Roll number and Drawing sheet No.

*Description*: Here, a more detailed description of the importance of the object and its relationship to the associated finds may be given. A small contact print photograph of the object can also be pasted for easy explanation.

A great advantage in the card index system is the flexibility it offers in regrouping under different categories. For example, if one is working on the coins of a site, he can take out all the cards pertaining to the coins. If further sub-division is needed, on the basis of metal, he can pick out the cards pertaining to silver, or copper or lead coins and re-arrange them. This system will help to have easy and quick access to the materials and facilitate in writing the report. It also helps to keep track of all the antiquities distributed to the draughtsman or photographer or Conservator for documentation or treatment. It is better to prepare the cards in duplicate—one for the permanent consolidated index and another set for each class of artefacts (eg, index cards of coins, beads, faunal remains and so on).
On similar lines, a separate set of index cards for the excavated features (structures, floors, hearths etc) can also be maintained and serially numbered and documented for easy reference.

Section II

PUBLICATION

When the excavations are over and the documentation is completed the stage is set for the preparation of a detailed report on the results thereof. It is only through the publication of the report that an excavator can inform the specialists and the general public about the importance of his excavations. Pitt-Rivers emphasised this aspect in his famous statement, "A discovery dates only from the time of the record of it, and not from the time of its being found in the soil". Sir Mortimer Wheeler endorsed this opinion and put it more bluntly when he wrote: "Unrecorded excavation is the unforgivable destruction of evidence." The excavator in his report presents his findings in a systematic and integrated manner supported by photographic illustrations drawings and technical reports. The data he has collected during the excavations and the documented evidence he has so laboriously prepared form the basis for his report. He attempts to synthesise the various aspects—the stratigraphical sequence, the soil samples, artefact analysis, the pottery evidence, the structural remains, the technical skill revealed by the artefacts and features, the environmental or historical factors and the like and tries to present a cogent history of the vicissitudes of the site. It should contain two important elements: (1) a matter-of-fact presentation of the findings with the related data and illustrations and (2) interpretation of the data in a broader historical or conceptual framework. This would include the various technical reports given by the
specialists to whom the findings were referred eg. the report on the skeletal remains by the physical anthropologist or a report on the metal objects given by the metallurgist. Here, the excavator's task is to integrate the evidence from different sources and synthesise the results for a proper and meaningful interpretation. If the excavation of a site is undertaken as a long time project for a number of years, brief or interim reports should be published at the end of every season pending a full report on the completion of the work. Typical of the brief notices on the excavation and the reports published on the various excavation projects of India is the "Indian Archaeology-A Review" brought out annually by Archaeological Survey of India. There are a few other such professional journals including University journals or departmental bulletins in which interim reports can be published. The detailed report is usually brought out as a separate monograph eg. Sir John Marshall's *Mohenjodaro and the Indus Civilization* in three volumes. The salient features of an excavation report may be outlined as follows:

1. Title

   Usually, the title mentions the site name and the year of excavation. A shorter descriptive subtitle can also be attached if found suitable (eg. Arikamedu-an Indo-Roman trading Station in South India, 1945). This is followed by a list of contents and illustrations.

2. Abstract

   A brief summary of the main results of the excavations can be highlighted in the abstract which may be given in one paragraph or two. It should focus attention on the new light thrown by the excavations and should help kindling the interest of the reader to study the report.
3. Introduction

A general description of the site, its exact location, approach, geological or topographical features should be provided. The location should be illustrated with a map and the topography with suitable photographs, plan drawings and contour map. Other environmental factors like weather conditions, rainfall, flora and fauna, soil nature may be included. A note on the condition in which the site was found may be mentioned.

A brief historical background of the site including any previous exploration or excavation done in the site should be mentioned with all relevant references. Circumstances necessitating the present excavations and the main objectives of the excavations and how far they were achieved should be explained. Special problems, if any, faced by the excavator and the methods adopted to resolve them may be mentioned.

Acknowledgements to the team members, permission granted for excavations, collaborators and sponsors who have helped in the excavations in various ways may be included here appropriately. A note on the disposal of the finds may be added i.e., the department or the museum in which the artefacts and the records are deposited for any future reference.

4. Lay-out of the excavations

Here the grid system or the substantive trench system followed may be described and the sectors and the trenches excavated with their location and nomenclature may be explained with the help of a plan of the grid. The area of the cuttings, the differential depth encountered and unexcavated or left out areas may also be marked.
5. Stratigraphy and Sequence of Cultures

The nature of the layers encountered right from the natural soil to the top humus may be explained with reference to their colour, composition and contents. This may be done according to their number, sequence of formation and inter-relationship. The disturbances in the strata like the pits and robber trenches should be also serially described and then related to the stratigraphical framework. Based on the stratigraphy and the associated antiquities, the sequence of cultures represented at the site may be outlined with sub-periods if any. Here, the evidences like pottery, coins or such fairly datable artefacts play a crucial role and may be briefly cited relevant to the discussion. The description of the stratigraphy should be fully supported by the section drawings and the photographs. On the section drawing itself, the period divisions or cultural levels may even be indicated for convenience. For eg. Period I-Neolithic culture; Period II Megalithic culture; Period III-Early Historical Period; IV-Medieval. The distinctive cultural content of each period is indicated—habitat, tool types, food habits, potteries, economy, ornaments, burial practices and other rituals.

6. Chronology

Closely allied to the cultural levels and the period divisions is the chronology of a site. Their stratigraphic positions give them relative dating and based on that, the chronological computation is done in terms of centuries by counting backwards from the known to the unknown periods. The broad chronological span for each period is indicated. But, for later periods, for example, periods III and IV cited above, more precise datings can be given because of the datable objects like coins or inscribed materials that are usually met with. But, for the earlier periods,
7. Structures and Other Features

This section is devoted to the description of the structural remains—their stratigraphical association the mode of construction, architectural features, function etc. A comparison with similar structures found in other sites should also be made wherever called for. Other smaller but significant details of the brick sizes, the cementing materials, the nature of brick laying already recorded in the record book (See previous section) should be given. Based on this data, interpretation regarding the architectural history of the site in different periods of its history would be fruitful. The text should be illustrated with drawings of plans, sections and elevation of the buildings and the photographs thereof.

8. Potteries

Ceramic analysis forms a major section in a report for reasons already explained in section A of this chapter. Potteries used in each period should be described in terms of their colour, technique of manufacture and typology. Period-wise analysis of the pottery equipment would show the evolution of the industry, techniques and types. The impact of pottery traditions from other cultural zones, the improvement or decline in the quality of the ceramics can be analysed. The variety of the vessels would show the multifarious functions to which they were put. The paintings, the graffiti, the inscriptions, potter's marks
or designs are to be described and analysed. Sometimes, the high quality of pottery would imply the social status of the person using it. The excavator has to mention when a particular ceramic type or technique originated in an area and proliferated and when it dwindled—a fair indication of its periods of peak and decline respectively. Normally, the pottery traditions are not confined only to a site or two. They are usually found in a wider area and in fairly compact time-range showing a homogeneity of a culture and chronological link for eg. the Painted Grey Pottery found in the Ganga Yamuna Valley or the Russet Coated ware are found in South India in a fairly specific time range. In short, the technical, cultural and chronological implications of the potteries have to be fully discussed with the help of the elaborate pottery drawings and photographs prepared.

Among the technical points to be investigated and the results analysed, are the manufacturing techniques: the nature and preparation of clay as revealed by the pottery section; hand made or wheel made or partly hand made and partly wheel made; inverted firing technique (as in the megalithic black and red ware) salt glazing; the nature of slips applied, burnishing and polishing; russet coatings before firing; post firing markings, paintings and designs. The results of these analyses would bring out the distinguishing characteristics of each category of pottery and help in classifying the potteries on the basis of the techniques.

Under pottery types, we analyse the various types of vessels from which we can infer their possible uses. Among the chief types may be mentioned: jars, bowls, dishes, tumblers (lotas), goblets, cups, sprinklers and lids. Each one of these may again be sub-divided eg. Jars: high necked or wide
mouthed, plain or handled and so on; bowls: shallow bowls, deep bowls, carinated bowls rimless bowls, etc. This type of analysis would throw light on the eating or drinking habits of the people besides other aspects of social life. For eg. large storage jars would show how grains were stocked; tall and narrow perforated jars found in the Indus valley sites are considered to be associated with a ritual of special significance. This kind of close analysis of pottery of different periods of a site on the technical and typological bases is very important and useful for evolution of one of the most prolific artefacts of the past ages. These should be fully supported by the photographs and the drawings, as pointed out earlier. Colour photography would help illustrate the original colour of the pots.

Inscribed pot sherds should find a special place for description and analysis. The photographic illustrations are very important to provide clear view of the letters for palaeographic study which often gives valuable clues for dating. Charts to explain the evolution of the script may also be useful. The technical reports on the analysis of clay, firing techniques, slip etc. should be given in the appendix.

9. Artefacts

The section on the antiquities forms another major element in a report. We have already discussed the various bases of classifying the artefacts. To cite only a few examples, antiquities like beads, bangles, coins, terracotta objects, metal objects, stone objects, bone objects etc. can undergo classification based on the material, shape and form. Examples are as follows:

i) Beads of a) Glass, gold, terracotta, semi-precious stones etc.
b) discular, long barrel, collared, corrugated, biconical etc.

ii) Metal objects: These can be classified under silver, copper, lead, iron etc.

iii) Terracotta Objects: Seals and sealings; Human figures, animals figures and miscellaneous objects. Hand made or moulded; ritual or utilitarian objects and so on.

The value of these antiquities as a source of social and cultural achievements of the past can hardly be exaggerated. They often reveal the technical or technological progress of an age, besides its social customs and habits. For instance, the analysis of the copper or iron objects would show the manufacturing technique and the quality of the metal. At the same time, the tools like the axes, hoes, crowbars would throw light on the agricultural and other domestic practices. The weapons of offence would reveal the martial qualities of the people and the nature of warfare.

Similar kinds of classification and analysis should be presented for each category of the artefacts and their social and cultural implications discussed. As has been aptly summed up by Martha Joukowsky, "The principle aim of the artefact analysis is to reconstruct cultural history by observing and analysing its components in detail, so that a picture of daily life of the people as well as a definition of the site's pattern of culture emerges."

10. Technical Reports

Under this section the technical reports furnished by the scientists and other specialists are given: Scientific reports on
carbon 14 or T.L. dating; soil analysis; physical anthropologist's report on the skulls and bones; zoologist's reports on the animal bone remains; metallurgist's reports on the metal analysis and so on. Similarly, reports of specialists like the numismatists (on coins) and epigraphists (on the inscriptions) should be given together with the relevant photographs, charts and drawings. Though the excavator has integrated the evidence from these specialists in the main body of his report, the technical reports have a much wider bearing on the technology of ancient objects and therefore, have much significance to the specialists in each field.

11 Interprétation and conclusions

The foregoing sections presented largely a factual description of the findings, their analysis and the inferences. Here, in this section, an overall view of the socio-cultural changes that the site represents is given together with a comparative assessment of the evidence of the site with that of other sites and conceptualisation of certain general patterns of material and cultural developments. Here, the excavator looks at the findings of the site in a larger context—the affinities with the neighbouring and far off cultural zones and identifies the links as well as the local adaptations. Questions like the interrelationships and migrations of communities and evolution or diffusion of social and cultural traditions and the processes of people's interaction with the environment are discussed.

The excavator can underline the special contributions of his excavations to the study of the problems taken up for investigation and also suggest future possibilities and lines of action. He can identify the inadequacies or deficiencies if any and ways of rectification. New sites or areas to be explored as a follow-up to the present study may also be indicated.
12. Appendices, Bibliography and Illustrations

Here, extracts from the original literary texts or inscriptions which are cited as evidence in the main body of the report can be given, if necessary, for further clarifications. Any other part or problem which is only indirectly connected to the subject but which may help further study by the interested can be elaborated in the appendices.

Bibliography should be comprehensive and should include the publications relating not only to primary sources but also secondary or published literature relevant to the report. The list of books is arranged author-wise alphabetically and the place and year of publication are given. Important articles from the periodicals may also be included, if necessary.

The major part of the photographic illustration can be given in the last if interleaving is not possible. They are given with serial Plate numbers with a short description below. A list of illustrations is given at the beginning, next to the list of contents. A more detailed description of the illustrated objects plate-wise and number-wise is also to be given at appropriate places. The plan and section drawing and such other illustrations are usually given along with the text with suitable designations.
CHAPTER VIII

CONSERVATION AND MUSEUM DISPLAY

Section 1

Conservation of Artefacts

Objects buried in soil for centuries become fragile and undergo decay. The organic and chemical content of the soil affect the antiquities in varying degrees according to their strength and composition. The chemical and organic contents of the soil leave their indelible mark on the artefacts besides the physical pressure. For example, the organic materials from excavations like bone or wood are seen considerably weak and fragile having lost their original cohesion and strength. This is usually the result of biological decay caused by the insects and the fungus. Metal object like copper coins or iron knives and nails are corroded by the chemical content of the soil. Moreover, buried objects when excavated and exposed are affected by the sudden change in the atmosphere which is named as "micro-environment". Hence, extreme caution is necessary not only in excavating them but also in their transportation to the museum or the laboratory. First aid methods to strengthen the objects in situ, before their removal is necessary to reduce the possibility of deterioration. If the object is found in fragments they have to be repaired or put together with suitable adhesives and then
comes the question of cleaning the object to remove the incrustations so that the object can be restored to its original condition as far as possible.

So, the usual stages in the recovery and conservation of the antiquities are: consolidation in situ; lifting, packing and transporting to the museum; and treatment and protection.

For all these purposes, there should be provision for a small field laboratory in excavation camp under the charge of an archaeological chemist with the necessary equipments and chemicals apart from a well-equipped chemical laboratory in the departmental museum. Only the first aid treatment necessary for the safe removal of the object to the museum need be given in the field. Further processes of cleaning and preservation may be done conveniently at the museum laboratory at a later date. There are well known works on the subject like H. J. Plenderlieth and A. E. A. Werner’s *The Conservation of Antiquities and Works of Art* (1974) and E. A. Dowman’s *Conservation in Field Archaeology* (1970) which should be consulted for more details as they provide a comprehensive and excellent study of the problems and treatment. Here, only a few important guidelines are given to help the excavator to interact with the chemist in the care and preservation of the excavated objects. They can be broadly classified as organic and inorganic. Under the organic, we have the bones animal and human, wood, leather, textiles, shells etc. and under, the inorganic, we have materials like the ceramics, terracotta figures and objects, bricks, tiles and the metals. Under the metals would come the objects made of copper, iron, led, silver etc. Let us take the more commonly available objects and study the kind of treatment they require.
1. Bones and Ivory Objects

Apart from the burials where skeletal remains in different forms are encountered, we do get bone tools and other objects in the habitation sites also. They should first be lightly brushed clean and a coating of vinyl acetate diluted with methylated spirits or shellac or alcohol should be given to strengthen them. When bone is extremely fragile it is to be consolidated with polynyl acetate in acetone and when the solution has dried, the bone can be lifted. The same treatment is recommended for ivory objects also. Quickfix can be used to join the broken parts of the bones.

2. Shell

Delicate and flaking shell objects can be given a soaking in a thin celluloid solution. Shells taken from the wet soil are likely to disintegrate when they are dry. They should be taken to the museum in a container that will preserve their moisture, so that chemical treatment can follow. They are soaked in 5% solution of clear gelatin after which they are placed in a formaldehyde bath which helps in providing a protective coat.

3. Wood

Wooden specimen found in damp or in waterlogged condition should be kept in the wet state till it is taken up for treatment. Otherwise, it is liable to warp and split. It can be covered with a damp paper or cloth and wrapped in a polythene sheet. To maintain its humidity, it can also be embedded in a layer of saw dust. It should be slowly dried and treated with glycerine or vinyl acetate or shellac in alcohol.

4. Textiles

Textile specimens are very rare in excavations. When they are found, they are delicate and should be treated with great care.
Laudermilk recommends a solution of clear rosin and acetone rather than celluloid as the latter tends to shrink the specimen upon drying. But samples for carbon-14 dating should be taken before the solution is applied as it would affect adversely the result of the dating. The textile samples can be wrapped (without folding) on the polythene sheets and a splint should be used to support it.

5. Glass

Ancient glass is frequently met with in excavations in the form of beads, bangles and vessel fragments. Moist or alkaline conditions affect the glass in many ways—leaching, discoloring and weakening of the structure. Further change in colour may occur when the excavated glass is exposed resulting in the evaporation of moisture and crystallisation of salts on the surface. So, glass objects should be colour-photographed as soon as they are unearthed since they are apt to change colour. Crackled and fragile glass should be gently cleaned before being consolidated with dilute coats of resin such as polyvinyl acetate or dilute soluble nylon. The same treatment holds good for the objects of faience.

6. Pottery

Potteries with the exception of the pre-historic ones are normally strong enough and hardly need any intensive treatment. They should be washed in salt-free water and dried. Brushing can also be done if there are no paintings or designs. In some cases when the incrustation is thick, treatment with a 2% solution of hydrochloric acid is recommended. Low fired pottery or fragile pottery of the prehistoric times, need not be washed in water but cleaned by soft brush. Dilute solution of polyvinyl acetate can be sprayed. Wet clay tablets or seals after being carefully packed
and transported to the museum can be baked carefully for preservation.

7. Metal Objects

a) Copper and Bronze: Copper objects are often met with in the excavations eg. copper tools in the Indus Valley and Chalcolithic sites. Historical sites usually yield plenty of copper coins which are so valuable for dating purposes. In South India, bronze icons have been unearthed at many places. Copper and its alloys corrode easily when buried in the earth. Soil contains many salts which change the metal into various salts. The main corrosion products, the copper oxides carbonates, chlorides and sulphates which form the incrustation weaken the metal and make it friable. Even after the removal of the metal from the soil, the chloride causes decay. It is known as the "brass disease" and it makes the surface of the metal green in patches. This brass disease is due to the presence of the basic cupric chloride which results from the penetration of oxygen and moisture through the weaknesses in the corrosion products and their reactions. Thus, the corrosion of a bronze object is aggravated on exposure to oxygen.

Before any treatment is undertaken, the chemist has to ascertain whether the object has sufficiently strong metal core to withstand the cleaning. If it is too weak, it is better to avoid any treatment and leave it with a protective coating. But if the metal core is reasonably strong, it can be subjected to mechanical or chemical treatment. The coin can be immersed in water and gently brushed with a tooth brush. If this does not succeed, soak the coin in a solution of one part tartaric acid, one part caustic soda and 10 parts of water. This would remove the green incrustations. Then it is thoroughly washed in water and coated with polyvinyl acetate.
Another treatment described by Wheeler is: (1) Citric acid and pickling in 5 percent sulphuric acid to remove any red oxide (ii) neutralize with ammonia or any alkali after the acid treatment (iii) wash in distilled water (iv) carry out the silver nitrate test with the last wash water (v) dry in alcohol and (vi) coat with bedacryl or polyvinyl acetate.

Objects with strong metal core can be cleaned by the electrolytic method which consists of "suspension of the object on a copper wire attached to the negative pole of battery and immersing it in a 2½ percent caustic soda solution contained in a glass vessel in which is immersed a piece of graphite wire to the positive pole of the battery. The electric current passes through the object and the solution removes the impurities from the metal" (Wheeler). After the treatment, the object is thoroughly washed in distilled water and coated with bedacryl or polyvinyl acetate as protecting cover.

8. Iron Objects

Iron artefacts are frequently met with in the excavations and more so in the megalithic burials. Weapons of defense and offense, agricultural implements and household objects are commonly found. They are subjected to rust formation which may have gone deep into the metal. Treatment of the specimens depends on the extent of rusting. Chlorides present in the soil cause the rusting and they can be removed by electro-chemical reduction with zinc and caustic soda or by boiling the object in changes of a dilute solution of caustic soda in distilled water. Some have recommended the application of silver oxide to iron objects to neutralise the chlorides. Immersion of the objects in a dilute solution (2%) of sodium carbonate could add stability.
Iron objects in broken or crumbled condition can be temporarily preserved by covering them with paraffin wax or plaster-of-paris and mounted in wooden splints by means of a cloth bandage.

9. Silver

Silver objects like coins recovered from historical sites are normally in a good state of preservation. Sometimes, black incrustation is found obscuring the inscriptions. They are affected by the mineralisation caused by the silver chlorides and sulphides. Whenever silver was alloyed with copper, the copper corrosion is found on silver objects. Silver chlorides can be removed by immersion of the objects in dilute ammonia. Copper salts found on silver objects can be removed with formic acid, ammonia or alkaline glycerol in the same way as with bronzes.

Section 2
Museum Display

After the preservative treatment, the excavated objects should not be dumped in a box or a room. They should be put on display at least selectively and periodically in a well classified arrangement in a museum. A museum exclusively designed to display the excavated objects is absolutely necessary. Scholars and serious amateurs would like to study the excavated materials kept on display and also those which are kept in the reserve collections or stores. So, suitable space and other display show-cases and shelves should be provided besides proper lighting arrangements and ventilation.

The idea of setting up museums near the excavation site or the village itself is gaining ground. A number of such site museums have come up in the historical sites like Nalanda, Sarnath, Lothal, Amaravati and Nagarjunakonda. But this is not
always feasible. Particularly, the universities conducting excavations bring the artefacts to their departments for display in their museums where they are more easily accessible to the students for study.

The museum may be designed in such a way that there are separate sections for the different cultural periods such as the pre-historic, proto-historic and historical periods. One section can be conveniently set apart for the display of the prehistoric sites, their geological deposits and the tools found in the site. An explanatory note giving the background details regarding the location of the site, the geological strata in which the tools were found is to be put up. Details regarding the raw material of the tools, techniques of tool making and the tool types and functions, the flora and the fauna—all these can be explained and suitably illustrated with drawings and photographs. Typical samples of the different tool types should be kept on display in show cases which should be safely locked. The rest can be kept in the reserve collection. A distribution map showing the sites of similar nature found in India or the world may be put up. This would enable the students to know the cultural links with other regions and countries.

The section on the historical sites may be so arranged that each site is separately represented and in the vertical show case the stratigraphy of the site can be projected through a photo enlargement or a section-drawing clearly indicating the different layers and the periods. The artefacts from each period can be shown sequentially from the earliest at the bottom to the later periods in the successive levels of the vertical show case. This arrangement would enable the visitor to have a clear idea of the stratigraphical sequence of the site and the structures and artefacts found therein.
Miniature Models

Miniature scale models of the interesting and more important structures found in the excavations may be prepared by the modeller for display. For example, the models of excavated structures like the Buddha stupas, viharas, chaityas and the secular buildings excavated at Nagarjunakonda are on display in the open museum there. A model of the famous Amaravati stupa is on display at the Amaravati museum. Models of even the megalithic burials can be prepared for display. Depending upon the space available in the museum, the size and the number of the models can be determined. Models give a three dimensional perspective and hence are more effective than the photographs or the drawings. The colour of the model should closely simulate the colour of the original structure to give a realistic effect.

Small Finds

But there are some difficulties in the display of smaller antiquities like the beads, terracotta figurines and gamesmen high up in the vertical section since they may not be clearly visible. The best thing would be to combine the two types of show cases—one showing the vertical sequence and the other placed in the table type show cases which bring the smaller objects closer to our eyes. Coins and coin moulds form an important item in the historical sites and hence a separate show case specially designed for the purpose can be set apart for each site. Inside the table show case, should be kept a slightly sloping tray covered with suitable light fabric on which the coins can be fixed. Coins may be arranged dynasty-wise or period-wise. Wherever we want to highlight some legends or figures in the coins which are too small to be seen, we can place reasonably sized photo enlargements of them by the side of the coin for easy reference. A note on the importance of the coin finds, their metal, age etc. should be kept in one corner of the show case or fixed on the side wall.
Terracotta Figures

Terracotta figures form another important item in the excavations. If they are many, they deserve to be exhibited in a separate vertical show case at the eye level. They should be arranged in a special way. If there are horizontal glass divisions in the show case, small pedestals of various heights made of plaster-of-paris and suitably tinted in grey or cream colour with socket or depression at the top to accommodate the figure may be used. This arrangement would enable us to avoid exhibiting all of them at the same level. Within the vertical show case, we can have different levels to show the figurines. Another method is to avoid horizontal divisions in the vertical show case and fix the terracotta objects at the back wall of the show case at various levels with suitable background fabric. An explanatory note on the techniques, style and the significance of the objects may put up by the side of the show case. Other terracotta objects like the gamesmen, beads or moulds can be exhibited in the table showcases like the other small finds.

Urns and Vessels

Another category of the finds that requires special attention is the ceramic finds. Large burial urns or storage jars can be suitably fixed in specially divided wooden or iron pedestals for display. Smaller vessels with painted designs or graffiti marks or inscriptions may be displayed in vertical or table show cases. Charts showing the graffiti marks and the inscriptions should be put up by the side with explanatory note.

Skulls and skeletal remains may be displayed separately within the section allotted to a site. Table show-cases are more suitable to exhibit the skeletons especially when they are full. We can also recreate the original state of their find with the
surrounding earth and the burial mode. Fragmentary bones or skulls may be exhibited in similar show cases. Photographs showing the context of their discovery and the original state of their find should be shown by the side along with a brief note on their importance.

Larger metal objects like the iron swords, lances, daggers, and shields can be exhibited on the wall showcases with suitable background. Smaller finds can be displayed in the table showcases.

For taking proper care of the museum and its objects, a curator, suitably trained in the modern museum display techniques, should be appointed. This will be in addition to a chemist to look after the preservation and cleaning problems and the security staff to keep watch over the exhibits. The curator will be in charge of all the artefacts and the valuables and should be the custodian of all the registers and the records thereof.
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