



Component-I (A) – Personal details:



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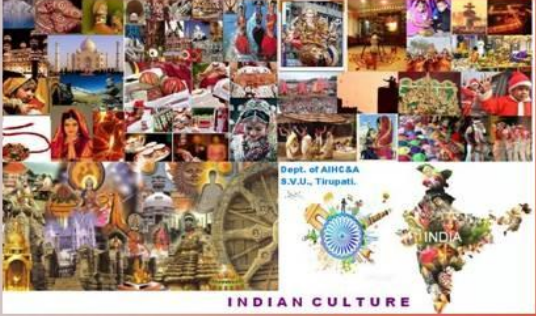
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Subject: **Indian Culture**



Production of Courseware
eG - Content for Post Graduate Courses

Paper **Archaeology; Principles and Methods**
Module **Relative Dating Methods**



ज्ञान-विज्ञान विमुक्तये



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Component-I (B) – Description of module:

Subject Name	Indian Culture
Paper Name	Archaeology; Principles and Methods
Module Name/Title	Relative Dating Methods
Module Id	IC / APM / 17
Pre requisites	
Objectives	
Keywords	Archaeology / Stratigraphy / Dating / Geochronology

E-Text (Quadrant-I) :

1. Introduction

In archaeology, the material unearthed in the excavations and archaeological remains surfaced and documented in the explorations are dated by following two methods namely, *absolute dating method* and *relative dating method*. In the former method, the artefacts are being precisely dated using various scientific techniques and in a few cases it is dated based on the hidden historical data available with historical documents such as inscriptions, copper plates, seals, coins, inscribed portrait sculptures and monuments. In the latter method, a tentative date is achieved based on archaeological stratigraphy, seriation, palaeography, linguistic style, context, art and architectural features. Though the absolute dates are the most desirable one, the significance of relative dates increases manifold when the absolute dates are not available. Till advent of the scientific techniques, most of the archaeological and historical objects were dated based on relative dating methods.

Archaeologists are resorted to the use of relative dating techniques when the absolute dates are not possible or feasible. Estimation of the age was merely a guess work in the initial stage of archaeological investigation particularly in 18th-19th centuries. As the research progress, different techniques were applied to estimate the age. The vast accumulation of data and the significant data analysis provided an ample scope for relative dating techniques. The time gap of approximation is progressively narrowed down due to the growth of knowledge in various fields.

2. Stratigraphy

The artefacts that are found in successive undisturbed cultural layers can be dated relatively based on the principles of stratigraphy. The principle of cultural/archaeological stratification is fundamental and it plays a dominant role in archaeological investigations. The technique is borrowed from geology. Sir Charles Lyell shaped the concept of stratigraphy in geology and published it in his outstanding book *Principles of Geology* by Sir Charles Lyell in 1830. There are certain basic laws and notions that are followed in identifying and studying stratigraphy. They are *Laws of Superposition*, *Laws of Original Horizontality*, *Laws of Original Continuity* and *Laws of Faunal Succession*. This concept was introduced in archaeology by the scholars like C.J.Thomsen, J.J.Worsaae, Kathleen M. Kenyon and Mortimer Wheeler. Later

on it was developed to suit the needs of archaeology by Edward C. Harris in 1970s. Edward Harris in his book *Principles of Archaeological Stratigraphy* (1979) questioned the application of geological laws directly in archaeology. He devised a new method in the interpretation of archaeological stratification which is popularly known as *Harris matrix*. It works on a simple basic principle that if one cultural layer lies upon another, then the lower layer must have been deposited before the upper layer. The time interval between the depositions of two cultural layers may be a century or a millennium depends upon the nature of cultural deposit. As per this concept, the contextual layer on the top is considered younger than the layer that is found below. Thus, a succession of layers would provide a relative chronological sequence from earliest to latest. Any cultural material found in a particular contextual layer can be dated relatively younger and older based on from which layer the particular artefact is recovered. The artefacts recovered from orderly placed stratified layers would help to classify them in certain chronological order. For instance, the collection of Stone Age tools such as Palaeolithic tools, Microlithic tools and Neolithic tools in different cultural layers helps to determine the approximate date of a particular cultural layer.

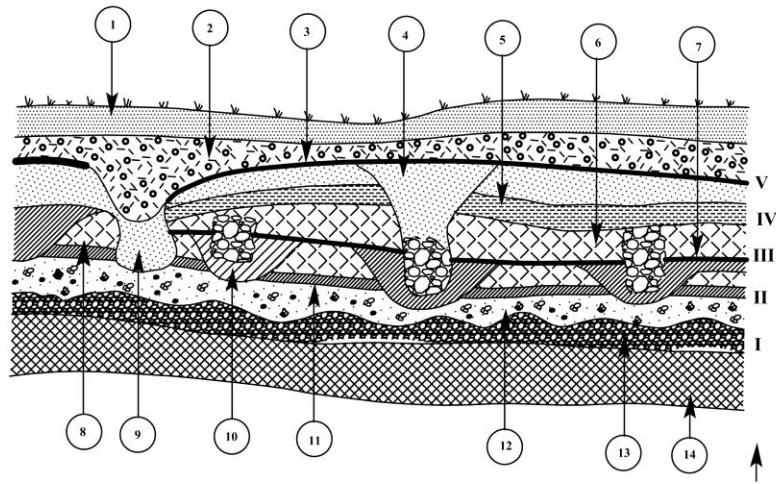
3. Seriation

Seriation is a method of determining the age of the artefacts based on the style, type, and technique. It is broadly divided into two categories namely stylistic seriation and frequency seriation. Stylistic seriation refers to a technique through which artefacts and attributes are ordered according to similarity in style. For instance, dish-on-stand, S-shaped jar and perforated jar are some of the diagnostic styles available in Harappan sites. The carinated vessel is the diagnostic pots of Jorwe ware. The availability of such diagnostic wares would help to determine the cultural phase.

The frequency seriation is more strictly oriented to chronological ordering of the artefacts and assessing the origin, popularity and disuse of the artefacts. The length of time and degree of popularity (frequency) would be assessed in the given archaeological context. For instance, Painted Grey ware, Northern Black Polished ware and rouletted ware were noticed in a particular time range only. Based on the quantity and frequency of the diagnostic ware, the date of the particular cultural phase is determined. The Copper hoard culture of Gangetic valley is relatively dated purely based on the type of copper objects like anthropomorphic figurines and harpoons encountered in hoards.

Likewise, the technology involved in making a particular object also provides relative dates. The occurrence of copper and iron objects provide relative dates to the context as the copper technology came first and iron technology followed latter. Heinrich Dressel's classification of Roman amphorae based on shape and texture and providing a probable date for each shape could be cited as one of the finest examples for the typological analysis (Dressel 1899). In the same way, the Harappan ceramics were also analysed based on structure and shape. Thus, the relative dates are derived by using various methods like stratigraphy, typology, texture, technology and context.

(After Barker 1977)



↓ Excavation Levels

- 1 Sandy top soil
- 2 Loose earth
- 3 Destruction of occupation
- 4 Wind blown sand
- 5 Ash
- 6 Destruction
- 7 Destruction of occupation
- 8 Destruction
- 9 Pit - sand
- 10 Construction

↑ Cultural Levels
There are five cultural levels

- I
- II
- III
- IV
Between level IV and V
There is a level of abandonment
- V

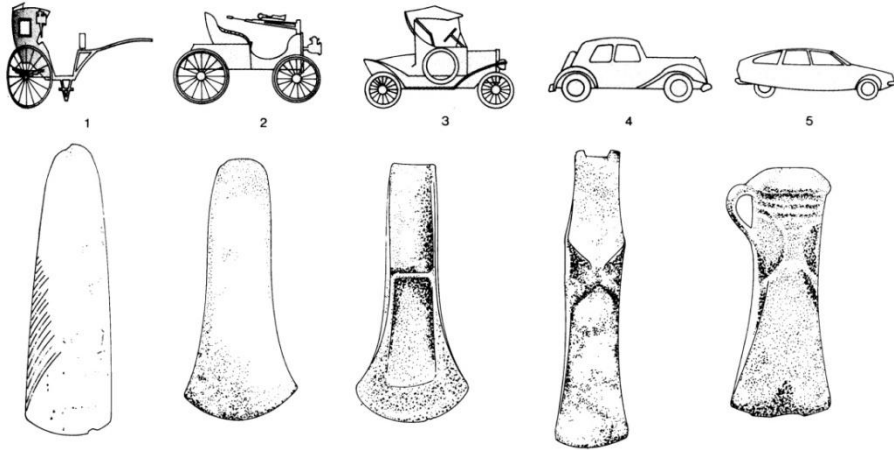
- 11 Earth floor
- 12 Pebbly
- 13 Rubble fill
- 14 Sterile earth



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(After Colin



Renfrew and Paul Bahn 2000:121)

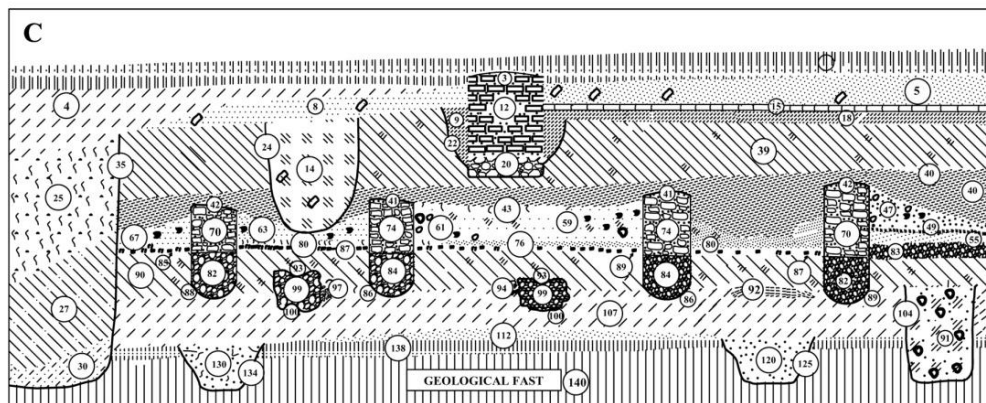


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(Source: www.anticopedie.fr)

Dressel Classification Number	Type	Period
1	Roman wine amphora	129BCE -13 CE
2	Roman wine amphora	16 CE – 29 CE
3	Roman wine amphora	28 CE – 146 CE
4	Roman wine amphora	4 BCE – 24 CE
5	Roman wine amphora- holo type	12 BCE
6	Roman wine amphora- holo type	36 CE
7-11	Betic amphora for salted fish (Hispanic)	
12	Betic amphora for salted fish (Andalusia)	
13-15	Betic amphora for salted fish	
20	Betic oil amphora	2 nd - 3 rd century CE
26-27	Amphora	3 rd century CE and later
	All other shapes belong to later period and were not catalogued by Dressel	



(After Harris 1983:63)

4. Dating of the Bones

Bones are one of the important organic samples recovered in excavations. These bones help to reconstruct various aspects human life such as the dietary pattern, palaeoclimate, trade network and rituals performed in ancient times. Therefore, the control over the date would help to identify the changing pattern of diet, climate, ritual and trade. The bones that are recovered from the archaeological investigations are dated based on the following methods namely Amino acid method, Electron Spin Resonance (ESR) method, Fluorine method and Nitrogen method. Among the four, the first two methods falls under absolute dating method and the remaining two falls under relative dating method.

4.1 Fluorine Test

Most of the ground waters contain small amount of fluorine. The fluorine ions combine with hydroxyapatite crystals of the bone to form fluapatite. A bone buried for a longer time will absorb more fluapatite than the one buried for a shorter time. The date of the bone is determined based on the amount of fluapatite present in the bone.

4.2 Nitrogen Test

Bones are made up of calcium phosphate, fat and bone protein or collagen. On death, the collagen decays at a uniform rate and turns into nitrogen. Like fluorine method, the amount of presence of nitrogen is measured and dated accordingly. The rate of decay depends on physical and chemical composition of the soil. Therefore, it is not universal. However, one can differentiate the date of the bones collected from a single deposit or from a single burial.

5. Geochronology

The age of artefacts can sometimes be determined by their association with geological deposits or formations. The effects of long-term geological processes such as glacial advances and retreat or fluctuations in sea levels can sometimes be useful in dating archaeological material. The advance and retreat of glaciers during Pleistocene period (Ice Age) had a marked effect on the action of rivers and on sea level. River terrace or coastal bed formations are due to this ice age effect. The sequences of erosion or deposition have been worked for a number of river valleys. Geologists assessed the age of these geological formations through various dating methods. These dates allow archaeologists to assign approximate date to artefacts that are found with such deposits. This dating method is widely used for prehistoric materials. For instance, the age of Palaeolithic tools found on the river terraces of the Soan valley in Punjab, is determined based on the geological deposit.

5.1. Varve Analysis

Streams flowing into still water bodies like lake commonly create silt deposit in summer and clay deposit in winter. Swedish scholar Baron Gerard de Geer in late 1870s noted a regular alteration between coarser silts deposited by glacial melt water in the summer, and fine clays deposited as suspended particles settled during the winter months when the lake was covered with ice. The recurring pattern of coarse and fine sediments could be read as a yearly record of glacial discharge. Geologists established a dated sequence of varve by moving back in time from recent layer of known age. The thickness of the varve pairs varies from year to year, depending upon the amount of glacial melting or discharge of flow. This also serves as a sequential landmark. Some of the ancient shorelines were established through this system. Scandinavian varve sequence is the best known in European countries. Archaeological remains collected from those deposits can be dated.

6. Deep-sea cores

The most coherent record of climatic changes on a worldwide scale is now provided by deep-sea cores, drilled from the ocean bed. These cores contain shells of microscopic marine organisms known as *foraminifera*, laid down on the ocean floor through the slow continuous progress of sedimentation. Variations in the ratio of two oxygen isotopes in calcium carbonate of these shells give a sensitive indicator of sea temperature at the time organisms were alive.

Besides, the presence of marine organism *foraminifera* in a soil is considered as one of the fine indicators to understand the extension of sea into the land. S.R.Rao claimed that sea was extended up to Lothal during Harappan times based on the presence of *foraminifera* in the soil samples collected from the dockyard excavated at Lothal. Rajiv Nigam of National Institute of Oceanography also claims the same for Dholavira too. This analysis helps to determine the nature of site as port towns and also its date of establishment.

7. Ice-sheet cores

Like deep-sea cores, cores extracted from the polar ice of the Arctic and Antarctic yielded impressive sequences revealing climatic oscillations. The date for each layer of compacted ice from annual deposits for the last three thousand years has been determined. The archaeological material recovered from a particular layer is dated accordingly.

8. Pollen Dating

All flowering plants produce the almost non-destructible grains called pollen. These were preserved in lake sediments that have allowed the pollen experts to reconstruct detailed sequences of past vegetation and climate. The best-known chronologically placed pollen sequences are those developed for the Holocene times of northern Europe. By studying the pollen samples from a particular site, one can safely place them in particular time-ranged pollen zones. The botanical samples are collected through a technique called *flotation technique*. Several screening methods are being used in the recovery of micro or macro botanical remains. The Flotation technique developed by Anthony J. Legge of Cambridge University remains the best method and being practised throughout the world as it yields the best recovery rates.

9. Historical Dating

Historical dating comprises both absolute and relative dating. Until the development of the scientific dating, dating in archaeology depended entirely on historical methods. Different dating systems are followed in determining the dates of the historical records. The ancient literate societies recorded their written documents with certain absolute dating methods. In India, different *eras* like Saka era, Kaliyuga era, Vikrama era and Kollam era have been used in the written documents like inscriptions and copper plates. The dates given in a particular era provide an absolute date to the inscriptions or copper plates.

Historians, epigraphists and historical linguists also give the approximate date to the historical documents like inscriptions, copper plates, coins and seals and art objects like sculptures and icons and architectural features like stupas, temples, mosques, churches, forts and others. Epigraphists provide relative date to the inscriptions based on palaeographical ground (styles of the script). The historical monuments like temples, mosques, churches, tanks and forts were given relative dating based on stylistic features. The above dating methods are used based on the nature of the material available to the archaeologist. Archaeologist always tries to attain an absolute dating for the material. He prefers the relative dating when the absolute dating is not feasible.

9.1. Palaeography

In India more than one lakh inscriptions were documented. These were found on different materials such as stone, copper plates, pottery, seals, conches and ivory. Most of the inscriptions are fragmentary in nature. Therefore, the evolution of script played a dominant role to decide the relative dating. For instance, the Brahmi script is considered as mother of

all Indian scripts. The Brahmi script evolved as various Indian scripts. For instance, the Tamil-Brahmi script in Tamil-Nadu has developed as *vatteluttu* script first and later on it developed as Tamil script. Each script has its own time range of its survival For instance Tamil-Brahmi script has survived between 6-5th century BCE down to 3rd century CE. Within these eight hundred years of its survival, the Brahmi script was transformed into *vatteluttu* script in 3-4th century CE. Based on the palaeography, the Brahmi script is divided as early, middle and late phase and each phase occupying approximately period of three centuries. Thus, one can date the Brahmi inscribed potsherd or object based on its palaeography. Nearly 70-80% of the inscriptions in India were dated based on palaeography.

The world of sciences is progressing well in all spheres of discipline. The dating methods are being refined quite often and are progressing towards accuracy. The new dating methods are being added to the list frequently. Therefore, archaeologists must keep in space with the progress and always should keep track of the new developments.

