

## *Chapter-VII*

### **CHRONOLOGY AND SOME SCIENTIFIC METHODS OF DATING THE PAST**

The first question asked is how old it is? Formerly the aim of archaeologist is to get an old, ancient, or artistic objects to satisfy the curiosity of the layman, the connoisseur of art with antiquarian zeal.

But the spirit of enquiry, how man and culture evolved a particular tool or weapon or living arrangements made what is the technique when and how it was made?

“The purpose of archaeology is to extract history from the monuments and artifacts of the past, to write history from the often inadequate relics that time has spared”.

Adequate system of chronology is a basic necessity in the field of archaeology. When compared to the history, Prehistory is of much greater length and magnitude and a broad chronological frame work is essential. There are several methods in vogue in different countries and they fall under three categories:

(1) Relative Dating.

(2) Some Scientific Methods of Dating.

B.C. obtained for a peice of wood unearthed at Amensfoot in the Netherlands. The first agricultural village of Jarmo in North Iraq was dated back to 7000 B.C. We have in India various  $^{14}\text{C}$  datings for Harappan and pre Harappan sites, Neolithic-chalcolithic sites, ranging from C.3000 B.C. to 2000 B.C.

### LIMITATIONS:

The method, however, is not without defects. The rate of production of  $^{14}\text{C}$  has been questioned. There is possibility of errors in sampling and calibration. In order to correct the error, the final count is expressed in plus/minus appended to the obtained date. The method gives a broad outline of chronology rather than a final date or nearly correct date. Though some of the following are scientific methods of dating, they provide only a relative and more often help to cross-check the sequential dating. Hence cannot be strictly included under absolute methods of dating. These are.

### (B) FLUORINE TEST:

This method was invented by a French scholar in 1893 and perfected by Oakley. K.P. Bones are subjected to this dating. The Flourine present in the ground water is gradually absorbed by the buried bones or teeth. The greater the flourine content in an excavated bone, or teeth, the greater is its antiquity. This chemical method of dating is powerful tool and if the analytical data involving the estimation of flourine, nitrogen and chlorine present in the buried bones is well correlated dating will be reliable. Uranium is non existent in fresh bones. When bones are buried in the soil they absorb uranium. The greater the percentage the older the bone. It provides a relative dating. Nitrogen: Fresh bones contain appreciable percentage of Nitrogen. The older the specimen the lesser the nitrogens. Nitrogen analysis is particularly useful for relative dating of bones of several ages and very valuable

where a date obtained by this method is found to compare favourably with that (1.75 million years), determined by the Pottassium-Argon method.

### (3) HISTORICAL SYNCHRONISM:

On the basis of contemporary kings, other, datable literary evidences etc. the inscriptions and historical events can be given a date. Maurya Chandragupta's date could be fixed on the date of Alexander and Seleucus Nicator. The Arretine, Rouletted pottery wares and Roman coins have provided a very reliable synchronism to the sites like Brahmagiri, Arikamedu. The Synchronism of Goshitarama monastery of Buddha's life time at Kausambi, Asoka's opening of the Vaisali stupa for the relic of the Master etc. as known through literature are some instances worth to be noted.

At Tell-el-Amar in Egypt a huge literary record was found in mud brick plates of two Egyptians kings, they contained the orders to the Governors in the different parts of his empire.

Ras Shama in Syria was destroyed due to a natural calamity during its best phase. Clear evidence of this was available in the records of Tell-el-Amama wherein the provincial governor sent a message, that due to fire accident the whole city was destroyed. Egyptians followed the calender after Sun god. They found out the error they committed in giving only 365 days to a year and revised the entire chronology upto 2000 B.C. Eridu: The first city of Babylonia was dated to circa 3200 B.C. The antiquity of the city could be fixed by calculating the distance from the sea once it was on the sea.

### REFERENNCES

1. H.D. Sankalia, An Introduction to Archaeology, (Poona, 1966)
2. K.V. Raman, Principles and Methods of Archaeology (Madras, 1986)

method is specially valuable in establishing dates and time sequences of prehistoric sites that have left no materials of carbon, such as charcoal, wood etc. When a piece of pottery, if heated the stored energy gets released, emitting as visible light which is related to the amount of time that passed since the original burning of the pottery. The sherds are heated to a high degree of temperature that the trapped electrons get released and they create a flow called Thermoluminescence. This flow is so faint and is not visible. It is detected by a photo multiplier tube. The more the light emitted, the greater the length of time, since the material was last heated. This method can date back upto 100,000 years. However, it is still in experimental stage. This dating method is applied to a limited extent in Indian Archaeology. The work is being done in Oxford University and in India, Bhabha Atomic Research Centre undertakes in a limited way.

#### **(D) POTASSIUM-ARGON DATING:**

This method extends the range of absolute dating beyond the limits of Radio Carbon. The method is based on the measurement of the ratio of potassium-40 to the gas argon-40 in many minerals. With the aid of this dating, the rock sites, associated with the geological ages can be dated. The geological chronology is thus put on absolute basis.

#### **(F) FISSION-TRACE DATING:**

Although Potassium-Argon method can date events in the time range of 70,000 to 30 lakh years, the measuring is labourious. This new method of fission tract dating is being employed to date materials ranging from 20 years to one crore year B.C. It must, however, be noted that the younger the sample, the larger is the requirement of uranium content for age determination. The reliability of the method can be seen by the evidence of olduvai

for cross checking the results of Uranium and Flourine analysis of the bones believed to be of Pliestocence age in open sites.

### **(C) DENDROCHRONOLOGY OF TREE ANALYSIS:**

The originator of this method was Dougless and covers upto 10,000 years. This is a biological counterpart of th Tree Ring Analysis. To date in this method, old timber or burial wood is required. When such wood is cut transversely, we find rings. These concentric rings usually represent annual accretion, grow on basing 11-year sun cycles. On the basis of this ring sequence Dougless dated in California upto 3000 years. This method has limitations and can provide only a terminus post quem as the timber cut out may have been reused from building to successive buildings after some centuries even.

### **(D) GEO-MAGNETIC METHOD:**

#### **ARCHAEO-MAGNETISM:**

This deals with the study of remnant magnetism in archaeological remains from burnt clay objects. Magnetic field of the earth is changing-continually in direction and intensity. These changes leave records. The objects of clay contain magnetic oxide of iron. When heated beyond the curie point the magnetite and Geomatite grains are aligned with the magnetic field of the earth surrounding them, and on cooling these are 'Frozen' and get locked up. It has been found that remains of ancient things such as pottery and burnt bricks do preserve their magnetization. This is measured and compared with the direction of earth's field at present. The method is in experimental stage and is found useful only for particular clay objects.

**Thermoluminescence:** This is a potential method for dating pottery. This method will be of much use for dating the various regional and subregional cultures based on pottery wares. T

promising and extensively used method. It can be applied directly to any archaeological layer which contains the requisite materials. In India particularly the method has been very useful in dating the pre and proto historical contexts and the dates obtained were dependable for cross-checking the evidence. We owe this method to American physicists J.R. Arnold and Willard F. Libby(1949). The latter was the first to recognise the existence of Radio Active  $^{14}\text{C}$  in living matter, in water and air. Chemically it behaves in the same manner as an ordinary carbon of atomic weight-12. Carbon- $^{14}\text{C}$  however differs from ordinary carbon-12 in one important respect. It is radio active and decays. The disintegration of  $^{14}\text{C}$  proceeds in a measurable way.

It is indeed remarkable and useful to archaeology that (a) all living organism contain the same proportion of carbon-14. (b) and after death organic materials loose their carbon-14 at the same ratio. It is calculated that half disappears in 5730 years and this is known as half life cycle. Thus the diminishing of this Radio active carbon in an archaeological sample is scientifically worked out.

### ITS APPLICATION:

The materials obtained for this date are charcoal or charred grains, bones, wood etc. The date will be accurate only when the collection made is not contaminated. We should not allow old carbon sample to be collected from a disturbed layer where water or modern rootlets have approached. The soil cover over the sample should be fairly undisturbed. It should be dry and neatly packed in an aluminium foil. It should not be touched with hand. The Tata Institute of Fundamental Research Bombay, The Birbal Sahni Institute of Palaeo-Botany, Lucknow and physical Research Laboratory, Ahmedabad are undertaking this work. About 500,  $^{14}\text{C}$  dates are available today for the various Indian sites. The method can date upto 60,000 years. The earliest date is 58,000,

(3) Historical synchronism.

**(1) RELATIVE DATING OR SEQUENCE DATING:**

These are Comparative dating methods or archaeological methods of dating.

(a) Archaeology derived its chronological concepts from Geology. There is difference however, geological strata and periods have global validity not so the archaeological strata of a site. Succession of deposits does give us a sequence. Stratigraphic excavations were unknown earlier to 1947. The prevailing method was bench 'level' recording.

**Three Dimensional recording:**

For a single site the stratigraphy is really useful: but problems come when a particular culture is compared with others. Major part of chronology of Indian pre and protohistorical periods is based on typology. Harappan type seals were found in Mesopotamian site. Such datable antiquities and comparative studies provide a reliable chronology.

**Statistical Method:**

To distinguish the change in culture or period resort is taken to statistical differences in the composition of a total assemblage.

**(2) SOME SCIENTIFIC METHODS OF DATING:**

Several scientific methods of dating are now available.

**(A) 14C OR RADIO CARBON DATING:**

The Carbon-14 method very briefly, and in simple words, is based on the discovery that Vegetation, (trees, plants, flowers), absorb carbon dioxide which contains 14C. This is a most