

Scientific Method

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Science is a process of learning and discovery through the systematic study of principles that govern observable phenomena. The basic assumption of all sciences is that there is a real and knowable world and that regularities in it can be reconstructed through the development and testing of hypotheses. Hypotheses are stated relationships between two or more variables in the empirical world that anticipate and explain the interaction between them. Stated relationships are confirmed or rejected through the observation of the empirical world. Confirmed hypotheses are incorporated into larger theories useful for explaining natural and behavioral phenomena. Scientists are required to be explicit about their assumptions when formulating a hypothesis. This allows other scientists to evaluate the foundations of the hypothesis and the validity of the test. Because scientific hypotheses are often dependent upon the accuracy of other confirmed hypotheses and assumptions they are always open to further evaluation and testing. This is the self correcting nature of a productive science.

In archaeology, the scientific method has provided a philosophical framework to develop and evaluate ideas that increase our knowledge about prehistoric human behavior. The scientific method was adopted by archaeologist's in the 1960's because they wanted to assign more accurate meaning to archaeological data. Until this time archaeology in the United States was largely descriptive in nature and focused on reconstructing particular cultural chronologies. Unlike scientific archaeology, traditional

archaeologist's interpreted patterns in the archaeological record largely from personal experience. Interpretations were evaluated based on professional competence of the archaeologist, rather than testing with empirical data. During the postwar era, faint murmurs for change were heard from small minority of archaeologists concerned with the way archaeological problems were formulated and approached. Walter Taylor (1948) and others (Willey and Phillips 1958) advocated the development and testing of general laws to explain cross-cultural regularities in human behavior, rather than the traditional approach of describing them. Taylor also proposed using a more scientific approach for reconstructing the prehistoric past that involved the formulation of hypotheses and testing them rigorously with the archaeological data.

The use of scientific method in archaeology was at the core of the "new archaeology" championed by Binford and his followers beginning in the 1960's. As a graduate student Binford became dissatisfied with the types of questions being addressed in archaeology as well as the way conclusions were being drawn. He proposed that the process of inquiry into the prehistoric past be modeled after the physical sciences. Initially, proponents of the new archaeology were interested in testing theories developed by traditional archaeologists. For this reason, Binford turned to the hypothetico-deductive (Hempel and Oppenheim 1948) school of scientific explanation that dominated philosophy of science in the United States at that time. This school of thought promoted the deductive testing of hypotheses and the confirmation of general laws. The principal tenets of this approach were adopted quickly by much of the archaeological community and were viewed by some as the only valid framework to describe, explain and predict human behavior (Spaulding 1968).

Over the past three decades archaeologists have debated which scientific methods are most appropriate for describing and explaining the prehistoric past. Much of this debate has focused on the most legitimate way of developing and testing hypotheses. Hypotheses are usually generated inductively through the observation of patterns and common features in the archaeological record. Ethnographic analogy is also a common means for inductively establishing testable hypotheses about human behavior. In some cases, hypotheses are also augmented or formulated in more creative ways using personal insight and imagination. Regardless of how hypotheses about past cultural events are developed they must also be tested. The hypothetico-deductive method of testing hypotheses requires an observational prediction to be deduced from the hypothesis. If observation of the empirical phenomenon under investigation conforms to the prediction, the hypothesis is said to be confirmed. A hypothesis is strongly supported when several confirming instances are observed.

Many archaeologist's have recognized the limitations of the hypothetico-deductive model for explaining prehistoric human behavior. In it's purist sense, explanation using this model is only attainable if a particular phenomenon can ultimately be predicted (Hempel and Oppenheim 1948), or in the case of prehistory, postdicted, given a certain set of circumstances. Unfortunately, the complexity of human behavioral systems does not meet the explanatory requirements of prediction. Ethnoarchaeological research clearly indicates that similar archaeological patterns can be produced by different types of human behavior. Therefore, many alternative hypotheses can account for the same pattern in the archaeological record.

Alternative models of scientific confirmation and explanation are generally more inductive in nature. However, the proponents of these

models still stress the importance of developing and testing hypotheses. Salmon (1982) argues that the plausibility of all hypothetical accounts of a particular archaeological pattern must be considered. Prior to testing a hypothesis the alternative hypotheses should be evaluated and those with a low probability (prior probability) rejected prior to the test. Statistical, rather than universal, laws of human behavior can be established in this manner. This philosophical model is more compatible with the systems approach which is inherently a more inductive method of scientific inquiry.

The foundations of the scientific method for reconstructing the prehistoric past have recently been questioned. Criticism have been put forward by archaeologists who emphasize the explanatory significance of historical factors for understanding prehistoric culture change. They argue that the complexity of historical trajectories are impossible to predict using scientific reasoning. For this reason, Hodder (1984) argues that the scientific method cannot be used to reconstruct prehistoric human behavior and that scientific objectivity is "a false and misleading goal of archaeology". This radical view is also based on the notion that archaeological theory is influenced by the historical, intellectual and sociopolitical climate in which it is developed (Shanks and Tilley 1987). Therefore, scientific verification of hypotheses is impossible because theory and data cannot be separated. Of course, these are valid criticisms of scientific archaeology, however, proponents of this radical school of thought have failed to propose a sound alternative approach.

With the exception of the radical fringe , scientific methods continue to be favored in contemporary archaeology. In general, archaeologists agree that the primary goal of archaeological research is to describe and explain behavioral changes in the prehistoric past. Description and explanation are