

Historical Facts and Theories

Frequently it is confusing when a term is used in more than one way, especially when it is used to describe related concepts. In essays discussing political battles over the teaching of evolution and creationism in public schools, Stephen Jay Gould explains that scientists since Charles Darwin have used the term evolution to mean both the fact that life on earth changes over time as new species develop, and to describe theories like natural selection that explain how and why these changes take place. Gould believes that the dual meaning of evolution as both fact and theory has either been misunderstood or misused by advocates of creationism, who dismiss the fact of evolution as just one among a number of possible theories. The definition of history is even more complicated because it refers to a number of different but related concepts. Along with scientists and social scientists, are engaged in an active process of asking questions, seeking out information, and forming explanations that enable society to understand and master our environment. What we commonly refer to as history actually includes a series of distinct but related ideas: (a) events from the past – “facts,” (b) the process of gathering and organizing information from the past - historical research, (c) explanations about the relationships between specific historical events, and (d) broader explanations or “theories” about how and why change takes place. History is the past, the study of the past, and explanations about the past.

One problem with this view of history is that not everyone agrees on which facts are important to include when analyzing the past. Babe Ruth hit 60 home runs the same summer that worldwide protests were being held against the scheduled execution of Sacco and Vanzetti. These are both interesting facts, but do they have historical significance? The status of a fact rests on its importance in explaining the causes of events that interest historians and societies. The Italian historian Benedetto Croce argued that essentially all history is contemporary history because people read the past and decide on what is important in the light of current problems and issues. Weighing the historical importance of facts is also a problem because they are continually screened through the decades and centuries. Historians are forced to draw major conclusions based on limited information that was preselected by contemporaries, considered important by earlier generations of historians, or survived because of fortuitous accident. Recognizing that facts take on meaning within the context of explanations, and that the historical record is, at best, incomplete, does not mean that all facts carry the same weight and that all interpretations are equally valid. Within the historical craft, accuracy is an obligation, interpretations must be supported by evidence, and evidence is subject to review. If we want students to become historians, we need to involve them in deciding which facts are important for understanding history and what criteria to use when making decisions, instead of focusing our efforts on providing them with lists of someone else’s important facts.

The role of theory or point of view in the study of history is sharply debated, yet crucial for understanding how historians know what they claim to know. Early in his career as a philosopher and mathematician, Bertrand Russell hoped for the development of a mathematics of human behavior as precise as the mathematics of machines (Carr, 1961: 71). However, the prevalence of contingent factors (accidents and uncontrolled or unanticipated incidents) and the recognition that individual points of view and cultural assumptions strongly influence what historians see have made Russell’s dream highly unlikely. According to the scientific method taught in high school, scientific experiments require a formal hypothesis to be tested, a predicted and quantifiable outcome, control over the immediate environment, the ability to regulate variables, and assurance that the same result will be obtained each time the experiment is replicated. Historians can never conduct this kind of experiment. They do not control events which happened in the past, are known incompletely, are much too complex, and are never repeated in exactly the same way, or people. They cannot remove a Lenin or Hitler from the historical equation and play back the 20th century, and they are not very successful at predicting specific historical events (the collapse of the Soviet Union or the election of particular candidates).

Significantly, many sciences do not have this kind of control either. Evolutionary biology, geology, and astronomy all have a historical dimension and a breadth of field that cannot be contained within a laboratory. Extinct species cannot be resurrected to see if they would survive under different circumstances, earthquakes cannot be replayed for closer observation, the big bang will not be repeated, at least not for many billions of years, and no one seems very good at predicting the weather. In addition, as scientists work with increasingly smaller and faster subatomic particles and charges, the certainty of Newtonian laws has been replaced by the uncertainties of quantum mechanics, relativity, and chaos theory. According to Werner Heisenberg, a German scientist writing in the 1920s,

when scientists examine a physical or chemical process, their observations and measurements interfere with and change what is taking place; they can never know exactly what was happening before they intervened. The classical scientific method still has value, but we need to remember that it can only be applied in its traditional rigor under special and limited circumstances.

The question for us is, how can any historical science where contingency is always a factor, including human history, be scientific? Stephen Jay Gould (1989: 277-291; 1991: 385-401) argues that the historical sciences have their own appropriate scientific methods based on constructing narratives of events that allow us to locate patterns, identify probable causes, and create broader explanations and encompassing theories. Historical explanation uses specific events to describe general categories and general categories to explain specific events. For example, labeling a group of events as *social revolutions* means they have similar qualities that historians and social scientists can identify in other locales and eras, and that these qualities explain human actions and point to new, potentially revolutionary situations.

However, if the label proves to be too inclusive or of little use in predicting revolutionary situations, new general categories and explanations must be sought. Historians and other historical scientists also search for evidence that defies our explanations and forces us to redefine them. Because history and the historical sciences do not rely on experiments that can be replicated in other laboratories, they also require a different form of verification. The ultimate check on the historian is the marketplace of ideas where explanations are debated and analyzed, and colleagues are convinced that interpretations explain the data, are logical, are consistent with other things that we know, and provide possibilities for new explanations and further research.

What do scientists mean by *Scientific Explanation*?

Explanations must be *Consistent*. The explanation for one set of phenomena cannot contradict the explanation for other sets of phenomena. If explanations are inconsistent, they must be rectified or abandoned.

Explanations must be *Testable*. Explanations must be examined in laboratories, in nature, in the field or through the study of past events and must be capable of shown to be incorrect. If they are incorrect they must be changed or abandoned.

Preferred Explanations should be *Elegant (Simple)*. Explanations that require the invention of the fewest “missing pieces” have the greatest reliability. Explanations cannot include pieces that are either inconsistent with what is already known or that are untestable.

What is “normal”?

The molecule H₂O comes in three forms – solid (ice), liquid (water) and gas (water vapor). Which form is normal?

How can evolution be both a “fact” and a “theory”?

H₂O will transform from liquid to gas at 100° centigrade.

Fact: Something that happened or exists (H₂O exists. So does the transformation of H₂O).

Hypothesis: A testable explanation of why or how something happened or exists (Will H₂O will transform from liquid to gas at 100° centigrade?).

Theory: A testable explanation of why or how something happened or exists that is strongly supported by evidence and testing (H₂O transforms from liquid to gas at 100° centigrade at STP).

Law: A testable explanation of why or how something happened or exists that is strongly supported by evidence and testing for a long period of time. Often it can be described in scientific or mathematical terms (Liquid H₂O + energy \rightleftharpoons Gaseous H₂O).

What is a scientific law?

$E=MC^2$. Energy equals mass times the speed of light squared. This formula describes the relationship between energy and mass. Great energy requires great mass. In a vacuum like outer space, when mass

approaches zero, potential energy (heat or temperature) approaches absolute zero. In a star with dense mass, potential energy (heat or temperature) will be tremendous.

Question: How did Einstein know that the speed of light had to be squared?