

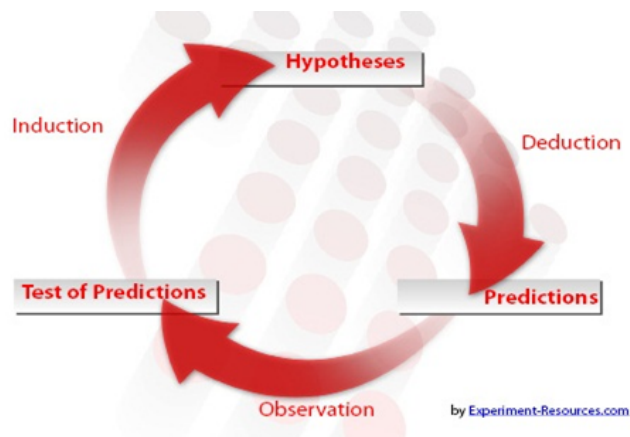


Historical Evaluation of Scientific Methods and Tradition in Science

Introduction::::

The root of science, method and scientific tradition in Platonism and Aristotileism thought on scientific process of understanding nature. Plato (428-427 BC) wrote that humanity was born with an innate knowledge of everything and that learning was a process of unlocking the memories(1).His argument was that everything had a perfect potential abstract from, and that any knowledge gained through observation and experiment was filtered by the senses (empirical knowledge and this type of pure knowledge could be advanced by logic (induction and deduction)(Magdalene and Mikalauckas, 1933).The Greek thinkers believed that science based on observation and measurement. Beyond the Greek particularly in Roman and Islam Ibn-Sina (980-1037), believed experiment and generalization is first step of scientific process.(2). Since, the renaissance period (13 century) Roger Grosseteste and Roger Bacon refined the scientific method on discovery of technology based on experiment. They believed science based on observation, experiment, validity and generalization. After the renaissance period developed mordan science by Copernicus, Brahe, Kepler, Galileo, Descartes and Newton, they established scientific tradition on observe, predict, test and generalize. See following figure,

Figure 1 Discovery of Scientific MethodM

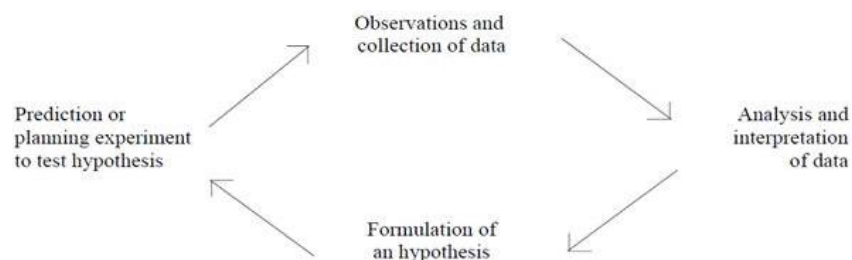


Source: <http://www.experiment-resources.com/what-is-the-scientific-method.html>

The Evolution of Scientific Method

Science is systematic study of nature, understanding this nature by scientific method. Scientist build hypothesis, use technique for collect data than investigating phenomena by observation or others methods and testing hypothesis and predict conclusion. Those entire steps include in scientific method or process of acquiring scientific knowledge. Therefore, scientific method is logical inquiry of phenomena or entire research process(3).

Figure 2 Steps in Scientific Method



Source: <http://www2.hawaii.edu/~halina/603/603scimeth.pdf>

The evolution of science and scientific methods we go back to history and philosophy of science they raise basic questions for research process like, is science based upon faith? What is the scientific method? How new scientific method discovered? All those quotations related to logic of systematic inquiry. This inquiry explain, chain of research events Copernicus to Newton, and their scientific tradition in science.

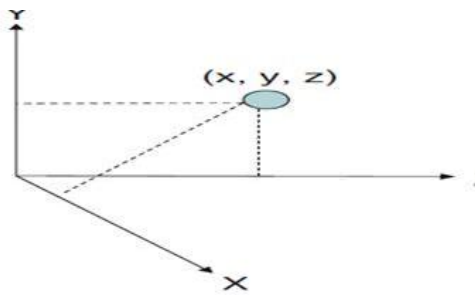
Nicolaus Copernics (1473-1543) was a mathematician and astronomer who proposed that the sun was stationary in the center of the universe and the earth revolved around it (Hugh and Gauch, 2003). He established sun-centric versus earth-centric system modal, this modal based on heliocentric hypothesis and it's contained seven basic assumptions. Therefore, he gathered data on solar system, but his modal had created more controversy in both scientific and religious communities and his ideas were generally disregarded(4) but Copernics modal refined by the Egyptian Ptolemy (90-168 AD) of Alexandria.

Copernics work moved new observation by the astronomer Tycho Brahe (1546-1601) in Denmark. Brahe an experimental scientist he use observations to ground theory- to place a theoretical modal upon an empirical foundation. Braha wanted to determine which modal was correct by direct astronomical observations (Ptolemy Earth-centric and Copernicus Sun-centric) then, he collected data on accurate measurement. Brahe, measurement understands experimental data is critical to theory construction or validation. Braha made experimental measurement than after Johannes Kepler (1571 to 1630) analyze all the data and to generalize the form, so that data from additional new observations would fit that from. The analysis of data is the connection of observation to theory. Kepler, find out phenomenological law of nature which nature follows a quantitative law and this quantitative formation of a law-of nature was major steps toward scientific method. Scientific method consisted not merely of qualitative observations of nature, but also of quantitative measurements and quantitative laws depicting the underlining from of the measurements-physical laws of natural phenomena (Betz, 2011) .

Kepler's published physical law of a natural phenomenon, after Gealileo Galilei (1908) in Netherland invented telescope, he was the first to observe the moons of Jupiter. At that time the analogy on Copernicus solar modal exist, with the sun the center of planetary orbits as was Jupiter the center of its moons orbits. Gealileo was published first astronomical observation in 1610 and established first scientific laws of physics. His experiments about motion and gravity and inferred new physical theory based upon experiment. He was pioneered the scientific method of doing quantitative experiments his physical laws provide a second historical example of morden scientific method after Braha experimental measurement (Hilliam, 2005). Galileo mad a very major contribution to advancing mathematics and physics.

After Galileo, emergence of the scientific method was to improve the language of qualitative analysis Rene Descartes (1596-1765) was pioneer of advancing mathematics particularly in analytical geometry(5). Descartes method describes a space with basis vectors X, Y, Z that every vector was at right angles to each other. Then any point in the space could be described by three numbers (xyz) as projections onto these vectors (see below figure) (Betz, 2011).

Figure 3 Three Dimension of Geometry Space



Source : Frederick Betz

The Descartes Geometry (Analytical Method) provides new space on Newton's laws of motion. Isaac Newton (1643-1727) in England he was founder to the investigation and acquisition of knowledge based upon physical evidence. Scientists use observations, hypotheses, and logic to propose explanations for natural phenomena in the form of theories (Blake, 1933). Newton method based on body of hypotheses he rejected single hypotheses supporting phenomenon. Newton's argument that the force on the moon is directed toward earth was based on phenomenon (see following figure), this method based on facts or direct observation.

Figure 4 Newton's Method

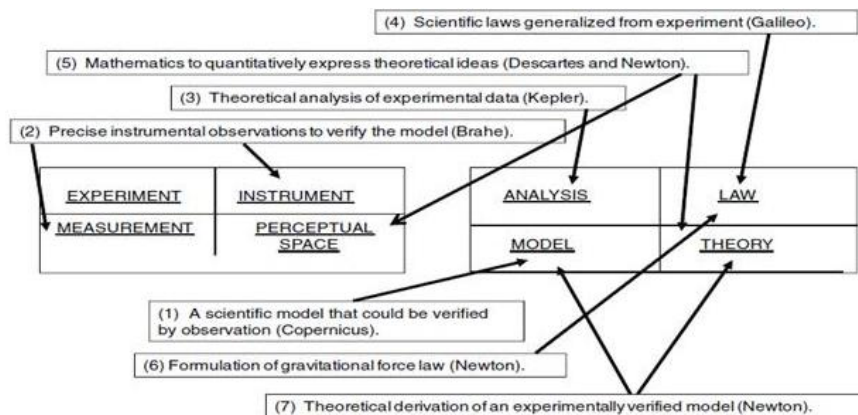
Method	Example
more general causes	law of gravity
↑	↑
causes	forces
↑	↑
phenomena	motions

Source: <http://patrick.maher1.net/317/lectures/newton3.pdf>

Observation, experiment, hypotheses testing and theory development is basic rules of scientific method.

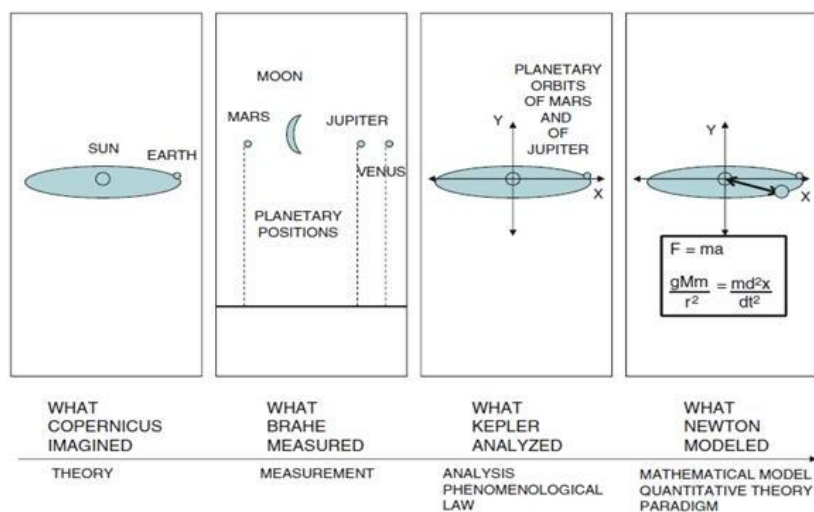
1. Copernics: observation and verification
2. Brahe: instrument and measurement
3. Kepler: experiment and developed phenomenological law
4. Galileo: experiment and formulated scientific law
5. Decarts : modeling physical events
6. Newton: generalization of scientific law

Figure 5 Developing Scientific Method



Source: Betz 2011

Figure 6 Theory in Scientific Method



Source : Betz 2011

The ideas of scientific method evolve in Aristotelian and Plato's thoughts on understanding natural phenomenon. Thereafter, 15th and 17th centuries new ideas and knowledge developed by Copernicus, Brahe, Kepler, Galileo, Descartes and Newton in mathematics, physics and astronomy they make tradition on scientific method for systematic understanding of nature (1) observation (2) hypothesis formation (3) measurement (4) experiment (6) tasting and analysis (8) causal relation building(7) theory development.

Conclusion:::

The evolution of science and scientific method go back to long history. The first morden scientific method developed Roger Grosseteste and Roger Bacon, Copernicus, Brahe, Kepler, Galileo, Descartes and Newton and others scientist. They all concluded any science based on observation, measurement, and experimentation and generalize scientific laws. Hence, all those developed scientific modal (See figure 5) for understanding natural phenomena in science.

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**Mrs. Sangita S. Patel,
Govt. Arts College, Gandhinagar.
&
Mr. Mukesh Lakum,
Govt. Arts College, Gandhinagar.
Sociology Department**