GNS 104: INTRODUCTION TO HISTORY AND PHILOSOPHY OF SCIENCE

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THE NATURE, STRUCTURE, AND METHODOLOGY OF SCIENCE

Science can be defined as the effort to get at reality by understanding and appreciating some latent but salient features of the universe.

- **The term science has become honorific because scholars from various disciplines as well as human beings engaged in different types of activities often claim that what they are doing is either a form of science or is scientific. Also there are those who insist that many things must be separated from the idea of science to avoid desecration of the discipline.**

Demarcation

- **Given the above, demarcation between science and non-science becomes essential. It is also vital to understand the source of the prestige of science. This has been attributed to its nature, structure, and methodology.**

- *Generally, the methodology of science has become accepted as the paradigm of rationality.*

Structure and Methodology of Science

- Presumptively the scientist engages in the study of nature via observation or experimentation and analysis. He must be objective, open-minded , sceptical, and accept that nature is orderly. Also he should be independent minded, diligent, persevering, and have love for simplicity. Clarity is crucial.

- **The simple method of science can be presented as follows: 1) Observation 2)Hypothesis 3)Experiment or Further Observation 4)Inference.**

Hypothesis, Theory, and Law

- **The initial assumption in science is called a hypothesis and this matures into a theory or law. This does not imply that the scientific theory or law can no longer be modified. So the simple progression of science is hypothesis (theory or law) deduction and test. This is because, based on the assumption of the uniformity principle or induction, the scientific theory will form the basis of predictions or explanations of singular events in the universe.**

- **These predictions and explanations can be about the past or the future or even present events we did not observe. These predictions are used to evaluate the theory. Their outcomes will either validate or vitiate the theory. No amount of positive cases can give the theory 100% certainty but one negative case can refute it because induction is not vindicated by logic.**

INDUCTION

Induction can be defined as a type of logical reasoning which proceeds from known premises or observed cases to infer about unknown or unobserved cases. As the foundation of scientific reasoning it is any form of non-demonstrative inference derived from repetitive occurrences based on the principle of causality.

- Logic does not establish the principle of induction because inductive arguments are not logically valid arguments. They are evaluated as cogent or un-cogent.

To defend induction on the basis of experience will entail the following: since certain observed circumstances have produced certain phenomena both in the past and at present, they will produce the same phenomena in the future. However, David Hume points that this is a clear case of using induction to justify induction which a mounts to committing the fallacy of begging the question.

Also the view that induction is justified on basis of numerous observed instances is ambiguous. What number truly constitutes *numerous?* There are cases where people have made up their minds on the basis of only one instance. In the same vein, some circumstances may be unnecessary. The truth is that observation is always theory-laden as it is usually couched on some assumptions.

The inherent difficulty in justifying the concept of induction or the uniformity principle made its proponents to retreat to probability. They assert that even though scientific theories do not connote 100% certainty they are highly probable.

This reformulation, however, does not solve the problem because it cannot withstand any standard probability theory. This is because the observed cases are finite while the scientific theory refers to an infinite number – actual or possible. The probability of a finite number divided by an infinite number is zero. So, scientific theories are neither certain nor probable. Furthermore, the observed cases are expressed in particular statements while the theory is expressed in a universal statement; intuitively, a universal statement cannot be derived from a set of particular statements.

POSITIVISM

- Scholars in this group are called the logical positivists. However, some of their members prefer being called logical empiricists to show that they are followers of David Hume rather than August Comte. Also the original members believe that they are advancing the view began by E. Mach. The movement started in Vienna, Austria; so they were also known as the Vienna circle. In the 20th century, they were a set of thinkers who attempted to demarcate

between science and pseudoscience. They accepted that science is truly based on induction and observation statements. They rejected metaphysics, propagated the emotive theory of ethics, and advocated the verifiability theory of meaning. The logical empiricists are very influential in 20th century philosophy of science. Their verifiability theory of meaning has implications for the nature and methodology of science. It is the most vital of their doctrines.

- The logical empiricists rejected metaphysics and as a consequence rejected all the *a priori* metaphysical foundations of natural science; namely, space, time, every event has a cause, the present resembles the past, causality, etc.

- They rejected all these *a priori* principles and insisted that every statement must be verifiable, at least, in principle, unless it is a tautology. For them any statement which is not logical or mathematical, and could not be verified is, *ipso facto,* cognitively meaningless.

- For them scientific theories must be verified through observation statements. This is where the problem starts for theories are universal statements while observation statements are singular statements and neither is derivable from the other.

- At this point the verifiability criterion collapsed as a method of demarcating between science and pseudoscience. They modified it to verifiability in principle but this did not salvage the situation for anything whatsoever is verifiable in principle. This made some of their leading members state that a theory is scientific if it is confirmable. However it is still difficult to determine the confirmability of scientific theories.

Recommended Books

1. A.F. Chalmers, What is this thing called Science?
2. K.R. Popper, Conjectures and Refutations
3. P.K. Feyerabend, Against Method
4. I. Lakatos, The Methodology of Scientific Research Programmes