CHAPTER II

THE HYPOTHETICO - DEDUCTIVE METHOD

Jevonsian System of Logic

In following out his design of detecting the general methods of investigation, Jevons has found that the more elaborate and interesting processes of quantitative induction have their necessary foundation in the simpler and more general science of Logic. His system of logic may be briefly summed up in the axioms that "whatever is, is" (or the Law of Identity), that "a thing cannot both be and not be," (or the Law of Contradiction) and that "a thing must either be or not be," (or the Law of Duality).[1] To Jevons, these are the Fundamental Laws of Thought. But to these he adds the principle of "the Substitution of Similars," that is to say, the axiom that whatever is true of A is true of everything that cannot be distinguished from A in the relation contemplated. For instance, when Milton says, "who kills a man, kills a reasonable creature, God's image, "Jevon's logic would conclude that "God's image = man = some reasonable creature," and that

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[1] W.S. Jevons, The Principles of Science, London, Macmillan & Co., 1913, p.17.

"the killer of a man is the killer of some reasonable creature, (and also) the killer of God's image."[2]

Jevons believes that all reasoning is a development of these fundamental principles in Logic. His conception of scientific method is, therefore, much linked up with his system of logic.

Error of Baconian Method

Jevons' conception of scientific method, though not very prominent among the modern methodologists, is surprisingly modern.

He was highly critical of the theory of induction expounded by Francis Bacon, who, seeing the futility of the scholastic logic which had long been predominant, construed induction as a routine process in which facts are first accumulated without the benefit of any prior hypotheses or "anticipation of nature." These facts are then exhaustively classified on the basis of certain properties in common, which are then orderly abstracted in the form of axioms or general laws.

Jevons remarked that the value of this method might be estimated historically by the fact that it

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[2] W.S. Jevons, Ibid., p.19.

had not been followed by any of the great masters of science. In fact the opposite method to that advocated by Bacon had been used by the great seventeenth and eighteenth century physicists, like Galileo, who proceeded Bacon, Gilbert, his contemporary, or Newton, Descartes, Leibnitz and Huyghens, his successors.

Jevons viewed Bacon's notion of scientific method as a kind of "scientific bookkeeping," whereby facts are indiscriminately gathered from every source and then posted in a ledger from which would emerge in time a balance of truth. The greater the array of facts, the lesser the probability that they will by any routine system of classification disclose the laws of nature they embody. Hence, exhaustive classification in all possible orders is out of the question, because the possible orders are practically infinite in number.[3]

Error of Mill's Method

Following the footsteps of Francis Bacon, John Stuart Mill felt that no really new knowledge is ever acquired by deductive reasoning, and that logicians who wish to promote scientific discovery

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[3] W.S. Jevons, The Principles of Science, London, Macmillan & Co., 1913, p. 577.

should pay more attention to the criteria of a kind of induction that would lead to thoroughly reliable conclusions. In essence, Mill's methods are methods of eliminative induction,[4] methods of discovering true casual laws by eliminating false alternatives. If all but one is eliminated, then the remaining one is accepted theory; but we have no assurance that further experimentation will not disprove this theory as well.

Jevons' study both of Formal Logic and of the Theory of Probabilities has led him to adopt the opinion "that there is no such thing as a distinct method of induction as constrasted with deduction, but that induction is simply an inverse employment of deduction."[5]

Jevons' Method of Inductive Procedure

For Jevons the essence of all inductive processes consist in the introduction of and the experiments with successive hypotheses. "All inductive investigation consists in the marriage of hypothesis and experiment,"[6] deductive reasoning being the link by which

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[4] For more detailed discussion on Mill's theory of eliminative induction, see An Introduction To the Philosophy of Science, by Arthur Pap, pp. 151 - 155.

[5] W.S. Jevons, op. cit., p. viii.

[6] W.S. Jevons, op. cit., p. 504.

experimental results are made to confirm or refute the hypothesis.

According to him, the inductive procedure may then be said to consist of three steps:

a) Starting from certain observed facts in our possession, we anticipate nature, in the sense of forming hypotheses as to the laws which are probable in operation.

In order that an hypothesis can be accepted as probable and valid it must conform to a certain important condition, the agreement with fact. This condition, however, may be said to involve three constituent conditions, nearly equivalent to those suggested by Hobbes and Boyle, namely:

(i) possibility of Deductive Reasoning;

(ii) consistency with the Laws of Nature; and

(iii) conformity with facts of observation.

b) Having obtained a probable hypothesis, we must not rest until we have verified it by comparison with new facts, which means we must first deduce the probability of various series of possible consequences which follow from this hypothesis, and then,

c) We compare these deductions with the particular facts, observing the probability

that they would occur under this hypothesis.

If any result proves different from what we expect, as we proceed to test the truth of our notion by fresh observations, we modify or abandon our hypothesis, as every new fact may give us some new suggestions as to the laws in action. Even if the result in any case agrees with our anticipations, we do not regard it as finally confirmatory of our theory, but proceed to test the truth of the theory by new deductions and new trials.

Experimentum Crucis

Jevons' conception of the inductive process gives much attention to the probability theory, especially the Inverse Method of Probabilities, which involves, according to him, the true principle of the inductive procedure.

"No inductive conclusions are more than probable," said Jevons, "and.....that the theory of probability is an essential part of the logical method, so that the logical value of every inductive result must be determined consciously or unconsciously, according to the principle of the inverse method of probability."[7]

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[7] W.S.Jevons, op.cit., p. 9.

Jevons contended that the probability of an hypothesis will increase very rapidly with the number of accordances. "Absolute certainty is beyond the powers of inductive investigation, and the most probable supposition may ultimately be proved false ..... we sometimes find ourselves in possession of two or more hypotheses which both agree with so many experimental facts as to have a great appearance of truth. Under such circumstances we have need of some experiment, which shall give results agreeing with one hypothesis but not with the other."[8]

In other words, it is only after decisive Experimentum Crucis (any experiment which decides two rival theories) have repeatedly resulted in favour of a theory that we can assert the falsity of all objections. However, a crucial experiment must not simply confirm one theory, but must negative other competing theories. It must decide a mind which is in equilibrium, as Bacon says, between two equally plausible views.

Comparison with Popper's "Deductivism"

Jevons' account of the inductive process resembles very much that put forward by Karl Popper in his book, The Logic of Discovery. Popper's deductive

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[8] W.S. Jevons, op.cit., p.518-19.

method of testing or "deductivism" in contrast to "inductivism" proceeds as follows:

> "From a new idea, put tentatively, and not yet justified in any way - an anticipation, a hypothesis, a theoretical system, or what you will - conclusions are drawn by means of logical deduction. These conclusions are then compared with one another and with other relevant statements, so as to find what logical relations (such as equivalence, derivability, comptability, or incompatibility) exist between them ..... And, finally, there is the testing of the theory by way of empirical applications of the conclusions which can be derived from it."[9]

Nevertheless, there is a point of difference between Jevons' conception of the inductive process and Popper's "deductivism." The former entertains the idea of probability in inductive logic, while the latter believes that the logic of probable inference, or "probability logic", like every other form of inductive logic, leads either to an infinite regress or the doctrine of <u>apriorism</u>, the doctrine that knowledge rests

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[9] K.R. Popper, <u>The Logic of Discovery</u>, Hutchinson & Co., Ltd., London, 1959, p.32-3.

upon principles that are self-evident to reason or are presupposed by experience in general.

Newtonian Method Adopted

Jevons had adopted the Newtonian method as a true model for scientific procedure. This method is known as the hypothetico-deductive method as developed in Newton's Principia

Newton's work is really that of developing the methods of deductive reasoning and experimental verification, by which alone great hypotheses can be brought to the touchstone of fact. In the Opticks, Newton persistently follows out the consequences of a preconceived theory, and tests the hypothesis by a variety of simple comparison with fact. He was led by his theory to a certain range of experiments, most of which could hardly have been devised by accident. Newton had actually remarked that it was by mathematically determining all kinds of phenomena of colours which could be produced by refraction that he had "invented" almost all the experiments in the book.

In proportion, Jevons concluded, as a science becomes deductive and enables us to grasp more and more apparently unconnected facts under the same law, so does it become more perfect.