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For all is but a woven web of guesses: Popper and the scientific method

Sir Karl Popper has been the most controversial of living philosophers, having contributed in a profoundly significant and original way to the philosophy of science, metaphysics, the theory of knowledge and social and political philosophy. Yet, it is a fact that he remains relatively unknown to a wider audience. Hence, this brief introduction to Popper so that Moharir's article (**page 669**) can be placed in better context.

Sir Karl is arguably, 'incomparably the greatest philosopher of science that has ever been', according to Lord Peter Medawar, a winner of the Nobel Prize for Medicine. His programme for evaluating any scientific investigation is simple. It recognizes a basic asymmetry, one can say, between truth and falsehood; no statements can be proved true, but some statements can be proved false. Science [...] is defined by this falsifiability — it is the fact that they can be proved false, but have not been, which gives accepted scientific statements their value. Once this is accepted, the underlying pattern of the development of a scientific study is characterized by the following chain

$$P_1 \rightarrow TS \rightarrow EE \rightarrow P_2,$$

where P_1 is the initial problem, usually a rebuff to an existing theory or expectation; *TS* is the trial solution proposed, usually a new theory based on a conjecture or guess, *EE* the process of criticism and error elimination (refutation) applied to the trial solution and P_2 the resulting situation with new problems. In this feedback procedure, P_2 is always different from P_1 – complete failure to solve a problem is welcome as it teaches us something new about where the difficulties lie.

It is the essence of Popper's philosophy that only through criticism can knowledge advance. Thus, his science is based on negativism, *eliminate error*, not *substantiate proof* – scientific laws are testable even if they are unprovable.

As a philosopher of rational social action, politics and history, Popper continues a tradition of classic liberalism of Locke, Bentham and John Stuart Mills. His *Open Society* (Routledge and Kegan Paul, London, 1945) is considered to be the most significantly novel reformulation of liberal doctrine in a long time. His *The Poverty of Historicism* (Routledge and Kegan Paul, London, 1957) is an irrefutable argument against modern totalitarianism, be it in its fascist, or its communist forms, as Popper faced it at the time he wrote his work, or more ominously now, in its various fundamentalist forms.

His liberalism is based on utility; his formulation of the principle of utility is governed by a similar negativism, as *eliminate suffering*, and not, *maximize happiness*. His prescription for good government is again deceptively (and negatively) simple – *one in which the public can change its rulers without bloodshed*.

Popper's world view is thus Socratic, admitting always the imperfections and uncertainties of our knowledge. The dispersion of error is always the first step toward knowledge. 'Our ignorance is sobering and boundless,' he says. 'With each step forward, with each problem we solve, we not only discover new and unsolved problems, but we also discover that where we believed that we were standing on firm and safe ground, all things are, in truth, insecure and in a state of flux.'

It is in this spirit that Moharir examines (**page 669**) the vast field of earth sciences for glimpses of Popperian critical rationalism. He shows that the definition of science presented by Popper offers now a systematic and coherent treatment of attitudes that many earth scientists have had. Thus, in spite of many inherent limitations in its practice, one can present many aspects of geosciences within a Popperian framework.

It is my belief that more scientists and knowledge workers can benefit immeasurably, if they can try to follow Popper in their investigation of their work and to adopt his ideas 'as the basis of operation of one's scientific life,' in the words of Sir John Eccles. It will be appropriate to reproduce here one of Popper's favourite quotations from the pre-Socratic philosopher Xenophanes:

The gods did not reveal, from the beginning,
All things to us, but in the course of time
Through seeking we may learn and know things better.
But as for certain truth, no man has known it,
Nor shall he know it, neither of the gods
Nor yet of all things of which I speak.
For even if by chance he were to utter
The final truth, he would himself not know it:

For all is but a woven web of guesses.

G. Prathap

Molecular communications during plant–pathogen interactions

All organisms sense their environment and respond to them. The sighting of a predator (usually the thesis supervisor) elicits an escape response in the prey (the graduate student). Strange as it may seem, plants respond to deadly enemies in much the same way as graduate students. The arrival of pathogens on the surface of plant tissue triggers a cascade of events that both tells the plant about the nature of the pathogen and also triggers a defense response. Ashalatha S. Nair explores in a review (**page 677**) the molecular mechanisms that operate during plant–pathogen interactions. Biologists observe plant–predator interactions at several levels. At the organismic level, the events can be dramatic. For example, in the African plains antelope sometimes feed on a particular species of acacia tree. When the first tree in a region is 'attacked' it releases ethylene, a plant hormone, that tells neighbouring trees that they are in danger. The attacked tree and the neighbouring ones then release nasty chemicals that are harmful to the antelope and persuade them to go elsewhere.

Understanding the molecular events in detecting predator signals, be they the munching of leaves or the growth of fungi, is a major area of research. Aspects of current work in this field are explored in Nair's article.

K. VR.