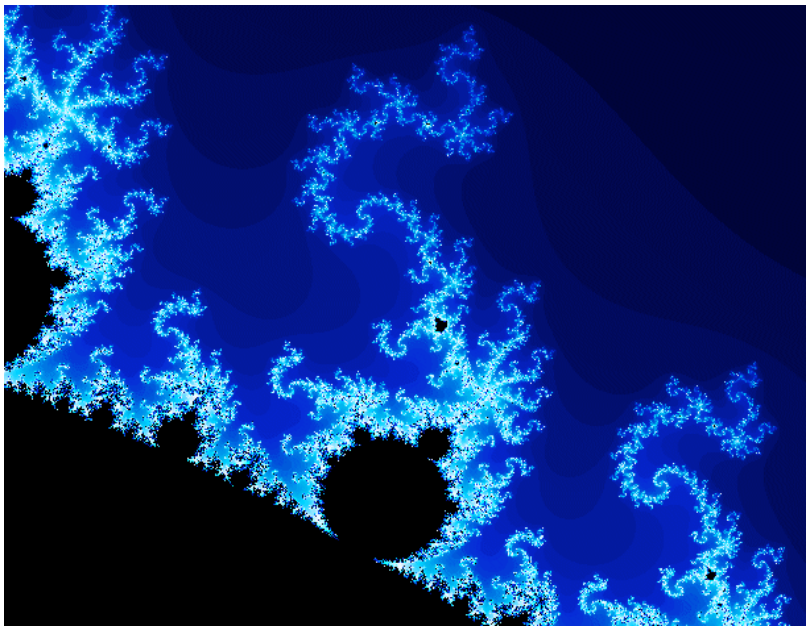

The New Theory of Science

Excerpt from Ernst Mayr

"The most incomprehensible thing about the world is that it is comprehensible."
– Albert Einstein

The Greeks always looked for rational explanations in the world of phenomena. The school of Hippocrates, for example, when trying to determine the cause of a disease, did not look for it in a divine influence but attributed it to natural causes such as climate or nutrition... The Greek philosophers, including Aristotle, were primarily rationalists. They thought — Empedocles being a typical example — that they could solve scientific problems simply by sharp reasoning, involving ordinarily what we would now call deduction. The undoubted success which these ancient physicians and philosophers had in their explanations led to an overrating of a purely rational approach, which reached its climax in Descartes. Even though he did some empirical research (dissections, for example), many statements of this philosopher read as though he had believed that everything could be solved simply by concentrated thinking...

Descartes endeavored to present only such conclusions and theories as had the certainty of a mathematical proof. Although there have always been some dissenters, the belief that a scientist had to supply absolute proof for all of his findings and theories prevailed until modern times. It dominated not only the physical sciences, where proof of the nature of a

mathematical proof is often possible, but also the biological sciences. Even here, inferences are often so conclusive that they can be accepted as proof, as for instance the claim that the blood circulates or that a particular kind of caterpillar is the larval stage of a particular species of butterfly... So far I have referred to facts, and to prove whether or not an assertion corresponds to a fact can usually be done. In many cases, however, and perhaps in the majority of the conclusions of the biologists, it is impossible to supply proof of such certainty (Hume, 1738). How are we to 'prove' that natural selection is the directing agent guiding the evolution of organisms?

Eventually the physicists also realized that they could not always give absolute proof (Lakatos, 1976), and the new theory of science no longer demands it. Instead, scientists are satisfied to consider as true either that which appears most probable on the basis of the available evidence, or that which is consistent with more, or more compelling, facts than competing hypotheses. Realizing the impossibility of supplying absolute proof for many scientific conclusions, the philosopher Karl Popper has proposed that falsifiability be made the test of their validity instead. The burden of the argument thus is shifted to the opponent of a scientific theory. Accordingly, that theory is accepted which has withstood successfully the greatest number and variety of attempts to refute it. Popper's claim also allows one rather neatly to delimit science from nonscience: any claim which in principle cannot be falsified is outside the realm of science. Thus, the assertion that there are men on the Andromeda nebula is not a scientific hypothesis.

Falsification, however, is sometimes as difficult to provide as positive proof. It is therefore not considered the only measure for obtaining scientific acceptability. As the history of science demonstrates, when scientific theories were rejected, it was often not because they had been clearly refuted but rather because an alternative new theory seemed more probable, simpler, or more elegant. Furthermore, rejected theories are often tenaciously adhered to by a minority of followers, in spite of a series of seemingly successful refutations.

The new theory of science, based on a probabilistic interpretation of scientific conclusions, makes it inappropriate to speak of truth or proof as something absolute.... It does not bother a scientist unduly that many of his generalizations are only probabilistic and that there is a remarkably high stochastic component in many, if not most, natural processes. Accepting great flexibility as one of the attributes of scientific theories, the scientist is willing to test numerous theories, to combine elements of different theories, and sometimes even to consider several alternate theories (multiple working hypotheses) simultaneously, while in search for evidence that would permit Exhim to adopt one in preference to the others.

Ernst Mayr, "The Growth of Biological Thought: Diversity, Evolution, and Inheritance", pp. 25-27, Harvard University Press, Cambridge, MA 1982