

Three Aspects of Science (Logical-Empirical, Metaphysical and Sociological)

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The scientist regards a theory as confirmed if the observable facts which can be logically derived from it are in agreement with what is actually observed by empirical processes. From this "logical-empirical" aspect, it seems to be puzzling that theories about the physical universe can be accepted or rejected, cherished or disliked on other grounds. Theories have been judged according to whether they support or discourage some metaphysical system, they have been favoured or persecuted according to whether they are helpful or harmful to the goals of social organizations like governments or churches. Scientists ask: How is it possible that, in addition to the logical-empirical (purely scientific) criteria, other criteria of an entirely heterogeneous type can be applied? It looks to the scientist as if there were some logical contradiction in the co-existence of these different types of criteria.

On the other hand, these "extra-scientific" reasons of acceptance are well confirmed historical facts. As every observable fact, it must have its place in the logical-empirical scheme of things. In any attempt to set up very general theories, we have to face a characteristic situation: It is certainly true that, from theories in the scientific sense, we can derive logically all the observable facts which are covered by the theory. But we cannot derive logically from the observable facts a theory which is true if, and only if, these facts are clearly observed. We can only infer, or more exactly speaking, guess or imagine some theories which will yield our observed facts as logical consequences. If we want to select one among these theories, we cannot be guided in this choice by logical-empirical criteria. We have to make the choice on "extra-scientific" grounds. But by no choice we can get in conflict with the observed facts. What has guided the scientist in the history of human thought has always been the attempt to select a theory which not only yields the observed facts, but is, moreover, itself intelligible, self-evident or at least plausible and "makes sense". This means practically that the general principles of the theory should be somehow analagous to some simple experiences of our everyday life or, in other words, should be in agreement with common sense.

The most famous example is the situation in astronomy when Copernicus had advanced his new system. At this time, the observed facts, the positions of the planets on the sphere could be derived as well from the geocentric system as from the new heliocentric system. If one had to make a choice between both systems, one argued which of them was more plausible or more in agreement with our common sense. Francis Bacon, for example, rejected the Copernican system because it was too "unnatural" and separated the sun from the planets, although they look alike from our direct observation. This choice of theory, according to an agreement with common sense, is actually identical with the metaphysical criterion for the validity of a theory. Instead of the agreement with common sense, the metaphysician speaks of agreement with the real nature of the universe, not merely with our sense observations. These arguments against the Copernican system didn't lose their strength before "common sense" had developed into such a stage that Newton's mechanics were regarded as an agreement with common sense and as "metaphysically true".

The choice of the geocentric system was not only motivated by its agreement with common sense, but by the fact that it was a part of the accepted philoso-

phical system of the Middle Ages as it is formulated, for example, in the writing of Thomas Aquinas. For the same philosophies from which the geocentric system in astronomy could be derived, one could also derive the mediaeval ideas about religion, morals, and politics on which that "good conduct of man" was based. The choice of the heliocentric system would have disappointed this philosophy and had, according to the opinion of its advocates, led to disastrous changes in human behaviour, religious as well as political. We can easily observe that the same way of metaphysical and sociological interpretation has occurred in every period of history, whenever general theories could not be satisfactorily validated by purely scientific methods. We may exemplify this situation by theories of the 19th and 20th centuries if we consider sweeping hypotheses like "there is no ether", "there is no evolution from monkey to man", "there is no mechanical explanation for human behaviour", etc. In all these cases, we easily observe the tendency to investigate directly the plausibility of these hypotheses from the viewpoint of common sense. But we can also easily observe the influence of human behaviour which is ascribed by powerful groups to these hypotheses.

Mind-like Behaviour in Artefacts

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This paper is not concerned with analogies between contemporary computing machines and brains, nor with much that has found itself entitled "Cybernetics". Its purpose is firstly to examine the extent to which in principle an artificial organism could parallel human activity, particularly those aspects by which we "justify the inference to other minds", and secondly to indicate some of the philosophical issues to which the possibilities discussed are relevant.

Familiar faculties of artificial goal-seeking mechanisms are briefly described, by way of introduction to a probabilistic reasoning-mechanism which, it is suggested, might in principle parallel all describable forms of human behaviour. For this mechanism, the meaning of a receptum is represented by a probability-spectrum over a set of possible *responses* by the mechanism. These responses may be internal, directed to the alteration of an internal formal representation of "that which is the case". This activity, it is suggested, distinguishes recognition from reception, in that the act of response by (formal) replication entails symbolic activity equivalent to the naming of the receptum.

The problem of abstraction is that of the naming of an invariant in the flux of recepta. It is suggested that if the elementary concepts of the universe of discourse are (and are symbolized or named by arousal of) the elementary component-acts of response, then the possession of an invariant mode of equilibrant response to a specific invariant, enables the artefact *ipso facto* to name the invariant under all its transformations. It is even possible for the artefact to discover and name for itself *new invariants*, by a self-guiding statistical discovery-process, and to generate new hypotheses in the form of abstractions from *abstractive* activity. Analogues of emotional behaviour, the weighing of evidence—prejudiced or otherwise—and other characteristically human activity suggest themselves automatically in terms of this probabilistic mechanism; words such as personality, consciousness, and self-consciousness seem to admit of consistent interpretation in such terms. Choices can be statistically reasonable yet individually unpredictable in principle,