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SOME COMMENTS ON THE NATURE AND USE OF TELEOLOGICAL EXPLANATIONS

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It is often supposed that a teleological explanation is of but modest use in physiology because it is lacking the predictability of strict causal reasoning. As such teleological hypotheses possess a definitely causal structure. They imply that a physiological process has been related to an environmental factor in a precise causal way. The organismic response is a purposive adaptation to an environmental challenge, defined in the hypothesis. Why is it then that teleological explanations often fail to be predictive?

The answer to this question is likely to be that causality in a purposive physiological response consists of an external definable component and an internal component difficult to express in precise terms. This component embraces memory, momentary background experience, states of arousal, of emotional excitement or depression, etc. It is this unpredictable element of a purposive response that in the past has discredited teleological approaches to physiology and made people prefer the strictly definable physico-chemical 'reductionist' experiment. This has good predictability, and physiology, which serves medicine and whose results often are tested in clinical practice, needs predictability even more than it needs physico-chemical explanations.

My last statement is best illustrated by the development of immunology. Without any definite physico-chemical explanations to offer, this science rose to greatness by the end of last century and in the beginning of this one,—on purely good observations and clear thinking. It became eminently useful, and the predictable conclusions drawn and tested in clinical practice saved the lives of millions of people. It lasted until the present day for immunology to reach physico-chemical explanations of the observed reactions.

However, let us not overemphasize the role of predictability in science, even though it is important for applicability in both medicine and engineering. It is not a universally valid criterion of scientific importance. Significant advance in understanding is possible in the absence of predictability. Remaining within biology, the best example is probably the synthetic theory of evolution such as it is today purged of its most obvious deficiencies. All leading biologists agree that the course of evolution is unpredictable. But this does not prevent the synthetic theory from being a major contribu-

tion to the understanding of evolution. It is a great and powerful generalization and in this capacity will live with humanity into the future, a guide for our thinking of ourselves as participants in the evolutionary process.

Many teleological hypotheses provide meaning and significance to otherwise uninteresting observations with or without causal links tying them together. Examples of rationalization of empirical data by a teleological interpretation abound in the field of sensory physiology. Consider, for instance, the old discovery of rods and cones in the retinas of vertebrates. This finding would have been meaningless had it not been possible to demonstrate that rods and cones serve different purposes in vision. The teleological explanation that cones mediate daylight vision, rods vision in the dark, gave rise to a very large number of experimental efforts aiming at investigating the properties of photopic and scotopic vision. Perhaps one could maintain that today the basic differences between these two adaptive states are known in outlines, photochemically as well as neurally.

Another good example is the discovery by the Austrian zoologist, Karl von Frisch, of the purpose of the curious dance («Schwänzeltanz») that returning bees execute in order to communicate to their associates the direction of a distant source of honey. His teleological explanation made sense of what without it would have been but another biological curiosity, seen, recorded, then forgotten. This example also shows how essential and useful it can be to ask plainly and openly for the purpose of something that one has observed. The teleological question, «why is it that...», inspires further research in order to remove the element of triviality from loosely assembled facts and replace it with an understanding of their significance for the organism.

With complex neural processes it may be exceedingly difficult to make sensible use of teleological hypotheses. There are commonly many alternative possibilities and, indeed, many neural circuits actually serve several purposes. Wrong guesses are easily made. Cause and effect can be confused. In this situation the personality and level of ripeness of the experimenter becomes decisive. General experience of the kind requiring matureness within a specific discipline is needed but, above all, familiarity with the particular set of phenomena within which one is looking for meaningfulness. What I have in view is the kind of familiarity with a field and its innate content of suggestions that makes it possible to exclude certain alternatives and test the right ones, the ones that are teleologically logical or, in simpler language, make sense. As I pointed out above, teleological explanations relate a response to an environmental factor in a causal manner. The task of the experimenter is to elucidate this causal connection between purpose and response. Success in this undertaking creates a lively feeling of satisfaction. Something has been understood and not merely described or quantified.