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## SCIENCE ONE AND SCIENCE TWO

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In order to understand recent work in cybernetics it is useful to look at our basic assumptions about the scientific enterprise. I find it helpful to distinguish two conceptions of science. But before we look at the two conceptions of science, let me first distinguish two models which exist within each version of science.

Assume for a moment that within science there are two models. Model one is the model that an observer constructs of the system observed. A model is any set of propositions about cause and effect relationships. A model may or may not involve the use of mathematics. Model one is what we are referring to when we talk about a model or scientific theory of some referent system. Model two is a set of propositions about how the observer interacts with the system observed. Model two explains how to collect data. Model two is a set of procedures. It is not a scientific theory. Model two is what we mean when we talk about "scientific method."

I have changed the words "scientific theory" and "scientific method" to Model one and Model two in order to emphasize that both are sets of propositions. Normally we would say that model one is a set of cause and effect relationships in the mind of an observer, and model two is a set of rules that govern the observer's behavior. But both are initially sets of propositions in the mind of the observer.

The physical sciences tend to emphasize model one. That is, most of the effort is focused on developing, ideally, mathematical models of the behavior of the observed system. Model two -- how data is collected -- is less problematic and usually receives less attention.

However, in the social sciences the emphasis is often reversed. How one obtains data receives a great deal of attention. There is much discussion of experimental groups and control groups and how one can eliminate or at least reduce the changes in the observed system caused by the experiment itself. The amount of effort expended on obtaining any usable data at all tends to diminish the attention that can be devoted to building a sophisticated theory of the observed system. Hence in the social sciences model two tends to receive more attention than model one.

Despite their differences both of these cases can be regarded as examples of Science One. In Science One the observer and the system observed are separate. The observer is outside the system observed, and the purpose of the procedures in model two is to reduce and if possible to eliminate any effect of observer or the experiment on the system observed. The goal is to acquire knowledge. This knowledge may later be used to change some system, but the role of the observer is merely to acquire knowledge.

In recent years another conception of science has been emerging. In Science Two the observer is not separate from the observed system but rather is a part of the observed system. Furthermore, the objective is not so much to accumulate knowledge in the form of models and theories but rather to change systems, usually social systems. The growth of knowledge is measured not by mathematical models of cause and effect relationships in observed systems but rather by improved methods for interacting with the systems the "observer" is trying to change. Hence a great deal of emphasis is placed on the observer's conception of himself and of appropriate actions. The observer functions more like a change agent or therapist and less like a model builder or data gatherer.

An epistemological justification for the change from Science One to Science Two is provided in the literature on second order cybernetics. Examples of the methods that have been developed in Science Two for changing organizations are the recent work of Ackoff, Beer and Checkland. The work in family or system therapy, by authors such as Watzlawick and Weakland, grew out of the work of Gregory Bateson and is another example of methods developed within a Science Two framework.

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