
From Pathways to Networks: Developments in the Science of Intracellular Signaling

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Abstract

In the 1970s scientists began to uncover the details of how cells communicate by means of electrical and chemical signals. The process by which an extracellular signal is received at a membrane-bound receptor and transmitted into the inner cell environment where it can trigger changes in cell behaviour was dubbed ‘signal transduction.’ The complete chain of events and molecular components describing this signal transmission was called a ‘signaling pathway.’ Metaphors and analogies from electronic engineering and cybernetic theory have strongly informed understanding of these processes. The cell is regarded as consisting of circuits and programs, which scientists have been busy trying to map in their efforts to understand development, health, and disease in humans and other organisms. The 1980s and 90s saw recognition of the widespread occurrence of ‘cross-talk’ between signalling pathways, and as a result the metaphor of signaling ‘networks’ began to appear more frequently. Increasingly one now sees criticisms that the signal pathway concept is misleadingly simplistic and impedes further progress in scientific knowledge and biomedical intervention. Signaling networks are highly dynamic processes which belie the implication of a stable entity suggested by the pathway and circuit metaphors, and yet the importance of scaffolding and adaptor proteins suggests the highly structured nature of signaling networks. This talk will describe some of the history of this shift in language and perspectives, and the implications for the philosophy of science’s account of mechanism as an explanatory scheme.

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