Evolution of Pain Theories

Theories of pain mechanisms, since the beginning of the century, have undergone evolutionary changes based partly on the accumulation of new experimental evidence and partly on imaginative assumptions derived from clinical observations. J. B. Conant's little book, On Understanding Science, which portrays the development of the physical sciences, illuminates the entire scientific process. New biological-medical theories, like theories in the physical sciences, are accepted reluctantly; an old theory is dogmatically maintained in the face of contrary evidence until a new theory that can account for both the older and newer facts supersedes it. In this process of evolution there is a characteristic swing of the pendulum between two major theoretical concepts (such as the phlogiston vs. oxygen theories of combustion), until one eventually dominates. Another feature of this evolution in science is that a theory may be conceptually correct although the particular explanatory mechanism that is postulated may well be wrong in one or more details. Thus, the theoretical concept often awaits widespread acceptance until a satisfactory mechanistic explanation is proposed.

Overriding all of these features of the scientific process is the bitter controversy generated between opposing schools of thought. The problems of cutaneous mechanisms in general, and pain in particular, have given rise to vituperation that is unparalleled in the biological sciences. The early three-cornered fight involving von Frey, Goldsheider and Marshall (whose emotion—or quale—theory of pain was soon pushed out of the ring, despite Sherrington's sympathy with his view) marked the beginning of a controversy that has continued throughout this century. Part of the reason for the bitterness engendered by the battle may be the obvious clinical implications that derive from any theoretical advance. The practice of medicine, because it deals with human lives, is generally conservative, so that old ideas that have worked (even imperfectly) are cherished and newer ideas are viewed with suspicion and often antipathy.

It was in the light of this understanding of the scientific process that Wall and I critically reviewed the two major theoretical concepts of pain—the specificity and pattern theories—that are the basis of much of the controversy on pain mechanisms, and proposed the gate control theory of pain as an alternative to both. We considered it important to recognize the obvious physiologic specialization of the nervous system without accepting the narrow specificity of such terms as "pain receptors" or "pain pathway," which imply a rigid one-to-one relationship between input and the eventual psychologic experience. Wall and I then proposed that the sensory input from the skin is modulated by a gating mechanism in the spinal cord. The explanatory mechanisms of our theoretical model were based partly on recent physiologic data and partly on speculation derived from a consideration of clinical
phenomena. We recognized that the model is probably wrong in several details, but hoped that it would stimulate new ideas to be tested in the laboratory and in the clinic.

The paper by de Jong, Robles, and Morikawa, which appears in this issue of Anesthesiology, is a splendid demonstration of the scientific process. Their discovery that halothane and nitrous oxide dramatically affect transmission at the earliest synapses in the spinal cord provides evidence that at least part of the theory has empirical value. But, at the same time, these investigators have done more: their data illuminate the organization of the peripheral receptive fields of dorsal horn cells, and they note that anesthetics seem to block selectively the peripheral portions of the field. These are new facts, which go beyond the gate control theory; they, together with other recent data, already begin to indicate the need of a new theory of pain.

This process underscores in dramatic form one of the major characteristics of scientific advance: that a good theory stimulates experiments which give rise to data that go beyond the theory and necessitate a new one. The old theory, in other words, contains within it the seeds of its own destruction and, at the same time, those of a new theory that will supersede it. Herein lies the power of the scientific process: it promotes the growth of concepts and ideas that have an organic continuity in a way that resembles life itself. We must learn to give up old and cherished ideas, painful as the process may be, because this is the only way scientific progress can occur.

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