Free Will from the Biological Point of View

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A reaction in an animal may be defined as a change resulting from a stimulus. By definition a stimulus is the transference of energy in some form to a cell or cells of the reacting organism. It is obvious that stimuli may originate outside of the body or within the organism. A stimulus applied to a nerve ending initiates a physico-chemical wave (nerve impulse) which travels over the nerve fiber. A nerve impulse may serve as a stimulus of an impulse in a second nerve cell. The second impulse may reach an effector (muscle or gland) and produce a reaction; or it may travel to the brain, or from one part of the brain to another, inducing a mental reaction. One reaction may serve as a stimulus to a second reaction, and this in turn to a third, and so on indefinitely in chain-like fashion.

The particular path followed by a nerve impulse and the succession of nerve impulses through the maze of neurons of the brain depends upon the structure of the brain and the physiological state of the cells. Structure and physiological state both depend in turn upon heredity and the past experiences of the individual. Heredity is an epitome of the history of the organism throughout all preceding generations back to the origin of life.

As a product of growth and differentiation the cells of the brain are hooked up in complex intercommunicating pathways. New pathways are formed throughout life as a result of the stimulus-response mechanism. We thus come to possess the physical basis for a chain-reaction system of stimulus-response. Since the number of neurons in the human cortex is numbered in billions, an exceedingly large number of possible pathways is indicated.

Introspection tells us that sustained mental activity (thinking) is subjectively in the nature of a chain reaction system, where one idea serves as a stimulus for the next. We have no evidence that mental activity may take place in the absence of neuron activity, nor that neuron activity can take place without the release of energy, although the energy released in conjunction with a nerve impulse is extremely small compared to that released by a contracting muscle fiber. Much positive evidence points to a close correlation between mental activity and neuron activity. This evidence includes the behavioral effects of the destruction of a portion of the cortex; the effects of drugs, such as stimulants and narcotics; experimental stimulation of the exposed cortex during operations on the brain; experiments with the electroencephalograph; and pathological changes in the neurons associated with hereditary or environmentally induced mental disease.

The will, using *will* in the sense of the exercise of choice, depends upon the dominance of one stimulus or set of stimuli over others. When we say that we make a difficult choice we mean that the stimuli tending to initiate alternative or opposing reactions are nearly balanced. We make a choice, that is, we exercise the will, when we reach a decision that we are going to do a certain thing now or at some future time or when we decide not to do it, or when we decide that something is good or bad, true or untrue, and so on. The contemplated thing or act may be either mental or physical in nature. Not until we have acted, however, can we say that we have made an irrevocable choice, since some new stimulus may prevent or modify the action decided upon up to the moment of action. Only in retrospect therefore can we say that we have made a final choice. And in retrospect we can always see that our choice depended upon a stimulus or stimuli. Consequently our choices are not free, if by *free* we mean autonomous. And if by *free will* we mean

complete freedom of choice our wills are not free.

If the foregoing analysis is accepted, how are we to explain that freedom of choice, or free will, which probably everyone at times feels that he possesses? Perhaps no one claims that we have open to us an infinite array of choices, and probably all would agree that our possible choices are limited by our natures. Nevertheless, we do have a great range of choices, owing, so the biologist would say, to the multitude of stimuli that have affected us and our ancestors during our long evolutionary history, and to the complex pattern of the nervous system that has evolved.

The nervous system of an adult human being is, among other things, an immense storehouse of past messages (subjectively, memory). Among these are memories of our past choices. Past choices condition subsequent behavior. Memory permits us to look ahead in imagination; an imagined goal may thus serve as a stimulus to affect our choices. A knowledge of the stimulus-response mechanism in ourselves also increases the variety of our possible choices: knowing what responses to expect in ourselves from particular stimuli we are able to choose those stimuli that lead to the highest satisfaction. Men choose those objects and actions that promise the greatest satisfaction, either now or at some future time. We differ from animals in that we live less for the moment and more in the future. If we accept the premise that all of our choices are directly or indirectly responses to internal or external stimuli, and if by free will we mean the power of making choices uninfluenced by past events, or without the functioning of the nervous system, as some apparently do, I can find no evidence that free will as thus defined exists.

Books for Biologists

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teachers to understand their proper role in contributing to the needs of the child who falls outside of the normal range.

INSECTS AND SPIDERS, C. P. Friedlander and D. A. Priest, 124 pp., $2.75, Philosophical Library, New York, New York, 1956.

This book is an attempt to present the classification of insects and spiders in a simple yet scientific manner, and thus foster the inclusion of these groups in the standard field-work projects of schools.

About a hundred families of insects and seventy genera of spiders are covered, and a feature of the keys, is the large number of line drawings used to illustrate the characteristics of the groups described. Any enthusiast should be able to use the book unaided, while teachers of "nature" and general science classes will find it useful in identifying the numerous specimens presented to them.

THE PRESERVATION OF NATURAL HISTORY SPECIMENS I, INVERTEBRATES, Reginald Wagstaffe and J. Hanelock Fidler, 205 pp., $10.00, Philosophical Library, Inc., New York 16, New York, 1955.

The techniques employed in the preservation of natural history specimens have been described in a diverse and scattered literature, often difficult of access to the reader. In the present volume up-to-date methods have been brought together which can be relied upon to demonstrate and preserve permanently the taxonomic characters of specimens from most groups of invertebrates.

ENCOURAGING SCIENTIFIC TALENT, Charles C. Cole, Jr., 259 pp., $3.50, College Entrance Examination Board, P. O. Box 592, Princeton, New Jersey, 1956.

Starting with a definition of the sciences and the characteristics of scientists, this book goes on to describe the ways in which scientific ability may be identified, the present and future need for engineers and scientists, and the large numbers of potential scientists and engineers who for various reasons do not attend college. The factors which deter the development of scientists —individual qualities, family and community conditions, social influences—are appraised and weighed against those forces which could increase their number.

This book is the product of a careful survey and research project which combines a critical review of all existing literature in this field with a nation-wide study of high school students and their plans.