

Behavioral Biology at Caltech

Now perhaps—at long last—
natural science can begin to join the
ancient quest to understand ourselves

To educate: to train, discipline, or form.

Caltech educates. It seeks “to train, discipline, or form” —to cultivate—the minds of its students. To do so it exposes them, through visual or oral communication, to the minds of its faculty and visiting scholars, to the knowledge in its libraries, to the unknown as probed in its laboratories and observatories.

But what occurs when a mind is trained, disciplined, or formed? Though we do educate, physically or biologically we know not what we do. With all the devices of natural science no one could distinguish the physical living brain of an illiterate from that of a Caltech graduate. We cannot detect a memory or an image; we cannot perceive terror or courage; we can see no trace of *imagination*, no track of *conscience*.

And we consider this an “age of science.”

Education is but one form of (especially human) behavior. All biological organisms exhibit behavior—they perceive and respond to at least some modes of environmental change. Behavioral biology seeks to analyze and understand the processes underlying the observed behavior.

In the more complex and differentiated organisms, with several modes of perception and many possibilities of response, the integration of behavior is performed by a special set of richly interconnected, electrically active cells—the neurons. A single neuron can perform a complex integration of the information impinging upon it: the potentials of a network or a plexus of neurons are even more intricate.

In these special aggregates of cells lies also the potential for the deposition and retrieval of memory; for that reorganization of memory we call thought and imagination; and—far beyond our present understanding—for the generation of sensation, emotion, and conscious awareness—indeed, for all the varied traits of humanity.

The organization of these aggregates of cells is clearly of

central importance. How does it arise, and according to what principles? The answers that now begin to emerge indicate two principal, interacting determinants of organization—genetic pattern and (particularly, early) environmental influence. The genetic pattern determines the initial matrix and thereby the ultimate potential; early experience enables the organism to select and reinforce those organizational patterns that lead to adaptive response. In man, particularly, the process appears to be cumulative and (for some years) open, in that selection of the appropriate organizational pattern progressively generates new possibilities of organization in a definable order. And, in man particularly, culture determines the nature of an “adaptive” response.

But these concepts merely frame the central questions: What organization, initial and adaptive, enables us to form an internal representation, an image, of the world about us? What limitations does this organization impose upon the validity of that image? In neuronal terms what does it then mean to know? What does it mean to want, to sense, to fear, to love? How are the diverse activities integrated into a functional unit? What differentiates the metastable states of organization—wakefulness, sleep, dreaming, et al? How does conscious experience arise and what is its role? Are there limits to our capacity to comprehend ourselves? Can we shape a mirror to the mind such that we can understand its reflections?

In our behavioral biology program we have begun to pose these questions. In these pages you will read of probing experiments: into the integration of diverse sensory inputs; into the widespread reorganization of brain pathways when an animal learns; into the microscopic changes that may underlie the formation of a memory; into the genetic specifications of the innate circuitry basic to behavior; into the effects of early visual experience upon subsequent cortical capabilities; into the diversification of function among the component sectors of the human brain.

Within the new Mabel and Arnold Beckman Laboratories

of Behavioral Biology we propose to expand and extend this research: to follow up the promising leads and exciting hypotheses as they emerge; to build, in the solid and cumulative style of science, an understanding of the physical bases of behavior and mind.

We should not expect quick success in this effort. The task is formidable and may indeed be comparable in magnitude to all that science has so far achieved.

But now perhaps, at long last, natural science can begin to join the ancient quest to understand ourselves—and thereby begin to illuminate the inner and deeper concerns of humanity.

—Robert L. Sinsheimer
Chairman of the Division of Biology

