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CONSCIOUSNESS REGAINED

THE SCIENTIFIC RESTORATION OF MIND AND BRAIN

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INTRODUCTION

This chapter critically examines the pathways through which the study of mind and consciousness entered the stream of twentieth century psychology with the disappointing consequence that the phenomenon of consciousness was concluded to be scientifically insoluble. Several philosophical, disciplinary, professional, and cultural factors converged which drove the study of consciousness out of psychology only to be embraced later by pioneering neuroscientists and psychologists who were unencumbered by behaviorist assumptions and sought new methods to explore the relation between the brain and behavior. Philanthropic and government support, professional organization and strategic leadership were critical to the revival of mind and consciousness in the 1950s as compelling if not uncontroversial objects of scientific attention.

Cybernetics and cognitive science contributed to the nascent revival of consciousness studies, but computing metaphors and mechanistic assumptions about mind, thought and language were challenged by American pragmatists and scientists who favored embodied, experiential conceptions of mind. Neurobiologists focused on how the brain works, how it develops, how it can be repaired when it is damaged and how it can be stimulated to enlarge the realm of human judgment and cognition. With

the advent of sophisticated imaging technologies, seemingly imponderable rival philosophical theories about human volition, judgment, intentionality and emotional expression can now be tested scientifically. Ironically, the field of psychology that once abandoned the study of consciousness is now engaging in a growing interdisciplinary and cultural movement to understand the mind and use the burgeoning knowledge about the brain to enhance human well-being.

COMPETING CONCEPTIONS OF MIND

The Continental Rationalists

Throughout history there has been a periodic swing between subjective and objective perspectives about mind and conscious experience that has impeded scientific advancement. Descartes separated the mind from the brain and the body from the soul in a dualism that has had a lasting legacy. Descartes asserted that while it would be possible to understand how the brain works, he believed that the mind and soul were subjective elements that could never be explained scientifically. Kant ultimately proposed a transcendental alternative in which the a priori principles of thought could be objectively understood even though this placed mind beyond the realm of human experience. Hegel rejected this dualism. He wanted science to rejoin knowledge and existence, sundered by Descartes and Kant, into a series of dialectical encounters between consciousness and nature in which mind is realized in Absolute Spirit. Unfortunately, Hegel's idealist conception of thought betrayed his willingness to impose spirit *on* nature rather than to understand how mind emerges from experience *in* nature.

Wundt and James

Even as scientific psychology was being founded in the 19th century, psychologists were caught up in these philosophical difficulties. Wilhelm Wundt, a physiologist by training, created a new field in order to study mental phenomena through introspection that were not considered accessible to scientific inquiry (Ben-David & Collins, 1966). William James' (1890) extraordinarily provocative metaphor for consciousness as a continuous stream of mental experiences, stimulated thinking about consciousness whose scientific implications remained unexamined for several decades until brain research resumed in the 1950s. James first proposed that consciousness was not a thing but a process involving volition and attention—a conception that strongly influenced his fellow pragmatist,

John Dewey. He also argued that events, which occur at the fringe or periphery of consciousness, influence perception just as pervasively as those occupying the center of vision.

But James was divided on how to construe the relationship between consciousness, mysticism and free will. James held that religious beliefs are based on ineffable experiences that can be explained through the study of subconscious processes. While James believed in the possibility of free will, he doubted that science would ever prove this to be so. Moreover, James and Lange proposed a controversial theory of emotion that seemingly reduced feeling to underlying physiological processes, thus creating tensions in James' theory of mind that undercut his premises about the efficacy of consciousness and the rational and voluntary nature of belief (See Taylor, 2002 & Barnard, 2002). Importantly, when the study of consciousness reemerged, James' ideas received renewed scientific attention and interest.

Freud

Toward the end of the 19th century other scientific thinkers—notably Pierre Janet and Sigmund Freud—began to infer unconscious processes quite freely, based on observable events such as post-hypnotic suggestion, conversion hysteria, multiple personality, slips of the tongue, motivated forgetting, and the like. Freud's insights have achieved extraordinary cultural influence (Ellenberger, 1970; Erdelyi, 1985). But Freud had curiously little impact on scientific psychology, in part because unconscious influences did not lend themselves to laboratory studies. Nevertheless, Freud inspired influential neurologists, psychologists and biologists in the mid-1950s (discussed later) to see if his concepts and theories could be used to support a scientifically based analysis of mind and consciousness.

THE REJECTION OF CONSCIOUS EXPERIENCE: BEHAVIORISM AND POSITIVISM

Behaviorism's Controversial Claims

A complete explanation for the widespread adoption and uncritical acceptance of the behaviorist paradigm in the social sciences is beyond scope of this paper. The conventional view is that behaviorists rejected 19th century psychology because it was unreliable and subjective, because it was mired in fruitless controversy, and because it was unscientific. "Consciousness", wrote John Watson in 1925, "is nothing but the soul of

theology" (Baars, 1986 p. 3). However, modern historical research has cast doubt on this view in all respects (Blumenthal, 1979; Danziger, 1979; Baars, 1986). It now appears that psychologists like Wundt used objective measures most of the time, and employed introspection only rarely. Even a cursory reading of James' great text (1890) indicates that he anticipated many "modern" empirical phenomena including the problematic relationship between thought, emotion and behavior (see Damasio (1999). Numerous important and reliable psychophysical effects were discovered in the 19th century. Many of these have been rediscovered since the passing of behaviorism, which include basic phenomena like selective attention, the capacity limits of short-term memory, mental imagery, context effects in comprehension, and the like.

It is worth pointing out that the behaviorist movement was opposed at the onset by late nineteenth century neuroanatomists and neurologists. Their important discoveries about the functional differentiation of the brain contributed to the subsequent distinction between motor, perceptual and cognitive processes that sustain modern theories of mind. But this knowledge about localized brain functions was exploited by phrenologists to contend that the neural basis of human cognitive functions and emotions eventually could be pinpointed and used to predict human behavior without reference to consciousness (Finger, 1994; 2000). Thus at the beginning of the 20th century consciousness was not viewed as a viable topic for psychology, even by those who wanted to better understand brain structures and functions, because no specific site had been discovered that lodged consciousness.

Why Behaviorism Attained Dominance

Many psychologists succumbed to the alluring prospect that behaviorism would bring about scientific unification. Behaviorism provided a common unit of analysis with the conditioned reflex and offered relatively straightforward experiments that produced replicable outcomes. Parents and educators were convinced that these methods could be applied in child rearing and schools to obtain more reliable and predictable developmental and educational results than through more traditional, "prescientific" approaches. Watson's confident predictions that behaviorism was an educational and vocational panacea seduced parents, educators and psychologists into accepting and adopting it as a cultural *fait accompli.* Behaviorism squared with the American creed of fairness and equal opportunity, even though the scientific status of its claim to enhance learning could not be fully scrutinized.

Philosophers of science and language also tried to dictate what was to be genuine psychology, which often sidelined mind. Ludwig Wittgenstein, in his various phases of development, inveighed against "mentalistic language"—the language of psychological common sense—as "a general disease of thinking" (Malcolm, 1967). In his later work he argued against the possibility of a "private language"—i.e., that people can really know themselves in any way. His fellow philosopher Gilbert Ryle presented very influential arguments against inferred mental entities, which he ridiculed as "ghosts in the machine" and "homunculi." Ryle (1949) believed that all mental inferences involved a mixing of incompatible categories, and that their use led to an infinite regress. From a modern psychological point of view, these twentieth century philosophers made strong but problematic empirical claims that are more properly left to science.

JOHN DEWEY'S ALTERNATIVE TO BEHAVIORISM: INTERACTING MINDS

The "American School" of Neurology

John Dewey, a cofounder of American pragmatism, believed that the behaviorist attempt to expunge mind and consciousness was mistaken. Dewey sought to avoid the methodological dilemmas of mind-body dualism and reductionism that caused many philosophers and psychologists to vacillate between the mental and physical—between reducing all psychological processes to conscious experience and reducing consciousness to brain functions. Dewey also stubbornly resisted the modern trends toward materialism and reductionism in science and logical formalism and epistemological realism in philosophy, which threatened to erase the naturalistic origins of mind. He adopted a psychobiological conception of mind proposed by the"American school" of neurologists led by Clarence L. Herrick, who viewed consciousness as an instrument for motor, cognitive and emotional integration (Windle, 1979). Dewey took the Darwinian position that the brain evolved in animals to mount more effective functional responses to environmental pressures. The evolutionary advantage of consciousness is that it enables the organism to discover new values by rendering explicit and in commensurate terms the physical and mental attitudes and desires that influenced past behavior and that will affect the outcome of future events. (Dalton, 2002).

Consciousness, Judgment and Value

Dewey contended, like James, that consciousness is not a thing but a process involving uncertainty and the transformation of indeterminate events into ones subject to human control. Beliefs and intentions are not about things that possess intrinsic worth or represent knowledge or truth but refer to actions performed on things that change their sequence or relationship to one another and that affect their efficacy. The capacity to shift attention between foreground and background is essential to balanced perception and judgment. This feature of consciousness makes mind contextual and dependent on the meaning and significance attributed to a situation in its entirety. Judgment grounded in sensori-motor functions is employed to detect and discriminate among qualitative and quantitative features of situations involving force, movement, duration, contrast and balance, among other elements, that affect sentient and energetic states and behavioral capabilities. Consciousness and judgment work in tandem with attitudes and emotions to enable the determination of whether changes in feelings, beliefs, behavior, intentions or meanings make a difference that have value in situations which satisfy a need or desire.

Dewey's Scientific Legacy

Only recently have psychologists and historians learned that Dewey collaborated in the 1930s with infant experimentalist Myrtle McGraw in her pioneering studies of the development of early motor processes (see Dalton and Bergenn, 1996). Dewey was testing his theory of mind in which the growth of the mind, brain and behavior is integrated through conscious experience (Dalton, 1999; Dalton & Bergenn, 1996). While McGraw's pioneering studies in early infant locomotion continue to be cited by contemporary researchers, her role in testing Dewey's conceptions of mind and consciousness have largely gone unrecognized (Dalton, 1998). In a subsequent chapter in this book, Dalton discusses in more detail their collaboration. He describes how Dewey and McGraw proposed to study brain states supporting consciousness, examines why McGraw failed to receive proper acknowledgement for her contributions to their endeavor and discusses how her case bears on the issue of prominence.

Finally, Dewey believed that the phenomenon of consciousness could be better understood by focusing on experiences involving uncertainty about values and consequences whose significance and control involved cooperation among people with different minds and beliefs. These circumstances favored the suspension of belief, shared perceptions and mutual problem solving—crucial elements of his theory of inquiry. But many of

the pioneers in modern neuroscience seem to have better understood and appreciated Dewey's conception of inquiry and his interdisciplinary and collaborative conception of science than his ideas about mind and consciousness.

THE MACY CONFERENCES, 1942–1954

Dewey not only was McGraw's advisor and collaborator in her research at Babies Hospital, Columbia University throughout the 1930s, but he was also a founding trustee of the Josiah Macy, Jr. Foundation in New York from 1930–1944. The Macy Foundation funded McGraw's studies among numerous other psychobiological and medical investigations and continues to be involved in medical education today (Kast, 1937). From the mid 1930s to mid 1950s, the Macy Foundation also sponsored a series of 19 seminal interdisciplinary conferences (Fremont-Smith, 1951), several of which were pertinent to consciousness (discussed below), that included: cybernetics (1947–1953); nerve impulses (1950–1954), and problems of consciousness (1950–1954) (Rappleye, 1955).

Dewey student and protégé Lawrence K. Frank, Vice President of the Macy Foundation from 1936–1941 originated the conference idea while working for the Rockefeller Foundation where he formed an international and interdisciplinary network of child study institutes in the 1920s and 1930s Frank (1962). The Macy conferences cultivated multidisciplinary scientific approaches to problems involving significant public consequences—a Deweyan ideal enunciated in his famous 1927 book, *The Public and It's Problems* (Dalton, 2002). (Dewey participated in the first and longest running Macy conference on Aging from 1936–1952) The participants at these meetings challenged conventional ideas about mind and intelligence. Freud's ideas also were debated and the formative influence of Dewey's interactionist conceptions of mind and communication were apparent. Some of the participants carried forward these Freudian and Deweyan intellectual agendas about mind and consciousness into new scientific venues in subsequent decades (Heims, 1991, pp. 169–170).

Cybernetics: A Counterrevolution?

An extraordinary group of individuals from many disciplines participated in the conferences on cybernetics that included mathematician Norbert Weiner, physicist Warren McCulloch, anthropoligists Margaret Mead and Gregory Bateson, Lawrence K. Frank and Lawrence Kubie, a psychoanalyst (von Forester, 1949). Arturo Rosenblueth, a physiologist,

introduced the concept of "feedback mechanisms" to capture the circular causality involved in goal-directed behavior, whose attainment requires feedback and error correction. This recurring theme in the cybernetics meetings marked a significant departure from the tenets of classical behaviorism in which human behavior was controlled by underlying reflex mechanisms (see Heims, 1991). Although outspoken critics of behaviorism and psychoanalysis, McCulloch and Walter Pitts, an MIT mathematician advanced a mechanistic conception of mind that relegated consciousness to a secondary status and reduced thought to computational principles that could be mimicked by machines.

McCulloch's (1948) belief that neurobiological conceptions of mind would be replaced by ones based on physics discouraged the possibility of creative collaboration which doomed the future of cybernetics (see Dupuy, 1994). Moreover, at the Hixon symposium neurophysiologist Karl Lashley (1948) challenged McCulloch's assumption that programmed switching mechanisms can simulate the exchange information in the brain, because the cortex sustains a complex level of interactions even in the absence of stimulation or functional response. While unable to build a machine that could think, the cybernetics engineers and mathematicians that included John von Neumann and Norbert Wiener (1948) formulated communication and information network theories that ultimately provided the foundation for the computing revolution. In fact, J. C. R. Licklider, a Harvard psychologist, an expert in psychoacoutics and language and a participant in the Macy meetings on the problems of consciousness (see Licklider, 1950), eventually headed the Information Processing Techniques Directory of the Defense Advanced Research Project Agency. Through his leadership the first electronically based communication system was created that led to the development of the Internet! (Norberg, 1988).

The conference series on cybernetics was the only Macy sponsored event to receive press coverage in *Time* and *Life Magazine*. Oliver Sacks, a famous neurologist (1994, p. 101) recalled his excitement as a boy "reading about [McCulloch and Weiner's] pioneer explorations of logical automata and nerve nets." Sacks admitted that he "thought, as many of us did, that we were on the verge of a computer translation, perception, cognition; a brave new world in which ever more powerful computers would be able to mimic, and even take over, the chief functions of brain and mind" (p. 101). Pioneers in the fledgling field of cognitive science that included Herbert Simon, Alan Newell, Marvin Minsky and George Miller believed that human cognition could be better understood if strongly rooted in cybernetics inspired theories of information processing. Their earliest attempts in the 1950s to develop cognitive science were counterrevoutionary, according to Miller (2003), because they framed their theories within a behavioral

discourse that they eventually repudiated. Herbert Simon acknowledged the strategic importance of Otto Selz, who avanced a new theory of thinking that reconciled rather than repudiated competing perspectives. As Van Strien and Fass note in their chapter in this volume, Simon recalled that "we obtained considerable encouragement from knowing that there existed psychologists, outside the domain of American behaviorism, who would not be scandalized by the direction we were taking" (Simon, 1981, p. 149).

Nerve Impulses

The Macy Foundation also sponsored five annual conferences on "nerve impulse" from 1950 to 1954 (Fremont-Smith, 1950). The conferences dealt with issues pertinent to understanding the molecular and biochemical basis, energetic dynamics and functional nature of synaptic and neurochemical processes of the nervous system and brain. New electrophysiological techniques were emerging pioneered by neurophysiologists Hans Berger, Herbert Jaspers, Wilder Penfield, which enabled scientists to measure more precisely than before nerve conduction involving excitation and inhibition. This accumulating knowledge enabled participants to propose well-grounded theories about the role of motorneurons in the brain stem and their relationship to reflex behavior, the corticospinal system and higher centers. These meetings reflected a new sense of purpose among scientists whose interest in mind and consciousness had been long discouraged. Nevertheless, their discussions did not reach the threshold of cognitive functions considered fundamental to mind and consciousness, such as memory, perception and judgment.

Problems of Consciousness

Perhaps the most provocative but ultimately, disappointing conference series sponsored by Macy was on "problems of consciousness" from 1950–1954. Chaired by David Wright, a Rhode Island psychiatrists. Psychoanalysts dominated the group with such dignitaries as Gregory Zilboorg, Lewis Wolberg, David Rapaport, Roy Grinker and Frieda Fromm-Reichmann, among several others. However, there were also several physiologists that included Hudson Hoagland, Abramson, Nathaniel Kleitman, and Paul Weiss as well as experimental psychologists Donald Lindsley and Harold Schlosberg. In addition, Margaret Mead and Ashley Montagu were two distinguished anthropologists in attendance along with Talcott Parsons, an eclectic sociologist from Harvard University.

The first conference dealt creatively with sleep, wakefulness, hypnosis and time, phenomena that involve the continuum of states of consciousness

and its absence. Margaret Brenman's presentation offered a particularly cogent analysis of how hypnotic suggestion changes conscious awareness by controlling the focus of attention. There was also discussion of levels of consciousness including self-awareness. These were promising developments but participants gravitated toward Freudian theories to explain things that disrupt consciousness rather than trying to understand the neurobehavioral factors that make possible perception or memory.

Brown University psychologist Harold Schlosberg best expressed at the second conference the recurring difficulty the conference participants, such as David Rapaport, had in clearly distinguishing levels of consciousness:

> I wonder if one of the troubles that we have had throughout this discussion of levels, strata, and dimensions is not the fact that we are really dealing with two or three or more concepts lumped together under one general, one generic term, "consciousness," whereas they should not be. . . . But the topic that Dr. Rapaport was talking about deals with the "content of consciousness." It is related to things like learning and selective attention. The problem of integration keeps popping up here, the mutual antagonism between two related patterns of behavior (Schlosberg, 1951, p. 42).

Rapaport wanted to distinguish between pathological cases involving individuals who lose their personal identity *without* awareness and individuals who suffer a loss of personal identity *with* the awareness of doing so. He noted that the Korsakoff syndrome is often singled out as an example of the former condition, because of the assumption that the individual has sustained brain damage from alcoholism. But Rapaport contended that the Korsakoff patients' tendency to make up stories to fill in gaps of memory was not limited to these individuals alone. This was related to a more widespread tendency that predisposes people not only to contrive their experiences and memories but also to believe that these stories involve real events. In this instance, consciousness becomes a tool of self-deception (see Rapaport, 1951, pp. 30–31).

These assertions about the self-deceptive and error prone nature of human perception continue to surface today regarding the crucial distinction between the process and phenomenological contents of consciousness. Neurologists have now traced the Korsakoff syndrome to a damaged hippocampas that confuses in the person's mind the distinction between recent and past events. Persons with anosognosia, a paralysis caused by stroke, are unable to detect the paralysis and strangely, they deny it even though they see that they are unable to move the afflicted appendage. While the element of denial remains perplexing and could be explained by Freudian

theory (see Ramachandran, 1998), the inability to detect paralysis can be explained by the fact that the effects of a lesion in one hemisphere are generally not communicated to the side of the body that is unaffected. Moreover, cognitive neuroscientists today employ neuroimaging technologies that have isolated neural mechanisms that account for "inattentional" or "change blindness" that do not require a conception of the unconscious.

Macy's International Political Agenda

It is important to mention that Fremont-Smith, Lawrence Frank and the Macy Foundation pursued an international political agenda through their sponsored conference series. The conferences promoted international policies to secure peaceful technological change, economic growth, human development and well-being in the post-WWII era. Fremont-Smith, Margaret Mead and Frank became involved in the International Preparatory Commission that led to the establishment of the World Federation for Mental Health (WFMH) in 1948. The federation adopted the motto borrowed from the UNESCO constitution that: "Since wars begin in the minds of men, it is in the minds of men that the defense of peace must be constructed."

Frank and Mead co-authored the Preparatory Commission report urging that political leaders employ a "dynamic theory of personality" to deal with social and health problems in nations undergoing economic development (Heims, 1991, p. 171). Mead and Frank co-authored the UNESCO sponsored publication, *Cultural Patterns and Technical Change*, which recommended that scientific knowledge about infant and human development be provided to developing countries. Unfortunately they did not foresee the politically polarizing consequences of the Cold War and the tremendous cultural barriers that prevented successful transfer and adaptation of this knowledge.

HERBERT JASPER AND THE LAURENTIAN CONFERENCES ON BRAIN AND CONSCIOUSNESS, 1954–1997

A Model for International Scientific Cooperation

Several organizations emerged after WWII whose members were dedicated to world peace and international scientific cooperation. In 1949, The Council for International Organizations of Medical Sciences (CIOMS) was established jointly by the World Health Organization (WHO)

and UNESCO. CIOMS's promoted international activities in the field of biomedical sciences. Herbert Jasper, a Canadian neurophysiologist sought closer collaboration between European colleagues involved in CIOMS and their North American counterparts. Jasper (1974, p. 405) acknowledged his debt to pragmatists John Dewey and Charles Peirce who inspired him to understand the brain by seeing how it responds to experience, because he concluded that "one would never know without trying."

Jasper also shared Dewey's belief in the importance of interdisciplinary communication as an instrument for strengthening international ties among scientists (Jasper, 1996). Toward these ends in 1947 Jasper became the founding president of the International EEG Organization and editor of a new journal on the subject. With UNESCO's support, and building on increased interest, Jasper and his colleagues formed next the International Brain Research Organization (IBRO) in 1961. The IBRO is dedicated to increasing communication between brain researchers around the world. IBRO members also were instrumental in forming in the early 1980s the Society for Neuroscience, an interdisciplinary professional association, has grown rapidly since then with over 35,000 members in 2002 (Worden, Swazey and Adelman, 1974, p. xxi). During this period of professional development, Jasper and his colleagues (1998) organized a series of conferences from 1952 through 1970, which became known as the Laurentian Conferences on Brain Mechanisms and Consciousness described below. Jasper's et al. (1998) final conference on consciousness occurred in Montreal at McGill University in 1997 when he was 91 years old! He was co-organizer also co-editor of the proceedings *Consciousness: At the Frontiers of Neuroscience.*

Brain Mechanisms and Consciousness

The first international conference on Brain Mechanisms and Consciousness was hosted by CIOMS in Paris in 1952. This meeting co-chaired by neuroscientists Herbert Jasper (Canada), Edgar Adrian (UK) and Frederick Bremer (Belgium) that attracted the attendance of 19 neurophysiologists that included Donald Hebb, Karl Lashley, Walter Penfield, Harold Mcgoun among others. Lawrence Kubie was the only neurologist. Importantly, four of participants were already veterans of the Macy conferences.

Noteworthy presentations included Lashley's (1953) broadside attack on behaviorism, who contended that dismissing consciousness as subjective sidestepped the crucial question of explaining the existence of consciousness. Hebb (1953, p. 411) made an eloquent plea for inclusion of introspective reports in neurophysiological research citing experimental evidence that thought precedes language. But perhaps A. E. Fessard's

(1953) talk was the most farsighted. In it he anticipated the contemporary notion that "in the hierarchy of conditions, that integration requires interaction between all parts of the system comes first, not centralization as is often supposed" (p. 207).

Jasper and Penfield invited theoretical speculation about the underlying neural processes that support different states of awareness involving conscious perception and deliberation. The role of the reticular activating system and thalamus were discussed which make possible interaction between cortex and subcortex, enabling the brain to reach the threshold of neuronal interaction and integration needed to support consciousness. But the scientists were divided on whether the reticular formation was limited to the function of arousal or, whether it indeed contributes to changes in specific patterns of activity associated with conscious thought. Moreover, many participants acknowledged that most conscious acts are also performed without consciousness, suggesting that attention cannot be dissociated from underlying motivational and affective processes.

The Pontifical Academy of Science and Consciousness

These attempts by scientists to fathom the relation between brain and mind eventually attracted the interest and support of the Roman Catholic hierarchy. The Pontifical Academy of Science hosted a conference in 1964 that was organized by John Eccles. Before then, Charles Sherrington was the only neuroscientist that had been recognized for his research on the brain and was elected to the Pontifical Academy in 1936. The 1964 meeting was indeed a watershed event for religion and science in which Pope Paul VI addressed the group in the spirit of the 1960s ecumenical council to reexamine church doctrine. Pope Paul made a remarkable statement that clearly ceded to science the study of higher brain mechanisms and mind, while welcoming the light that this knowledge would shed on humans' moral and spiritual life and values.

> "Brain and conscious experience:" seeing these words associated suffices to make clear that there you touch on that which is most specifically human in man, on that which approaches most nearly the mechanisms of his psychology, the problems of his soul. To be sure, when you speak of 'consciousness,' you do not refer to the moral conscience: the very rigor of your methods ensures that you do not leave that strictly scientific domain which belongs to you. What you have in mind exclusively is the faculty of perceiving and of reacting to perception, that is to say, the psychophysiological concept, which constitutes one of the accepted meanings of the word 'conscience.'
>
> But who does not see the close connection between the cerebral mechanisms, as they appear from the results of experimentation, and

> the higher processes which concern the strictly spiritual activity of the soul?. . . By widening our field of view, We would like to profit by the occasion thus presented to Us to reaffirm before you the Church's attitude of esteem and confidence with regard to scientific thought in general (Pope Paul VI, 1966).

This papal statement significantly modified church policy on the relationship between brain and mind. For example, Gross (1998) reported, in his fascinating history of brain science, that for over 1500 years (from Roman times to Descartes) scientists held that the cerebral ventricles or the empty sinus cavities within the brain were the seat of intelligence. Theologians sanctioned this view because they believed that the mind and soul could not be corrupted by the physical elements of the brain that lay outside these voids.

Modern neuroscience has rendered these beliefs anachronistic. Recent brain imaging studies provide evidence that the prefrontal and other brain regions play a crucial role in moral choice, conscience and judgment (see Greene et al., 2001). There is a growing body of neuroscientific (LeDoux, 2002) and neurological research (Damasio, 1999:2003) which indicates that the capacity to make decisions requiring moral reflection is seriously compromised by prefrontal brain damage. While the catholic hierarchy may not be completely at ease with these findings, Pope Paul and his successors, including Pope John Paul II, continued to support the scientific study of mind while preserving Catholicism's traditional spiritual sphere of influence (John Paul, II, 1990).

Several other neurobiologists participated in the Pontifical Scientific Academy in 1964 whose work was just gaining attention that included Roger W. Sperry, Benjamin Libet, and Vernon Mountcastle, communications professor, Donald M. McKay, and psychologist H. L. Teuber. These and other conference attendees speculated about the relationship between cerebral organization and conscious activity, discussed evidence for brain plasticity, examined the effects of stimulation and injury, looked at the role of attention and examined the issue of conscious control or free will. These are important phenomena in contemporary neuroscience because they pertain to the neural mechanisms that support consciousness, determine whether conscious experience can change brain structure or function and help assess whether our belief in free will is justified.

Key Issues for Contemporary Studies

Binding and Integration

The participants at the 1964 Vatican conference debated first whether consciousness can be localized or should rather be considered an emergent

phenomenon whose complexity encompasses the whole brain. MacKay 1966), a philosopher, drawing on cybernetics, contended that consciousness is sustained by a "metaorganizational" feature of brain processes that cannot be localized in the cerebral cortex. Mountcastle (1966) disagreed with MacKay, contending that consciousness is a cortically based function. He stressed that investigations of time-dependent dynamic aspects of cortical function would reveal complex patterns of neural response involving emergent properties of large populations of neurons. Jasper (1966) thoughtfully interjected that while consciousness involves an *interaction* between cortical and subcortical domains, there is something peculiarly unique about this interaction when consciousness is involved that enables an extraordinary selectivity of focus or awareness. Mountcastle concurred with Jasper that more details about this interaction may be revealed by study of the reticular formation—and the possible relationship between the frequency response of signals emerging from the reticular formation and the threshold of conscious awareness.

Research about what binds or sustains conscious attention continues today. Crick and Koch (2003) contended, until recently, that synchrony of neuron firing is sufficient for conscious thought, which stresses integration while failing to explain selectivity. Edelman and Tononi (2000) argue instead that the selectivity and integrity of consciousness are sustained by reentrant connections, which favor stronger interactions between widely distributed neuron groups involving short-term, temporal correlation and synchrony. The power of local synchronization by itself is not sufficient to sustain consciousness. The level of coherence between widely distributed groups provides evidence for this view (Srinivasan et al., 1999). Resolving these theoretical differences about binding requires a more detailed understanding of the neural events that take place below the threshold of consciousness (i. e., neuromodulation of bodily states that affect perceived value). More information is also needed about the events that contribute to the lapse, extinction, or replacement of conscious perception or behavior, such as binocular rivalry, selective attention and sleep or brain dysfunctions, which affect the relationship and synchrony among neuron groups.

Neural Plasticity

Neural plasticity and the efficacy of conscious experience to change brain growth patterns or alter function were also discussed at the Vatican conference on brain mechanisms and consciousness. Lashley (and Donald Hebb, a psychologist) championed the idea that the human motor cortex is highly plastic and susceptible to variation. Lashley's experiments indicated that the motor cortexts of rats exposed to stimulation do not exhibit

a uniform response suggesting the movement maps differed to reflect the uniqueness of each rat's experience. The neuroscientific community did not accept nor fully grasp the implications of this discovery until 60 years later. That is when Michael Merzenich and Jon Kass demonstrated more convincingly that the receptive fields of the somatosensory cortex exhibited a different mapping within the same monkey when efferent inputs were surgically altered and reshaped by subsequent experience. The brain compensates for substantial loss of neurons that retrieve sensory or motor signals by enabling the activity or receptive fields of nearby neurons to invade the cortical space vacated and take over functions previously supported by lost neurons. Similarly, cross-modal neural plasticity accounts for the recovery of motor and speech functions incurred from strokes. For example, the loss of speech incurred by damage to the Broca's area in the left frontal cortex enables the right frontal areas, which are normally suppressed to support limited speech functions.

Attention

Vatican conference participants also examined the possible role of attention in facilitating changes in brain function. H. L. Teuber (1966) argued that when rats are exposed to enriched and complex environments they show greater reliance on vision and thus exhibit more alertness in executing specific tasks. A few years later Greenough et. al. (1993) discovered that rats which receive enriched experience learn and perform tasks more attentively. They also grow more synapses in the dentate nucleus of the hippocampus than those that receive non-enriched experiences. Perhaps the most convincing evidence that attention is instrumental to neural reorganization was presented recently by Merzenich and deCharms (1996). They showed that change in topographic maps occurred only in the auditory cortex of monkeys who *attended* to changes in sound frequencies; no change occurred in monkey's brains that received these same stimuli *passively*. While the question remains open as to how consciousness contributes to these neural effects, the capacity to attend to novel stimuli appears to be an important factor in attaining and integrating experience-dependent neural reorganization (see Stigler, 2001; Schwartz & Begley, 2002).

Free Will

Finally, neurophysiologist Benjamin Libet reported at the Vatican conference his pioneering attempts to employ EEG techniques to determine when subjects first become aware of sensory stimuli and how this affects our understanding of free will. Libet (1966) discovered that there is a half-second delay between the receipt of a stimulus and conscious awareness. These results led scientists prematurely to conclude that the neural

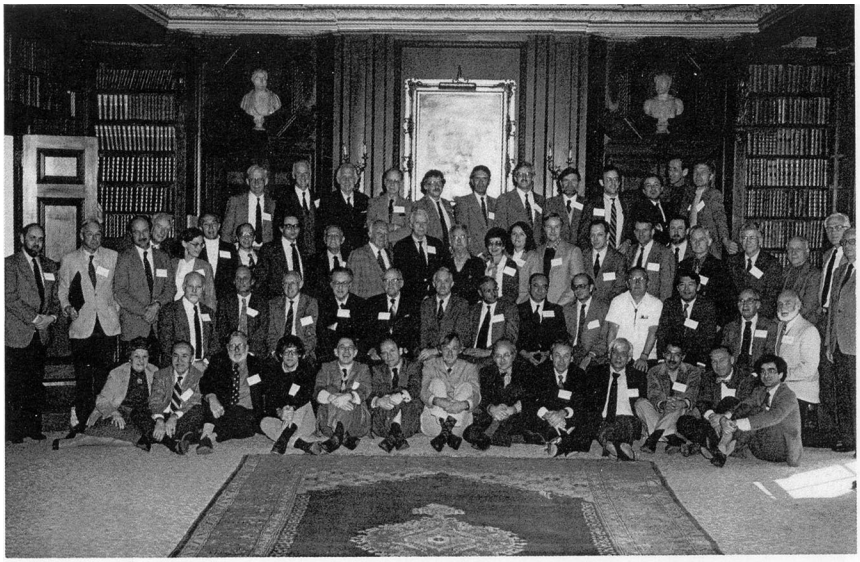
processes underlying self-consciousness may have causal force but consciousness itself is an after-affect. But Libet persisted in devising another series of studies in the 1980s to determine when subjects become consciously aware of the desire to act. Although he found that an unconscious motor activation precedes response (Libet et al., 1983a), subjects are still able to override and thus consciously and willfully control their decision to act (Libet et al., 1983b).

FRANCIS SCHMITT AND THE NEUROSCIENCES RESEARCH PROGRAM, 1962–1982

The momentum was building for several decades in the twentieth century to undertake a large scale and long-term program dedicated to the study of the brain. The proponents of a new brain science faced two crucial problems: (1) how to enlarge the number of scientists involved in the research and discussion and; (2) how to create an organizational structure that would sustain the research and increase support over time. Schmitt (1990, p. 189), who participated in the Macy conferences on nerve impulses, believed that a new "hybrid" field of biophysics was emerging in the 1950s that would reveal the chemical and electrical properties of energy that make possible the intercellular transfer of information in the brain. Through his connections with the National Institutes of Health, he obtained support for a study program at the University of Colorado at Boulder in 1958 to examine fundamental aspects of biophysical science. In attendance were veterans of the Macy conferences on nerve impulses Paul Weiss, W. A. Rosenblith and Donald Lindsley, who helped promote his agenda.

Building Support

Schmitt devised a research program called "the biophysics of the mind" (Adelman & Smith, 1995). He passionately pursued the goal of "improved intercommunication between minds," a Deweyan ideal that inspired the Macy Foundation conferences (Swazey, 1974, p.529). He strongly supported the idealistic aims of the UNESCO and CIOMS conference programs, which he believed to be "to survive this present world crisis and advance a new quantum leap . . . in human evolution" (Swazey, 1974, p. 331). He found a receptive audience at MIT, which provided institutional sponsorship and at the National Institutes of Health (NIH), which awarded a multiyear grant in 1962 to develop the Neurosciences Research Program (NRP). (MIT resumed its support of brain science decades later with the creation of the McGovern Institute for Brain Research in 2000). An



Forty-third (and final) Stated Meeting of NRP Associates, March 14–17, 1982. Front row, left to right: K. Cusick, G. Adelman, R.D. Keynes, C.F. Stevens, E.R. Kandel, T.N. Wiesel, W.R. Adey, D.H. Hubel, P. Mueller, R.R. Llinas, F.E. Bloom, D. Ploog, T. Poggio. Second row, left to right: R.M. Held, P. Greengard, W.M. Cowan, D.A. Glaser, F.O. Schmitt, R.Y. Moore, W.E. Reichardt, H. Fernandez-Moran, P. Rakič, T. Melnechuk, M. Konishi, D. Bodian, T.H. Bullock. Third row, left to right: N. Bernick, A. Hodgkin, G.D. Fischbach, F.H.C. Crick, A.M. Graybiel, R.B. Livingston, L.C.M. DeMaeyer, G.M. Edelman, S.S. Kety, N.E. Miller, A.M. Liberman, R. Galambos, Y. Homsy, S.J. Bird, L.L. Iversen, S.H. Snyder, J.E. Dowling, W.E. Gall, W.H. Sweet, F. Plum, M. Calvin, F.G. Worden, H.V. Hyden. Back row, left to right: V.B. Mountcastle, D.M. MacKay, J. Szentágothai, S.L. Palay, F. Morrell, R.J. Wurtman, J.B. Martin, P. Marler, R.W. Nichols, J.-P. Changeux, H. Thoenen, J.J. Hopfield.

Forty-third (and final) stated meeting of NRP Associates, March 14–17, 1982. (Courtesy of NRP)

international "core group" of scientists were formed, many of whom became members of the board of trustees of the Neurosciences Research Foundation (NRF), an independent non-profit corporation. Hudson Hoagland, who attended Macy conferences and who was President of the American Academy of Science at the time, provided space in the Academy's building in Brookline to house the NRP staff (Mcgoun, 1974).

Promoting Discussion and Synthesis

Schmitt designed a remarkable participatory framework for the conduct of "work sessions," and "intensive study programs" that would attract natural scientists from several countries and fields who were interested in neuroscience. (Gross and Cori, 1974). The work sessions did not focus explicitly on mind or consciousness, but did examine neural processes and mechanisms that potentially contributed to understanding functions

involving consciousness, such as memory, language use and cognition (Schmitt, 1992, pp. 231–239). The NRP elected 75 associates, 13 of whom were awarded Nobel Prizes. The *NRP Bulletin* that was distributed worldwide included synthetic overviews of the field and discussion summaries that defined future directions and goals and identified the most promising research in the field (Schmitt, 1974, pp. 7–9). Schmitt constructed, through these instruments of discussion, recognition, coordination and dissemination, scientific networks equivalent in structure, if not stature, to the "invisible colleges" of the Royal Society of 17th century England (Swazey, 1974, p. 542).

GERALD EDELMAN AND THE NEUROSCIENCES INSTITUTE, 1982–

From Immunology to Neuroscience

Gerald Edelman, an immunologist, who was Associate Dean of Graduate Studies at Rockefeller University at the time, was first invited to participate in the NRP in 1964. Edelman (1974, p. 65) was impressed with Schmitt's attempts to "integrate, to probe, and to define things without pretense." Edelman soon attracted his colleagues' attention with his pioneering co-discovery that eventually led to the Nobel Prize in 1972 that revealed the chain structure of antibodies, and which accounted for their tremendous variability and versatility. Edelman presented a novel theory that antibodies in the immunologic system exhibit the capacity to remember deep structures of antigens that is strikingly similar but not equivalent to psychic memory (Eigen and De Maeyer, 1966). The evidence favored a "selective" (i.e., canvassing an existing repertoire of shapes to find the correct structural match) rather than an "instructive" (i.e., antibodies are instructed to fit correctly through the transfer of information from the antigen) mechanism (Edelman, 1999). Edelman's provocative thesis puts pressure on the conventional neuroscientific wisdom by contending that memory does not require a specific site for information storage and retrieval but may involve the dynamic and transient combinations of different recognition units or neuronal structures.

Collaboration and Legitimation

Edelman assumed leadership of NRP in 1982 and created the Neurosciences Institute (NSI) at the Rockefeller University. In 1991 the NSI staff

transferred operations to the Scripps Institute in La Jolla, California, before moving into their permanent quarters in Torrey Pines in 1993. In 1988 the NSI established a program in theoretical neurobiology and later, an experimental program, involving specially appointed resident fellows. A visiting fellow program also was established at the NSI, which has hosted small conferences and visiting fellows involving over 1000 individuals from 300 institutions and 25 countries. The NSI also continues to host the NRP annual conference. Participants have included for example, neuroscientists Michael Merzenich and Eric Kandel, a Nobel Laureate, Harvard psychologist Daniel Schacter, neurologist Antonio Damasio, neurobiologists Jean-Pierre Changeux and Rudolfo Llinás and philosopher John Searle. These distinguished scientists have each contributed significantly to the science of mind and consciousness research. These efforts increased the perceived legitimacy of a scientific investigation of the brain and the mind that has languished since the turn of the twentieth century.

Selectionism and the Brain

Gerald Edelman has contributed fundamentally to NSI's success by advancing an unrivaled and brilliant theory of mind. Edelman first presented his theory of neuronal group selection in *Neural Darwinism* (1987) and *Topobiology* (1988). In his glowing review of *Neural Darwinism* in the *New York Review of Books* (1986), Israel Rosenfield (1986) even included several technical articles that Edelman wrote or co-authored in scientific journals, which described his novel theory of memory and perception. Edelman presented a more detailed argument for primary and higher level consciousness in subsequent books that included *The Remembered Present*, (1989), *Bright Air, Brilliant Fire* (1992) and *A Universe of Consciousness* (2000), co-authored with Giulio Tononi). In these books, Edelman defined the key concepts of "selection," "degeneracy," "reentry," which form the "dynamic core" of conscious experience. These terms are worth describing because they involve phenomena that have attracted the attention of and analysis by numerous contemporary neuroscientists, psychologists and social theorists.

Edelman contends that *selection* (i. e., systems for recognition of variation) takes place during development and through experience. Neural growth processes that result in billions of synapses and millions of connections between axons and dendrites are not preset but respond to contingencies of order, competition and probability that produce a unique individual brain. *Degeneracy* is the capacity of elements that are structurally different to perform the same function or yield the same output (Edelman

& Gally, 2001). Degeneracy contributes to flexibility by enabling neuronal groups to form connections that respond differently to the contingencies of experience. Early experiences are crucial in providing the organism sufficient stimulation from the environment to adopt behaviors and to make choices that have value. The interconnected neuronal groups that form in response to experience create perceptual maps and categories that enable the construction of reality. These maps communicate with one another through reentrant signaling processes yielding a basis for the conversion of perceptual categories of information into more complex and even metaphorical pictures and understandings of the world, as brilliantly argued by Johnson and Lakoff, 1999).

Importantly, the concept of reentry should not be confused with "feedback" as proposed by Norbert Weiner, to mean the detection and correction of errors. *Reentry* involves the ongoing parallel signaling between separate neuronal groups along ordered anatomical connections that occur in both directions simultaneously and recursively. Reentry makes possible the simultaneous comparisons of bodily (i. e., kinesthetic) mental and emotional states involved in making choices based on value. Activating those neuron groups that are interacting more strongly with one another and which sustain integration and a high degree of complexity during a given experience constitute the *dynamic core* of consciousness (Tononi and Edelman, 1998).

Implications for Development

Edelman's emergent conception of mind has found support among psychologists. Infant experimentalists Esther Thelen and Linda Smith contended that infants integrate and consolidate their motor and perceptual achievements through reentrant processes (Thelen and Smith, 1998). Infant experimentalists Philip R. Zelazo and Philip David Zelazo contend that the neurobiological structures supporting consciousness and the mental capabilities that derive from them emerge during infancy (Zelazo & Zelazo, 1998). Philip David Zelazo (2000) also argues that the recursive process whereby infants and young children acquire powers of self-reflection by subsuming lower level by higher level rule-governed reasoning processes also conforms to reentrant principles. Finally, Dalton (2000), a developmental theorist, contends that emotions help temporarily bind together specific patterns of reentrant connections that render feelings explicit and which sustain different behavioral states and postures. Through these neurobehavioral processes infants learn how to express their emotions by experiencing the different demands that these emotions place on

their energy and their capacity to communicate them accurately to care givers.

The Brain, Mind and Consciousness

Edelman's theory has precipitated an avalanche of commentary that includes the prestigious philosopher Charles Taylor (see Taylor 1994, pp. 233–235), who praised Edelman for his non-reductionist conception of mind. Edleman is critical of modular and genetic theories of the brain and mind proposed by some cognitive scientists. Edelman rejects the notion that the brain is hard-wired and that there are particular neurons exclusively dedicated to conscious processes. He also dismisses as naive the belief that consciousness can be isolated in specific areas of the brain. He believes that perception constructs reality rather than represents it. He also holds that the primary norms of human experience are variability and transformation rather predictability and redundancy and that with its fullest expression, higher level consciousness involving meaning and significance requires language. Finally, Edelman contends that no two patterns of neural connections supporting consciousness are the same. Not since the great debates instigated by Cartesian dualism, Kantian rationalism and Hegelian idealism have scientists and philosophers been presented with such a theoretically profound, empirically testable and morally significant theory of mind.

THE REVOLUTION IN NEUROIMAGING

The contemporary movement away from purely abstract computational and philosophical conceptualizations of mind to theories that are scientifically grounded in brain science marks an important milestone in the revival of consciousness studies. For several decades, unanswerable questions have been posed about the mind and consciousness that now can be framed empirically. By employing brain-imaging techniques, neuroscientists have recast philosophical debates about free will and determinism into biologically grounded (i.e., embodied) rival hypotheses about the genetic and experientially variable constituents of human thought and behavior. This once diffuse issue has been broken down into a series of functionally specific questions, for example, about prefrontal processes that underpin planning and expectation (Cabeza and Nyberg, 2000).

Mapping the Interactive Brain

These advances occurred because cognitive psychologists and neuroscientists agreed to map the brain according to a conventional grid system and accept as valid the assumption that changes in metabolic activity are indicative of shifts in cognitive activity. Thus subjects' performance of tasks vary according to the difference in amount of metabolic activity that occurs in relevant regions of the brain. The development and widespread acceptance of these brain mapping standards has contributed to an enormous output of research that has identified brain regions believed to play a crucial role in human perception, emotion, thought and behavior. The first generation neuroimaging studies led many scientists to believe (as do those conducting single cell electrical studies) that receptors and neurons are functionally specialized to perform genetically determined roles. Nevertheless, the theoretical significance of these studies of cognition is controversial largely because brain functions overlap and the same structures have been found to perform different functions (Edelman and Gally, 2001). Consequently, neuroscientists have proposed new methods to better capture the interactive nature and contextual basis of conscious brain processes first proposed by John Dewey that have thus far eluded cognitive neuroscientists and psychologists (McIntosh, 2000).

Diagnosing Brain Disorders

Brain imaging also may pinpoint the neurobiological sources of learning disorders, such as dyslexia, attention deficit disorders and many other brain-related dysfunctions that appear to adversely affect perception and attention. For example, until recently, infants were assumed to possess a genetic predisposition to learn language and that this capability was isolated in the left temporal region of Broca and Wernieke's areas. Research by psychologists Helen Neville (1993) and Elizabeth Bates (1999), however, suggests that, contrary to Noam Chomsky, children do not automatically understand syntax, but must be capable first of linking sounds with syllables before understanding more complex grammatical constructions. Auditory and visual cortex play an important role in the construction of speech and language use that engage both left and right hemispheres—a finding that has enabled dyslexics to adopt compensatory strategies. Brain imaging studies forced neuroscientists to drop the notion that structural and functional anatomy are equivalent and to recognize that cognition involves system-wide relationships and interactions within the brain (Beaulieu, 2002).

EXPANDING THE BOUNDARIES OF MIND: FROM SCIENCE TO CULTURE IN THE 1990s?

Thrust into the National Spotlight

The intellectual, scientific and organizational initiatives contributing to the reemergence of the study of consciousness converged with political and cultural forces in the mid-1990s. President Bush's proclamation to dedicate the 1990s to study of the brain stimulated scientific interest and government funding and aroused the news media to cover the brain and mind in more depth than in previous decades. Significantly, after reluctantly acquiescing to this slogan, the American Psychological Association quickly adopted in 1999 a new slogan for the first decade of the 21st century calling it the "decade of behavior." A major conference on infancy and the brain sponsored by the White House and organized by Hilary Clinton in 1997 capitalized on the Bush initiatives and the increased interest among parents in the developing brain. Several professional societies and groups in the United States and Great Britain also became active during this time organizing conferences and promulgating manifestos that proposed new methods for studying the mind and consciousness, which were touted as crucial to understanding the human condition in modernity.

A New Foundation for Conscious Experience

For example, in 1992 an interdisciplinary group of professors from physics, neuroscience, psychology and anthropology recommended a new epistemological approach to consciousness that its spokesman said, "takes the personal characteristics of the observer into account" (Harman, 1994, p. 143). The group urged that this approach be "radically empirical," "objective," acknowledge the "partial nature of scientific concepts of causality," emphasize the "unity of experience," and embrace a "participatory" approach to problem solving (pp. 147–148). This emphasis on epistemology and method was indicative of need to resurrect the term consciousness from its premature burial by behaviorists and logical positivists that denied that scientists could say anything meaningful about phenomena, which lacked empirical evidence. Several other conferences were convened through the mid-1990s, which also asserted the need to restore the scientific respectability of consciousness. (see Sutherland, 1994).

The reemergence of an interest in consciousness also signaled an increasing dissatisfaction with the intellectual hegemony of postmodernism and deconstruction. Michel Foucault, Jacques Derrida and Richard Rorty, among other notable leaders of this genre of thought, contended that mind,

self and consciousness are outmoded terms bequeathed by the Enlightenment. They argued that the belief in free will underpinning these terms no longer reflects the realities of a world of technologically subservient, decentered selves who exhibit the endless capacity for new forms of expression but who are also caught in self-spun webs of desire and deceit. Their belief that science is not impartial but implicated in culture of control and thus incapable of understanding or defending the freedom and integrity of human thought has failed to attract many converts. It also misjudges the motives and goals of pioneering neuroscientists who sought through their studies to enlarge individual access to the resources of mind and consciousness for intelligent communication and peaceful human interaction.

The Tucson Center and the Journal of Consciousness Studies

Perhaps the biggest boost to the popularization of consciousness studies occurred when an international conference "Toward a Scientific Basis of Consciousness" was held in Tucson in 1994. This became a minor media event when physicist Roger Penrose and anesthesiologist Stuart Hammeroff presented their quantum theory of consciousness that drew coverage by the *New York Times* science writer Sandra Blakeslee (Clark, 1994; Freeman, 1994). The proceedings of this and subsequent biennial conferences were published by MIT Press with the title, *Toward a Science of Consciousness*. The Center for Consciousness Studies was created in 1998 at the University of Arizona to provide small research grants and web-based courses. Conference and research topics have included evolutionary and developmental perspectives, phenomenal knowledge, neural correlates of consciousness, computational and cognitive approaches, first-person methodologies, aesthetics, sleep and dreaming among others.

The *Journal of Consciousness Studies* (*JCS*), founded by Keith Sutherland (1994) in 1994, provided an early forum for conference presenters and rapidly increased its readership among researchers in several fields who are interested in the problem of consciousness. Sutherland (1996) passionately supports the notion that a multidisciplinary program must be open to all points of view, including transpersonal and paranormal, and that this is the best antidote to the premature adoption of a paradigm that turns out to be profoundly mistaken. Moreover, Sutherland cited approvingly philosopher John Searle's admonition that "At the present state of our investigation of consciousness, we don't now how it works and we need to try all kinds of different ideas" (Sutherland, 1997, p. 386).

Sutherland's colleagues cautioned however, that by pursuing this broad-based approach, *JCS* and would forfeit its influence among

scientists. Bernard Baars, a psychologist cited the increased interest among mainstream scientific journals, such as *Science* and *Nature,* which were devoting more attention to brain-based studies of consciousness. Thomas Metzinger argued that the study of consciousness was in a chaotic, preparadigmatic state and that further progress necessitated the concentration of scientific intelligence and resources (see Sutherland, 1997, p. 385). Sutherland appropriately expressed concern about the possible Balkanization of consciousness studies, which he believed would create separate camps of scholars who pursued their own agendas in isolation. But this did not thwart the effort to create another society for the study of consciousness.

DEFINING A SCIENTIFIC AGENDA: THE ASSC 1997–

In 1997 a small group of philosophers and scientists that included: philosophers Thomas Metzinger and David Chalmers; psychologists Bernard Baars and William Banks and neuroscientists Christoph Koch, Patrick Wilken, and Jackie Andrade formed the Association for the Scientific Study of Consciousness (ASSC). The society is dedicated to the promotion of research within cognitive science, neuroscience, philosophy, and other relevant disciplines in the sciences and humanities to better understand the nature, function, and underlying mechanisms of consciousness. The ASSC sponsors an annual international conference, hosts Internet seminars, and has two official journals: *Consciousness and Cognition,* edited by William Banks, Bernard Baars and Anti Revonsuo and *Psyche*, an online journal edited by Patrick Wilken.

The ASSC hosts conferences with tightly focused themes involving experimentalists who utilize brain imaging and other technologies. This approach, reminiscent of the Macy conferences, has succeeded in attracting distinguished scientists who have illuminated several phenomena that constitute important core issues for consciousness and mind. The inaugural conference in 1997 at Claremont College examined implicit cognition and at Bremen in 1998, the neural correlates of consciousness were discussed. The third conference at Western Ontario looked at consciousness and self, while the fourth, in Brussels, focused on phenomena associated with the unity of consciousness, such as binding, integration and the dissociation of consciousness. The latest three conferences dealt with the perceptual contents of consciousness (Duke University, 2001), language (Barcelona, 2002) and models and mechanisms of consciousness (University of Memphis, 2003).

The Crucible of Culture

Thomas Metzinger (2000) edited a volume of essays on the neural correlates of consciousness contributed by participants at the conference in Bremen in 1998 (Mutalik 1998). Not since Frank Schmitt's efforts to document and synthesize the NRP conferences, has there been a comparable attempt to pull together contemporary research into such a coherent and thematic exploration of issues central to the function of the brain in relation to the mind and consciousness. The success of this endeavor, as Metzinger cogently notes, depends crucially on the recognition that scientific models are produced by socially interacting groups whose theories do not depend naively on some objective reality, but on *intersubjective* understanding and agreement. The contributors to Metzinger's book demonstrate historical continuity and also indicate substantial progress in understanding the neural dynamics underpinning conscious experience. For example, Damasio (2000) contends that emotions *inform* consciousness rather than override it, as neurophysiologists had previously believed, by being rooted in bodily feelings that furnish "second order neural maps" of events that have perturbed the individual and led him to the perceive and act differently than before.

Metzinger thoughtfully recognizes, as did his predecessors, that perhaps the most critical challenge researchers face is the need to increase public support by creating a "consciousness culture" that seeks new applications from knowledge about the mind:

> Our current lack of genuine consciousness culture can be interpreted as an expression of the fact that the project of the Enlightenment got stuck. What we need is not faith, but knowledge; what we are lacking is not a new metaphysics, but a new variant of practical rationality . . .
>
> We have to move away from a purely defensive position (as is currently widespread in the humanities), away from any cheap, counterproductive resentment. Laying the foundations for a consciousness culture means taking a more active attitude, a—nevertheless critical—point of view that allows us to ask positive questions like How would a future culture look that uses the results of consciousness research in a fruitful way? How to protect the individual from new potentials for manipulation and the dangerous side effects of commercially exploited, newly emerging consciousness technologies . . . .

Historical Continuity and Scientific Support

The ASSC has succeeded in attracting as leaders some of the most noteworthy and innovative scientists and theorists in psychology and the

neurosciences. As founding president, Bernard Baars (1986; 1988), a cognitive psychologist, is widely recognized for his historical analysis of the cognitive revolution and his cognitive theory of consciousness. His historical study included interviews with pioneers whose careers spanned the behaviorist and post-behaviorist eras, such as B. F. Skinner, George Mandler (1975), Howard Kendler and George Miller. Baars (1997; 2002) penetrating metaphor of mind in the theater of consciousness has helped researchers understand how the limited states or stages of conscious awareness are enlarged by access, through the recticular activating system, to an enormous array of subconscious mechanisms that enlarge our powers of thought and behavior. Baars' theory has unquestionably contributed to a revival of James' theory of the volitional mind by suggesting how conscious thoughts recruit physical processes to execute intended goals with consummate efficiency by exploiting the highly distributed but interactive nature of functional brain processes.

Another recent president is Christopher Frith, an experimental neurologist at University College of London. Through his studies of individuals with brain disorders, such as schizophrenia and autism, Frith has proposed a remarkable theory of consciousness, whose neural correlates link the capacity to form intentions with the ability to read other minds. Significantly, Frith's research was given added weight and credibility by being published in the journal *Science* (see Frith and Frith, 1999). Through the leadership of these and other ASSC presidents, the ASSC has succeeded in attracting distinguished neuroscientists around the world to participate in their conferences.

TOWARD A COMPARATIVE AND INTERDISCIPLINARY SCIENCE OF MIND AND CONSCIOUSNESS

The resurgent interest in mind and consciousness in the 1990s could not have been foreseen a few decades ago. The evocative counterculture of the 1960s introduced "consciousness raising" into the lexicon of serious scholarship. But this term had more to do with an increased social awareness of racial prejudice and inequality and with drug-based altered states of consciousness than with the relationship between mind and brain. The dramatic growth of cognitive psychology in the late 1970s eclipsed the prominence of the behavioral school within the field of psychology although it retained behavior as an important empirical indicator of mental events. In the 1980s, psychologists began to incorporate the computing based "information processing" conceptualization of mind in their studies of human cognition. This mechanistic mode of understanding mental

operations in terms of storage, retrieval and computation has given way to new methods of modeling brain processes that show greater sensitivity than before to emergent properties of brain function (Elman et al., 1998).

Modeling the Minds of Animals and Children

Pioneering studies in the 1970s also traced the ancestry of the human mind in chimpanzees. Psychologist Gordon Gallup (1970) developed a clever technique to determine if chimps are capable of self-recognition by seeing if they notice a change in their appearance in a mirror. Through this technique, not only have chimps demonstrated self-recognition but two year-old infants have also demonstrated the same capacity Lewis & Brooks-Gunn, 1979. Premack and Woodruff (1978) discovered that chimpanzees are able to attribute mental states to other con-specifics and thus possess a theory of mind. This has stimulated related lines of inquiry in animals and young children, described in this volume by Corballis and Lea, that include tactical deception, mental perspective taking and imitation. These important comparative studies underscore the need to better understand the evolution, developmental origins and cultural dynamics of mind.

Neurobiological conceptions of mind can be traced back to Dewey and his scientific colleagues Clarence L. Herrick, Charles. J. Herrick and C. M. Child (see Dalton and Bergenn, 1996) that focus on the emergent, self-organizing, dynamic and interactive nature of neurobehavioral networks and that stress the role of experience, context, emotion and effective (versus functional) connectivity. Significantly, these elements of mind preserve an evolutionary and functional role for consciousness that is not apparent in computational models that minimize awareness and construe mental operations in terms of automatic processes of informational exchange. Moreover, philosophers and neuroscientists find the cultural and ethical implications of an "embodied" conception of mind compelling. This conception opens new avenues for understanding how language, emotion, belief, and intention constitute our self-images and contribute to our awareness of and capacity to interact and communicate with other minds (Johnson and Lakoff, 2001; Dalton, 1999; Damasio, 1999; Frith and Frith, 1999).

Citation Trends

This increased interest in mind and consciousness among scientists is reflected in articles published in professional journals. A steady growth of the word "consciousness" in scientific publications is shown in Figure 1. It goes from almost zero citations in 1950 to more than 1400 in year 2000. The

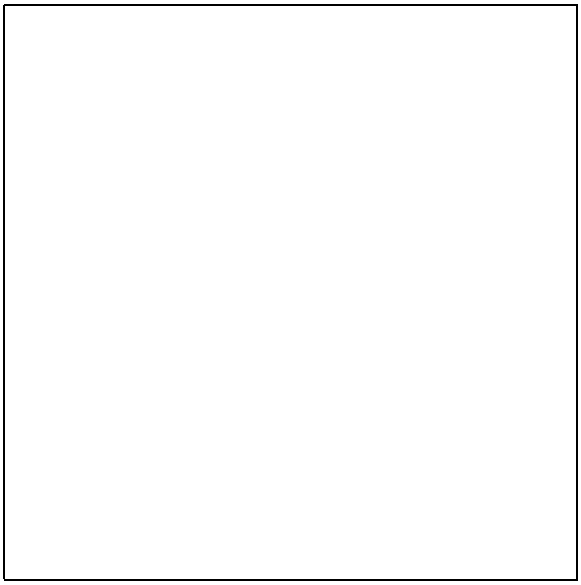


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Figure 1.

numbers were collected from the biomedical literature, using PubMed—a biomedical database that contains 9 million titles and abstracts. They seem to confirm that consciousness is back in science. But it doesn't appear yet that the brain and the phenomena of consciousness are central concerns of psychology.

In their fascinating comparative study of citation patterns among flagship journals in behavioral, psychoanalytic, cognitive and neuroscientific fields over the last half-century that appears in this volume, Tracy, Robins and Gosling contend that neuroscience is achieving high levels of prominence *outside* the field of psychology. They found that the rate at which psychologists publishing in the top journals in these fields cited neuroscientific journals fell well below the citation rates of those who published their work in top scientific journals, such as *Science* and *Nature.* That is to say that mainstream psychologists did not pay increased attention to developments in neuroscience until only within the last five years, and then only modestly so. The authors found this surprising because the cognitive school has enjoyed the biggest surge in prominence in psychology and the brain has become the common currency for discussing psychological ideas. They urge that the field of psychology strengthen its disciplinary relationship with neuroscience rather than let it "slip away" and perhaps form stronger bonds with the biological sciences.

American Psychological Association Initiatives

Leaders in the field of psychology face daunting dilemmas in their attempts to support the growth of knowledge that strengthens rather than weakens ties with neuroscience. Psychologists face pressures, as do most professionals and academics, to not only produce new knowledge but to use that knowledge to enhance human well being. The centrifugal forces of specialization, and the demand for applied knowledge and therapeutic interventions are weakening the capacity of the American Psychological Association (APA) to sustain the participation of scientists by finding common intellectual ground (Fowler, 1996; Dewsbury, 1996). The APA has undertaken two recent initiatives that show promise of fostering interdisciplinary collaboration that is necessary to bring about reunification.

Sponsoring Neuroscientists

In 1998 and 1999, APA Divisions 3 (Experimental Psychology) and 6 (Behavioral Neuroscience and Comparative Psychology) jointly sponsored an invited symposium series, Mind, Brain and Behavior supported by a grant from the National Science Foundation. This innovative and well attended program attracted some of best known researchers in the cognitive sciences and neurosciences that addressed phenomena that included vision, perception, attention, memory, language and decision-making and choice. Invited speakers included, among others, Michael Posner, Michael Merzenich, Jeremy Wolfe, Larry Squire, Barbara Tversky and Marlene Behrman. The 1998 meeting also featured a Plenary address on consciousness by the late Harvard philosopher Robert Nozick. And Division 24 (Theoretical) sponsored an invited symposium on the "Revival of Consciousness in Psychology" that included Thomas Dalton, Bernard Baars, anthropologist Kathleen Gibson and infant experimentalist Philip David Zelazo.

Conference Reorganization

In 2001, the APA also restructured its annual meeting to reduce the size of the program and to promote interdivisional collaboration. The divisions were divided into program clusters of 3–6 units each and then asked to propose common program themes. Through this process, the APA sought more cooperation and consensus among the divisions regarding issues and themes likely to attract the most interest for organized panels. Perhaps not surprisingly, the program cluster that included Divisions 7 (Developmental), 3, 6 and several others selected two of three themes pertinent to mind and consciousness that included early experience and the

brain and consciousness and unconscious processes! This new program structure may furnish avenues for the reemergence of common themes like mind and brain that may contribute to reunification.

Undergraduate Education and the Brain

Beyond these initiatives however, undergraduates in psychology and in the arts and humanities want to become better informed about the revolutionary advances in scientific knowledge about the brain and mind. This educational effort is urgently needed because professors in the arts and humanities claim to be experts on the mind yet they know the least about the brain. Responding to this concern, Neil Rudenstein, then president of Harvard University approved in 1993 the first undergraduate certificate program in the nation in Mind, Brain and Behavior (MBB). MBB brings together over 60 scholars and nearly 600 students from the full range of academic disciplines and from the professional schools. The fellows in the MBB academic program critically probe the implications of the neuroscientific revolution and develop multi-level frames of reference that put "the brain in context" and that emphasize the interplay of biology, culture and ethics in human experience.

Elizabeth Coleman (2003), president of Bennington College and a recent NSI visiting fellow, has also undertaken an unprecedented initiative to break down artificial barriers to knowledge by eliminating departments and introducing interdisciplinary courses in brain and mind that are intended to stimulate institutional transformation. These initiatives at Harvard and Bennington may contribute to the development of a culture of consciousness that is needed to sustain long-term societal and scientific support. They may also level the playing field for faculty in the arts and humanities by providing access to brain imaging technologies that will enable them to ground their research in the latest knowledge about learning involving human perceptual, cognitive, emotional and aesthetic capabilities.

CONCLUSION: UNDERSTANDING THE SCIENTIFIC REVIVAL OF CONSCIOUSNESS

Our review suggests that there are numerous conceptual, interpersonal, organizational, professional, political and cultural factors, which have contributed to the events leading to the scientific revival of mind and consciousness. These developments do not yet appear to signal a major

paradigmatic shift away from reductionist scientific perspectives involving the dominance of physics and a molecular biology grounded in the genome. The prevailing paradigm that pursues the elusive knowledge of the universal physical forces that bind all natural things and that explains the biological origins of all living things, continues to relegate issues involving the relationships among mind, brain and behavior to a subordinate status. However, the study of mind and consciousness portend a much stronger neuroscientific influence in psychology and philosophy and the emergence of new methods and styles of inquiry in biology and neurology. These developments may revolutionize how biologists and practitioners in the social sciences and humanities understand the role of mind and experience in the conduct of inquiry and in the advancement and reconciliation of culture and science.

Religious and Scientific Domains

The study of the human mind and consciousness has deep historical roots, but knowledge of the brain lagged until nineteenth century scientists contributed modest but critical breakthroughs in our understanding of neuroanatomy and functional brain processes. For many centuries theologians and philosophers dominated the discourse on mind. Although significant, Descartes' attempt to model brain functions, which traced consciousness to the pineal gland (and the ventricles), did not advance brain science because he equated mind with soul that stood wholly apart from the brain. Papal acquiescence in the 1960s to scientific expertise in the realms of brain and mind, which preserved church authority in matters of conscience and soul, constituted an explicit break with the political worldview of Cartesian dualism. The separation of church authority and scientific method contributed, in part, to the rapid advancement of the scientific study of consciousness in last half of the twentieth century.

Prominence, Progress and Synthesis

While ideas sometimes seem to take on a life of their own, this perception underestimates the considerable role of prominence in sustaining interest in and attention on concepts that endure. In fact, mind and consciousness have attracted through the centuries an enormous number of distinguished proponents of competing theories. By the middle of the nineteenth century, the major philosophical theories of mind today were well established. This monopolization of the discourse on mind by philosophers has sometimes hindered progress because of the tendency among

Descartes, Kant and Hegel's successors, for example, to reaffirm their alternative perspectives in competing schools of thought rather than to develop novel approaches. Contemporary theorists and researchers are breaking the bonds of their philosophical heritage first undertaken by James and Dewey. Striking progress has occurred because leaders in brain science realized that the essence of inquiry involves the suspension of belief, the discovery of new methods and that originality has more to do with the synthesis and integration of knowledge than its origination. Nevertheless, dramatic progress in research on consciousness would not have occurred without scientists like Gerald Edelman, who creatively exploited the analogous processes of selection in immune and neural systems to advance a scientifically testable theory.

Essential Insights and Relevance to the Human Condition

The great philosophers of mind have contributed important insights about the human condition and the crucial role that beliefs and ideas about autonomy, freedom, and responsibility play in sustaining human dignity and integrity. But much of the progress in the science of mind since the late twentieth century has depended less on addressing bold questions regarding human ethics and creativity than on neurological and neurobiological disorders that diminish or alter human cognition, choice and behavior. By taking this tact of studying brain disorders, neuroscientists have been more successful in identifying the processes that make consciousness possible, by isolating those factors whose absence seriously compromises awareness, attention, the capacity to plan and anticipate, which ultimately interfere with judgment and ethical behavior. Victims of strokes now obtain more accurate diagnoses through neuroimaging than before and the successful treatment of children with dyslexia, attention deficit syndromes and other disorders has vastly improved. Federal laws now regulate the use and transplantation of neural stem cells, establish research guidelines regarding interventions and therapies for persons afflicted with Parkinson's and Altzeimer's disease and that control other related practices (Blank, 1999). The scientific study of consciousness will undeniably flourish if it can be demonstrated that advances in brain repair and the mitigation of cognitive dysfunction depend crucially on knowledge of human perception, attention, and the relationship between motor, cognitive and emotional states of mind. Importantly, this approach reflects Dewey's seminal ideas, who strongly emphasized that understanding the integrative nature mind and brain was the key to changing habits and understanding inquiry.

Conceptual Clarity and Communication

Advances in science are sometimes impeded by disputes over concepts whose terms defy precise definition. For a long time, philosophers disputed the nature of motion, energy, matter, space and time because they were unable to render these concepts into commensurate physical terms. Metaphors and analogies are literary devices that have often been employed effectively to best express similarities between known and unknown events. Synonyms are frequently employed to do so, sometimes with unfortunate results. Behaviorists substituted the term "conditioned reflex" for learning thus considerably reducing the realm of behavior indicative of higher cognitive function. Similarly brain-imaging researchers have been particularly vulnerable to the criticism that regional brain activation cannot be equated with the presence or absence of consciousness, but entail complex continually changing interrelationships among structures. The challenge today is to conceive of mind in terms that recognize its embodiment in multiple brain functions but that also reflects the *interdependence* between persons who must use their brains to communicate thoughts and experiences whose meaning and understanding require more than one mind. The future of neuroscientific studies of the brain will depend not only on their success in overcoming brain disorders that limit individual potential but on their capacity to enhance communication and interpersonal understanding.

Judgment, Sovereignty and Human Rights

Controversy has doggedly followed attempts to understand the human capacity for judgment, thought and reason. Throughout the centuries, theologians, philosophers and scientists were contented to accept the widespread belief that powers of the human mind were the product of divine creation, and that human judgment was imperfect and morally flawed. This explanation not only satisfied scientists who believed that mind was insoluble, but it also furnished a convenient justification for monarchical authority. Nineteenth century democratic movements challenged the sovereignty and legitimacy of monarchies and triggered a crisis in authority in modernity that led to democratic movements grounded in the belief in the inviolable rights of human beings. The belief in the capacity for self-reflection and self-governance naturally elevated the stature and dignity of men and women whose cognitive powers became the subject of increased interest, study and debate (Taylor, 1989). These same ethical and political considerations dictate that the uniqueness and integrity of each human mind must be respected and that the capacity for

conscious choice and emotional expression must be protected (see Damasio, 2003).

Scientific Legitimacy and Public Support

A controversial phenomena is unlikely to attract the serious interest of scientists or produce a growing body of research unless it is considered a legitimate object of inquiry supported by private and public funding. Private or public organizations or professional societies have never universally and unconditionally supported the study of mind and consciousness. Ever since ecclesiastic views of the soul and mind were considered sacrosanct, scientists have been reluctant to pursue investigations that would not attain peer approval and organizational support. Only when scientists were given the opportunity and financial support to candidly discuss the relation between mind and brain did the science move forward. Through strategic leadership, professional and organizational contacts were forged throughout the world that set the stage for cultural expansion and popularization. Through these mechanisms of expanded communication, scientists and educators are fulfilling the promise of Dewey's pragmatism whereby communities organized for intelligent action form publics dedicated to addressing issues with significant policy consequences. But the current popularity of mind and consciousness studies may not last unless it becomes institutionalized. Historically this has required that intellectual and professional ownership be asserted that generates a distinctive body of research. It is too soon to tell whether any single field will claim consciousness as its primary concern and it is also possible that an interdisciplinary amalgam of researchers may be formed from several fields.

Scientifically Testable Phenomena

Science does not advance when scientists spend more time proving and supporting what they already know rather than challenging assumptions and gaining new insights that produce new knowledge. The demand for reliable evidence and corroboration are important scientific principles that can be taken to extremes, as evidenced in the medieval era and during the Inquisition, when Galileo's ideas and novel methods were subjected to intellectually tortuous and treacherous logical challenges by those who opposed his new ideas. The emergence of the scientific study of mind and consciousness has been challenged by the unusual physical attributes of being supported by observable brain processes but whose phenomenal,

experiential properties are not directly accessible to third person analysis. The so-called "hard problem" of demonstrating what it is like to experience one's own and another's consciousness is asserted to lie at the heart of the scientific paradox of mind (Chalmers, 1995). Construing phenomenal experience as primarily an epistemological problem of self-knowledge needlessly reintroduces Cartesian dualism. Moreover, this seriously understates the interpersonal and intersubjective nature of consciousness, as Dewey understood its role in human experience.

Ultimately, it may be impossible to duplicate a first-person experiential perspective, because that would require that all internal and peripheral phenomena that make an experience uniquely personal be isolated and then correlated with brain states. Perhaps the conundrum of whether perception takes place inside or outside the brain, Hurley (1998, 420) asserts, can be avoided by allowing perception and action to be "constitutively as well as instrumentally interdependent." Brain states and perception are chronically underdetermined primarily because attention and action are needed to actualize any one intentional state of mind and there are always alternative strategies and structures available to do so that make each experience uniquely different (see Edelman and Tononi, 2000). Nevertheless, humans would be unable to communicate unless they were capable of sharing and mutually understanding common experiences.

Understanding the experiential nature of brain states ultimately requires comparative and inter-species analyses, as argued by Michael Corballis and Stephen Lea in this volume. This study may reveal unexpected similarities among neural processes and functional capabilities across species (Corballis, 2002). Technical advances in brain imaging methods may eventually enable the interpersonal and longitudinal studies of experiential states of mind needed to understand the quantitative and qualitative basis for differences in conscious perceptual processes (Montague et al., 2002). This line of inquiry will also demonstrate the tremendous flexibility and freedom humans possess to continually develop and expand their powers of mind and consciousness (see Adolphs, 2003).

Theoretical Pluralism and Interdisciplinary Collaboration

The publication of Thomas Kuhn's *The Structure of Scientific Revolutions* in 1962 precipitated a provocative debate whose outcome remains inconclusive. Kuhn was heralded for his analysis of the paradigmatic practice and revolutionary transformation of the sciences that he illustrated from the sixteenth through twentieth centuries. But scholarly

reaction quickly focused on conceptual distinctions between "normal" and "revolutionary" science and whether or not scientific fields qualified as paradigmatic or pre-paradigmatic in their theoretical and methodological development (see Fuller, 2000). Neuroscientists, psychologists and scholars from other disciplines engaged at different times in these debates. The intention was to become more theoretically self-conscious about disciplinary roots and practices and to examine whether fields of knowledge can and should be demarcated from one another according to some unique paradigmatic features (see Connolly, 1973; Overton, 1998 & Fuller, 2000).

Swazey and Worden (1974) wanted to see whether the field of neuroscience fits the Kuhnian pattern of science in which mid-range puzzle solving and theory testing gives way, under the accumulated weight of anomalies, to the adoption of a completely new framework of understanding. They concluded that neuroscience was pre-paradigmatic with research largely concentrated in exploratory and experimental studies. They believe that this is illustrated by the swing back and forth between plasticity and connectionist theories and between local and global theories of brain structure and function (see Sperry, 1974). Contrary to their analysis however, I believe that exploratory and experimental methods, complemented by continuous technological innovations and accompanied by vigorous competition between well-defined and testable alternative theories is the hallmark of *dynamic* science rather than a mature science that is theoretically moribund. The great strength of neuroscience thus far has been its capacity to attract many disciplines, to innovate and to continually spur new discoveries and theories that have revolutionized our knowledge of the relation between brain and behavior. This suggests that the rules of intellectual and scientific engagement characteristic of a "mature" science are being redefined.

Contrary to Swazey and Worden's (1974) assertion, the pervasive multidisciplinary character of contemporary neuroscience, including consciousness studies, is not indicative of the "immaturity" of this endeavor in a Kuhnian sense. Rather it signifies the hallmark of a new science of human experience in which brain, mind and consciousness play a fundamental role. In this scenario, breakthroughs in our knowledge of the human mind will increasingly depend on collaboration, the combination of resources, replicable experiences and shared insights. No one discipline or profession possesses an intellectual monopoly of ideas, concepts and theories about mind or their application. The future state of the art of scientific discovery and advancement in psychology and other fields may be foreshadowed in the emerging and growing interdisciplinary study of mind and consciousness documented in this chapter.

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