INTERFACING RELIGION AND THE NEUROSCIENCES: A REVIEW OF TWENTY-FIVE YEARS OF EXPLORATION AND REFLECTION

by James B. Ashbrook

Abstract. Exploration and reflection on the interfacing of religion and the neurosciences in the last twenty-five years provide a unique point of convergence on the relationship between science and religion. A focus on two streams of consciousness characterized the first phase in the 1970s. Scholarship suggested correlates between the styles of analytical steps and synthetic leaps of imagination and the belief patterns of proclamation and manifestation. The use of lateralized consciousness was critiqued as covering too much as well as not attending to evolutionary developments and philosophical and theological foundations. A shift to whole brain functioning with more differentiated investigations came during the second phase in the 1980s. Empirical studies corroborated the earlier analytical speculations in neurotheology and advanced the heuristic value of using the whole brain as a metaphor for understanding religion. By the third phase of the 1990s, meaning-making and integrating consciousness emerged as shaping the agenda between religion and cognitive neuroscience. The emerging methodology combines analogical continuities among levels of complexity and metaphorical leaps of inferential patterning.

Keywords: bimodal consciousness; cognitive neuroscience; lateralization; religion; science; whole-brain functioning.

The relationship between religion and science traditionally focused on the context of nature and the working of God (Barbour 1966, 1974, 1990; Gilkey 1993; Pannenberg 1976; Rolston 1987; Breed 1992; Jones 1994). With the emergence of the human sciences the discussion now

James B. Ashbrook is Senior Scholar in, and formerly Professor of, Religion and Personality at Garrett-Evangelical Theological Seminary, 2121 Sheridan Road, Evanston, IL 60201. This article is adapted from a paper presented at the Chicago Center for Religion and Science for the CASIRAS 1994 Advanced Seminar, "Knowledge Most Worth Having in the Decade of the Brain," and from portions of a forthcoming book by Ashbrook and Carol Rausch Albright, *The Brain That Minds: Clues to God's Ways of Being God.*

[*Zygon*, vol. 31, no. 4 (December 1996).]
 ISSN 0591-2385

includes the significance of humanity (Arbib and Hesse 1986; Gerhart and Russell 1984; Hefner 1993). Within the last quarter of a century, neuroscience is bridging the physical and the human sciences. Exploration and reflection on the relationship of religion and neuroscience are accelerating.

The collaboration between the two had its seeding in shifts in both areas. The scientific paradigm shifted from a positivistic reductionism to a systemic holism (Sperry 1993). The religious paradigm shifted from revelation as propositional to an experiential dynamic of meaning-seeking and meaning-making (e.g., Capra and Steindl-Rast 1991). We now know the last decade of the twentieth century as "the decade of the brain."

This article examines the emerging interface. I initially sketch assumptions underlying the interfacing and then examine three (roughly chronological) phases of that development. The phases overlap yet provide central foci of investigation. They are: the 1970s with its focus on two modes of consciousness, the 1980s with its consideration of whole-brain processing, and the 1990s with its attention to the meaning-making intentionality of the human brain.[1]

ASSUMPTIONS

One assumption underlies such interfacing, namely, that religious implications can be—and are—present in the data with which neuroscience deals. As that which is the most encompassing of all languages of discourse, religion embraces all of life.

Three additional assumptions flow from that basic view of relatedness.

1. There are many ways to describe reality. One is expressed in Aldous Huxley's conviction that we "ought to be able to talk about a mystical experience simultaneously in terms of theology, of psychology, and of biochemistry" (cited by Taylor 1979, 17–19). No one way is privileged to the exclusion of other ways. Each has its own contribution; none has a definitive edge.

2. A second, similar in intent though different in form, emphasizes correlates among physiological activity, cognitive processes, and symbolic cultural expressions (Cacioppo 1992; Cacioppo and Tassinary 1990; Cacioppo and Berntson 1992; Sarter, Berntson and Cacioppo 1996; Tillich 1963). Societal and symbolic forms combine the origins of human meaning-making in neurocognitive processes and the destiny of human meaning-discerning in theological aspirations. Thus, we can suggest cultural parallels, symbolic affinities, and central tendencies that represent the coincidences of time, place, and idea. These can mark a period in

history with a culturally significant style as found in a period's architecture, sculpture, painting, literature, music, and ideas (Fleming 1974).

3. A third assumption respects the integrity of disciplines of discourse. It recognizes a reciprocal process of differentiating because of specialization and of integrating because of shared humanity. The disciplines are free to go their separate ways even as they find overlapping concerns.

In their fullest form, these assumptions reflect a theological method of correlation. There are commonalities with the various expressions of cultural specialization even as there are tensions with every cultural construction (Tillich 1951; 1959; Niebuhr 1951). In a generally accurate depiction, historian Lancelot Whyte claimed European thinkers fall into two camps: "the one seeking order, similarities, and unity (often called 'mystical' or 'religious') and the other seeking differences among particulars (the 'tough' thinkers or scientists). The first seek comfort in feeling a unifying order, the second in defining particulars" (Whyte 1973).[2] To examine religious thinking on the neurosciences clearly puts us on the side of those "seeking . . . a unifying order" while taking seriously those "defining particulars."

Science, and particularly neuroscience, constitutes a search for explanatory causality and particular differences. Religion, whether understood in broad cultural terms or in narrower theological categories, reflects a search for experiential meaning and unity. In holding these two perspectives together I propose that the humanizing brain mediates between them. More specifically, the brain-mind can be understood as an information system of pattern making. Such a view allows us to consider information processing as a way to make sense of biochemical, cognitive, and cultural affinities and differences.

What, then, do I find in this last quarter of a century of exploring and reflecting on the relation of religion and neuroscience? (While thinking went in both directions, this article deals primarily with a religious orientation, not a neuroscience one).

PHASE ONE—THE 1970s: TWO MODES OF CONSCIOUSNESS AND TWO COGNITIVE STYLES

Split-Brain Research and Two Modes of Consciousness. On 9 September 1973, the cover of the *New York Times Magazine* displayed a picture of a human head looking out at the reader. The left half showed the page of a dictionary with definitions of *dance*, the right half Degas's painting of ballet dancers. The lead article was entitled: "Right Brain, Left Brain: Two Astonishingly Different Personalities."

Behind this burst into public awareness of bimodal consciousness lay the popular pioneering book of Robert Ornstein, *The Psychology of*

Consciousness ([1972] 1986). Ornstein identified and synthesized the theory of creative impulses originating in the right half of the brain and rational impulses in the left half. He depicted ordinary consciousness as being a major barrier to effective living. Behind Ornstein lay the pioneering Nobel Prize–winning work of Roger W. Sperry and associates on split-brain research (Sperry 1982; Trevarthen 1990a).

Interest in bimodal consciousness spread rapidly. Julian Jaynes's *The Origin of Consciousness in the Breakdown of the Bicameral Mind* (1976) fueled the interest. He located the origin of consciousness in the catastrophe of three thousand years ago which forced humanity "to *learn* consciousness." Under stress, language shifts from the intentional expression of the left hemisphere to the intuitive expression of the right hemisphere. In ancient Greece, people believed the utterances from the "other side"—the right hemisphere—to be the voice of the gods. This breakdown of a two-chambered worldview, Jaynes argued, became the basis of the problem-solving awareness of the modern mind. He proposed that we find the throwback of consciousness to bicamerality in contemporary experiences of hypnotism, schizophrenia, and poetic and religious frenzy.

Cosmologist Carl Sagan fanned further fascination with implications of split-brain research in *The Dragons of Eden* (1977). He speculated on the evolution of human intelligence with particular attention to neurophysiologist Paul MacLean's (1970) concepts of the triune brain and bimodal consciousness.

Evidence from split-brain research generated speculative generalizations among scientists themselves about the nature of human functioning (e.g., Bogen; Eccles; Gazzaniga; Penfield; Sperry). Much of the motivation seemed focused on the debilitating consequences of an Enlightenment rationalism and an overvaluation of materialism in contrast to an emergent humanism and a valuing of the spiritual (cf. Harrington 1992, 237). Dichotomies without reference to cerebral lateralization included clinical neurologist Kurt Goldstein's contrast between a concrete-realistic attitude and an abstract-discursive attitude and psychoanalyst Sigmund Freud's distinction between primary and secondary processes (see table 1).

Dichotomies with reference to lateralization have been extensive. As long ago as the 1870s, British neurophysiologist J. Hughlings Jackson contended that the left hemisphere engaged in expressive activity and the right hemisphere in perceptual activity. In the 1960s, neuropsychologist J. Semmes distinguished between discrete and diffuse processing in the left and right halves. Joseph Bogen, one of the two neurosurgeons who performed the initial split-brain operations, looked at the neurological findings in split-brain patients and "postulate(d) the existence of two different ways of thinking": a propositional mode in the major hemi-

sphere[3] and an appositional mode in the minor hemisphere[4] (Bogen [1969] 1973).

TABLE 1
Dichotomies without Reference to Cerebral Lateralization

Suggested by	Dichotomies	
C. S. Smith	Atomistic	Gross
Price	Analytic or reductionist	Synthetic or concrete
Wilder	Numerical	Geometric
Head	Symbolic or systematic	Perceptual or nonverbal
Goldstein	Abstract	Concrete
Reusch	Digital or discursive	Analogic or eidetic
Bateson & Jackson	Digital	Analogic
J. Z. Young	Abstract	Map-like
Pribram	Digital	Analogic
W. James	Differential	Existential
Spearman	Education of relations	Education of correlates
Hobbes	Directed	Free or unordered
Freud	Secondary process	Primary process
Pavlov	Second signalling	First signalling
Sechenov (Luria)	Successive	Simultaneous
Levi-Strauss	Positive	Mythic
Bruner	Rational	Metaphoric
Akhilinanda	Buddhi	Manas
Radhakrishnan	Rational	Integral

Source: Joseph E. Bogen, "The Other Side of the Brain: An Appositional Mind," in *The Nature of Human Consciousness*, ed. Robert E. Ornstein (San Francisco: Freeman [paper], and New York: Viking, 1973), p. 120. Reprinted by permission from *Bulletin of the Los Angeles Neurological Societies* 34, no. 3 (July 1969).

Such speculation ignited interpretive imagination. Ornstein himself set forth "a tentative dichotomy" of two modes of consciousness integrating the polarities of intellect and intuition (table 2). He contrasted day and night, sequential and simultaneous, argument and experience.

I added other cognitive contrasts (1984d, 8–9), including theologian Paul Tillich's distinction between technical reason and ecstatic reason

TABLE 2
The Two Modes of Consciousness: A Tentative Dichotomy

Who Proposed It?	Dichotomies	
Many sources	Day	Night
Blackburn	Intellectual	Sensuous
Oppenheimer	Time, History	Eternity, Timelessness
Polanyi	Explicit	Tacit
Levy, Sperry	Analytic	Gestalt
Bogen	Propositional	Appositional
Lee	Lineal	Nonlineal
Luria	Sequential	Simultaneous
Semmes	Focal	Diffuse
I Ching	The Creative: heaven, masculine, yang	The Receptive: earth, feminine, yin
Many sources	Verbal	Spatial
Many sources	Intellectual	Intuitive
Vedanta	Buddhi	Manas
Jung	Causal	Synchronicity
Bacon	Argument	Experience

Source: Robert E. Ornstein, *The Psychology of Consciousness*, 2d ed. (New York: Harcourt Brace Jovanovich, 1977), p. 120.

and psychologist David Bakan's distinction between agency (achievement) and communion (relatedness) (table 3).

Jungian analyst Anthony Stevens synthesized Carl Jung's theory of archetypes with bimodal consciousness (Stevens 1982, 247–75; 1986). Wholeness consists of "the union of opposites," balancing left and right. At the same time he associated cortical activity with subcortical limbic activity, taking into account MacLean's understanding of the triune brain (Stevens 1982, 262–67).

These perceptions of the information-processing patterns of left and right brain arose out of one hundred years of scientific investigation of the brain and its function (Harrington 1987; Young [1970] 1990). Between 1861 and 1961, scientists directed primary attention, and attributed superior value, to the talking left hemisphere. With Sperry's and Bogen's work in the 1960s the emphasis shifted to the contrast between the speaking left hemisphere and the silent right hemisphere. Researchers began directing attention to the double brain with its complementary processes of the analytic and the intuitive.

By 1981, researchers Sally Springer and Georg Deutsch could advance a list of dichotomies that, though quite varied, seemed "to have something in common," specifically the rational left and the metaphoric right, the differential left and the existential right (Springer and Deutsch [1981] 1989, 285). They asked the basic question and offered a tentative interpretation:

> Why so many two-part divisions? Do they label truly distinct and separate qualities, or do they just describe the extremes of a set of continuous behaviors? In other words, are we dealing with all-or-none differences, or are there gradations in between? Some have insisted on the former view [of all-or-none] because, they claim, it conforms best to a neuroanatomical reality—the existence of a left brain and a right brain capable of operating independently. Another view is that the formulation of dichotomies or opposites is just a convenient way of viewing complex situations. (Springer and Deutsch [1981] 1989, 285)

From the suggested affinities based on lateralization evidence, others have expanded this binary understanding of human complexity (e.g., Hampden-Turner [1981] 1982; TenHouten 1985).

Such a sweep of humanity's mind-sets suggests that the concept of two streams of consciousness is fruitful as "a convenient way of viewing complex situations" whether or not there is an actual neuropsychological basis.

Religious Implications in Bimodal Consciousness. Many religious scholars, including myself, found themselves caught up in possible religious implications of bimodal consciousness. At first, bimodal consciousness provided an interpretive lens through which to understand ministry in a postcritical, post-Enlightenment era (Ashbrook 1977; Ashbrook and Walaskay 1977). I used an understanding of the way the brain works as a metaphoric analogy to elaborate aspects of belief. These included reading the Bible, praying for the Spirit, living for Christ, and speaking of God. In speaking of God, for instance, it seemed consistent with bimodal consciousness that godtalk be based on what we first experience in the full subjectivity of the right brain's in-touch awareness and then express that in the intentional consciousness of the left brain's discursive language. A fuller understanding of the theological task requires attention to both in-touch and intentional processes. Bimodal consciousness serves as a warning against one-sided perspectives.

New Testament scholar Paul W. Walaskay examined the mystical experience of the Apostle Paul in light of bimodal consciousness (Walaskay 1977). He identified Paul holding together the ecstasy of eros and the agape of ethics in a mature imitation of Christ. In Christ, the Pauline perceptions of the "sane" and the "insane" (foolish) religious life found "no divided cognition, the active and the receptive provid[ing] for a flowing fullness," in truth, "a pathway to God" (Walaskay [1979] 1989, 208).

TABLE 3
Cognitive Contrasts with Suggested Hemisphere Activity

Left Hemisphere	Right Hemisphere[a]
DEMONSTRATED CONTRASTS	
expression	perception of patterns
linguistic	kinesthetic
propositional	visual
discrete process	diffuse process
logical	synthetic
verbal	visuospatial
SUGGESTED CONTRASTS	
In philosophy:	
knowledge by argument	knowledge by experience
explicit knowledge	tacit knowledge
technical reason	ecstatic reason
regularities	variations
time	eternity
discursive symbolism	presentational symbolism
In personality theory:	
agency (achievement)	communion (relatedness)
secondary process	primary process
power	love
demonstrative theories	dialectical theories
digital communication	analogic communication
In mythology:	
sun	moon
light	dark
good	evil
Heaven	Hell
yang	yin

TABLE 3—*Continued*

Left Hemisphere	Right Hemisphere[a]
SUGGESTED CONTRASTS	
European thinkers:	
seek differences among particulars	seek order, similarity, and unity
Identified emphases:	
abstract from objective	attend to subjective
In split reality:[b]	
healthy	neurotic
actualized	alienated
abstract	concrete
free	bound
salvation	sin
sacred	profane
life	death

Source: James B. Ashbrook, *The Human Mind and the Mind of God: Theological Promise in Brain Research* (Lanham, Md.: Univ. Press of America, 1984), pp. 8–9.

a. Right hemisphere attributes can be identified with less confidence than left hemisphere attributes.

b. These designations under left and right hemisphere are reversible depending upon the value orientation of the person or group. They are listed here from the perspective of a left brain bias.

The lure of interpretive expansiveness with the recognition of bimodal consciousness enticed religiously oriented thinkers to focus on the intuitive and imaginative aspects of right-brain activity. This included exploring the roots of ministry (Holmes, 1978), transforming Bible study (Wink 1980), exploring the aesthetic dimensions of religion and religious education (Laeuchi 1980; Durka and Smith 1979), engaging theology and pastoral counselling (Ashbrook 1979; 1995; Stone 1983), and examining issues of morality (Browning 1976). D. Gareth Jones

(1980), professor of anatomy and human biology at the University of Western Australia, summarized for the nonprofessional reader the then-current state of knowledge of the brain from "a Christian perspective." He gave particular attention to issues of fragility, finiteness, and dignity.

In an article entitled "Half Brains and Split Minds" I advanced the most speculative reaches of a religious response to this focus on bimodal consciousness (Ashbrook 1985b). I described how choreographer Dana Reitz presented a "Journey for Two Sides: A Solo Dance Duet." She danced straight lines with staccato movements on the right and curving lines with flowing gestures on the left. I used Reitz's dancing to explore the metaphoric implications of a two-sided cosmos with its bisected planet (northern and southern hemispheres, East and West) (Arguelles 1975), its bisected brain, a split-brain history of human conflict, and the possibility of a greater unity.

The most developed extrapolation of bimodal consciousness came as I identified the left brain with God's redeeming activity and the right brain with God's (re)creating activity (Ashbrook 1984a; 1984c; 1984d; 1985a; see table 4). Philosopher Paul Ricoeur (1978) and theologian David Tracy (1981) had distinguished between the hermeneutics of proclamation and the phenomenology of manifestation. I used these as the basis for elaborating cognitive styles and patterns of believing (Ashbrook 1984d, 261). The one dome of Byzantium's Basilica of Holy Wisdom (popularly known as Saint Sophia's Basilica) and the two towers of the medieval cathedral at Chartres represent central ecclesiastical tendencies and cultural convergences, archetypal images if you will. There is a domelike manifestation and imaginativeness of religious depth and a spirelike directed intentionality in religious conviction. Some years later, I (Ashbrook 1988) added a third expression of religious orientation. It is derived from the phenomenon of the shopping mall becoming the symbolic Ceremonial Center of Urban America (Zepp 1986). This pseudo-centering and organizing of the surburban sprawl reflects the religious impulse to integrate life in a communally adaptive way. I call it center-likeness in contrast to the domelike and the spirelike.

The result of this juxtaposing of brain and belief was a new natural theology in an empirical mode. In contrast to the rationalism of late medievalism's natural theology, I began attending to the basic role of emotions in rational human activity (cf. Johnson 1987; Damasio 1994). Much traditional theology has been anchored, understandably, in philosophy. Twentieth-century empirical theology focused on lived experience (Meland 1969). I turned, instead, from concern for Being itself and for lived experience to the brain and its working (Ashbrook 1989a). I associated experiential cognition with the constructed patterns of metaphor, linking realistic perception with a tangible analogical focus.

TABLE 4
Theological Contrasts with Suggested Activity of God

Redeeming Activity	(Re)Creating Activity
BIBLICAL	
Exodus	Easter
prophetic	priestly
Word-event	Image-event
the cross	the resurrection
eschatological-apocalyptic	realized eschatology
THEOLOGICAL	
wrath	love
judgment	mercy
kerygmatic	apologetic
not-yet	always-already
Protestant Principle	Catholic Substance
PHILOSOPHICAL	
logos	eros
Thomistic cosmology	Augustinian ontology
doctrine	experience
verbal	preverbal
INTENTION	
historical	metaphysical
political	mystical
ethical	aesthetic
loyal obedience	trusting dependence
FOCAL MEANING	
proclamation	manifestation
SENSORY MODALITY	
hearing	seeing/sensing
HEMISPHERE DOMINANCE	
left brain's step-by-step	right brain's all-at-once

Source: James B. Ashbrook, *The Human Mind and the Mind of God: Theological Promise in Brain Research* (Lanham, Md.: Univ. Press of America, 1984), p. 17.

Sensory Systems and Limbic Processing. During the mid 1970s two additional developments provided powerful interpretive possibilities. One was the popularization of neurolinguistic programming (NLP) and sensory language. NLP is a quasi-scientific lens for clinical practice (Bandler and Grinder 1975; Grinder and Bandler 1976). Samuel Adams, a pastor, associated the major sensory systems of the visual, the auditory, and the kinesthetic with biblical assertions about blind eyes, deaf ears, and hard hearts (Isa. 6:10). Further, he pointed to Pentecost as an experience in which people "*saw* something" like tongues of fire, "*heard* something" like the sound of a mighty wind, and "*felt* something," being filled with the Holy Spirit (Acts 2:1–4). What many theologians had taken as figurative language became concrete, referring to actual sensory processes of seeing, hearing, and sensing. The conclusion: one way to recover the power of God may be to recover primary sensory processing. As one experiences the sensory richness of reality—apart from words—one experiences the really real or God.

The other development began with a suggestion from neuroscientist Robert B. Livingston (1981). He speculated that the limbic arch—from the septum in front to the amygdala in back—might well be the neurological correlate for the psychological phenomena that Tillich referred to as the courage to be part of the whole and courage to be as oneself (Tillich 1952). The amygdala is associated with arousal and survival of the self; the septum with relaxation and continuity of the species.

Continuing Dilemmas and Critical Appraisals. Both theologians and neuroscientists questioned such leaps of association. The leaps ranged from physics through chemistry and biology to cognitive neuroscience to hemisphere lateralization to bimodal consciousness to the brain-mind as "a pathway to God."

Brain researcher Marcel Kinsbourne warned against a cascading landslide of dichotomies organized according to right- and left-brain activity. He labeled this phenomenon "dichotomania" (cited by Galin 1977, 46; Goleman 1977). As has happened many times in the past, an explanatory concept had become so attractive that people applied it uncritically to almost everything. Bimodal consciousness was in danger of being stretched beyond its capacity to cover anything adequately.

More substantively, theologians Philip Hefner (Hefner 1985) and Ralph Wendell Burhoe (personal communication) criticized my book *The Human Mind and the Mind of God* for dwelling too much on lateralization and ignoring other levels of brain activity. Further, Hefner critiqued my ascribing an "unquestioning normativeness . . . to Ricoeur's typology of manifestation and proclamation." I failed to attend to the phenomenology of religion and needed to attend more to philosophical and theological assumptions. Research psychologist T. M. Wong ques-

tioned juxtaposing the brain and belief (Ashbrook 1984a) because of the ambiguity and vagaries of evidence about hemisphere lateralization. In other words, I made "loose inferences . . . [which] lack[ed] firm empirical support" (Wong 1984).

So ended this phase of reflecting on religious and cultural implications in split-brain research and bimodal consciousness. Issues of handedness, gender, sampling, and culture added variations and nuances calling for constraint in speculating. These qualified every generalization about left and right modes of thought (Bryden 1982; Dingwall 1981; Springer and Deutsch [1981] 1989; Ashbrook 1984b; Gibson and Petersen 1991). The imaginative sweep of interpretation was heady, but the immediate awareness of details proved sobering.

The effort to connect scientific explanation and religious understanding seemed to have run its course. At best, the conversation clarified issues about levels of complexity and types of analysis. These issues ranged from the organized regularities of neuroscience through the emerging features of mind to the purposeful patterns of theology (Ashbrook 1984d, 310). In making sense of God (Bowker 1973; Burhoe 1973; 1981), however, interpreters needed to attend to the interrelated qualities of empirical sense, experiential sensibility, and cognitive coherence. Each level has its own logic, its own language, and its own relevant data. At the same time, a method of correlation must include both an analysis of similarity of forms and processes and a recognition of substantive differences and tensions.

PHASE TWO—THE 1980s: DIFFERENTIATED WHOLE-BRAIN FUNCTIONING

Developments in Neuroscience. Despite specialized developments in the neurosciences, some researchers persisted in grappling with the brain-mind problem. For them, this is the basic issue in the conversation about religion and the neurosciences. How are brain and mind related? The issue is complex.

Many neuroscientists held a strictly reductionist view. In this view events were "fully explained atomistically from below upward" (Sperry 1992, 251). Brain and mind were one and the same; biochemical processes were all that mattered. A few, like Nobel laureate John Eccles ([1980] 1992) and neurosurgeon Wilder Penfield (1975), wrestled with what Nobel laureate Roger W. Sperry called the "mentalist logic for the brain-mind relation" to which he himself had come in the mid 1960s (Sperry 1992, 246–48).

Eccles ([1980] 1992) espoused a dualist-interactionism. He located the self-conscious mind in the left hemisphere. Many disputed that view,

though the position bears similarity to neuropsychologist Michael Gazzaniga's association of "the interpreter" with the left hemisphere (1985, 1988). Eccles himself found it "difficult to accept Sperry's rejection of dualism" in his "postulating that there are holistic configurational properties of mental events that are composed of neural events of a lower order" (Eccles [1980] 1992, 23).

Penfield (1975) espoused a dualistic or "two-element" position. He identified centrencephalic integration and coordination in the diencephalon, that region below the new cortex. Here were the brainstem's two units of meaning-making consciousness: one, a mechanism essential to consciousness; and the other, a mechanism of sensory-motor coordination constituting the central integrating system. Despite a lifetime of hypothesizing that the brain and mind are one, Penfield believed "[t]he highest brain-mechanism switches on [the mind as] this *semi-independent element*, which instantly takes charge during wakefulness, and switches it off in sleep" (Penfield 1975, 82, emphasis in original). A close reading suggests less of a dualism and more of an interactionism, a view similar to Sperry's mentalist doctrine.

British brain scientist Donald M. MacKay (1978; 1985) argued that the indeterministic mind, or the "I-story," and the deterministic "brain-story" are complementary correlates. People, not brains, are free. Brains, not people, may be machines.

The most persistent and prominent neuroscientist speculator was Sperry himself (1977; 1982; 1985; [1988] 1993; 1992; 1993). He insisted on both downward and upward causation: the mind emerged from neurons and nerve assemblies with a power greater than its parts. For Sperry, this unified the brain-mind and closed the tension between science and religion. He regarded this as a "consciousness revolution [that] might equally well be called a values revolution" (Breed 1992, xiii) that may help people to identify beliefs to live by that are consistent with science (Sperry 1991; 1992).

In the meantime, research in neuroscience increased exponentially. Biopsychologist Jerre Levy (1985), a former student of Sperry, lifted up interhemisphere collaboration and the single-mindedness of the asymmetrical brain. Researchers specified neuropsychological deficits and normal functioning with ever greater precision (Kolb and Whishaw [1980] 1985; Goodglass 1994). The paradigm of parallel distributed information processing (rather than centralized processing) took on increasing significance (Rummelhart et al. [1986] 1987). In linguistics, experiential realism replaced a propositional view of categories (Rosch and Lloyd 1978; Johnson 1987; Lakoff 1987). In other words, people arrive at categories—whether colors or objects or entities of whatever kind—by means of a configuration of best-fit exemplars rather than

ideal essences. There is no one, absolute right instance. Technically, this is known as a prototypical epistemology.

The suggestive value of bimodal consciousness spurred developments in other disciplines. As neuroscientists moved to take account of subjective consciousness, anthropologists began to take account of neurobiology.

Neuropsychiatrist Eugene G. d'Aquili, with Charles D. Laughlin, Jr., and John McManus, pioneered an anthropological position which they called biogenetic structuralism (Laughlin, Jr., McManus, and d'Aquili 1974; 1990; d'Aquili and Laughlin 1979; d'Aquili [1983] 1993). Their thought moved dialectically between the brain as thesis and the environment as antithesis. For them, cultures developed in tandem with the activity of simpler evolutionary elements in the nervous systems of mammals, including human beings. They termed these elements *neurognostic.* Neurognostic organization of the neural network provides a basis for the universal features of mind and, therefore, for culture (Laughlin, McManus, and d'Aquili 1974, ch. 5).

Next, in *The Spectrum of Ritual,* they applied their theory to ritual as a " 'universal' cultural institution" (d'Aquili and Laughlin 1979, xiii). In this volume Barbara W. Lex argued that ritual readjusts out-of-phase biological and social rhythms by careful manipulation of neurophysiological structures. Right hemisphere dominance is permitted, promoting "a feeling of well-being and relief." Further, ritual synchronizes cortical rhythms in the hemispheres and evokes the rebound of adaptive arousal (d'Aquili and Laughlin 1979, 144–45).

Motor behavior—a trait common to all mammals—links environmental struggle with the rhythmicity of ritual activity. Both ritual and meditative states simultaneously stimulate the energy-conserving parasympathetic nervous system and the energy-expanding sympathetic system. The result is a unified consciousness that "places us in harmony with the universe" (d'Aquili [1983] 1993).

From that theorizing they went on to present a holistic model of human experience which, they say, we construct through the interplay between experience and action. For them, myth-making, like other cognitive processes, arises from the evolution and integration of various parts of the brain with common experience. They call their inquiry a search for "a neurophenomenology of human consciousness" (Laughlin, McManus, and d'Aquili 1990). This phrase refers to the neural structures that make us conscious. Among other functions, these structures deal with "the primal urge to know," what d'Aquili calls "the cognitive *imperative.*"

Previously, cultural anthropologist Victor Turner had pioneered in studying ritual behavior (1969). He had examined the symbolic mean-

ing of human behavior as "the result of social conditioning." In the last phase of his work, however, he turned to what he regarded as "inherent resistances to conditioning." His acquaintance with cerebral neurology led to his fashioning what he called "a new synthesis with anthropological studies." His lecture/article "Body, Brain, and Culture" ([1983] 1993) marks this shift, actually, a conversion from a strictly social to a biosocial view.

Drawing on the work of neurophysiologist Paul D. MacLean and d'Aquili, Turner explored theologian Ralph Wendell Burhoe's conviction that "the creative processes result from a coadaptation, perhaps in ritual itself, of genetic and cultural information." The division of labor between right and left hemispheres suggested the importance of play and playful combinations of "as-if" activity. Play is intimately involved in ritual. Significantly, Turner considered how understanding brain activity "accords with some distinctive features of the religious systems dominant in human culture." The "free interplay and mutual support" between humanity's intuition and its genetic pool indicated a condition of nonconflict that is "sometimes called love" (Turner [1983] 1993).

In neurophilosophy, Patricia Smith Churchland (1986) took a materialist view of brain-mind. For her, "mental processes are brain processes." In the face of that conviction, she claimed that philosophy provides a "synoptic vision" that helps "make sense" of immediate research goals and transcends "disciplinary boundaries" by testing "the integrity of the governing paradigm" (Churchland 1986, 481–82). Her view, however, contrasted with that of leading neuroscientists referred to above.

Developments in Religion. In theology, David Tracy (1981) and Sallie McFague (1982; 1987; 1993), among many, explored analogical and metaphorical discourse, respectively. A metaphorical approach imaginatively leaps across levels of complexity. It recognizes discontinuities and dissimilarities, even as it holds together features of reality which normally do not go together. An analogical approach, in contrast, assumes a sacramental association across levels of complexity. It argues for continuity and similarity consistent with empirical evidence.

With such an emerging methodological refinement, cross-disciplinary efforts between religion and neuroscience gained momentum. Philosopher C. Don Keyes (Macklin 1978; Keyes 1990) explored the possible bearing of MacLean's "triune brain" on philosophy and ethics (MacLean [1975] 1993; 1990). MacLean contended that the human brain, as it emerged, possesses "three mentalities." The first two brain mentalities—the reptilian instinctual brain and the mammalian emotional brain—"appear to lack the power of speech." Only the new rational brain provides the constructed scripts basic to our telling the stories of our subjective experience.

An Orchestrator of the Science-Religion Conversation. Beginning in the mid 1950s, the Institute for Religion in an Age of Science (IRAS), under the leadership of Burhoe, provided a focal point for what he called "an invisible college for scientific study of values and religion" (Burhoe 1981, 14; Breed 1992). In this second phase of interfacing religion and neuroscience specifically, IRAS and the Center for Advanced Studies in Religion and Science (CASIRAS) began sponsoring conferences and seminars with neuroscience input.

In 1979, IRAS's conference theme was "Evolution, Human Nature, and Values." Biopsychologist Jerre Levy (1980) addressed "Varieties of Human Brain Organization and the Human Social System." In 1982, CASIRAS sponsored "Ritual in Human Adaptation." Anthropologist Victor Turner ([1983] 1993) presented the work we have described above. At the same symposium, d'Aquili ([1983] 1993) expounded upon "The Myth-Ritual Complex: A Biogenetic Structural Analysis."

The IRAS conference in 1984 was entitled "Recent Discoveries in Neurobiology—Do They Matter for Religion, the Social Sciences, and the Humanities?" Child psychologist Colwyn Trevarthen ([1986] 1993), another former student of Sperry and colleague of Levy, presented his pivotal paper "Brain Science and the Human Spirit." Building upon the work of MacLean, d'Aquili, Turner, Levy, and others, he reviewed the chemistry and anatomy of the neural core of human motivation, particularly contact with a knowing caregiver. He extended that understanding to the newborn infant and to the transcendent reaches of the human spirit. He combined that theoretical reflection on the brain with "innate motivation for social cooperation and celebration."

Trevarthen jumped from the human brain to the "human communal mind." From here his logic moved to "the parts of the brain that form the essential crucible of the human spirit." In detailing the evidence, he described "the human spirit in children" as the result of the two-person cooperation between a newborn and its mother. "The human spirit," he insisted, "defines itself in qualities of fellowship discovered in play and achieves fulfillment in companionship made strong with ritual." In a way analogous to the work of d'Aquili and the biogenetic structuralists, I would say Trevarthen is dealing with "the primal urge to connect," what I would call "the relational *imperative*."

In 1986, CASIRAS had Jerre Levy and pastoral theologian Don Browning respond to my "neurotheology" position (Ashbrook 1984c; 1984d). Each found it suggestive and not at odds with either neurobiological data or theological understandings. That summer IRAS's theme was "Freedom and Determinism." Levy addressed the issue from her perspective of biopsychology. The next year, 1987, CASIRAS had neurophysiologist Rodney

Holmes, psychologist Robert Glassman, and me critique Churchland's (1986) *Neurophilosophy*. While we applauded her neurological material, we questioned her materialistic reductionism.

Two Advances in Interfacing Religion and Neuroscience. In the first phase religious thinkers used bimodal consciousness as an interpretive lens—a metaphor—through which to understand religious thought. In this second phase, religious thinkers moved in two directions. One was to empiricize the impressionistic hunches of neurotheology, the other to take account of whole-brain functioning.

Empirical Investigations. Jungian analyst Jenny L. Yates, under the direction of Roger Sperry, empirically explored *Psyche and the Split-Brain* (Yates 1994). She assumed that "we have indirect perception of meaning mediated through symbols, particularly in the areas of depth psychology and religious studies." From her investigation, however, it appears that split-brain individuals perceive the meaning of symbolic images directly. This contrasts with perceiving meaning *through* the image, as in normal cognitive processing. When asked what they saw, for instance in M. C. Escher's print of *Sky and Water I,* "they named parallel images with similar meanings" (Yates 1994, 9). Yates found that split-brain individuals saw the pattern with the right hemisphere but did not discern the part, which was the fish. The left hemisphere saw one fish, among the many displayed, but not "a pattern of fish." It took *both* hemispheres "to put together the pattern and the part" [Yates 1994, 6].

Psychologist and theologian J. David Pierce (1986) took an empirical approach to my (Ashbrook 1984d) speculation about analytic and imagistic cognitive styles and ways that people organize their beliefs. He used a multidimensional scaling technique called Individual Differences Scaling (INDSCAL) which preserved individuals' own phenomenological perspectives. From his data he concluded that "the *nature* of the dimensions in this study provides strong support to the thesis that the metaphor of left and right brain processing strategies is relevant to the way that theologians perceive biblical material" (1989, 259). In short, he corroborated my speculation about the hermeneutics of proclamation being an analytic (left half) cognitive style and the phenomenology of manifestation being an imagistic (right half) cognitive style.

Further, Pierce's data distinguished between the perceptions of women socialized in a male-dominated world and those struggling to experience and express a female way of knowing. The average male tends to organize reality in terms of polar contrasts. It matters not whether the contrast is human effort versus God's acting, a rational doing versus a rational being, a redeeming God versus a creating God. Such polarities are con-

trary to what women naturally know and intuitively believe (Ashbrook 1988, 78).

Sex and gender differentiation attracted increasing attention in the 1980s (McGlone 1980; Ashbrook 1989c; 1992a; Levy 1980). Evidence indicates that men tend to focus more upon the physical world and its more abstract features, while women tend to emphasize the social world and its more tangible aspects (Levy 1980, 367–71). Sex-related differences are apparent in preferred strategies of organizing experience (Hellige 1990, 74). Even so, what specific conditions influence the display of sex specific and gender-related behavior remains the central issue (Deaux and Major 1987).

Feminist scholars (e.g., Harding and Hintikka 1983; Ruether 1983; Crysdale 1994) rightly point to the pervasiveness of male power, male hierarchy, and categorical dualisms. For them, the origin of sex and gender differences lies, primarily if not exclusively, in social conditioning, not biological predispositions. However, the evidence of a biogenetic component in religious understanding seems strong.

Psychotherapist Charlotte Smith (1989) wanted to know whether experienced and novice wakeful dreamers had different brain wave patterns in responding to the task of guided imagery. She examined their electroencephalogram (EEG) differences. The results suggested "that females processed their imaging experiences differently than males in both degree and location of brain wave amplitudes." Males processed in the frontal regions, females in the central regions.

This evidence supported other evidence about sex- and gender-related differences. I speculated (Ashbrook 1989c; 1992a) that late maturation of language, mostly in males, makes for hemisphere specialization. This contributes to conceptual and categorical distinctions, polarities, and dichotomies. Early maturation of language, mostly in females, makes for hemisphere bilaterality. This contributes to experiential integration and uncomfortableness with contrasts that suggest dichotomies and dualism.

Both evidence of male-female brain differences and closer examination of belief patterns expand the prototypical patterns identified with bimodal consciousness (Ashbrook 1988). The left brain still is associated with proclamation and saving the world through its characteristic activities of naming reality and analyzing experience. The right brain still is concerned with manifestation and savoring the world; it immerses people in sensory experience and imagines liberating possibilities. However, a third style appears more prevalent than the other two: the whole brain integrating its experience cognitively and affectively, thereby caring for the world. This is most apparent in all forms of prophetic theology—liberation, feminist, Third-World, political. The locus of the holy is in

the concrete situations of people responding to specific pragmatic concerns of survival and significance (Ashbrook 1988, 213).

Taking evolutionary and philosophical foundations more fully into account than in the earlier phase, I spelled out a way the whole brain could be used for an analogical expression of God (Ashbrook 1989a). Human beings try to explain their experiences of what matters, and God is the symbol-concept of what matters most. The meaning-making brain connects us with the environment at the emotional, limbic level—the relational imperative—and constructs our understanding of the world at the cerebral level—the cognitive imperative. The whole-making brain, thereby, combines empathy and imagination (Ashbrook 1989b).

This strategy sets humanity's destiny in the evolutionary scheme of things. Cognition is an emergent phenomenon. It reflects an *expressive ordering* of reality as part of a "single natural system" (Burhoe 1981, 82, 74–75). Human destiny, thereby, comes from and depends upon the mutual interchange between the cultural knowledge of the new brain and the genetic wisdom of the old brain.

Thus, the second phase of whole-brain differentiation drew to a close. Religious scholars turned to empirical investigations of cognitive belief styles and sex-specific imaging processes. Further, they brought evolutionary and philosophical foundations to bear on neuroscience data. As an analogical way to understand God, the brain-mind took on a fuller pattern than the earlier use of bimodal consciousness as a metaphor.

PHASE THREE—THE 1990s: MEANING-MAKING AND AN INTEGRATING CONSCIOUSNESS

The current phase is still unfolding; yet, its directions for religious understanding are apparent. Important as differentiated whole-brain activity is, the overriding feature is the presence of an intentional, integrating consciousness involving every level of the brain and every aspect of culture. Exploration and reflection are developing the neural underpinnings of meaning-making consciousness—the power of making whole (Ashbrook 1989e). The information-processing model of brain-mind, thereby, becomes the meaning-making proclivity of *Homo sapiens*. The contrast between two neuroscientists sets the stage for this third phase.

Nobel laureate Francis Crick writes a best-seller, *The Astonishing Hypothesis: The Scientific Search for the Soul* (1994). After marshaling an impressive range of information about the human brain, he concludes that the hypothesis of soul is unsupportable. Instead, neurons best characterize human beings. Human beings are "*no more than* the behavior of

a vast assembly of nerve cells and their associated molecules" (Crick 1994, 3, emphasis added; 256). No whole, only parts. No soul, no God.

At the same time, neuroscientist Antonio R. Damasio (1994) contends that in separating body and soul the Cartesian split of emotion and reason led to a breakdown of rationality itself. Furthermore, he concludes, "it should be clear . . . that the secrets of the neural basis of mind cannot be discovered by unraveling all the mysteries of one single neuron, . . . or by unraveling all the intricate patterns of local activity in a typical neuron circuit" (Damasio 1994, 259). A purely biological model of the human person fails to deal with the complexity of human suffering. It equally fails to engage the creativity of human significance.

"The truly embodied mind," Damasio insists, "does not relinquish *its most refined levels of operation, those constituting its soul and spirit.*" For here is the dignity, the complexity, the uniqueness, the "human scale" that is basic to our being the human beings that we are (Damasio 1994, 252, emphasis added). Life emerges "not simple, but complex and whole" (Kauffman 1995, 47–48). There is no such reality as a single and simple thing.

Crick and Damasio represent contending views of whole-making and, by inference, the rediscovery of soul and of God. The interfacing of neuroscience and religion resonates with Damasio and his awe of "the human scale." Awe and wonder come in response to the deep order inherent in life itself, to that whole-making and meaning-making that the humanizing brain exhibits. With historian of science Anne Harrington, I suggest that many in both domains of knowledge are taking seriously "the neurobiology of meaning" (Gewertz 1995, 10).

Making Sense of Soul. A significant advance in interfacing religion and neuroscience came when I linked brain processes and the making of meaning (Ashbrook 1991a; 1991b; 1992b; Winson [1985] 1986; Bergland [1985] 1988; Hobson 1988). I was responding to the issue of, Where is the locus of the soul, or is there privileged tissue in the brain?

Soul marks the core or essence of a person (or group). This requires a working memory of personally meaningful behavior. The state of the soul is reflected in the states of the mind and their physiological correlates—the brain states of waking, sleeping, and dreaming. These cycles appear similar to the biblical cycle of creation-Sabbath-consciousness. The biorhythm of brain-mind is waking and work, sleeping and rest, dreaming (rapid eye movement or REM) and the reorganization-integration process that is ever making sense of our senses by synthesizing what they mean to us. Working memory and biorhythms, I have speculated, are crucial for the making of meaning. Meaning I have equated with the making of soul.

These speculations have provided impetus for subsequent reflection

on the function of the limbic system. The limbic system deals with information derived from events, memories of events, and emotional meanings associated with those events (Winson [1985] 1986, 32; Ashbrook [1989b] 1993). I have suggested that here might be the functional seat of the soul (Ashbrook 1991a; 1991b; 1992b). Such empirical data hold promise for understanding more fully the psalmist's song of praise that we are "fearfully and wonderfully made" (Psalm 139:14a).

Homo Religiosus. Perhaps the boldest speculation of a neuroscientist is that of Rodney Holmes, first voiced during the same period as my exploration of the soul. Holmes was developing an understanding of *Homo sapiens* as *Homo religiosus* (Holmes 1991; 1996), suggesting that humanity's religious dimension emerged from the brain's own evolution. We are meaning-making creatures by virtue of the very evolution of our neocortex. Human beings connect with each other by their "narratives about what is ultimately significant" as "a whole." Intellect, consciousness, and religion, he contended, "are methods of handling knowledge as a whole."

Thus, for Holmes, religious understanding is "a hermeneutic of the text of nature," showing us "what is most real." The brain's capacity for imagination—expressed through language, memory, a sense of the future, and gestalts—is "linked to, but not reducible to, particular structures and functioning of the peculiarly human brain" (Holmes 1996).

In 1991, CASIRAS asked me (Ashbrook 1991a) to deal with the soul as the intersection of religion and neuroscience and Holmes (1991) to deal with the issue of *Homo religiosus.* Together, our explorations converged on the issue of a neuropsychology of religion as the making of meaning. I came at meaning-making via the imperative of empathic attunement centered in the limbic system, while Holmes came at meaning-making via the imperative of cognitive coherence centered in the neocortex.

At its 1992 summer conference, IRAS focused on "The God Question in an Age of Science." I spoke on "Our Illusory Relation with God: A Neurotheological Approach" (published in 1994 as "The Cry for the Other"), and d'Aquili presented "Mystical States and the Experience of God: A Model of the Neuropsychological Substrate" (d'Aquili and Newberg 1993). I explained that we fill the gap experienced when loved ones (originally, parents) inevitably fail to meet our every need with "transitional objects"—originally teddy bears and blankets, but in later, more sophisticated life with the arts, learning, and religion. These transitional objects and symbols serve the function of demonstrating what the world is like (Winnicott 1971). D'Aquili elaborated a neuropsychological model for mystical states in the functions of various sensory association areas and the integrating patterns of limbic activity. I need to note that

each of these approaches, while compelling in correlating consciousness and neuronal activity, remains speculative. No necessary causative explanatory mechanisms are detailed nor is experimental empirical evidence cited. Investigation with high-tech imagining procedures is called for.

In the spring of 1994, CASIRAS sponsored an invitational seminar, "Renewal of Your Mind." It was orchestrated by Holmes and jointly sponsored by the Chicago Center for Religion and Science and the Park Ridge Center for Health, Faith, and Ethics. That summer, IRAS sponsored another conference, this time on the theme "Knowledge Most Worth Having in the Decade of the Brain." It, too, was under the direction of Holmes. During the same period, Philip Hefner, prominent theologian in the science and religion conversation and editor of *Zygon*, made the decision to highlight the neurosciences specifically in several issues of 1996 and 1997.

Currently President Neil L. Rudenstine of Harvard University has set forth five university-wide themes including the Mind/Brain/Behavior Initiative (MBBj) 5 (Gewertz 1995). This interdisciplinary approach is generating discussion, research, programs, and course offerings. Anne Harrington, the Kahn Associate Professor of the History of Science, is a key participant in the process. Her concern is to fit human consciousness into the scientific model, particularly identifying links among various disciplinary domains and levels of analysis. She, like many of us, is translating meaning and metaphor into the language of science.

WORK IN PROGRESS

A quick survey of work in progress suggests future developments. Some of it is sketchy so far; some is already fleshing out possibilities of interdisciplinary development. Three active areas are the human relatedness of religion, cross-cultural variations, and sensory processes and spirituality.

Religion and Relatedness. Much, if not all, of the above points to the human brain as a humanizing brain. We live in a humanly understandable reality, because our brain functions in humanly understandable ways (Guthrie 1993). The brain-mind develops only in the presence of other human beings. Regardless of the individuals involved, to omit its "relations with other members of its group is to leave out almost everything" (Gregory 1987, 533). (Group relatedness is relevant to all animals that reproduce sexually.) Attachment and aspiration go together (Bowlby 1969; 1973; 1980; 1988; Trevarthen [1986] 1993; Ashbrook 1994).

Developments in the neurosciences are specifying ever more precisely what attachment means for human life. There is the neural core of chemistry, anatomy, and mental energy. In the core brain we are

hard-wired for intentional attention to faces and places. Our instinctive motor patterns are to act on our curiosity about people as well as things. Instead of randomness, such selectivity is primary (Gazzaniga 1992).

Limbic activity is the locus of emotional attunement to others and to our general situation (MacLean 1990; Trevarthen [1986] 1993; 1990b; Ashbrook [1989b] 1993). Autonomic emotional processes involve arousal, relaxation, and play (d'Aquili [1983] 1993; Lex 1979; Laughlin, McManus, and d'Aquili 1990; Turner [1983] 1993). The limbic system's motivational divisions include the amygdalar system and self-preservation, the septal system and sociability, the thalamocingulate division and family behavior (care-giving), empathy, vocalization, play, and tears (MacLean 1970; 1985; 1990).

In speculating about the intersection of psychoanalysis and neuroscience, psychoanalytic psychiatrist Fred Levin regards the cerebellar and cerebral mechanisms of "human adaptation as a hierarchy of self-in-the-world potentials" (Levin 1991, 110, 115). He believes NREM (non–rapid eye movement) sleep resolves "'the . . . problem [of] attribution of meaning to one's own states of tension'" (p. 126). That suggests NREM sleep is crucial in our search for cognitive meaning and its conceptual coherence. Similarly, REM (rapid eye movement) sleep resolves "problems involving ambivalence" (p.126). That concerns our search for human relatedness and its affective impact.

I and science writer-editor Carol Rausch Albright are elaborating a neurobiology of religion (Ashbrook and Albright, forthcoming). We draw on MacLean's classic view of a triune brain with three anatomical and functional sectors—three minds, if you will—to serve as an analogical reference for understanding God's ways of being God. The sensory-based reptilian brain points to the attention-oriented activities of God expressed through the concrete reality of people and places. The emotional-relating empathy and meaningful memory of the old mammalian brain highlight God's caring. And the rationality of the neocortex seems to employ an ordering power that uncannily reflects the order in the universe. This pattern-making consciousness suggests God as intentional and purposeful.

The humanizing brain creates and reflects a universe in which the brain-mind is the center of knowing (Guthrie 1993). It is the collective "brain" of the species and not simply any single individual that receives, analyzes, and aspires to what matters most in the world in which we find ourselves. What we are able to perceive as the mind of God reflects and expresses the intentionality and purposes to which we aspire in our most human and humane ways. What we are able to conceive of as the heart of God reflects and expresses the empathic caring and nurturing that are

both the means and the meaning of what it is to know what matters to us as we discern our place in the cosmos. These, of course, are sweeping strokes of interpretation; they call for more precise neurobiological correlates.

Neuropsychologist Brian Lancaster, in a similar vein, developed a model of the mind that stresses the "quest for meaning" (Lancaster 1991; 1993). Out of a Jewish mystical tradition, Lancaster links left-brain creating, right-brain knowing, and whole-brain consciousness as keys to the imaginative faculty, which, he maintains, "places us most fully 'in the image of God'" (Lancaster 1991, xiv 2). The analytic, interpreting left brain emphasizes subject-object distinctions. The intimate, knowing right brain dissolves these distinctions, "fusing self to object in the act of knowing" (Lancaster 1991, 186). Both together create balance and address the unknown. Paradigmatically, the first letter of the Hebrew alphabet, *alef*, embodies the principle of balance and symbolizes the unknown. But this letter *alef* is silent. The next three letters together form the Hebrew word for clothing, *beged*, which, says Lancaster, also means "the teaching." "We can know only the clothing"—the teaching (Lancaster 1991, 190). In actuality, the unknown confronts us on every side. It both frightens and challenges. Here is the ground of our potential, our alpha and our omega.

Other scholars and researchers have directed attention to non-Western traditions as well. Biogeneticists Laughlin, McManus, and d'Aquili (1990) and Newberg (d'Aquili and Newberg 1993) as well as cognitive scientist Francisco J. Varela (Varela, Thompson, and Rosch [1991] 1993) have pioneered in linking Buddhism, especially Buddhist meditation, and neuroscience. "Embodiment" is a key term in this exploration. It carries the double sense of encompassing "both the body as a lived, experiential structure and the body as the context or milieu of cognitive mechanisms" (Varela, Thompson, and Rosch [1991] 1993, xvi). The cornerstone of the Buddhist tradition is a nonunified or decentered cognitive being—a selfless self, an egoless self. They spell out neurobiological correlates with great precision. The connections, however, remain more speculative than empirical.

In the language of neuroscience, these views of God suggest: first, attentional selectivity in the upper brainstem; next, empathic attunement in the limbic system; and, finally, cognitive coherence and goal seeking in the frontal lobes of the neocortex. All this is psychobiologically integrated and evolutionarily adaptative in biorhythm activity. Here, then, is a common relational structure matching brain and perception of God.

These twin aspects of meaning-making and object-seeking represent the reality of religion (Peters 1985; Eliade 1987; Reat and Perry 1991;

H. Smith 1990; W. Smith 1979; Smart and Konstantine 1991; Chopp 1994; Kaufman 1992, 1993). In its unconscious roots, religious understanding suggests there is "more" to God than rationalization of feelings (Liddon 1989). In its conscious reaches, there is the "more" of imagination and mystery and there are the narrative accounts of our human condition that Holmes describes.

Both religion and neuroscience converge on this perspective. Gordon Kaufman's book *In Face of Mystery* reminds us that theology, or religion, is "an activity of *deliberate* imaginative construction," "small steps" of faith that lead to a modern understanding of God (Kaufman 1993, 287). This accords with evidence of brain research that we make "do or die" decisions in the unconscious about what matters. "The environment triggers three forms of preconscious analysis: perceptual, evaluative, and motivational" (Azar 1996, 25). We act based on our judgment and assessment of the results of these unconscious processes. Thus, we live by faith, as manifested in our pattern-making capacity, and not by literal sight.

Cross-Cultural Variations. Cross-cultural perspectives (Tsunoda 1989; Gibson and Petersen 1991) help us distinguish that which is culture specific or culture related and that which is metacultural or transcultural.

Pastoral theologian Sang Bok Lee (1995) has made a major contribution to this in a biocultural-theological analysis of possible Korean resolution of Han. Han refers to cultural, political, and personal pain in the Korean context. In the context of religious pluralism, process theology offers a vision of the universal relationality of God. In the context of cultural particularities, neurotheology and neurognostic activity of rituals make sensible, and thereby give some validity to, the folk religious practices of Shamanism and the mask dances. In the context of societal constraints, a social system analysis identifies the protective and constructive function of social processes in structuring and restructuring society.

Lee delineates "the neurophenomenology of the Kut"—the mask dance—in terms of the theory of cerebral lateralization, the activity of the limbic system and the hypothalamus, and psychoneuroimmunology. More specifically, he describes "the phenomenon of synchronicity from the neuroscientific perspective and [suggests] the Kut's psychotherapeutic effects on releasing the . . . Han as well as enhancing the immunity of the mind" (Lee 1995, 116–17).

Sensory Processing and Spirituality. One of the more intriguing developments has been the rediscovery of sensory processing as basic to spirituality.

Byzantine-Syriac historian Susan Ashbrook Harvey is investigating the sense of smell, the meaning of olfactory experience, in early Christianity. Instead of staying with the development of the senses of sight and hearing, so prominent in *Homo sapiens*, she is reminding us of our most primitive link with other mammals. At Saint Vladimir's Orthodox Seminary she presented the Alexander Schmemann Memorial Lecture on "'The Very Fragrance of Paradise': Sense Perception and Knowledge of God in the Church Fathers" (Harvey 1994a). Later that year, at a Byzantine Studies Conference (Harvey 1994b), she described in vivid detail "Sanctity and Stench: When Holy Fragrance Turns Foul."

As a category of religious experience, fragrance grew prominent during the late fourth century. However, Harvey concluded by indicating that soon fragrance became "crucial to the sensory ordering of Christian piety in the Byzantine world. The motif of holy stench offers a profound critique of what may well have been perceived (by some) to be excessive enthusiasm in the religious use of incense and spices—a corrective to any simplistic understanding of how sense perception relates to religious knowledge."

Women's Religious Experience. Pastoral psychotherapist Susan Cross (1994) investigated visceral process in the context of women's trauma and religious experience. Four women in their mid to later years reported on their relationship with their mothers, the trauma of growing up in dysfunctional families, the psychic pain of their adult years, and the healing that accompanied vivid sensory experience with explicit religious content. Such accumulating evidence supports other researchers' work on the primacy of the sensory for religious experience (Henry 1986; 1992; Lancaster 1991; 1993; d'Aquili [1983] 1993; d'Aquili and Newberg 1993).

Emerging Directions. The new cognitive neuroscience bridges careful empirical work and imaginative theory building (Eimas and Galaburda 1989; Kosslyn and Koenig 1992). We find this, for instance, in Damasio's argument that conscious events are *not* related to an increasing convergence and abstraction in the frontal and temporal cortices (Eimas and Galaburda 1989; Damasio 1994). Instead, they are distributed reactivating of areas related to primary sensory analysis and perception of events.

Modern technology accelerates the pursuit of localization and specification. I do not lament this. Rather, I celebrate our increasing ability to identify and describe—in truth, explain—the mechanisms of meaning-making so central and pervasive in the brain-mind. At the same time, the religious or whole-making dimension of human experience reminds us of the elusiveness of every attempt at literalization and reductionism. Life is always "more than" the sum of its parts; its parts are always functioning in novel and surprising self-organizing ways (Kauffman

1995). In pursuing technological refinements of cognitive processing we are to avoid what philosopher Alfred North Whitehead alluded to as "misplaced concretion." No part is capable of containing the whole. Such is the religious meaning of idolatry.

In addition to technical and methodological complications about the cognitive significance of brain-imaging data, there are basic interpretive limitations (Valenstein 1994). Accurate and precise functional localization is uncertain for several reasons. It may be widely distributed and/or diffusely organized. It may represent anatomical overlaps and even shared neuronal elements with neural structures that mediate different functions. It may engage in different functions depending on input patterns associated with other cognitive conditions. Most of all, "some central circuits may have differential and overlapping functions depending on the pattern of activation" (Sarter, Berntson, and Cacioppo 1996, 16–17).

Despite the intuitive appeal of brain mapping, "the organization of cognitive phenomena [cannot be mapped] in a 1:1 fashion into the organization of underlying neural substrates." Top-down approaches—moving from larger units of patterns to smaller elements of specification—do highlight structure-function correlations. However, these "may not be validly interpreted as pointing to the 'actual fundamental faculties' processed by focal brain areas of circuits" (Sarter, Berntson, and Cacioppo 1996, 20).

The great Russian neuropsychologist A. R. Luria underlined this caveat against reducing the basic qualities of living organisms to the features of separate cells. He pointed out, drawing on the work of his colleague Leo Vygotsky, that such reducing comes up against certain limits. "In order not to lose the basic features of water," for instance, "one must split it into *units* (H_2O), not into *elements* (H and O). The same," he concludes, "is true for the psychological analysis of human conscious behavior" (Luria 1987, 675).

Luria went on to focus on *relationships* as the essential feature of human experience. To understand and explain subjective experience—objectified though it can be by high-tech equipment—requires "*its inclusion in a rich net of essential relations*" (Luria 1987, 676, emphasis added). A configurational-relatedness view of the really real constitutes the core of meaning-making. Religion itself—in all its variations—reflects humanity's meaning-discerning/meaning-constructing participation in the ecosystem of which it is a part and which it most fully expresses. Sensory processes awaken symbolic processes and, in turn, are shaped by symbolic processes. Symbolic processes are relational patterns—linking this piece with that piece and these pieces with other pieces in constructing a mosaic of that which makes sense and brings satisfaction and fulfillment.

From a theological view I parallel the localizing-globalizing tension in neuroscience with the proclaiming-manifesting tension in theology. The locus of the holy can be specified. Some places, some patterns, some relationships are more fruitful—have more survival value—than others. Yet, no place, no pattern, no relationship is ultimately privileged and definitive. The locus of the holy—the whole-making integrating of differentiating processes—is everywhere, with everyone, even in distorted and dysfunctional expressions. Religion reminds us of God and soul. It directs our attention to the depth of experience. It seeks the value of what is. It insists upon the relatedness of everything, in a universe that is to be cherished even as it gives birth to *Homo sapiens, Homo religiosus.*

Research and reflection lead us into an ever-expanding future of possibilities. We can differentiate elements of complexity—and even units of complexity—with ever-increasing specificity (e.g., Davidson and Hugdahl 1995). At the same time, we are called to name the concrete, rich interrelatedness of units and elements without eliminating their life-giving powers. There is no place, no entity, no tangible reality that encompasses all that the concepts God and soul and humanity represent. Yet the dynamic differentiating and integrating process is active—in every place, in every entity, in every concrete element (Kauffman 1995).

To return to Huxley's comment above, we can talk about anything and everything that matters to our humanity in terms of the several languages with which we engage reality. Neither the language of neuroscience nor the language of religion is adequate in itself, or even in combination. We need every human language and every domain of knowledge if we are to be all that we can be. This is what I call the "Pentecostal Paradigm," the inclusive languaging of every culture and every discipline (Acts 2:1–13; Ashbrook 1996, 79–80, 132–33). Our understanding of the world is "inseparable from our bodies, our language, and our social history—in short, from our *embodiment*" (Varela, Thompson, and Rosch [1991] 1993, 149). Only from our embodiment does the really real come back to us as the urgently right.

The emerging methodology combines analogical continuities of levels/dimensions with metaphorical leaps of the discontinuities of levels/dimensions. We are to move back and forth among physiological signals, psychological significances, symbolic meanings, and social organizations (Cacioppo 1992; Cacioppo and Tassinary 1990; Cacioppo and Berntson 1992; Caldwell 1994) to assumptive orientations and worldviews or religion. While such moves are synergistically suggestive and tentatively integrative, we must keep these levels/dimensions distinct for empirical anchoring and to avoid both procedural arbitrariness and disciplinary imperialism.

More specifically, there is a physiological level or hormonal synthesis

and release, a bottom-up objective orientation of evolving knowledge of causality in developmental neuroscience (Gunnar and Nelson 1992). There is a behavioral level of attention and approach that mediates collaboration and exponential complexity in cognitive neuroscience. There is a subjective level of feelings, awareness, and intentionality in the social contexts and universes of influence in the human sciences. There is a symbolic level of cultural assumptions and valuations (Klivington 1989; Gunnar and Nelson 1992) in a top-down value/religious orientation in neurotheological hermeneutics.

And ultimately there is a flowing fulfillment of complexity (Csikszentmihalyi 1993; Kauffman 1995) generated by "the human factor" (Hefner 1993) and the humanizing brain (Ashbrook and Albright, forthcoming). Nature, as psychologist William Bevan has observed, is "orderly in its complexity rather than lawful in its simplicity" (cited by Cacioppo and Berntson 1992).

CONCLUSION

Over twenty-five years, religious thinking on neuroscience has attained some maturity. The first phase gave simplistic attention to bimodal consciousness as an interpretive tool for understanding religious thought and practice. The second phase developed a more sophisticated exploration of whole-brain functioning and possible cultural correlates. Diversity of theological voices, a pluralistic world situation, religion and Christianity viewed as movements and lived praxis in community, and theology as handed-down texts all contributed to a more sophisticated view of religion itself (Chopp 1994). Simultaneously, the explosion of work in the neurosciences contributed to a more informed and awesome appreciation of the brain-mind itself. The current phase focuses increasingly on the making of meaning and the integrating of differentiated experience.

In his Gifford Lectures of 1937, the great brain scientist Charles Sherrington declared: "The brain is waking and with it the mind is returning. It is as if the Milky Way entered upon some cosmic dance. Swiftly the head mass becomes an *enchanted loom* where millions of flashing shuttles *weave a dissolving pattern though never an abiding one; a shifting harmony of subpatterns*" (Sherrington [1940] 1951, 184, emphasis added).

As I reflect on these twenty-five years of thinking religiously about neuroscience, I am brought more and more to an awed appreciation of our humanizing brain. We are ever engaged in the task of weaving meaningful patterns in our lives. These are always shifting harmonies and never *the* abiding one. These ever-new harmonies are what most truly reflect our relatedness and our meaning-making.

NOTES

The author expresses appreciation to Rodney Holmes for collaboration and critique.

1. I use the single word *brain* because it is the current designation and for shorthand purposes. To let *brain* be the only word to describe my view of neuroscience, however, allows a mistaken yet implied, though unintended, reduction to biochemical processes, which do not take account of those most human qualities of mentalistic processes at least and spiritual processes at most.
2. There are, however, many exceptions, notably among theoretical physicists who often appreciate the particulars while also seeking order and theoretical beauty in ways reminiscent of mysticism.
3. Bogen cites Jackson's distinguishing the major hemisphere's *use* of words rather than its *possession* of words: "A proposition is not a mere sequence . . . it consists of words referring to one another in a particular manner [so that each] modifies the meaning of the other" (Bogen [1969] 1973, 108).
4. In choosing "appositional" to characterize the minor hemisphere's activity, Bogen recognized the then current "ignorance" of that hemisphere's ability. His term was "sufficiently ambiguous to permit provisional use," implying "a capacity for apposing or comparing of perceptions, schemas, engrams, etc., but has in addition the virtue that it implies very little else. If it is correct that the right hemisphere excels in capacities as yet unknown to us, the full meaning of 'appositional' will emerge as these capacities are further studied and understood. The word 'appositional' has the essential virtue of suggesting a capacity as important as 'propositional,' reflecting a belief in the importance of the right hemisphere function" (Bogen [1969] 1973, 111).
5. The others are children's education, ethics, the environment, and health policy.

REFERENCES

Arbib, Michael A., and Mary B. Hesse. 1986. *The Construction of Reality.* Cambridge: Cambridge Univ. Press.

Arguelles, Jose A. 1975. *The Transformative Vision: Reflections on the Nature and History of Human Expression.* Boulder, Colo.: Shambhala.

Ashbrook, James B. 1977. "Postcritical Ministry: Beyond Critical Coolness and Uncritical Warmth." *Foundations: A Baptist Journal of History and Theology* 20 : 60–78.

_____. 1979. "The Working Brain: A New Model for Theological Exploration." *Religion in Life* (Spring) : 6–16.

_____. 1984a. "Juxtaposing the Brain and Belief." *Journal of Psychology and Theology* 12 : 198–207.

_____. 1984b. "Ambiguity in Neuropsychology: A Response to Wong." *Journal of Psychology and Theology* 12 : 314–319.

_____. 1984c. "Neurotheology: The Working Brain and the Work of Theology." *Zygon: Journal of Religion and Science* 19 (September) : 331–50.

_____. 1984d. *The Human Mind and the Mind of God: Theological Promise in Brain Research.* Lanham, Md.: University Press of America.

_____. 1985a. "Brain, Mind and God." *The Christian Century* (March 19–26): 295–98.

_____. 1985b. "Half Brains and Split-Minds." *Pastoral Psychology* 34 : 9–20.

_____. 1988. *The Brain and Belief: Faith in Light of Brain Research.* Bristol, Ind.: Wyndham Hall Press.

_____. 1989a. "The Whole Brain as the Basis for the Analogical Expression of God." *Zygon: Journal of Religion and Science* 24 (March) : 65–81.

_____. [1989b] 1993. "The Human Brain and Human Destiny: A Pattern for Old Brain Empathy with the Emergence of Mind." *Zygon: Journal of Religion and Science* 24: (September 1989) : 335–57. Reprinted in *Brain, Culture, and the Human Spirit,* ed. James B. Ashbrook, pp. 183–210. Lanham, Md.: Univ. Press of America, 1993.

_____. 1989c. "Ways of Knowing God: Gender and the Brain." *The Christian Century* (January 4–11): 14–15.

_____. 1989d. *Faith and Ministry in Light of the Double Brain.* Edited with contributions. Bristol, Ind.: Wyndham Hall Press.

_____. 1989e. "Learning Faith: Beyond Reason and Emotion." In *Faith and Ministry in Light of the Double Brain,* ed. James B. Ashbrook, 262–301. Bristol, Ind.: Wyndham Hall Press.

_____. 1991a. "The Seat of the Soul: Where Religion and the Neurosciences Intersect." *Insights: The Magazine of the Chicago Center for Religion and Science* 3 : 6–10.
_____. 1991b. "Soul: Its Meaning and Its Making." *The Journal of Pastoral Care* 45 : 159–68.
_____. 1992a. "Different Voices, Different Genes: Male and Female Created God Them." *The Journal of Pastoral Care* 46 : 174–83.
_____. 1992b. "Making Sense of Soul and Sabbath: Brain Processes and Making of Meaning," *Zygon: Journal of Religion and Science* (March): 31–49.
_____, ed. 1993. *Brain, Culture, and the Human Spirit: Essays from an Emergent Evolutionary Perspective.* Lanham, Md.: Univ. Press of America.
_____. 1994. "The Cry for the Other: The Bio-cultural Womb of Human Development." *Zygon: Journal of Religion and Science* 29 (September): 297–314.
_____. 1995. "The More Things Change: Learning to Know What I Already Knew." *Journal of Supervision and Training in Ministry* 16 : 77–92.
_____. 1996. *Minding the Soul: Pastoral Counseling as Remembering.* Minneapolis: Fortress Press.
Ashbrook, James B., and Carol Rausch Albright. Forthcoming. *The Brain That Minds: Clues to God's Way of Being God.*
Ashbrook, James B., and Paul W. Walaskay. 1977. *Christianity for Pious Skeptics.* Nashville, Tenn.: Abingdon Press.
Azar, Beth. 1996. "Influences from the Mind's Inner Layers." *The APA Monitor* 27: 1, 25.
Bandler, Richard, and John Grinder. 1975. *The Structure of Magic I: A Book about Language and Therapy.* Palo Alto, Calif.: Science and Behavior Books.
Barbour, Ian G. 1966. *Issues in Science and Religion.* Englewood Cliffs, N.J.: Prentice-Hall.
_____. 1974. *Myths, Models and Paradigms: A Comparative Study in Science and Religion.* New York: Harper and Row.
_____. 1990. *Religion in an Age of Science: The Gifford Lectures 1989–1991, Vol. One.* San Francisco: Harper and Row.
Bergland, Richard. [1985] 1988. *The Fabric of Mind.* Ill. Katt Bromley. New York: Viking Penguin.
Bogen, Joseph E. [1969] 1973. "The Other Side of the Brain: An Appositional Mind." *Bulletin of the Los Angeles Neurological Societies* 34 : 135–62. Reprinted in *The Nature of Human Consciousness: A Book of Readings,* ed. Robert E. Ornstein, 101–25. San Francisco: Freeman.
Bowker, John. 1973. *The Sense of God: Sociological, Anthropological and Psychological Approaches to the Origin of the Sense of God.* Oxford: Clarendon Press.
Bowlby, John. 1969. *Attachment,* vol. 1. New York: Basic Books.
_____. 1973. *Separation: Anxiety and Anger,* vol. 2. New York: Basic Books.
_____. 1980. *Loss: Sadness and Depression,* vol. 3. New York: Basic Books.
_____. 1988. *A Secure Base.* New York: Basic Books.
Breed, David R. 1992. *Yoking Science and Religion: The Life and Thought of Ralph Wendell Burhoe.* Foreword by Roger W. Sperry. Chicago: Zygon Books.
Browning, Don S. 1976. *The Moral Context of Pastoral Care.* Philadelphia: Westminster Press.
Bryden, M. P. 1982. *Laterality: Functional Asymmetry in the Intact Brain.* New York: Academic Press.
Burhoe, Ralph Wendell. 1973. "The Concepts of God and Soul in a Scientific View of Human Purpose." *Zygon: Journal of Religion and Science* 8 (September-December): 412–42.
_____. 1981. *Toward a Scientific Theology.* Belfast: Christian Journals Limited.
Cacioppo, John T. 1992. "The Principles of Multiple, Nonadditive, and Reciprocal Determinism: Implications for Social Psychological Research and Levels of Analysis." In *The Social Psychology of Mental Health: Basic Mechanisms and Applications,* eds. Diane N. Ruble, Philip R. Costanzo, and Mary Ellen Oliveri, 328–49. New York: Guilford Press.
Cacioppo, John T., and Gary G. Berntson. 1992. "Social Psychological Contributions to the Decade of the Brain." *American Psychologist* 47 : 1019–28.
Cacioppo, John T., and Louis G. Tassinary. 1990. "Inferring Psychological Significance from Physiological Signals." *American Psychologist* 45 : 16–28.
Caldwell, Alex B. 1994. "Simultaneous Multilevel Analysis." *American Psychologist* 48 : 144–45.

Capra, Fritjof, and David Steindl-Rast. 1991. *Belonging to the Universe: Explorations on the Frontiers of Science and Spirituality.* San Francisco: HarperCollins.
Chopp, Rebecca S. 1994. "Recent Works in Christian Systematic Theology." *Religious Studies Review* 20 : 3–12.
Churchland, Patricia Smith. 1986. *Neurophilosophy: Toward a Unified Science of Mind-Brain.* Cambridge: M.I.T. Press.
Crick, Francis. 1994. *The Astonishing Hypothesis: The Scientific Search for the Soul.* New York: Scribner's.
Cross, Susan. 1994. "Women's Religious Experience." D. Min. thesis, Garrett-Evangelical Theological Seminary, Evanston, Ill.
Crysdale, Cynthia S. W. 1994. "Gilligan and the Ethics of Care: An Update." *Religious Studies Review* 20 : 21–28.
Csikszentmihalyi, Mihaly. 1993. *The Evolving Self: A Psychology for the Third Millennium.* New York: HarperCollins.
Damasio, Antonio D. 1994. *Descartes' Error: Emotion, Reason, and the Human Brain.* New York: Grosset/Putnam.
d'Aquili, Eugene G. [1983] 1993. "The Myth-Ritual Complex: A Biogenetic Structural Analysis." *Zygon: Journal of Religion and Science* 18 (September): 247–69. Reprinted in *Brain, Culture, and the Human Spirit,* ed. James B. Ashbrook, pp. 45–75. Lanham, Md.: Univ. Press of America.
_____. 1993. "Profile: Eugene G. d'Aquili." *Zygon: Journal of Religion and Science* 28 (June).
d'Aquili, Eugene G., and Charles D. Laughlin, Jr., eds. 1979. *The Spectrum of Ritual: A Biogenetic Structural Analysis.* New York: Columbia Univ. Press.
d'Aquili, Eugene G., and Andrew B. Newberg. 1993. "Religious and Mystical States: A Neuropsychological Model." *Zygon: Journal of Religion and Science* 28 (June): 177–200.
Davidson, Richard J., and Kenneth Hugdahl, eds. 1995. *Brain Asymmetry.* Cambridge: M.I.T. Press.
Deaux, Kay, and Brenda Major. 1987. "Putting Gender into Context: An Interactive Model of Gender-Related Behavior." *Psychological Review* 94 : 39–89.
Dingwall, W. A. 1981. *Language and the Brain: A Bibliography and Guide,* 2 vols. New York: Garland.
Durka, Gloria, and Joan Marie Smith, eds. 1979. *Aesthetic Dimensions of Religious Education.* New York: Paulist Press.
Eccles, John C. [1980] 1992. *The Human Psyche: The Gifford Lectures 1978–1979.* New York: Routledge.
Eimas, Peter D., and Albert M. Galaburda, eds. 1989. *Neurobiology of Cognition,* 2d ed. Cambridge: M.I.T. Press.
Eliade, Mircea, ed. 1987. *The Encyclopedia of Religion.* New York: Macmillan.
Fleming, William. 1974. *Arts and Ideas.* New York: Holt, Rinehart and Winston.
Galin, David. 1977. "The Two Modes of Consciousness and the Two Halves of the Brain." In *Symposium on Consciousness,* Philip R. Lee; Robert E. Ornstein; David Galin; Arthur Deikman; and Charles T. Tart, 26–53. Baltimore: Penguin.
Gardner, Howard. 1985. *The Mind's New Science: A History of the Cognitive Revolution.* New York: Basic Books.
Gazzaniga, Michael S. 1985. *The Social Brain: Discovering the Networks of the Mind.* New York: Basic Books.
_____. 1988. *Mind Matters: How the Mind and Brain Interact to Create Our Conscious Lives.* Foreword by Robert Bazell. Boston: Houghton Mifflin.
_____. 1992. *Nature's Mind: The Biological Roots of Thinking, Emotions, Sexuality, Language, and Intelligence.* New York: Basic Books.
Gerhart, Mary, and Allan Russell. 1984. *Metaphoric Process: The Creation of Scientific and Religious Understanding.* Foreword by Paul Ricoeur. Fort Worth: Texas Christian Univ. Press.
Gewertz, Ken. 1995. "Inquiring into Mind: Anne Harrington Translates Meaning and Metaphor into the Language of Science." *Harvard College Gazette* (Fall): 3, 10.
Gibson, Kathleen R., and Anne C. Petersen, eds. 1991. *Brain Maturation and Cognitive Development: Comparative and Cross-Cultural Perspectives.* New York: Aldine de Gruyter.
Gilkey, Langdon. 1993. *Nature, Reality, and the Sacred: The Nexus of Science and Religion.* Minneapolis: Fortress Press.

Goleman, Daniel. 1977. "Split-Brain Psychology: Fad of the Year." *Psychology Today* (October): 88–90.
Goodglass, Harold. 1994. "Diversity and Unity in Neuropsychology: A Perspective on the Discipline." *The Diplomat* 13 : 5–7.
Gregory, Richard L., ed. 1987. *The Oxford Companion to the Mind*, with O. L. Zangwill. New York: Oxford Univ. Press.
Grinder, John, and Richard Bandler. 1976. *The Structure of Magic II: A Book about Communication and Change*. Palo Alto, Calif.: Science and Behavior Books.
Gunnar, Megan R., and Charles A. Nelson, eds. 1992. *Developmental Behavioral Neuroscience*. Hillsdale, N.J.: Erlbaum.
Guthrie, Stewart Elliott. 1993. *Faces in the Clouds: A New Theory of Religion*. New York: Oxford Univ. Press.
Hampden-Turner, Charles. [1981] 1982. *Maps of the Mind: Charts and Concepts of the Mind and Its Labyrinths*. New York: Collier.
Harding, Sandra, and Merrill Hintikka, eds. 1983. *Discovering Reality: Feminist Perspectives on Epistemology, Metaphysics, Methodology, and Philosophy of Science*. London: D. Reidel.
Harrington, Anne. 1987. *Medicine, Mind and the Double Brain: A Study in Nineteenth Century Thought*. Princeton, N.J.: Princeton Univ. Press.
_____. 1992. "Other Ways of Knowing: The Politics of Knowledge in Interwar German Brain Science." In *So Human a Brain: Knowledge and Values in the Neurosciences*, ed. Anne Harrington, 229–44. Boston: Birkhauser.
Harvey, Susan Ashbrook. 1994a. " 'The Very Fragrance of Paradise': Sense Perception and Knowledge of God in the Church Fathers." Alexander Schmemann Memorial Lecture, Saint Vladimir's Orthodox Theology Seminary, Crestwood, N.Y., February 2. Mimeographed.
_____. 1994b. "Sanctity and Stench: When Holy Fragrance Turns Foul." Paper presented at the Byzantine Studies Conference, October.
Hefner, Philip. 1985. "*The Human Mind and the Mind of God* by James B. Ashbrook." *Zygon: Journal of Religion and Science* 20 (September): 345–49.
_____. 1993. *The Human Factor: Evolution, Culture, and Religion*. Philadelphia: Fortress Press.
Hellige, Joseph B. 1990. "Hemisphere Asymmetry." In *Annual Review of Psychology*, vol. 41, ed. Mark R. Rosenzweig and Layman W. Porter. Palo Alto, Calif.: Annual Reviews.
Henry, James P. 1986. "Religious Experience, Archetypes, and the Neurophysiology of Emotions." *Zygon: Journal of Religion and Science* 21 (March): 47–74.
_____. 1992. *Instincts, Archetypes and Symbols: An Approach to the Physiology of Religious Experience*. Dayton, Ohio: College Press.
Hobson, J. Allan. 1988. *The Dreaming Brain*. New York: Basic Books.
Holmes, Rodney. 1991. "Did *Homo religiosus* Emerge from the Evolution of the Brain?" *Insights: The Magazine of the Chicago Center for Religion and Science* 3 : 10–14.
_____. 1996. "*Homo religiosus* and Its Brain: Reality, Imagination, and the Future of Nature." *Zygon: Journal of Religion and Science* 31 (September): 441–55.
Holmes, Urban T., III 1978. *The Priest in Community: Exploring the Roots of Ministry*. New York: Seabury Press.
Jaynes, Julian. 1976. *The Origin of Consciousness in the Breakdown of the Bicameral Mind*. Boston: Houghton Mifflin.
Johnson, Mark. 1987. *The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason*. Chicago: Univ. of Chicago Press.
Jones, D. Gareth. 1980. *Our Fragile Brains: A Christian Perspective on Brain Research*. Downers Grove, Ill.: Inter-Varsity Press.
Jones, Stanton L. 1994. " A Constructive Relationship for Religion with the Science and Profession of Psychology." *American Psychologist* 49 : 184–99.
Kauffman, Stuart. 1995. *At Home in the Universe: The Search for Laws of Self-Organization and Complexity*. New York: Oxford Univ. Press.
Kaufman, Gordon D. 1992. "Nature, History, and God: Toward an Integrated Conceptualization." *Zygon: Journal of Religion and Science* 27 (December): 379–402.
_____. 1993. *In Face of Mystery: A Constructive Theology*. Cambridge: Harvard Univ. Press.
Keyes, C. Don. 1990. "Altruism and Triune Brain Function: An Interpretation of Paul D. MacLean's Evolutionary Research." Grant proposal.

Klivington, Kenneth. 1989. *The Science of Mind.* Cambridge: M.I.T. Press.
Kolb, Bryan, and Ian Q. Whishaw. [1980] 1985. *Fundamentals of Human Neuropsychology,* 2d ed. New York: Freeman.
Kosslyn, Stephen M., and Olivier Koenig. 1992. *Wet Mind: The New Cognitive Neuroscience.* New York: Free Press.
Laeuchi, Samuel. 1980. *Religion and Art in Conflict: Introduction to a Cross-Disciplinary Task.* Philadelphia: Fortress Press.
Lakoff, George. 1987. *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind.* Chicago: Univ. of Chicago Press.
Lancaster, Brian. 1991. *Mind, Brain, and Human Potential: The Quest for an Understanding of Self.* Rockport, Mass.: Element.
_____. 1993. "Self or No-Self? Converging Perspectives from Neuropsychology and Mysticism," *Zygon: Journal of Religion and Science* 28 (December): 507–26.
Laughlin, Charles D., Jr., John McManus, and Eugene G. d'Aquili. 1974. *Biogenetic Structuralism.* New York: Columbia Univ. Press.
_____. 1990. *Brain, Symbol, and Experience: Toward a Neurophenomenology of Human Consciousness.* Boston: Shambala, New Science Library.
Lee, Sang Bok. 1995. "The Interpretation of Korean Shaman's Traditional Healing Ritual in Light of Modern Clinical Neuroscience." In *Korean Cultural Roots: Religion and Social Thought,* ed. Ho-Youn Kwon, 105–19. Chicago: North Park College and Theological Seminary.
Levin, Fred M. 1991. *Mapping the Mind.* Foreword by John E. Gedo. Hillsdale, N.J.: Analytic Press.
Levy, Jerre. 1980. "Varieties of Human Brain Organization and the Human Social System." *Zygon: Journal of Religion and Science* 15 (December): 351–75.
_____. 1985. "Interhemispheric Collaboration: Single-Mindedness in the Asymmetrical Brain." In *Hemispheric Function and Collaboration in the Child,* ed. Catherine T. Best, 11–31. Orlando, Fla.: Academic Press.
Lex, Barbara. 1979. "Neurobiology of Ritual Trance." In *The Spectrum of Ritual: A Biogenetic Structural Analysis,* ed. Eugene G. d'Aquili and Charles D. Laughlin, Jr. New York: Columbia Univ. Press.
Liddon, Sim C. 1989. *The Dual Brain, Religion, and the Unconscious.* Buffalo, N.Y.: Prometheus Books.
Livingston, Robert B. 1981. Personal Communication. National Science Foundation Seminar on the Neurosciences, White Plains, N.Y., March.
Luria, A. R. 1987. "Reductionism in Psychology." In *The Oxford Companion to the Mind,* ed. R. L. Gregory, 675–76. Oxford: Oxford Univ. Press.
MacKay, Donald M. 1978. "Selves and Brains." *Neuroscience* 3 : 599–606.
_____. 1985. "Machines, Brains, and Persons." *Zygon: Journal of Religion and Science* 20 (December): 401–12.
Macklin, Ruth. 1978. "Man's 'Animal Brain' and Animal Nature: Some Implications of a Psychophysiological Theory." *Philosophy and Phenomenological Research* 39 : 155–81.
MacLean, Paul D. 1970. "The Triune Brain, Emotion, and Scientific Bias." In *The Neurosciences: Second Study Program,* ed. F. O. Schmitt, 336–49. New York: Rockefeller Univ. Press.
_____. [1975] 1993. "On the Evolution of Three Mentalities." *Man-Environment Systems* 5 : 213–24. Reprinted in *Brain, Culture, and the Human Spirit,* ed. James B. Ashbrook, pp. 15–44. Lanham, Md.: Univ. Press of America.
_____. 1985. "Brain Evolution Relating to Family, Play and the Separation Call." *Archives of General Psychiatry* 42: 405–17.
_____. 1990. *The Triune Brain in Evolution: Role in Paleocerebral Functions.* New York: Plenum Press.
McFague, Sallie. 1982. *Metaphorical Theology: Models of God in Religious Language.* Philadelphia: Fortress Press.
_____. 1987. *Models of God: Theology for an Ecological, Nuclear Age.* Philadelphia: Fortress Press.
_____. 1993. *The Body of God: An Ecological Theology.* Philadelphia: Fortress Press.
McGlone, Jeannette. 1980. "Sex Differences in Human Brain Asymmetry: A Critical Survey." *The Behavioral and Brain Sciences* 3 : 215–63.

Meland, Bernard S., ed. 1969. *The Future of Empirical Theology.* Chicago: Univ. of Chicago Press.
Niebuhr, H. Richard. 1951. *Christ and Culture.* New York: Harper.
Ornstein, Robert E. [1972] 1986. *The Psychology of Consciousness.* Revised and updated. New York: Penguin Books.
_____, ed. 1973. *The Nature of Human Consciousness: A Book of Readings.* San Francisco: Freeman.
Pannenberg, Wolfhart. 1976. *Theology and the Philosophy of Science.* Trans. Francis McDonagh. Philadelphia: Westminster Press.
Penfield, Wilder. 1975. *The Mystery of the Mind: A Critical Study of Consciousness and the Human Brain.* Princeton, N.J.: Princeton Univ. Press.
Peters, Karl E., ed. 1985. "Anniversary Issue and Twenty-Year Indexes." *Zygon: Journal of Religion and Science* 22.
Pierce, James David. 1986. *A Multidimensional Scaling of the Cognitive Dimensions Used by Seminary Students in Their Perception of Biblical Material.* Ph.D. diss., Northwestern Univ., Evanston, Ill.
_____. 1989. "Styles of Believing: Analytic and Imagistic." In *Faith and Ministry in Light of the Double Brain,* ed. James B. Ashbrook, 243–61. Bristol, Ind.: Wyndham Hall Press.
Reat, N. Noss, and Edmund F. Perry. 1991. *A World Theology: The Central Spiritual Reality of Humankind.* Cambridge: Cambridge Univ. Press.
Reed, Bruce. 1978. *The Dynamics of Religion: Process and Movement in Christian Churches.* London: Darton, Longman and Todd.
Ricoeur, Paul. 1978. "Manifestation and Proclamation." *The Journal of the Blaisdell Institute* 12 : 13–35.
Rolston, III, Holmes. 1987. *Science and Religion: A Critical Survey.* New York: Random House.
Rosch, Eleanor, and Barbara B. Lloyd, eds. 1978. *Cognition and Categorization.* Hillsdale, N.J.: Erlbaum.
Ruether, Rosemary Radford. 1983. *Sexism and Godtalk: Toward a Feminist Theology.* Boston: Beacon Press.
Rummelhart, David E., James L. McClelland, and the PDP Research Group. [1986] 1987. *Explorations in the Microstructure of Cognition, Computational Models of Cognition and Perception.* Vol. 1, *Foundations.* Vol. 2, *Psychological and Biological Models.* Cambridge: M.I.T. Press.
Sagan, Carl. 1977. *The Dragons of Eden: Speculations on the Evolution of Human Intelligence.* New York: Random House.
Sarter, Martin, Gary G. Berntson, and John T. Cacioppo. 1996. "Brain Imaging and Cognitive Neuroscience. *American Psychologist* 51 : 13–21.
Schmitt, F. O., and F. G. Worden, eds. 1974. *The Neurosciences: Third Study Program.* Cambridge: M.I.T. Press.
Sherrington, Charles S. [1940] 1951. *Man on His Nature.* New York: Doubleday/Anchor.
Smart, Ninian, and Steven Konstantine. 1991. *Christian Systematic Theology in a World Context.* Minneapolis: Fortress Press.
Smith, Charlotte. 1989. "Investigation of Brain Wave Symmetry: An EEG Imaging Study Based on the Wakeful Dreaming Process." Ph.D. diss., Northwestern Univ., Evanston, Ill.
Smith, Huston. 1990. "Postmodernism's Impact on the Study of Religion." *Journal of the American Academy of Religion* 58 (Winter): 653–70.
Smith, Wilfred Cantwell. 1979. *Faith and Belief.* Princeton, N.J.: Princeton Univ. Press.
Sperry, Roger W. 1977. "Bridging Science and Values: A Unifying View of Mind and Brain." *American Psychologist* (April): 237–45.
_____. 1982. "Some Effects of Disconnecting the Cerebral Hemispheres." *Science* 217 : 1223–26.
_____. 1985. "Changed Concepts of Brain and Consciousness: Some Value Implications." *Zygon: Journal of Religion and Science* 20 (March): 41–57.
_____. [1988] 1993. "Psychology's Mentalist Paradigm and the Religion/Science Tension." *American Psychologist* 43 : 607–13. Reprinted in *Brain, Culture, and the Human Spirit: Essays from an Emergent Evolutionary Perspective,* ed. James B. Ashbrook, pp. 109–28. Bristol, Ind.: Wyndham Hall Press.

_____. 1991. "Search for Beliefs to Live by Consistent with Science." *Zygon: Journal of Religion and Science* 26 (June): 237–58.
_____. 1992. "Paradigms of Belief, Theory and Metatheory." *Zygon: Journal of Religion and Science* 27 (September): 245–59.
_____. 1993. "The Impact and Promise of the Cognitive Revolution." *American Psychologist* 48 : 878–85.
Springer, Sally P., and Georg Deutsch. [1981] 1989. *Left Brain, Right Brain.* 3d ed. New York: Freeman.
Squire, Larry R. 1987. *Memory and Brain.* New York: Oxford Univ. Press.
Stevens, Anthony. 1982. *Archetypes: A Natural History of the Self.* New York: William Morrow.
_____. 1986. "Thoughts on the Psychobiology of Religion and the Neurobiology of Archetypal Experiences." *Zygon: Journal of Religion and Science* 21 (March): 9–30.
Stone, Howard W. 1983. "Left Brain, Right Brain." *Theology Today* (October): 292–301.
Taylor, Gordon Rattray. 1979. *The Natural History of the Mind.* New York: Dutton.
TenHouten, Warren D. 1985. "Cerebral-Lateralization Theory and the Sociology of Knowledge." In *The Dual Brain: Hemisphere Specialization in Humans,* ed. D. Frank Benson and Eran Zaidel, 341–58. New York: Guilford Press.
Tillich, Paul. 1951. *Systematic Theology.* Vol. 1, *Reason and Revelation, Being and God.* Chicago: Univ. of Chicago Press.
_____. 1952. *The Courage to Be.* New Haven, Conn.: Yale Univ. Press.
_____. 1959. *Theology of Culture,* ed. Robert C. Kimball. New York: Oxford Univ. Press.
_____. 1963. *Systematic Theology.* Vol. 3, *Life and the Spirit: History and the Kingdom of God.* Chicago: Univ. of Chicago Press.
_____. 1968. *A History of Christian Thought,* ed. Carl E. Braaten. London: SCM Press.
Tracy, David. 1981. *The Analogical Imagination: Christian Theology and the Culture of Pluralism.* Chicago: Univ. of Chicago Press.
Trevarthen, Colwyn. [1986] 1993. "Brain Science and the Human Spirit." *Zygon: Journal of Religion and Science* 21 (June): 161–200. Reprinted in *Brain, Culture, and the Human Spirit,* ed. James B. Ashbrook, pp.129–81. Lanham, Md.: Univ. Press of America.
_____, ed. 1990a. *Brain Circuits and Functions of the Mind: Essays in Honor of Roger W. Sperry.* Cambridge: Cambridge Univ. Press.
_____. 1990b. "Growth and Education in the Hemispheres." In *Brain Circuits and Functions of the Mind: Essays in Honor of Roger W. Sperry,* ed. Colwyn Trevarthen, 334–63. Cambridge: Cambridge Univ. Press.
Tsunado, Tadanobu. 1989. "Hemisphere Dominance in Japan and the West." In *The Science of Mind,* ed. Kenneth Klivington, 54–59. Cambridge: M.I.T. Press.
Turner, Victor. 1969. *The Ritual Process: Structure and Anti-Structure.* London: Routledge and Kegan Paul.
_____. [1983] 1993. "Body, Brain, and Culture." *Zygon: Journal of Religion and Science* 18 (September): 221–45. Reprinted in *Brain, Culture, and the Human Spirit,* ed. James B. Ashbrook, pp. 77–108. Lanham, Md.: Univ. Press of America.
Valenstein, Elliot S. 1994. "Neuroscience: Paths, Detours, and Hazards." *Contemporary Psychology* 39 : 140–43.
Varela, Francisco J., Evan Thompson, and Eleanor Rosch. [1991] 1993. *The Embodied Mind: Cognitive Science and Human Experience.* Cambridge: M.I.T. Press.
Walaskay, Paul W. 1977. "The Mystic Experience of the Apostle Paul: Recovery of a Model for Christian Living." In *Christianity for Pious Skeptics,* eds. James B. Ashbrook and Paul W. Walaskay, 15–88. Nashville, Tenn.: Abingdon Press.
_____. [1979] 1989. "A Pathway to God." *The Christian Century* (March 7): 246–49. Reprinted in *Faith and Ministry in Light of the Double Brain,* ed. with contributions by James B. Ashbrook, 200–208, as "Classical Religious Experience and Neurological Research." Bristol, Ind.: Wyndham Hall Press.
Whyte, Lancelot. 1973. *Contemporary Psychology* 18 : 330.
Wink, Walter. 1980. *Transforming Bible Study: A Leader's Guide.* Nashville, Tenn.: Abingdon Press.
Winnicott, D. W. 1971. *Playing and Reality.* New York: Basic Books.
Winson, Jonathan. [1985] 1986. *Brain and Psyche: The Biology of the Unconscious.* New York: Vintage Books.

Wong, T. M. 1984. "One Brain's Response: A Reaction to Ashbrook's 'Juxtaposing the Brain and Belief'." *Journal of Psychology and Theology* 12 : 208–10.

Yates-Hammett, Jenny L. 1994. *Psyche and the Split-Brain.* Lanham, Md.: Univ. Press of America.

Young, Robert M. [1970] 1990. *Mind, Brain, and Adaptation in the Nineteenth Century: Cerebral Localization and Its Biological Context from Gall to Ferrier.* New York: Oxford Univ. Press.

Zepp, Ira G. 1986. *The New Religious Image of Urban America: The Shopping Mall as Ceremonial Center.* Westminster, Md.: Christian Classics.