Chapter 3

RELIGION AND BIOLOGY

Man is by constitution a religious animal.

Biology has nothing directly to do with religion, and by no possibility can religion, such as we know, be based on biology.

Darwin was a most careful observer . . . there was great truth in the theory and there was nothing atheistic in it if properly understood.

If you are a Darwinist, I pity you, for it is impossible to be a Darwinist and a Christian at the same time.

Truly, he who unfolds to us the way in which God works through the world of phenomena may well be called the best of religious teachers.[1]

RELIGION AND BIOLOGY: A TROUBLED RELATIONSHIP

The foregoing quotations linking biology to religion cover the spectrum of possibilities. The common point among them is, however, well stated by Hearn (1968): "Probably in no other area has the encounter between Christianity and science generated so much misunderstanding or left such deep scars as in that of biological science" (p. 199).

The Trials of Evolution

If there were ever a point of contention between biology and religion, the theory of evolution is that point. In 1859, when Darwin (1859/1972) published his *The Origin of Species,* it immediately became a target for conservative religionists. The famous debate between Thomas Huxley and Bishop Samuel Wilberforce (also known as "Soapy Sam") acquired the status of legend, and few could question that the winner in this clash of verbal arms was Huxley, also known as "Darwin's bulldog" (Irvine, 1955). Science and the theory of evolution won the war, and rather rapidly many Christians placed evolution within a Christian framework (Fiske, 1883; Himmelfarb, 1962; Kennedy, 1957; McCosh, 1890). Still, the conflict continues to reappear—as in the John Scopes trial of the 1920s, the more recent controversy over "creationism" and "creation science," and now the debate over "intelligent design."

1. These quotations come, respectively, from the following sources: Burke (1790/1909, p. 239); Haldane (1931, p. 43); McCosh (1890, p. vii); Russell (1935, p. 76), quoting his boyhood tutor; and Fiske (1883, p. 369), speaking about Darwin.

"Creationism" is a fundamentalist religious doctrine that avers the literal truth of the creation of the world and life as pictured in Genesis; any notion of evolution is therefore denied (Carter, 2000). "Creation science" is a more recent development, whose proponents seek to attach the idea of science to creationism. Their motivations to do so are perhaps twofold: (1) to endow creationism with the intellectual, worldly stature of science per se, and (2) to permit the incorporation of scientific ideas into the conservative faith of creationists (Gilbert, 1997; Wilcox, 1996). Science is thus seen as in harmony with the account of creation in Genesis. However, the premises, interpretations, and conclusions of creation science are at considerable variance with traditional scientific theories, methods, and findings (Gould, 1997, 1999). In recent years, another attempt to unite science and the religious concept of creation has emerged in the idea of "intelligent design." Advanced by sophisticated, religiously orthodox scientists, this theory accepts evolution in a modified form, and basically claims that many observed facts of nature cannot be explained by evolution and require the action of a creator. Just as a watch is made by a watchmaker, it is claimed that many complex biological and biochemical phenomena can only be accounted for through the intervention of God, the creator (Behe, 1996). This analogical argument at the root of "intelligent design" probably constitutes the most elemental critique of the doctrine as well (Shreve, 1996).

These developments illustrate the complicated, and sometimes uneasy, interplay at work between traditional religious beliefs and the theories propounded by biological science. Whether an attempt is made to expunge evolution from religion (creationism) or to incorporate it (intelligent design), the need clearly exists in religious believers to come to terms with modern biology. This chapter outlines several ways in which this interplay between religion and biological science has been conceptualized, and examines a range of scientific theories designed to help account for the various roles and functions of religion.

The Search for a Religious Instinct

In the late 19th and early 20th centuries, any discussion of evolution entailed a search for internal, biological sources of complex behavior. The classic concept of "instinct" came to the fore. Though full agreement has never been achieved regarding the nature of instinct, it generally refers to complex, unlearned behavior with a physiological basis and evidence of evolutionary involvement (Bateson, 2000). These are rather exacting criteria, and until the early 1920s they were loosely applied to humans (Bernard, 1924). With the rise of behaviorism, learning and the influence of environment became the preferred explanations.

A common idea among religionists was that God had implanted religion in humans; hence there existed a religious instinct. This instinct has been claimed to encompass a wide range of phenomena: animism, myth, ritual, beliefs in God, Christianity, the necessity of Sunday observance, the seeking of ideals and perfection, self-abasement, and the potential for other religious beliefs, behaviors, and experiences. One review of this literature found that some 83 types of religious instinct had been theorized (Bernard, 1924). Their vagueness, cultural relevance, and hypothetical character also suggested that learning, not instinct, was probably the real element being observed.

The Influence of Environment versus Heredity in Religion

For over a century, psychology has been plagued with the basic question of whether some psychological phenomena are the result of genetics or environment. This issue has been

Research Box 3.1. Genetic and Environmental Influences on Religious Attitudes, Interests, and Values: A Study of Twins Reared Apart and Together (Waller, Kojetin, Bouchard, Lykken, & Tellegen, 1990)

Utilizing respondents from the famous Minnesota Twin Study, Waller and colleagues were able to obtain data on five measures of religious attitudes, interests, and values. These were well-known scales: Religious Fundamentalism (Wiggins, 1966), Religious Occupational Interests (Waller, Lykken, & Tellegen, 1995), the Religious Interest subscale of the Strong–Campbell Vocational Interest Inventory (Hansen & Campbell, 1985), Religious Leisure Time Interests (Waller et al., 1995), and the Allport–Vernon–Lindzey Religious Values Scale (Allport, Vernon, & Lindzey, 1960).

The participants were 53 pairs of monozygotic (identical) twins and 31 pairs of dizygotic (fraternal) twins who had been reared apart. The measures were also given to 458 pairs of identical and 363 pairs of fraternal twins who were raised together. Data analyses suggested that about 50% of the variation in the scores on the religious measures was a function of genetic influences. In other words, in this study, genetic and environmental factors were equal in their effects regarding the origins of religious inclinations.

RELIGION, GENETICS, AND EVOLUTION: A THEORY

We have already claimed that religion appears to be a universal human phenomenon. This suggests a need to look for universal psychological mechanisms; if such exist, their presence hints at a role for evolution in this process. Evolution's role may, however, be indirectly expressed through what religion does for people. For whatever reasons, evolution has endowed us humans with large brains in order to adapt to the exigencies of living (Barash, 1977; Pinker, 1997; Stanford, 2001). Regardless of why our big brains evolved, there is good reason to believe that they can be employed for many things for which they were not designed. Gould (1991) terms this "exaptation," in which an organ or physiological process that developed for one purpose can also be used to attain other goals.

According to the Darwinian perspective, the goal of adaptation is basically twofold—to enable organisms to survive and to reproduce (Dawkins, 1976). This is the essence of natural selection, and we may theorize that religion meets at least three basic needs, which we have posited in our integrating framework in Chapter 1. Broadly speaking, these are cognitive, motivational, and social. For our purposes, we label these as needs for meaning, for control, and for relationships with others (i.e., sociality). The position taken here is that the religion–genetics connection may be diagrammed thus:

(Evolution and Genetics) → (Meaning, Control, and Sociality) → Religion

Before we discuss these factors, we might offer a few directions intimating a relationship between evolution and genetics on the one hand, and religion on the other, that could be either direct or indirect. As noted above, we favor the latter possibility. Data pointing toward such a possibility may be inferred first from evidence of religion during Paleolithic times (Mithen, 1996; Thompson, 1981). In addition, even though most anthropologists concep-

tualize religion as a specifically human phenomenon (Guthrie, 1993; Spiro, 1966), we should expect some signs of prereligious activity among animals. Goodall's (1971) observations of animism and ritual behavior among chimpanzees suggest precursors to religion. Specifically, Goodall describes collective gesturing toward the sky during storms and associated marching behavior, both of which are patterned. These primate behaviors appear to meet some of the needs that religion gratifies among people.

The Naturalistic Basis of the Need for Meaning

Broadly speaking, meaning is inherent in responses to stimuli and implies personally relevant knowledge. We are interested in the psychological reactivity of people, and overwhelmingly invoke consciousness and awareness on some level. Even though this might to some degree involve conditioned responses and habit, when we turn to religion, we focus on higher-level cognitions and some understanding of ourselves and our relationship to others and the world. The result is meaning, the cognitive significance of sensory and perceptual stimulation and information to us.

Maslow (1963) believed that the need to understand is part of human biological nature. In parallel, anthropologist Margaret Mead (1966/1972) universalized the search for meaning, labeling it the "cosmic sense . . . a basic human characteristic . . . a need found in every child and expressed in every culture" (pp. 155–156). The evolutionary psychologists Cosmides and Tooby (1987) take the final step by asserting that "information systems . . . actually link the evolutionary process to manifest behavior" (p. 277).

Many similar observations by other scholars lead to the inference that the search for knowledge, information, and meaning is a fundamental evolutionary drive that is basic to survival and to furthering one's genetic lineage.

We aver that seeking meaning is fundamental to evolutionary success and therefore plays a central role in religion, as well as aiding people to adapt to the exigencies of life.

The Naturalistic Basis of the Need for Control

Gibbs (1994) places the need for control in an evolutionary framework, suggesting its necessity on both human and nonhuman levels. Wilson (1993) offers the hypothesis that evolution might select humans with a long-range view of their interests, as impulsive action is likely to place an individual in jeopardy.

Twin studies have found that from one-third to one-half of the variance in measures of control and locus of control can be attributed to genetics (Finkel & McGue, 1997; Hur & Bouchard, 1997; Pedersen, Gatz, Plomin, Nesselroade, & McClearn, 1989). Finally, control and mastery confer survival and reproductive advantages upon those who possess power.

In summary, control motivation—regardless of its expression, whether social, magical, or religious—appears to rest on firm ground in evolutionary theory and genetics. Among humans, learning and culture dominate; however, the underlying biological substrate is far too extensive to be overlooked.

The Naturalistic Basis of Sociality (The Need for Relationships)

The evolutionary origins of social behavior were first suggested by Darwin, who viewed the association of pleasure with social relationships as contributing to success in natural selection (see Gardner, 1999). Brewer (1997) feels that "coordinated group living is the primary

survival strategy of the species" (p. 55). To develop this idea fully would take volumes. Suffice it to say that sociality would include social responsiveness, cooperation, altruism, and attachment/bonding. The significance of language and communication in the expression of sociality cannot be minimized. In fact, the centrality of communication among humans and animals indicates its evolutionary significance.

Social behaviors such as affiliation and attachment can be shown to have biological foundations. Many studies among mammals reveal neuroendocrine influences empowering attachment behavior—in particular, the hormones oxytocin and vasopressin (Carter, 1998; Insel, 1993; Porges, 1998). These influences involve genetic and evolutionary factors. They constitute the biological substrate of much social behavior.

A similar potential exists with respect to social cooperation. Over a half-century ago, Ashley Montagu (1950) articulated the radical assertion that cooperation "is the most important factor in the survival of animal groups" (p. 41). Cooperation is allied with evolution in general and natural selection in particular. This recommends that natural selection "informs" the organism that its own interests are best met by supporting the social body. This is certainly true for humans.

Conceptually, altruism and social cooperation are closely affiliated. Summarizing a large and impressive amount of informed writing from the first half of the 20th century, Herrick (1956) stated that altruism is "deeply rooted in the prehuman ancestry of mankind" (p. 215). It is clearly present among a broad spectrum of animals, ranging from social insects through birds to primates (Breed & Page, 1989; De Waal, 1996). Selective pressures for genes that promote neural complexity may be a result of the need to cope with intricate relationships (Sigmund & Nowak, 2000). Like cooperation, altruism brings people together, and cultures reinforce such connections. Still, evolution and genetics lurk in the background.

Batson (1983) has nicely summarized the relative universalization of what were originally thought to be "kin-specific altruistic impulses" (p. 1385). He notes that "religious kinship images may promote prosocial behavior by increasing the range of application of a highly limited natural impulse toward altruism" (p. 1385). Similar thoughts hold for cooperation and any other form of positive social responsiveness.

SOME ALTERNATIVE PERSPECTIVES

Religion and Natural Selection

The door to modern biological speculation about evolution and religion was opened by Alister Hardy (1976) in his noted book *The Biology of God*, which is basically an appeal for reconciliation of Darwinian natural selection and genetics with religion. Hardy turned Darwinian theory upside down. Whereas the traditional perspective views behavior change as following physical change, Hardy saw "a powerful behavioral selection to bring about a relatively rapid bodily change" (p. 62). He considered this pattern an appropriate "behavioral selection" (p. 62) for human evolution. How this selection works was not specified, and this constitutes a weakness in Hardy's theory. This view, however, was pioneering, and is currently quite popular in evolutionary psychology (Bonner, 1980; Durham, 1982). The problem can be resolved if the concept of exaptation is introduced, as the behavior in question could easily be the result of existing anatomy and physiology. The underlying physical body may not have been designed for what occurred in behavior; rather, it may have been co-opted for what took place. Once again, the big human brain was used for something other than that for which it evolved.

Hardy, then, saw religious experience as a core element aiding adaptation, and hence as involved in natural selection. To buttress his biological substrate, he quoted another scholar to the effect that "there is a profound human instinct to seek something personal behind the processes of nature" (p. 96). Next, Hardy analogized from a dog's allegiance to his human master to humanity's dependence on God. Religion is thus a natural creation.

Hardy broadened his scholarly effort to include a theology with biological underpinnings. He explicitly offered what he hoped was a scientific and biological justification for religion, rather than simply a biological integration that would meet the criteria of contemporary science.

Rayburn and Richmond (1998, 2000) have also linked biology to religion in what they term "theobiology." Since this emanates more from a religious than from an empirical-psychological framework, we simply mention it here. It merits consideration as a theory for further exploration of possible links between biology and religion.

Religion and the Naturalistic Basis of Cognition

Several other scholars have advanced theories of religion that, on one level or another, involve biology and evolution. One impressive thinker is Pascal Boyer (1994), a noted anthropologist, who wrote a volume entitled *The Naturalness of Religious Ideas.* This is a cognitive theory of religion premised upon "universal cognitive processes." Natural selection is mentioned, but somehow the biological basis of these notions is never developed. Still, we are led to the classic evolutionary notion that religious ideas aid survival; however, even this notion remains obscure. Basically, we read that our thinking (cognition) is constrained in a variety of ways that support religious ideas. A constraint might be how past experience directs and focuses our present thinking. Biology remains in the shadows, and is never made explicit.

Sociobiology and Religion

The distinguished biologist E. O. Wilson of Harvard University has been termed the father of "sociobiology," a controversial field. He has defined sociobiology as "the systematic study of the biological basis of all forms of social behavior, in all kinds of organisms, including man" (Wilson, 1978, p. 16). Turning to religion, he calls it "one of the universals of social behavior" (p. 169). Wilson, then, perceives religion as involved in creating both evolutionary change and conferring genetic advantage. It may accomplish this through the exercise of power by religious leaders, who would choose and reward those who show conformity and loyalty to ecclesiastical authority, and who further display religious zeal and charisma. Insofar as faith might select for learning and motivation to acquire religious behaviors, the frequencies of genes that support such tendencies should increase in the population. Conversely, the frequencies of genes that support opposing propensities should be reduced. Implied here is the idea that religious leaders and religious practices weed out nonconformity, and enhance both the survival and reproduction of those who display valued religious responses. These inclinations would certainly be true for religious groups that separate themselves from the larger social matrix and sponsor ingroup marriages. Such groups include the Amish, Hutterites, Chasidic Jews, Mormons, Shakers, Doukhobors, and a host of other religious bodies (Stark, 1985b; Wilson, 1970).

Wilson has broadened his perspective to include a variety of religious expressions—myth, ritual, and magic. He has searched for the biological advantage religion and its com-

ponents confers on believers, implying that religious indoctrination relates to learning rules that have evolved and are therefore genetically based.

In this section and the preceding one, we have presented a very brief summary of some contemporary thinking about possible roles for evolution and genetics in the development and expression of religion. Needless to say, the current popularity of evolutionary theorizing has spawned a variety of such notions. We can expect further refinement of these ideas from future studies of twins, plus the efforts of both evolutionary psychologists and anthropologists.

RELIGION AND THE BRAIN

Any approach to religion via biology raises questions about possible underlying anatomical and physiological correlates of religion. On a theoretical level, d'Aquili and his associates (d'Aquili, 1978; d'Aquili, Laughlin, & McManus, 1979; d'Aquili & Newberg, 1999) offer a complex neurobiological framework for understanding religion. Though it goes far beyond what we can deal with here, the theory is described as "a holistic neurophysiological model for the generation of mystical states, religious rituals, near-death experiences, culture, and consciousness itself" (d'Aquili & Newberg, 1999, p. 47). This approach clearly has no limits when it comes to explaining religious behavior, belief, and experience—or, for that matter, any form of human action. So far, this theoretical scheme has not resulted in much confirmatory research. Still, we describe some of its potentialities here.

Epilepsy: The Sacred Disease

Even though the ancient Greek physician Hippocrates wrote that epilepsy appeared to him "to be nowise more divine nor more sacred than other diseases" (Hippocrates, 1952, p. 154), the association of this condition with religion existed in his era and still persists. Today, of course, no one speaks of epilepsy as emanating from religious origins; however, it is still widely associated with expectations of religious expression. Formal medical recognition of such a likelihood first occurred in the 19th century (Dewhurst & Beard, 1970). A respected psychiatric text of the early 20th century referred to "a pathologic religiosity" as a major characteristic of epilepsy (Kraft-Ebing, 1904, p. 474). With greater qualification, the connection continued to be made in later psychiatric works (Strauss, 1959). Recognizing that the affiliation of religion and epilepsy in general is quite weak, White and Watt (1981) suggested a more specific link to temporal lobe epilepsy (TLE)—a view that is currently widespread. Additional caution in making this association is called for, though. Ogata and Miyakawa (1998) focused on the temporal lobe and limbic system in a sample of 234 patients with epilepsy; only three cases, or 1.3%, reported religious content during epileptic episodes. Thus, although the linkage of epilepsy and religion may be quite striking when it occurs, in actuality it seems rather uncommon. Expectations of such a connection have nevertheless stimulated some very significant research. The foregoing statistics explain, in part, why this work has employed very small samples.

Religion and Brain Stimulation

Persinger and his associates (Makarec & Persinger, 1985; Persinger, 1987, 1993; Persinger & Makarec, 1987; Persinger, Bureau, Peredery, & Richards, 1994) have studied the religious

ideation accompanying the neuroelectric activity in TLE that Persinger terms "temporal lobe transients." More recently, Ramachandran and Blakeslee (1999) have reported God-associated mental content with TLE and limbic system involvement during epileptic episodes. Virtually every religious possibility has been reported (mystical experiences, conversions, strengthened religious beliefs, etc.). Ramachandran and Blakeslee feel that the content of these episodes is learned, and that such learning depends to a large extent on an individual's cultural context. As in near-death experiences, one can expect cultural shaping of religious content (Zaleski, 1987).

Even though Ramachandran and Blakeslee (1999) feel that the association of brain function with religious experience, belief, and behavior may be universal, they note that "it doesn't follow that the trait [here, religious experience] is genetically specified" (p. 184). They appropriately conclude that "there are circuits in the human brain that are involved in religious experience . . . and we still don't know whether these circuits evolved specifically for religion" (p. 188). Since the limbic system is central in such emotion-associated processes, these researchers stress the role of the limbic system in the production and regulation of emotional expressions in general. MacLean (1989) captures this notion well when he asserts that "under the abnormal conditions of a limbic discharge, the feelings that light up in the patient's mind are free-floating and out of context—being attached to no particular person, situation, or thing" (p. 449).

Ogata and Miyakawa (1998) stress "an underlying mechanism, enhanced affective association to previously neutral stimuli, events, or concepts. Experiencing objects and events shot through with affective coloration engenders a mystically religious world view" (p. 465). In other words, MacLean's (1989) "free-floating and out of context" unattached feelings do not last long.

Why "a mystically religious world view" would result when the appropriate limbic area is stimulated remains an open question. The position adopted here is that the brain structures are available for emotional and experiential usage, and that, through learning and culture, they are employed for religion.

Much research indicates that the process does not simply go from arousal to "religious" response. An intermediate cognitive step, variously termed "appraisal," "labeling" or "attribution," must be interposed here (Hewstone, 1983a; Shaver, 1975). For example, from a physiological perspective, religious, nature, and aesthetic emotional experiences appear to be equivalent; however, the individual selectively makes attributive interpretations on the basis of the language available to him or her, the context in which events take place, the person's past experience, and his or her attitudinal and personality propensities (Bourque, 1969; Back & Bourque, 1970; Proudfoot, 1985; Spilka, Shaver, & Kirkpatrick, 1985). Considering the prevalence, availability, and importance of religion in Western culture, it is appropriate to hypothesize that profound but ambiguous emotional experiences have a high probability of eliciting religious identifications, particularly in health-related situations (Spilka & Schmidt, 1983a).

Are We Hardwired for Religion?

When combined with research on brain stimulation, the recent emphasis on evolution and genetics has resulted in a movement claiming that much of our human behavior is predetermined by our genes. The Darwinian emphasis on adaptation and natural selection has convinced a number of biologists and evolutionary psychologists to focus on the genetic

determination of complex human behavior (Buss, Haselton, Shackleford, Bleske, & Wakefield, 1998; Dawkins, 1976). The current mood proposes the question "Are we hardwired?" (Clark & Grunstein, 2000). It is then a short step to ask, "Are we hardwired for religion?" (Begley, 2001). In a logical extension of d'Aquili and Newberg's (1999) work *The Mystical Mind*, Newberg is quoted as asserting that "The human mind has been genetically wired to encourage religious beliefs" (Begley, 2001, p. 59). Newberg further states: "As long as our brain is wired the way it is, God will not go away" (Begley, 2001, p. 59). d'Aquili and Newberg (1999) label their view "neurotheology." In keeping with their previous work, this effort remains largely theoretical. They basically posit a direct connection between religion and specific aspects of biology—a position we challenge.

A fair amount of recent research indicates that activity occurs in various brain structures when one prays or has religious experiences. These studies simply show brain involvement in cognitive, emotional, or motor areas, as should occur for all behavior. They do not suggest that this neural activity either developed exclusively for religion or is solely dedicated to religious functions. This is a research realm that calls for considerable caution, qualification, and controlled enthusiasm. We are far from ready to embrace biology as a final answer to understanding religion. We need theory that eventuates in testable hypotheses. Nothing else will be satisfactory. We must also ask questions that may disprove some of the assertions being made about this topic. For instance, if we are "hardwired for religion," and "God will not go away," why is it that belief in God is often quite low in a number of European countries (see Greeley, 2002)?

We have tried to show that religion has become involved with evolutionary and genetic theorizing—in particular, through research on the action of the nervous system, as well as the results of twin studies. These ideas and research findings reveal new pathways to understanding the role of religion in how people function on the level of biology.

THE BIOLOGY OF RELIGIOUS BEHAVIOR

Let us continue our search for physiological correlates of religious behavior. We know how profoundly important religion is to many people; does this mean that religious activity may have biological repercussions? We do not have to look far to find a number of possible answers to this question. Ritual, rite, and ceremony are central to religion. Furthermore, ritual has a considerable evolutionary history, and is still significant in the functioning of the human nervous system. We humans can thus be rightfully called ritualizing animals. Clearly, we follow a long line of animal predecessors that have also engaged in ritualistic activities.

Before we go further, let us define "ritual," in order to clarify that religious ritual is only one realm in which such behavior is manifested. Among humans, ritual is individually and/or socially organized and patterned behavior that is often repetitive in nature. Its roots lie deep in the genetic prehistory and neurophysiology of our species.

The Prevalence and Significance of Ritual

Human life is pervaded by ritual. It can, depending on the situation, be called "social," "political," "spiritual," "religious," or whatever adjective is elicited by immediate circumstances. When we meet someone we know, the ritual is "How are you?" The expected response is "Fine, how are you?" A pattern of small talk follows unless a ritual reaction to events

dictates otherwise. The words we use and the gestures we make are all in the service of ritualistic design—at least in form, if not in content. As a rule, we are not usually aware of such actions in our everyday behavior. Even though similar tendencies hold for religious systems, there is much conscious learning of approved verbal and nonverbal communication modes, such as when to genuflect, kneel, adopt other postures or movements, say certain prayers, engage in dance, drink liquids or eat foods with religious significance (e.g., wine, wafers, matzoh), and so forth. Over the centuries, institutional religion has refined and redefined its rituals. Private and public forms of worship are specified for certain times of day (on arising, prior to sleep, at calls to prayer, etc.). Particular days of the week plus certain times of the month and year are set aside for special recognition and action by the faithful; all have their formally structured ceremonial expressions. Ritual circumscribes the entire process.

The Biology and Utility of Ritual

The prevalence and importance of ritual in animals and humans have led some biogenetic thinkers to theorize an underlying neurophysiology with specific brain sites (Bell, 1997; d'Aquili et al., 1979; d'Aquili & Newberg, 1999). d'Aquili and his associates have specifically applied their neurological analyses and interpretations to religious ritual and experience (d'Aquili et al., 1979; d'Aquili & Newberg, 1999).

There is general agreement that the basic purpose of ritual is communication, whether the ritual is the waggle dance of a bee to its fellow bees or the fervent prayer of a petitioner to a God. Messages are sent through whatever means an organism or a person apparently feels is most effective. These messages counter the stress of ambiguity and uncertainty. They contain information that endows the vague and indefinite with meaning. The discomfort, distress, and threat of uncertainty are lessened when one possesses ritualistic means of coping with troublesome situations. As Leach (1966) has pointed out, ritual summarizes a great deal of information that in many settings "is essential for the survival of the performers" (p. 405).

Communication, verbal or nonverbal, is a social control mechanism. Communication and language organize interpersonal and group situations to elicit behaviors that primarily maintain peace and harmony on all societal levels (Scheflen, 1972). Ritual thus coordinates religion, both in the public domain and within individuals (Ostow & Scharfstein, 1954). This relationship has led Rappaport (1999) to theorize that religion originated in ritual. There is a regularizing order to the way things are ritualistically done. This provides the kind of organization that supports consistency and comfort for individuals, and, in most instances, amity and understanding in community life. With this in mind, many scholars see ritual as reducing aggression and managing sexual impulses (Wulff, 1997). More broadly, rituals are viewed as means of encouraging and controlling emotion. Rituals in general and religious rituals in particular usually survive not because of the power of authorities, but because people want them, volunteer to participate in them, and probably gain pleasure from having roles to play in them.

To most people, religion represents an ideal state, with institutional faith emphasizing the discrepancy between reality and the ideal over which one frequently lacks control. Smith (1982/1996) perceives ritual as indicating the way things ought to be. Religious ceremonial participation confirms identification with the ideal, reestablishing a sense of mastery.

People frequently make religious attributions when serious medical problems arise (Spilka & Schmidt, 1983a). Ritual also becomes significant at such times (Helman, 1990). Healing rituals are efforts to transform illness into health. Psychologically, for both patients

and their supporters, they reduce anxiety and uncertainty. These actions are in effect religious appeals and behaviors designed to bring supernatural forces to the aid of the afflicted. Prayer and participation in religious healing ceremonies often alleviate suffering and increase social integration.

Prayer: A Special Kind of Ritual

The Nature and Scope of Prayer

A ritual that lies at the core of religion is prayer. Since approximately 90% of U.S. residents pray, it is evident that prayer should have some positive effects—or theoretically, as behavior, it should simply be extinguished (Poloma & Gallup, 1991).

Prayer has often been compared and contrasted with meditation and the specific technique known as Transcendental Meditation (TM). Though "meditational prayer" has been identified and discussed (Paloma & Gallup, 1991), meditation does not always imply religion. Studies of meditation and prayer may be treating two phenomena that either are definitely religious or are actually opposed to each other, with only one having religious or spiritual significance. In Eastern religions such as Buddhism and Hinduism, meditation may be comparable to what we term "prayer"—specifically, to forms of prayer that attempt to foster identification with God or gods, a lessened sense of self-involvement while seeking salvation, enlightenment, and basically religious mystical experience (Hong, 1995; Puhakka, 1995). We must also keep in mind that both prayer and meditation are distinguished from mystical experience.

The overlap of prayer with meditation implies another problem—namely, the tendency of many people to think that "prayer is prayer is prayer." Prayer is not simple and unitary. There are many different kinds of prayer (Lucknow, McIntosh, Spilka, & Ladd, 2000; Paloma & Gallup, 1991). From one perspective, Foster (1992) suggests 21 different forms of prayer. Any study of the biological aspects of prayer should deal with this complexity. No such investigation has yet been made. Since prayer is important in religious coping, we return to it in Chapter 15.

The Biology of Prayer

Since prayer involves ritual, the neurobiological correlates of ritual may also hold for prayer. The results of research studies are not consistent in supporting the selective neural suppression postulated by d'Aquili and Newberg (1999). Noting that TM seems to slow down brain waves (as recorded by electroencephalograms or EEGs), Surwillo and Hobson (1978) claimed that TM was similar to prayer. They then expected to observe the same neural slowing effects in prayer as in TM. Using EEGs from a rather small sample, they were unable to confirm their hypothesis. Yoga and Zen meditation have, however, been associated with the production of alpha brain waves, which occur with feelings of well-being (Benson, 1975).

Utilizing the same theoretical approach, but with a much larger sample, Elkins, Anchor, and Sandler (1979) focused on tension reduction in subjects' muscles. They compared relaxation techniques with intercessory and reflective prayer. No information was provided as to how they defined these forms of prayer. Subjective claims of relaxation by the prayers were not objectively confirmed by the measurement of muscle potentials. The relaxation condi-

tion seemed to be more effective than prayer, but the latter demonstrated minor but non-significant tendencies toward tension reduction.

Though prayer may be aimed at reducing tension, its goal may not be relaxation per se, but rather an altered state of consciousness, either contemplative or mystical (Benson, 1975). Insofar as prayer may induce relaxation, Benson (1975) suggests that it should also result in a slowing of breathing, and thus a lowered exchange of oxygen and carbon dioxide. This relaxation response pattern has been observed in TM. Regardless of how it is elicited, such relaxation is considered a healthy body reaction (Benson & Stark, 1996). Benson and Stark further report that 80% of their patients selected prayer as an avenue to the relaxation response, and that 25% felt it enhanced their spirituality. Interestingly, this latter group manifested less medical symptomatology than those who did not experience any spiritual enlightenment.

Benson impressively conveys his belief that the use of religion as in prayer is physiologically and psychologically beneficial. This is buttressed by research showing that faith lowers anxiety, blood pressure, and depression, and that it counters the use of drugs, alcohol, and tobacco (see Chapters 13 and 15). These and other similar observations suggest to Benson that evolution has "hardwired" the brain for religion. In other words, beliefs in God and religion have aided humans to survive and perpetuate themselves through offspring—possibly, in part, because these beliefs have encouraged beneficial physiological reactions such as tension reduction and relaxation.

Prayer and Physical Health

The above-described biological correlates of prayer suggest that it may actually affect the health of those who pray. One way of looking at this potential is to conceive of prayer as an "emotion-regulating strategy" (Koenig, George, & Siegler, 1988). In one study of older adults, prayer appeared to reduce negative emotional expressions under stress (Koenig et al., 1988). Using a broad-based national sample, Ferraro and Albrecht-Jensen (1991) concluded that "people who pray and participate more actively in their religions have better health" (p. 199). A similar conclusion came from a study of patients undergoing coronary artery bypass, whose authors claimed that those who prayed evidenced better postoperative emotional health (Ai, Bolling, & Peterson, 2000). Though noting the positive effects and correlates of prayer relative to bodily health, those who have conducted extensive surveys of this literature are more cautious in their conclusions. They point out a variety of design, analytic, and interpretive problems in the research (McCullough, 1995). Prayer appears to be helpful, but the reasons are not so clear. Once again, controlled enthusiasm is merited.

THE BIOLOGY OF RELIGIOUS EXPERIENCE

Religious and mystical experiences are dealt with at length later in this volume (see Chapters 9 and 10), so we treat the biology of such experiences rather briefly at this point. We have referred earlier to the neurological investigations of Persinger and colleagues, and of Ramachandran and Blakeslee (1999); both groups of researchers associated religious experiential content with the limbic system. As already noted, this system is intimately involved with emotional expression.

d'Aquili and Newberg (1999) offer a rather involved theory of how the brain functions during altered states of consciousness. The main burden of the brain and consciousness with

regard to religion falls on what they term "the emotional operator" (i.e., brain structures that mediate the control and expression of emotion). The complexity of emotion and evaluation is stressed. Cognition is afforded recognition, but the essence of the religious encounter is said to rely primarily on the emotional operator. The limbic system takes center stage in this view.

An example of research representing an alternate view is presented in Research Box 3.2. This work as a whole has attempted to locate empirically those brain regions that are active during religious experience. Despite the fact that the immense literature describing religious experiential states has emphasized emotion, cognitive elements—both psychological and neurological—have recently entered the picture. One indication that cognition might play an experiential role came in a study of meditation in Tibetan Buddhist meditators (Institute for the Scientific Study of Meditation, 2001). Single-photon emission computed tomography (SPECT) revealed frontal and parietal lobe activity in areas usually involved in cognition. A more direct experimental approach to this issue is described in Research Box 3.2. In the future, similar studies will undoubtedly be used to define further the relative roles of cognition and emotion in religious experiences. The seeds for such research have been sown, and much supportive theory is currently being created (Bower, 2001). To date, however, there is no definitive evidence that these patterns of brain response are unique to religion.

BIOLOGICAL INFLUENCE OF RELIGIOUS TEACHINGS AND PRACTICES

The Biological Effects of Forgiveness

The doctrine of forgiveness is often a primary ideal of religion. Studying a national sample, Gorsuch and Hao (1993) have shown that personal religiousness and a sense of forgiveness go together. Lack of a willingness to forgive correlates positively with hostility. In turn, the

Research Box 3.2. Neural Correlates of Religious Experience (Azari et al., 2001)

In pioneering research, Azari and her coworkers attempted to locate those areas in the brain that are active during religious experience. Utilizing positron emission tomography (PET) to image the brain during religious and other activities, six religious and six nonreligious participants took part in a total of six religious and control conditions. In all conditions, the state achieved was subjectively defined. While reading the 23rd Psalm, the religious respondents apparently attained a religious experiential state. Of most importance, the PET scans showed activation of cognitive areas in the frontal and parietal lobes of the religious subjects. Limbic emotional regions did not reveal involvement, unless specific feeling states were aroused. This cognitive emphasis is consonant with findings of roles for expectancy and desirability in religious experience (Spilka, Ladd, McIntosh, & Milmoe, 1996). Azari and her coworkers feel that religious experience is likely to be a cognitive process utilizing established neural connections between the frontal and parietal lobes.

finding that hostility is associated with unhealthy cardiovascular reactions has been well documented (Baum & Singer, 1987; Sarafino, 1990). In many people, hostility, stress, hypertension, and coronary heart disease constitute the main features of a syndrome known as the "Type A personality" (Friedman & Rosenman, 1974). The main destructive feature of Type A is its hostility component (Rhodewalt & Smith, 1991). As we have seen, research shows that forgiveness, not only counters hostility, but also lowers blood pressure and subjective and objective signs of stress (Witvliet & Ludwig, 1999). The positivity of the religion–health connection is more extensive than this work on forgiveness indicates. More such possibilities are presented in Chapter 15.

Neurological Correlates of Religious Practices

A worldwide perspective on the religious practices of individuals reveals virtually every human action that can be conceived. Altered states of consciousness are associated with such phenomena as meditation, dancing, and ritualistic frenzy, as well as the ingestion of stimulants, depressants, and "magic potions" of indefinite composition. Though we emphasize these practices in their religious forms, there is no reason to believe that their bodily effects are exclusively associated with religion.

d'Aquili and Newberg (1999) claim that these activities parallel the arousal of a variety of brain structures and functions. Much work on how neurons communicate with each other emphasizes, among other things, the role of the brain chemicals known as "neurotransmitters." A potent natural set of neurotransmitters produced in the brain is collectively termed "endorphins." Chemically related to drugs such as morphine, they are considered even more powerful than the usual opiates; they are said to heighten pleasure and reduce discomfort. One may hypothesize that endorphins are stimulated by religious practices that are designed to create a sense of exhilaration and ecstasy.

RELIGION AND BIOLOGY IN HEALTH AND ILLNESS

Health and disease raise crucial questions about biology and religion. First, do the practices of religious groups affect the bodily health and survival of their members? The answer is "Yes," and the Church of Jesus Christ of Latter-Day Saints (whose members are known as the Mormons) is an excellent example of how a church can favorably influence the health of its adherents. Second, can religious groups react in such a way that reproductive isolation (i.e., the confinement of sexual activity within the group) takes place, and genetic factors come to distinguish different religious populations? The answer again is "Yes," and the presence of various genetically based diseases among Jews testifies to the power of the historically conditioned aversion of Jews and non-Jews to intermarriage. The health situations of Mormons and Jews clearly illustrate how the biology of health and illness may be a function of the social expressions of a religious body's theology and practices.

The Effects of Health Behaviors: The Mormons

The virtues of a healthy lifestyle are central to Mormon theology and culture. From early childhood, Mormons are taught to avoid smoking, drinking, using stimulants (e.g., caffeine), and engaging in activities that might damage their bodies. In like manner, a nutritious diet

and the elements of a positive and wholesome life are enthusiastically taught in Mormon communities. When one examines the health statistics for Utah, the so-called "Mormon state," the benefits of living such a carefully prescribed existence are well evidenced. With respect to the primary death-causing diseases, Utah has far lower death rates than the 48 contiguous United States as a whole (U.S. Bureau of the Census, 2000; see Table 3.1).

These data can, in part, be further specified by findings showing that Mormons have heart disease rates one-third to one-half those of their non-Mormon peers (Koenig, McCullough, & Larson, 2001). One should not lose sight of the fact that Utah has the highest birth rate in the United States, and therefore probably the youngest population. Still, there is much reason to believe that Mormon health practices do bear fruit.

The Mormons constitute an excellent example of the effects of engaging in healthful behaviors premised on religious doctrines. Similar results have been observed for the Seventh-Day Adventists, a group whose views are similar in many respects to those of the Mormons. Since many Adventists are vegetarians, they also evidence very low colon cancer rates (Koenig et al., 2001).

Problems of Inbreeding: The Jews

To a considerable degree, Jewish history in the past 2,000 years has been a tale of anti-Semitic discrimination and self-imposed separation from Christian neighbors. Long before Jesus, the early Hebrews sharply distinguished themselves from the other peoples who resided near them in the Near and Middle East. This pattern continued into the Christian era, when the separation of Jews into their own communities was finally formalized in the Middle Ages by the creation of the ghetto. Contrary to general belief, the ghetto was instituted by the Jews themselves, not by the Christian authorities (Wirth, 1928). "To the Jews the geographically separated and socially isolated community seemed to offer the best opportunity for following their religious precepts" (Wirth, 1928, p. 19). Administratively, the ghetto was an agency of social, political, and economic control that enforced the segregation of Jews from non-Jews. Considering the prevailing anti-Semitism of Christians, this separation also served their desires well. Simply put, the physical isolation of the Jews for millennia offered a lengthy opportunity for genetic mutations to develop.

Many religious groups have a long history of relatively high rates of inbreeding, with the associated possibility of developing and perpetuating genetic defects. Among such bodies are the Amish, the Hutterites, and other relatively isolated conservative religious com-

TABLE 3.1. Death Rates for the Main Death-Causing Diseases for Utah and the 48 Contiguous United States

Diseases	Utah	48 contiguous United States
Heart disease	146.0	271.6
Cancer	103.6	201.6
Cerebrovascular disease	42.5	59.7
Chronic pulmonary disease	21.5	40.7
Diabetes	21.0	23.4
Total (all causes)	562.3	864.7

Note. Data from U. S. Bureau of the Census, 2000, Tables 126 and 130, pp. 90 and 94. Rates are expressed as number of deaths per 100,000 population as of April 1, 1997.

munities. Since these groups are often distant from the social mainstream, reliable medical data on the health of their members are usually difficult to obtain. The situation of the Jews is quite different. Historically, as already noted, they were often separated from their Christian neighbors in Europe and America. This situation began changing rapidly in the 20th century. Prior to World War II, Jewish intermarriage rates were below 5%. By 1970, about 32% of Jews were intermarrying. In more recent years, incidences of 40–60% have been reported (Silberman, 1985). This is likely to change the genetic situation in the not too distant future.

Interesting recent genetic marker analyses reveal that Jews from Eastern and Western Europe, North Africa, and the Near and Middle East are related despite over 2,000 years of the Diaspora (i.e., the dispersion from their roots in Palestine during Biblical times) (Ostrer, 2000). These genetic indicators were probably preserved by centuries of Jewish segregation and inbreeding.

Medical information about a number of genetic mutations among Jews is not hard to find. Though Jews are prone to a wide variety of genetically based illnesses, in many instances one can argue that lifestyle and other factors contribute to the expression of certain diseases (Koenig et al., 2001). We must also keep in mind that in most cases genetics is more probabilistic than deterministic (Barkow, 1982; Gould, 1978). Still, a number of genetically based conditions evidence great discrepancies between Jews and non-Jews (Griffiths, Miller, Suzuki, Lewontin, & Gelbart, 2000; Post, 1973). For example, Gaucher syndrome—a metabolic disease that affects the liver, spleen, bones, blood, and possibly the nervous system—has an incidence of 1 per 2,500 among Ashkenazi Jews, but 1 per 75,000 among non-Jews. Another condition occurring disproportionately among Jews is Tay–Sachs disease, a degenerative disorder of the brain that results in blindness, deafness, paralysis, and death, usually by the age of 3 or 4. It is found in 1 per 3,500 Jews, but 1 per 35,000 non-Jews. Those who would like to peruse the medical literature might research other genetically based states, such as essential pentosuria, familial dysautonomia, Niemann–Pick disease, and torsion dystonia, plus other possibilities.

Concern among Jews about these conditions has resulted in a National Foundation for Jewish Genetic Diseases.[3] It is a voluntary, nonprofit health and research organization that gathers and provides information on research, care, and resources for those interested in and/or affected by any of the genetic diseases to which Jews are susceptible.

Inbreeding: Other Possibilities

So that the problems of relative reproductive isolation and genetic drift may be further appreciated, we briefly note such problems among the Amish, a strongly Bible-based Christian sect. They are reported to manifest disproportionate rates of hemophilia, phenylketonuria, two forms of dwarfism, and a rare type of anemia (Hostetler, 1968).

Since cancer also involves chromosomal and gene defects in cells, efforts have been made to see whether religious groups differ in the forms of cancer to which everyone is subject. Differences between Jews and non-Jews are evident for a variety of cancers. Sometimes Jewish rates are high, sometimes low (Shiloh & Selavan, 1973). The general picture, however, is that lifestyle characteristics such as diet, smoking, and environmental factors (e.g., occupational

3. The foundation can be contacted at 250 Park Avenue, Suite 1000, New York, NY 10177.

exposure to carcinogens) are the main factors inducing cancer (Post, 1973; Shiloh & Selavan, 1973).

Though the history of group separation has contributed to the development and spread of genetic diseases, the continuing breakdown of barriers between groups may well disseminate the undesirable mutations to a larger population. We live in an age where, we hope, progress in genetics should eventually counter and correct these conditions.

OVERVIEW

In this chapter, we have rather briefly examined the main questions surrounding the relationship of religion to biology. This is a realm about which volumes can be written. It is also one that rapidly becomes highly specialized and technical, invoking the esoterica of biochemistry and the neurosciences.

The relationship between religion and biology has been historically conditioned by the theory of evolution. Soon after Darwin presented his views, the religious community split—interestingly, with conservatives on both sides of the conflict. One group saw evolution as posing a dire threat to faith by doing away with the distinction between humans and other animals. The religious proponents of Darwinism saw evolutionary theory as testimony to the wondrous way God works through natural law. This battle is continuing into the 21st century. The basic issues remain the same, but in the contemporary world, the scientific mainstream occupies center stage.

Many thinkers have attempted to present scientific theories for the various roles and functions of religion. One such framework has been detailed here. Although we acknowledge the data from twin studies that speak to a genetic component in religious devotion, we suggest that there is no direct connection between religion and genetics. An indirect connection may be found because of the various functions religion performs in life. Our suggestion is that religious faith satisfies people's needs for meaning, control, and social relationships. Even though this approach is testable, it need not challenge the basic ideas of religion in general, or of any specific theology.

In current biological and social-scientific thinking, religion has become a popular topic. Anthropology, and the newly developed but very controversial field of sociobiology, have offered perspectives on possible origins and roles for religion. Grand, all-encompassing theories may be intellectually exciting, but unless they eventuate in fruitful evaluative research, they will essentially remain sterile.

Research on religion and the brain appears to be a "hot" research area today, but it is basically in its infancy. Work in this domain has, however, opened new avenues to understanding the biological correlates of religious experience and practice. Related research has further demonstrated that these facets of faith do have bodily effects that are primarily positive. In broader perspective, we must recognize that the use of certain substances (e.g., drugs), and ritualistic actions (e.g., starvation, mutilation, etc.) can be physically damaging. On a more general plane, much still needs to be done to unravel the issues of cause, correlation, and effects between religious expression and these physical processes.

Finally, religion and theological doctrines may act as independent variables to foster healthy or unhealthy body states. With our national emphasis on health directing our attention to such concerns as diet and the deleterious effects of smoking, alcohol, and drug abuse,

there are obvious lessons that can be learned from the lifestyles practiced by such groups as the Mormons.

It is abundantly evident that religion, which seems so distant from biology, is actually intimately involved with it on many levels. The tip of this iceberg is now displayed, but more and more of its body is coming into view as science studies the various links between religion and biology.