

## 11 Beyond Scopes

### Why Creationism Is Here to Stay

E. MARGARET EVANS<sup>1</sup>

(2000). In Rosengren, K., Johnson, C., & Harris, P. (Eds.) Imagining the impossible: Magical, scientific and religious thinking in children. (pp. 305-331) Cambridge: Cambridge University Press.

Despite more than a century of scientific support, the theory of evolution has not been fully assimilated and embraced in contemporary society. Creationist beliefs continue to be endorsed by many adults (Numbers, 1992) and adherents of creation science now enjoy considerable success at the school district level in the United States, advocating that "intelligent design" theory and evolutionary theory be given equal time (Scott, 1994).

Why are creationist beliefs so persistent? In this chapter I shall argue that this persistence is not simply the result of fundamentalist politics and socialization. Rather, these social forces themselves depend on certain propensities of the human mind. On this account, the persistence of creationist beliefs in a population attests to their cognitive affinity as well as their public availability (cf. Evans, 1994/1995; Shore, 1996; Sperber, 1996).

This chapter offers a broad look at the nature and genesis of beliefs about the origins of species. Recent evidence on the development of children's thinking on this subject is presented in the larger context of an examination of the nature and distribution of creationist and evolutionary beliefs in contemporary society. The chapter begins with a look at the current ideological debate between proponents of evolution versus creation "science." The case is made that their differences are better understood in terms of dissimilarity in ontological commitment rather than in the capacity to reason scientifically. The next section reviews what is known about the distribution of beliefs about

<sup>1</sup> The studies reported in this chapter were supported by a Spencer Foundation Dissertation Grant, a University of Toledo Research and Fellowship Award, and a Spencer Foundation Small Grant.



origins among ordinary adults in the population at large. The final section reports on a series of empirical studies examining the development of such folk beliefs in children growing up in families from fundamentalist and nonfundamentalist communities in the United States.

### Evolution Versus Creation Science

Modern evolution science is derived from Dobzhansky's 1937 synthesis of Darwinian theories about the origin of species and Mendelian genetics (Mayr, 1997). The contemporary scientific establishment accepts both Darwin's theory of natural selection, that species arise naturally through adaptive change, and his theory of a common descent for all species, including humans. These theories are so central that without them modern biology would make no sense (Berra, 1990; Kitcher, 1982; Mayr, 1991; Scott, 1994).

Creation science stands as a modern challenge to evolution science, with the intent of providing empirical evidence to support the Biblical story of creation, the core tenet of which is the creation of separate species through divine, intentional design. Creation science beliefs are rooted in Biblical creationism and derived from the Book of Genesis in the King James English Bible, which is taken literally to be the word of God (Kehoe, 1995). While most Western religious traditions have accepted the scientific truth of evolution, embracing some form of theistic evolution, a subset of fundamentalist Christians have sought to challenge the theory of evolution on scientific grounds.

Like evolution science, creation science is a twentieth-century product. Notwithstanding their outraged response to Darwinian theory, most Biblical creationists of the Victorian era (1850–1900) accepted the geological theories of that time, including the antiquity of the earth (Gregory, 1986; Numbers, 1992). In contrast, contemporary creation scientists are more radical in defending Biblical teachings even with regard to the age of the earth. Creation science, also known as scientific creationism, really came into its own following the 1961 publication of the Whitcomb and Morris book, *The Genesis Flood* (Numbers, 1992). In this work and subsequent publications (e.g., Whitcomb, 1988), the Biblical dictum of a young earth was preserved and the Noachian Flood was invoked to explain the fossil record. The contemporary interpretation of the geological column was discredited and replaced with flood geology. This literature fostered a reappraisal and

reawakening of creationist beliefs across the industrialized world (Numbers, 1992). Importantly, modern "creation science" stands as a peculiar "transmogrification of creationism from religion into science" (Numbers, 1992, p. 244) with the expressed purpose of procuring a place for creationism in the science classroom.<sup>2</sup>

### Science in the Service of Religion

In many ways, creation scientists harken back to a time when science was viewed as a "religion's truest handmaid" (Shapin, 1996, p. 142). Seventeenth-century natural philosophers seeking a scientific understanding of God's creation were deemed "priests of nature;" their experimental studies could even be performed, quite properly, on the Sabbath (Shapin, 1996, p. 153). In revealing God's handiwork, the detailed observations of the natural historian were thought to complement those of the theologian, the interpreter of the Holy Scriptures. Nonetheless, the scientist's enterprise differed quite radically from that of the theologian's. Natural philosophers scrupulously investigated the mechanical or efficient causes underlying nature's complex operation, leaving aside questions about final causes (Deason, 1986; Mayr, 1982; Roger, 1986; Shapin, 1996; Schrader, this volume).

The seventeenth century marked the beginning of revolutionary changes in the scientific view of nature. Challenging the teleological and vitalistic beliefs of earlier thinkers, scientists began to look on nature as a passive kind of machine or mechanism (Deason, 1986; Roger, 1986). This "depersonalization of nature" (Shapin, 1996) initially fostered the argument from design as the central tenet of a natural theology. If nature is not itself purposeful, but rather functions like a blind machine, then it followed that this artifact must be the handiwork of some higher power (Dawkins, 1987; Shapin, 1996).

In the absence of any natural explanation for nature's apparent functional design for living, a supernatural account was accepted. But as the study of natural history progressed in its own way, a powerful, naturalistic account of the origin of species emerged. The handmaid of religion thus ended up challenging the authority of religion itself. Modern science has relentlessly challenged all appeals to final causes

<sup>2</sup> Notably, this position has not been embraced by hard-core Biblical creationists, who eschew attempts to ground their religious beliefs in any source other than the Bible.

and supernatural intervention as it seeks to explain reality in naturalistic, purposeless terms (Root-Bernstein 1984; Shapin, 1996).

### **Creation Science: An Oxymoron?**

Creationism has been commonly dismissed as a religion, dominated by faith rather than scientific evidence. The National Academy of Sciences (1984) draws a sharp line between natural and supernatural kinds of explanations:

The goal of science is to seek naturalistic explanations for phenomena such as the origins of life, the earth and the universe . . . within the framework of natural laws and principles and the operational rule of testability. . . . Religion provides one way for human beings to be comfortable with these marvels. . . . Creationism, with its accounts of the origin of life by supernatural means, is not science. It subordinates evidence to statements based on authority and revelation . . . its central hypothesis is not subject to change in the light of new data. No body of beliefs that has its origin in doctrinal material rather than scientific observation should be admissible as science in any science course. (p. 26)

In 1987, the U.S. Supreme Court expressed the same opinion, ruling that creationism is a religion and hence should not be taught in science classes. In effect, this opinion finally reversed the outcome of the famous "Monkey Trial" of 1925, in which John Scopes was tried and convicted of the crime of teaching evolution to high school students in Tennessee. The Supreme Court's 1987 decision, however, only prompted creationists to bolster their credentials as scientists (Scott, 1994). Indeed, creation scientists appeal to classic standards of science. For the most part, they look at nature in depersonalized, mechanistic terms. And, their efforts are directed toward challenging the theory of evolution on empirical grounds, independent from matters of faith.

What distinguishes creation scientists is not a general failure to be "scientific" so much as their commitment to an ontological position that denies the adequacy of a naturalistic explanation of origins. Consider four positions along this line. At one extreme, the world is viewed in purely naturalistic terms, eliminating any possible role for supernatural forces and final cause explanation. In this case, science, originally the handmaid of religion, effectively becomes the mistress. At the other extreme, a "magical" world view infuses nature with

vital forces, with no clear line separating the natural from the supernatural order. For the most part, Western science and religion have marked out positions between these extremes. Creation scientists hold to the more traditional position of an original creator, God, who fabricated the essential kinds of natural entities in the world. In contrast, most Western religions have moved to a middle ground characterized by some form of theistic evolution. The scientific truth of evolution is accepted while crediting God with initiating or guiding the process as well as creating the spiritual soul, if not the biological body (cf. John Paul II, 1996).

Creation scientists are well aware that they must defend their scientific claims on scientific grounds. To this end, they are quite adept at marshaling criticism against the verifiability of evolution as a scientific theory (see Cavanaugh, 1985; Godfrey & Cole, 1995; Numbers, 1992). Creation scientists gravitate toward the epistemological position that there is something inherently wrong with the theory of evolution, at least when compared to theories in the physical sciences (Cavanaugh, 1985; Godfrey & Cole, 1995). For instance, the following has been recently inserted in Alabama biology textbooks: "No one was present when life first appeared on earth. Therefore any statement about life's origins should be considered as theory, not fact" (Applebome, 1996). This argument harkens back to a kind of Baconian ideal of science based solely on induction from unbiased observation (Woodward & Goodstein, 1996).

Perhaps the most telling criticism of creation science is that it has failed to muster a systematic research program to accompany its rhetorical criticisms of the theoretical and factual bases of evolution (Berra, 1990; Cavanaugh, 1985; Kitcher, 1982; Root-Bernstein, 1984; Wise, 1998). Yet, despite efforts to characterize creationist science as a monolithic, scientifically impoverished endeavor, in a careful investigation Numbers (1992) found considerable dissent, with alternative theoretical proposals and a rudimentary research program. Although most of their output was polemical, the Creation Science Institute has supported some credible research, such as Lammerts' work on mutations in roses and Gentry's on radioactive halos in granite.

Despite these fledgling research efforts, however, it is quite apparent that the goals of creation science cannot be sustained in the face of actual empirical research. There are few doctoral-level geologists or paleontologists in the creation science camp, despite the willingness

of the Creation Science Institute to support such training. There were several contenders, but once they became immersed in the new theories and data they either turned to a safer research area that did not challenge their world view or to theistic evolution (Numbers, 1992; Wise, 1998). With theistic evolution, it was possible for creationist geologists to maintain the dual ontologies, that of science and that of religion. However, the Creation Science Institute rebuffed this compromise position, because it failed to maintain a central tenet of creation science, the Biblical dictum of the young earth.

In sum, creation science cannot be simply dismissed as religion, oblivious to the standards of science. More accurately, it stands as an ultimately futile effort to use science to defend a particular ontological position. As Chinn and Brewer (1993, this volume) argue, beliefs that are entrenched in deep ontological assumptions are the most resistant to change based on contrary evidence. Insofar as creation scientists and evolutionary scientists are committed to distinct ontologies, it is not surprising to find them interpreting the same evidence in radically different ways. For example, if, consistent with creation scientists' beliefs, fossils are not signs of ancient life but are, instead, the remains of organisms drowned in the Noachim flood, then their placement in the earth's sediments may be considered to be the result of their specific gravity instead of geologic processes. Furthermore, it might follow that human fossils are rare because, when living, humans tried to survive the rising water by moving to the hilltops, where their remains decayed rapidly, rather than being fossilized in the more forgiving debris at bottom of the waters (Whitcomb, 1988; Wise, 1998).<sup>3</sup>

### The Depersonalized Human Versus the Privileged Human

Efforts to dismiss the scientific standing of creationist beliefs typically fail to consider why such beliefs are so entrenched. The persistence of creationist beliefs cannot be accounted for by a naive acceptance of the literal truth of the Bible, nor with general ignorance of the empirical standards of science. In fact, fundamentalists are generally "scientific," even accepting scientific evidence that runs against heliocentrism as presented in the Bible (Scott, 1987, 1994). Evolutionary beliefs

<sup>3</sup> Consistent with their thesis, creation scientists have attempted to prove that all fossils are of the same age (Numbers, 1992).

are peculiarly objectionable because they more deeply threaten to undermine the privileged status of God and the human soul in the universe. Without this special status, the fear is that all higher value will collapse, causing a moral decay that is seen to underlie a host of modern secular evils including fascism, communism, Freudianism, humanism, and witchcraft (Scott, 1987, 1994).

In keeping with their essentialist beliefs, members of the Creation Science Institute insist that "The first human beings did not evolve from an animal ancestry but were specially created in fully human form from the start. Furthermore, the spiritual nature of man (self-image, moral consciousness, abstract reasoning, language, will, religious nature, etc.) is itself a supernaturally created entity distinct from mere biological life" (Applebome, 1996). Evolution is seen to radically challenge this privileged status, threatening to reduce humankind to mere animals, absent their special spiritual and moral status. As one parent explained: "If children are nothing more than apes evolved, then we cannot expect them to act more than that to one another. . . . We must instill the belief of their divine worth" (Evans, 1994/1995, p. 124).

The great success of the scientific revolution, viewing nature as a depersonalized mechanism, very soon began to raise doubts about the status of persons in this new order (Shapin, 1996). Fundamentalists clearly fear that if they abandon their literal reading of the Bible, they must also abandon moral certitude. Science has no easy answer to this uncertainty. Mayr (1997) devoted a whole chapter of his most recent discourse on biology to the evolution of morality and ethics (see also Dennett, 1995), concluding that both an "innate ethical predisposition" and an "exposure to a set of ethical norms" were necessary ingredients for a moral child (p. 262). This leaves open a role for both science and religion but lacks the certitude of a higher religious truth. In a recent letter to the Pontifical Academy of Sciences, the Pope clearly drew a line: "to consider the mind as emerging from the forces of matter. . . . is incompatible with the truth about man" (John Paul II, 1997).

How do these ideological concerns play out in the thinking of ordinary people? The foregoing analysis suggests that creationism appears to be sustained by an effort to seek a final cause explanation, combined with beliefs in the supernatural. The notion of evolution, in contrast, offers a purely naturalistic, purposeless explanation of origins. In the stabilization of creationist and evolutionist beliefs, it has

been argued, reliance on such ontologies is likely to be at least as important a factor as the ability to reason scientifically. The nature and genesis of the relevant intuitive ontologies is investigated in the next sections, in the folk beliefs of adults and the intuitions of children.

### The Distribution of Creationist and Evolutionist Beliefs

In contrast to the popular idea that creationist ideas are confined to the less well educated of the rural American South, such beliefs are commonly found wherever Protestants have settled, including much of the former British Empire (Cavanaugh, 1985). Creationist literature has been published in ten languages, from Chinese to Czech (Numbers, 1982). Within the United States, according to Cavanaugh, the movement is most longstanding in the midwestern and western states. Creationists are often highly educated (Cavanaugh, 1985; Evans, 1994/1995; Numbers, 1992), although, in general, adults with only a high school diploma are less likely than those with college degrees to endorse evolutionist origins (Miller, 1987).

Numerous polls indicate that the U.S. adult population is almost evenly split between evolutionist and creationist beliefs, with a few fence-straddlers (Miller, 1987; Almquist & Cronin, 1988; Numbers, 1992). A typical Gallup Poll finding is that 47% of the adults surveyed will agree that "God created man pretty much in his present form at one time within the last 10,000 years" (Numbers, 1992). As most surveys confine themselves to the analysis of single questions, they rarely reveal the complexity of adult thinking or much about the nature of their belief structures.

Studies of students' beliefs about species origins have been more thorough. Given the ideological climate discussed above, considerable research has focused on the relationship between creationist beliefs and scientific competencies and attitudes in general: Do courses in scientific reasoning increase students' acceptance of evolution? Are creationist beliefs associated with other unscientific, supernatural ideas such as beliefs in the paranormal? Are creationists generally anti-intellectual or anti-scientific? In contrast, another line of research focuses more specifically on domain-specific learning, considering the preconceptions and misconceptions of students who are being taught evolutionary theory.

### College Courses in Scientific Reasoning: Do They Help?

Although college students are more likely to subscribe to evolution, and less likely to subscribe to beliefs in the paranormal, than the rest of the population (Miller, 1987), they still exhibit some strikingly resistant beliefs (e.g., Harrold & Eve, 1995a). In an extensive survey of over 21,000 students, Almquist and Cronin found 38% of the students agreeing that "The garden of Eden is the point of origin of human life and the origin itself was an act of creation as performed by God, as recorded by Genesis" (Almquist & Cronin, 1988).

Aside from creationist beliefs, Gray (1995) evaluated the effect of three years of college education on students' beliefs in paranormal phenomena, such as extrasensory perception, astrology, and UFOs. He found surprisingly little change and little effect of either general courses in scientific method or specific courses designed to target the fallacious reasoning presumed to be associated with paranormal beliefs. Consistent with Tversky and Kahneman's (1974) research, he concluded that students were selectively biased toward evidence that confirmed their prior beliefs. A larger body of research along this line points to the importance of evaluating the factors underlying students' endorsement's of particular beliefs, as distinct from their reasoning abilities (see also Harrold & Eve, 1995b; Lawson & Worsnop, 1992).

### Creationism and Cult Beliefs: Anti-Intellectual or Anti-Scientific?

An extensive study of students' beliefs in creationism, cult archeology, and the paranormal indicates that "unscientific" beliefs are not all of a kind (Feder, 1995; Harrold & Eve, 1995b). Overall, creationist students were just as likely as other students to have positive attitudes toward science in general and were no more likely to endorse beliefs in the paranormal, cult archeology, or unconventional ideas about the origins of civilizations (e.g., Von Daniken's ancient astronauts; Atlantis). Examining whether creationists are generally anti-intellectual, Harrold and Eve found that they did indeed read fewer books outside classes and were more likely than other students to choose business

majors.<sup>4</sup> Unlike cult beliefs in the paranormal, however, creationist beliefs were allied to a restricted world view involving a strongly held value system centering on political and religious conservatism and eschewing secular humanism. Harrold and Eve termed this ideology "cultural fundamentalism."

### Biology Students' Misconceptions About Species Origins.

Investigations of student learning demonstrate that the Darwinian concept of natural selection poses as many challenges ontogenetically as it did historically (Mayr, 1982). Highly educated biology and medical students, and less advanced students alike, show a persistent tendency to misconstrue biological change as a response to an animal's "wants" or "needs." Moreover, biological change is often viewed as a nonrandom process operating at the individual rather than at the population level (Brumby, 1979, 1984; Clough & Wood-Robinson, 1985; Deadman & Kelly, 1978; Greene, 1990; Settlege Jr., 1994). Overall, students tend to endorse a Lamarckian-type mechanism for biological change, with the inheritance of acquired features, as distinct from the Darwinian idea of natural selection from random variation. For example, students report that rabbits change their color in winter to protect themselves from predators, with their offspring also inheriting this tendency. Courses specifically designed to redress such misconceptions seem to have minimal impact (e.g., Bishop & Anderson, 1990). Students' explanations are remarkably teleological, commonly invoking the purposes and needs of the individual organism (Evans, 1994/1995).<sup>5</sup>

In summary, the spread of evolutionary ideas is only minimally helped by courses in scientific reasoning; in fact, such ideas seem quite difficult to acquire. Creationist beliefs are not associated with other beliefs in the supernatural or the paranormal, nor are creationists

<sup>4</sup> Otherwise, Cavanaugh (1985) found that young creationists were encouraged to become engineers, and to avoid the humanities. Whether these career choices are merely pragmatic or reflect a desire to avoid hard challenges to core beliefs is unclear.

<sup>5</sup> Care must be taken when interpreting the teleological or volitional explanations of students as they may simply lack a better means of expression, rather than truly believing in the existence of intentional forces. Many of the biological textbooks and television programs to which these students may be exposed often couch their arguments in similar terms (Jungwirth, 1975; Brumby, 1979; Clough & Wood-Robinson, 1985). Such language is hard to avoid, even by the experts.

generally anti-scientific. There is some evidence to suggest a kind of anti-intellectualism, however, as this may be associated with an open-minded liberalism. Ironically, the beliefs of creationists are more likely to be challenged in the humanities than in the sciences (with the exception, of course, of evolutionary biology). A deeper understanding of these propensities is offered in the next section, reporting empirical studies designed to look at the emergence of beliefs about origins in different subcultural contexts.

### Cognitive and Cultural Factors in the Emergence of Beliefs About Origins

The origin of species can be viewed in two fundamentally different ways. We can imagine that the intricate design of species must be the intentional handiwork of some superhuman maker. Or, we can suppose that species must have come into being by some nonintentional, natural means. Historically, both of these perspectives are evident. Consistent with their naturalistic outlook, many early Greek thinkers adopted a nonteleological and naturalistic theory of origins, namely, spontaneous generation. This view was subsequently upstaged by a monotheistic creationism,<sup>6</sup> which, in turn, has only lately and partly been challenged by theories of evolution (Deason, 1986; Mayr, 1982).

In a study of public elementary school children from a midwestern university town (Evans, 1991, 1994/1995), the ontogenesis of beliefs about the origins of species was found to be remarkably similar to the historical pattern (see Figure 11.1). Children responded to the question: "How did the very first X get here . . . ?"; where X was a human or an animal. Responses coded as spontaneous generationist included any of a variety of nontransformational origins that appealed to a natural cause, whereas those coded as evolutionist had to clearly reference a natural transformation from one distinct species to another.

<sup>6</sup> Creationism, however, did not completely supplant spontaneous generation beliefs. Even as late as the seventeenth century the idea that "living beings could arise from non-living matter" by a variety of means was prevalent (Roger, 1986). Of course, caution must be exercised when using a historical analysis as a blueprint for ontogenetic change, as the conceptual base needed for individuals to generate ideas is likely to be very different from the conceptual base needed for the adoption of those ideas. Even so, this is a promising line of attack that has been used with some success to identify intuitive conceptions (e.g., Kaiser, McCloskey, & Proffitt, 1986; Vosniadou & Brewer, 1987; Wiser, 1988; Samarapungavan & Wiers, 1997).

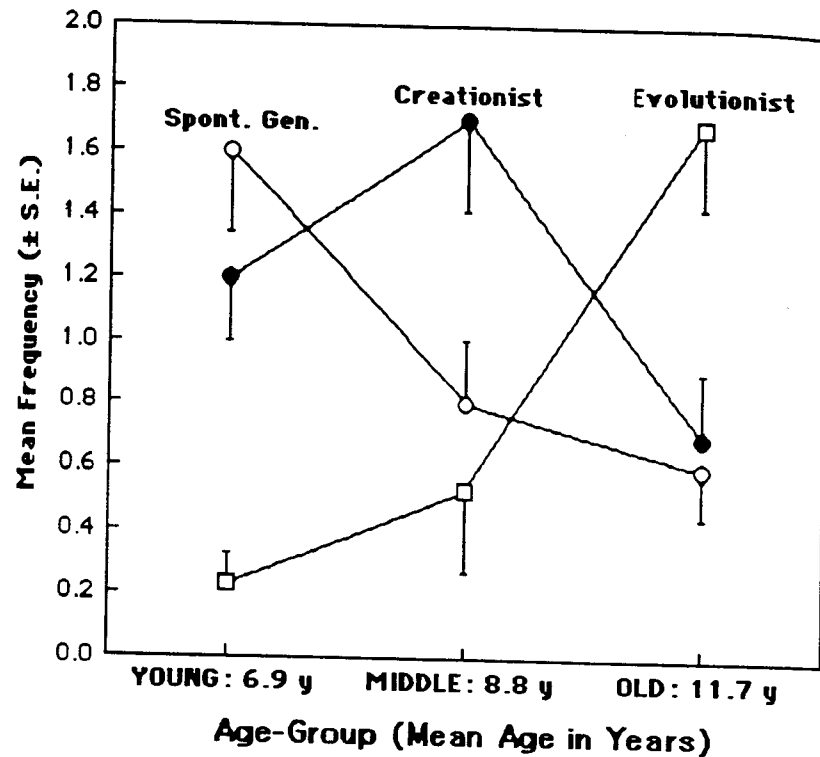


Figure 11.1. Frequency of each origin's explanation by age group.

References to an intentional agent, not necessarily God, were coded as creationist. Mixed spontaneous generationist and creationist responses were generated by the youngest children; consistent creationist beliefs were found in the middle age group, and evolutionist beliefs did not appear until early adolescence, where they predominated (Evans, 2000).

The youngest children were the most variable of all of the age groups, often endorsing both spontaneous generationist and creationist responses. Their spontaneous generationist responses, in particular, offered some clues as to their comprehension of the "origins" questions. From some of their more primitive explanations (e.g. "they were borned here"), it appeared that they failed to appreciate the need to explain why species originally came to be the way they are. The youngest children often seemed limited to proximate-cause arguments for the origins of species, such as growth or birth (e.g., "dinosaur grew on earth from eggs, like a bird), which take the existence and

design of the organism to be a given. These children apparently have not yet confronted the "existential" question. Seemingly, they were explaining how an organism becomes manifest, but not how it got to be there in the first place.<sup>7</sup>

I propose that, at least in certain contexts, creationist thinking is a precursor and impetus to the later development of evolutionary theory. By drawing out the analogy between artifacts and species, creationist thinking brings to attention the question of how species came to be existent and have the functional designs that they do. Once the problem of original design is framed, proximal-cause explanations no longer appear adequate. Thinking about the design is naturally linked to thinking about a designer (Dawkins, 1987).

The idea that random, natural processes could explain the intricate design of organisms seems comparatively implausible. In this sense, the theory of evolution is not something that arises intuitively, but rather requires a specific knowledge structure, with attention to special kinds of data. That is, an individual is unlikely to make such an argument without an understanding of the history (fossils) and adaptation of species. It is from this base that a natural, specifically an adaptationist, evolutionary explanation could arise as it forces essentialist assumptions in the stability of species to be overridden (Evans, 2000).

To assess the effect, children in the reported study were questioned about their knowledge of fossils and adaptation. As predicted, such knowledge correlated with whether the children were evolutionist, independently of age. Nevertheless, while allowing for the evolution of species in explaining biological changes, these children were not yet Darwinian. Consistent with the research on college students' misconceptions, these children offered Lamarckian explanations such that animals change with the purpose of adapting themselves to the environment (Evans, 2000). Here again a teleological explanation appears to be readily applied, in the absence of knowledge of other causal mechanisms.

A cognitive account can thus be made for parallels between the historical and ontogenetic development of thinking about origins. However, it is equally important to consider how social factors may

<sup>7</sup> Such responses could well have their origin in the apparently spontaneous appearance of new organisms in spring, which preexist in embryonic forms, such as seeds in the ground (Evans, 1994/1995, 2000).

play a role in the story. The developmental sequence reported above was found in a sample of children from a midwestern university town. It seems likely that adults in this highly educated university community would tend to foster evolutionist beliefs. What would the developmental pattern be in a more fundamentalist community that subscribes to creationist views?

### Developing Beliefs About Origins in Fundamentalist and Nonfundamentalist Communities

The impact of social context was examined by comparing the ontogenetic sequence in communities that differed markedly in beliefs about the origins of species. As described earlier, to Christian fundamentalists the mere idea that different species might have come about as a result of natural transformations of animal kinds is quite implausible, even laughable; for them, entities as complex as biological kinds must have been the intended outcome of God's design (Whitcomb, 1972). How would children reared in such communities differ in the development of their beliefs about species origins from those reared in communities that believe that nature, not God, is responsible for the complexity of biological life?

For the purposes of the study, the definition of communities as fundamentalist or nonfundamentalist was determined by school attendance (Evans, 1994/1995, 1999). Fundamentalist families were recruited from two private Christian academies and a Christian Fundamentalist home-schooled group. As far as possible, the nonfundamentalist children were matched by age and the geographical location of their homes to their fundamentalist counterparts, but they attended public schools. All of the children came from rural and suburban areas in the Midwest. In addition to this difference between communities, the study included a survey of parental beliefs, providing a more direct index of adults' beliefs bearing on a child's experience at home. Assessments were also made of a variety of environmental influences, including home, school, and church, to determine the degree to which any child was exposed to a saturated belief system, be it creationist or evolutionist.

The findings for the nonfundamentalist elementary school age children replicated the development pattern found in the first study, reported above (Evans, 2000). In both studies, mixed spontaneous generationist and creationist beliefs predominated in the youngest

children (five to seven years), exclusively creationist beliefs were found in the middle aged group of children (eight to ten years), and evolutionist and creationist beliefs were found in the oldest children (10.5–12 years). In the second study adults were also included, and their beliefs resembled those of the older elementary school children (see Figure 11.2).

It should be noted that the nonfundamentalist communities sampled in these two studies differed on several characteristics. In the original study, the children were drawn from a midwestern university town, where it was expected that evolutionist beliefs predominated among the adult population. In the second study, the subjects were drawn from rural and suburban communities, which were more likely to endorse creationism (Almquist & Cronin, 1988), and where adults had fewer years of formal education. These differences were reflected in the proportion of older children from the two communities who endorsed evolutionist rather than creationist beliefs: In the university town population evolutionist beliefs predominated, whereas in the

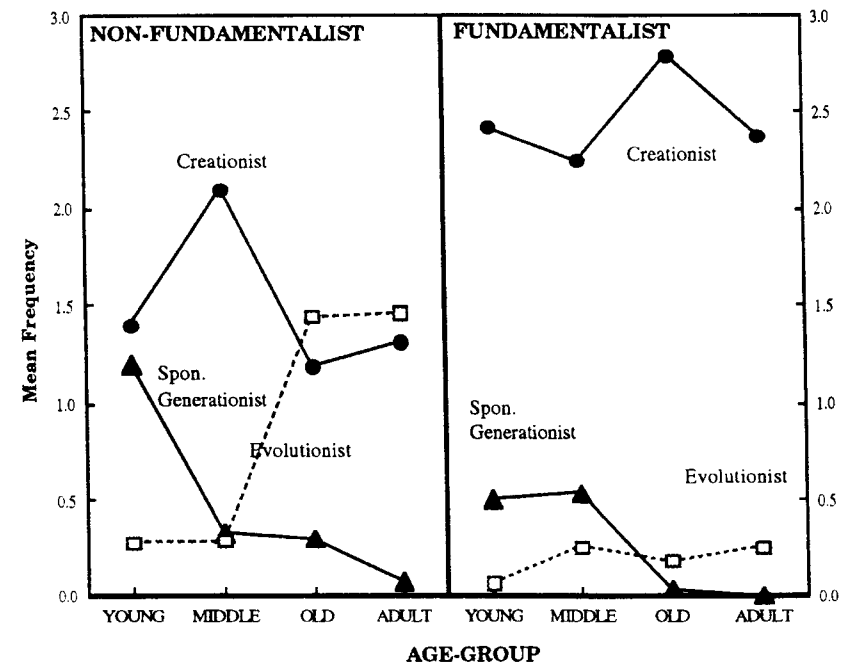


Figure 11.2. Frequency of each belief about the origins of animals by age group in nonfundamentalist and fundamentalist school communities. Age groups: Young (5–7 years); Middle (8–10 years); Old (10.5–12 years).



rural and suburban areas creationist and evolutionist beliefs were both similarly endorsed. On closer examination, this difference appeared to be primarily due to a curious pattern that was peculiar to individuals in the nonuniversity communities. These individuals endorsed evolutionary explanations for nonhuman species, but not for human beings. Humans were thus held out to have a privileged status (Evans, 1994/1995).

The fundamentalist children in this study were drawn from the same geographical areas as the nonfundamentalist children, with parents who had comparable levels of education. An analysis of interests revealed that fundamentalist and nonfundamentalist children were equally likely to enjoy nature studies, dinosaurs, reading, sports, and a number of other activities common to children in this age range. They differed significantly, however, in expressed interest in religious activities and fossils. The fundamentalist children were more interested in the former and nonfundamentalists, in the latter. Likewise, parents from the two communities differed in the degree to which they would encourage these particular activities in their children. Fundamentalist parents were less likely than nonfundamentalist parents to foster their children's interest in natural history and more likely to encourage religious activities (Evans, 1999).

Given this background, the critical question is whether the developmental pattern differs for fundamentalist children as compared to their nonfundamentalist counterparts. The answer is yes. Creationist beliefs predominated in all age groups for fundamentalist children (see Figure 11.2). In the fundamentalist community both naturalistic explanations for the origins of beliefs were suppressed, relative to the nonfundamentalists; evolutionist beliefs did not appear in any age group, and, although there was some expression of spontaneous generationist beliefs in the younger age groups, they were completely eclipsed by creationist beliefs. One interesting correspondence was maintained: Children from the middle age groups of the two communities expressed comparably high levels of creationist beliefs.

The children's creationist beliefs appeared to be linked with a pervasive belief in the essential, unchanging nature of species. Moreover, regardless of their religious leanings, all children, except the oldest group of evolutionists, refused to endorse the possibility that one kind of animal can be transformed into another, even when presented with the explanation (Evans, 1999). Similarly, Rosengren and his colleagues have found that children under the age of seven will not accept metamorphosis as a natural explanation. Adults and offspring of species

that undergo metamorphosis are treated as members of different species (K. Rosengren, personal communication, June 13, 1997). From the historical evidence, Mayr (1982) claimed that essentialist beliefs in the stability of species impeded the development of evolutionary explanations, as essentialism was incompatible with idea that species could change through adaptive processes. Essentialism appears to act as a cognitive constraint (see Gelman, Coley, & Gottfried, 1994) that has to be overcome if evolutionist explanations are to be endorsed. Essentialism, however, is perfectly compatible with proximate-cause explanations, such as spontaneous generationism, as well as creationist final-cause arguments.

### Consistency of Belief

Up to this point the two cultural groups, the fundamentalist and nonfundamentalist school communities, have been described as separate entities and treated as if each had uniform cultural meaning systems. Anthropologists often deride such an approach. D'Andrade (1990) argues that beliefs are most likely to be distributed differentially in a cultural group, with some informants exhibiting more coherent or systematic beliefs than others (see also Boster, 1987; Shewder, Goodnow, Hatano, LeVine, Markus, & Miller, 1998; Turiel & Neff, this volume). The following quote from a parent illustrates a kind of complexity that is overlooked in polls and surveys that dichotomize responses: "If we attribute a well written news article, book, or study to a particular author then why are we so quick to assume we are just a chemical accident. Wouldn't such a complex galaxy and beyond lead one to believe in a master blueprint along with a master author and creator. Although our religion doesn't agree with evolution, I feel that, Biblically, people of Christ's era wouldn't have understood . . . but the reference of man coming from dust to me represents some sort of evolution . . . God's planned evolution" (Evans, 1994/1995, p. 124).

Many parents from both school communities acknowledged both evolutionist and creationist beliefs, whereas others were exclusively creationist or exclusively evolutionist. In effect, beliefs about origins were distributed differentially in these populations, and they varied from a consistent creationism, through various combinations of mixed beliefs, to consistent evolutionism.

It was hypothesized that parents who were more consistent and absolute in their views would foster children with similar stances. To

the extent that the parents' beliefs were consistent, the child's environment would be relatively more saturated with a particular belief system. At the same time, it was also hypothesized that the capacity of this saturated environment to act as an enabling device would be limited or constrained by the child's intuitive beliefs. Specifically, community-endorsed beliefs would be more or less likely to be transmitted depending on the state of the child's conceptual development. To test these hypotheses, subjects from the two communities were combined into one group and the unit of analysis was the consistency of their belief systems (see Table 11.1).

The results showed highly significant patterns of correlation. Parents who were more consistently creationist tended to have children who were more likely to attend a fundamentalist school and a fundamentalist church. Their children attended church more frequently and were more enthusiastic and interested in religious activities, in general. Children of consistent evolutionists were more likely to attend a nonfundamentalist school or church, or no church, showed less of a preference for religious activities, but had greater natural history knowledge, especially of fossils. Importantly, there was no significant

Table 11.1. *Distribution of Consistent and Mixed Creationist and Evolutionist Beliefs Among Children and Adults from Matched Nonfundamentalist and Fundamentalist School Communities (percent of age group)*

| Age Group                                   | Measure of Belief Consistency* (percent) |     |     |     |     |
|---|--|-----|-----|-----|-----|
|   | (1)                                      | (2) | (3) | (4) | (5) |
| <i>Nonfundamentalist School Communities</i> |  |     |     |     |     |
| Young (5-7 Years)                           | 0  | 4   | 12  | 44  | 40  |
| Middle (8-10 Years)                         | 0  | 0   | 4   | 67  | 29  |
| Old (10.5-12 Years)                         | 12                                       | 26  | 15  | 26  | 22  |
| Adults                                      | 20                                       | 17  | 10  | 29  | 24  |
| <i>Fundamentalist School Communities</i>    |  |     |     |     |     |
| Young (5-7 Years)                           | 0  | 3   | 0   | 35  | 62  |
| Middle (8-10 Years)                         | 0  | 0   | 3   | 31  | 67  |
| Old (10.5-12 Years)                         | 0  | 0   | 0   | 43  | 57  |
| Adults                                      | 3  | 0   | 3   | 28  | 68  |

Note: This measure was derived from scaled, closed-ended questions assessing the degree of agreement (1-4 scale) with creationist and evolutionist explanations for the origins of three animate entities. Spontaneous generationist beliefs were not included in this analysis (Evans, 1994/1995).

\* (1) Evolution/No Creation, (2) Evolution > Creation, (3) Evolution = Creation, (4) Creation > Evolution, (5) Creation/No Evolution.

relationship between the consistency of parent beliefs and children's general interests, in sports, reading, and collecting dolls or race cars.

Consistent belief in evolution among the children was significantly correlated with their adaptationist ideas,<sup>8</sup> even when such ideas were not strictly correct. That is, consistent evolutionists tended to endorse the "incorrect" idea that animals acquire new features in response to environmental pressures and that such acquired characteristics can be inherited. The rejection of such beliefs by creationist children appeared to be part of a general reluctance to admit that animals could change in response to environmental influences. For example, when asked, "whether an animal would get a long neck, if it stretched into a tree to get food," one eleven-year-old fundamentalist child explained, "God made it that way, so it can't change" (Evans, 1994/1995, p. 125).

These relationships support the hypothesis that the more consistent the parent's beliefs the more likely the parent was to provide an environment that was relatively more saturated with these beliefs. However, such correlations do not indicate which, if any, of these factors operate independently as predictors of children's beliefs. It is plausible that attendance at a nonfundamentalist or fundamentalist school, for instance, overrides all of the other variables; that is, school attendance might be the major underlying predictor and the others may just be uninteresting correlates of school attendance. All significantly correlated factors were entered into a series of regression analyses, which were carried out separately for each age group.

Saturated environments, as indicated by consistent parent beliefs, did not predict the consistency of child beliefs until the children reached early adolescence. The two significant independent predictors of early adolescents' beliefs were the consistency of parent beliefs and the adaptationist beliefs of the adolescent, together explaining more than half of the variance. The more consistently creationist a parent and the less an adolescent endorsed adaptationist beliefs, the more likely the adolescent was to be a consistent creationist. Conversely, the more consistently evolutionist a parent and the more an adolescent endorsed adaptationist beliefs, the more likely the adolescent was to be a consistent evolutionist. All of the other factors, from the type of

<sup>8</sup> This is not an evolutionist belief as there is no claim that a new species results from this process. A sample statement, with which a child could agree or disagree (1-4 scale), was, "If an animal swims a lot it might get webbed feet, and its babies will have webbed feet, too."

school attended to the interests of the child, were subsumed under these major factors.

Only in the early elementary school years (five to seven years) did the type of school attended have an effect on the consistency of the child's beliefs. Attendance at a fundamentalist school increased the consistency of child creationist beliefs, presumably by suppressing or failing to facilitate naturalistic ones, such as spontaneous generationist. The more children in the middle age group (eight to ten years) knew about natural history and the more they endorsed adaptationist beliefs, the more likely they were to be evolutionist, whereas those children who were more interested in religious activities were more likely to be creationist.

These results provide strong support for the thesis that the dissemination of beliefs about origins is a function both of availability and attractiveness. Up through the middle years, children appear generally unreceptive to evolutionary explanations, even in households where parents endorse such beliefs. No matter what their religious leanings, children in middle childhood appeared to be commonly attracted to creationist ideas. Young children also offered naturalistic explanations of spontaneous generation that were never espoused by parents (see also Samarapungavan & Weirs, 1997). Only in early adolescence did access to information about evolution begin to exert a differential effect.

The social environment appears to operate by shaping the expression of intuitive beliefs, by privileging some and suppressing others, and directing attention to particular kinds of activity and data. In fundamentalist communities essentialistic intuitions are deified while evidence of adaptive change is actively reinterpreted and suppressed. The subject of fossils and evolution was not completely ignored in fundamentalist populations, but such information was actively challenged. For example, an eight-year-old stated, "I don't believe that monkey thing . . . they think that monkey's kept changing and then became human . . ." (Evans, 1994/1995, p. 132). And, a twelve-year-old explained, "Sometimes the schoolbooks say . . . this guy named Derwin or something has a theory, but the teachers say the theories that disagree with the bible are not true. His theories are about how some animals changed" (Evans, 1994/1995, p. 132).

While fundamentalist parents appear to successfully support children's involvement in religious activities and creationist beliefs, children of nonfundamentalist parents were more knowledgeable about

fossils. Such knowledge appeared to importantly challenge a pervasive creationist and essentialist bias, characteristic of children up to early adolescence.

Consistent with the reported studies of college students' ideas, children's initial adaptationist beliefs were of the Lamarckian variety. Even though erroneous, this understanding appears to be an important step toward a fuller knowledge of evolutionary explanation. The late development of this adaptationist understanding, however, seems to be contradicted by Keil (1994), who demonstrates that even kindergartners grasp the notion of adaptive function, what he calls the design stance. At this point, however, Keil has demonstrated only that young children evince what I would call static adaptation (Evans, 1994/1995, 1999), in which every feature of an organism is seen to be adapted to a specific environment. It is this form of adaptation to which Aristotle subscribed (Atran, 1990) and which is a feature of creationist beliefs. Static adaptation is perfectly compatible with essentialistic beliefs that an animal is destined to fit its surroundings; moreover, it is also, I contend, a feature of early naturalistic beliefs, such as spontaneous generationism. Static adaptation, however, does not take into account the role of the environment as a source of change, which is the crucial feature of the dynamic or Lamarckian adaptationist beliefs of the early adolescent.

### Artificialism Revisited

From these findings it is clear that parent beliefs underdetermine the beliefs of their children, at least until early adolescence. Most eight-year-olds, for instance, were very likely to embrace creationism, whether or not their parents were avowedly evolutionist. If creationist beliefs are intuitive, how do they arise? The answer, I suggest, is to be found in childhood artificialism (Guthrie, 1993). The creation of artifacts is always done for a purpose, be it functional or aesthetic, and always a human purpose. Childhood artificialism is the application, by children, of these principles to all entities, natural as well as artificial (Piaget, 1929).

A plausible explanation for the derivation of an artificialist explanation is that it arises from an intuitive ontology, specifically a naive theory of mind (see also Boyer & Walker, this volume). By the early elementary school years, children have a well-developed and coherent theory of mind (e.g., Wellman, 1990), and this theory is likely to

include some ideas about the intentional origins of artifacts (Bloom, 1996). Children's creationist beliefs about animate origins may simply reflect the "transfer of expectations" (Boyer & Walker, this volume) from the artificialism of an intuitive theory of mind. Rosengren and Hickling (this volume) suggest that it is only when children recognize the impossibility of an event that they are likely to "recruit alternative causal models." What violation of children's expectations might stimulate the emergence of a creationist belief? Piaget (1929) theorized that once the limitations of human capacities become obvious to a child, around the early- to mid-elementary school years, a superhuman might take on the role previously ascribed to the all-knowing, all-powerful parent. The recognition of human frailty might motivate children to transfer their expectations regarding human creative capacities from the realm of an intuitive theory of mind to an alternative model, that of theistic creationism.

If these conjectures have validity, then it should follow that children would initially conflate creationist and artificialist explanations and only later separate out these beliefs. Exactly this sequence was found in the above study, with the conflation being most pronounced for young nonfundamentalist children (see also Evans & Gelman, 1999; Piaget, 1929). In contrast with their fundamentalist counterparts, young nonfundamentalist elementary school children were more likely to conflate creationist and artificialist explanations for the origins of artifacts. By the time they were seven to nine years of age, fundamentalist and nonfundamentalist children alike discriminated between the powers of God and those of the human: God, but not humans, created animals; whereas humans, but not God, created artifacts (Evans, 1999).

Moreover, there is some preliminary evidence for a link between artificialism, creationism, and the existential question. By the time children are seven to eight years of age, they clearly understand first that artifacts are created exclusively by humans and not by God, and second that artifacts did not always exist. A similarly coherent understanding of animate origins arises a year or so later (see Evans & Gelman, 1999). As outlined earlier, such evidence suggests that an understanding of artifact origins forces children to confront both the existential and the teleological questions. Seemingly, when children have constructed a coherent explanation for artifact origins, they no longer take the existence and design of an entity, artifact or animate, to be a given.

Further findings from this set of studies (Evans & Gelman, 1999), in which preschool and early school age children's creationist and naturalistic beliefs were compared with those of fundamentalist adults, revealed some telling differences. Whereas children are likely to be limited creationists, applying creationist beliefs to familiar animals, only, fundamentalist adults are principled in their beliefs. They apply creationist explanations to all natural entities, animate and inanimate, from unfamiliar prehistoric animals to rocks or ponds. In effect, fundamentalist adults endorsed two principled theories of origins, one is artificialism, in which humans create artifacts, and the second is creationism, in which God creates all natural kinds. The causal model in which adult creationist beliefs are embedded is much more complex and coherent than that of young children's creationism.

### Conclusion

Creationist and evolutionist beliefs about the origins of species became public property in our historic past; now they are part of our collective repertoire of beliefs, transmitted from generation to generation. At one point such beliefs were intuitive (Sperber, 1996), in that they were a product of untutored inferential processes (Atran & Sperber, 1991). Once released and transmitted to other human minds, however, they attained the status of reflective beliefs (Sperber, 1996), largely spread through communication. When a child espouses such beliefs, is it because he or she has acquired them through communication, validated by some authority, be it teacher or religious leader? Or, is it because he or she acquired them through inferential processes similar to those that led to the original development of the belief? Both processes, I have claimed, operate in the emergence and transmission of beliefs about the origins of species (Evans, 1994/1995, 1999).

In an environment in which such beliefs are underdetermined, the child appears to develop both naturalistic and intentional beliefs about origins intuitively, through a process of self-discovery, in the course of normal interactions with the environment. In this case, the ontogenetic sequelae in contemporary elementary school children bear some similarity to those found in early scientists, with shifts from a primitive naturalistic belief, spontaneous generation, along with creationism, to an exclusive creationism, to a more sophisticated naturalistic belief, evolution. However, if children are reared in an environment in which creationist beliefs are overdetermined, as is found in funda-

mentalist communities, then any naturalistic belief about origins is either suppressed or not facilitated, and creationism predominates in all age groups.

Creationist beliefs are both intuitively attractive and culturally available; evolutionist beliefs are less so. Availability is determined by cultural or societal processes, attractiveness by cognitive processes. At least part of the reason for the easy embrace of creationism seems to be that young elementary school children have a coherent theory of mind, one that is easily extended beyond its natural boundaries. This well-developed intentional system could explain the origins of artifacts, and thus raises the existential question, that of existence versus nonexistence. By analogy this system can also explain the origins of natural entities, in teleological terms, that is, in terms of purpose and design. But a naturalistic explanation at this developmental point has limited explanatory power. It does not explain how species come to have the designs that they do, being limited to proposing proximate causes, such as growth or birth. The shift to evolutionary explanations, albeit of the Lamarckian variety, is only accomplished, it is claimed, when children are exposed to evidence that species have in fact changed. It is knowledge of fossils and adaptation that allows essentialist beliefs in the stability of species to be abandoned; it is in this sense that evolutionist explanations are counterintuitive as they violate such essentialist assumptions.

In summary, by taking a developmental perspective and investigating multiple layers of representation from the individual to the collective, intuitive beliefs can be disambiguated from the cultural meaning systems that support and extend those beliefs. The picture that emerges is one in which preschool and young school age children have a propensity to generate somewhat incoherent, or unprincipled, naturalistic and intentional beliefs about origins. Such competing explanations are typical of developmental systems (Siegler, 1994). These intuitive beliefs are the building blocks for a much more complex system, leading ultimately to evolutionary science and creation science. The environment plays a causal role in selecting and shaping a particular belief system, in part by transmitting information that either facilitates or suppresses these intuitive beliefs. In effect, the environment acts as an enabling device, which is, in turn, limited or constrained by the child's intuitive beliefs. This endorsement by the environment privileges either a naturalistic or an intentional intuitive belief system.

Although these intuitive propensities of the human mind appear to be given more coherent expression by the custom complex (Shewder et al., 1998) in which they are embedded, explanatory coherence is not necessarily a hallmark of adult belief systems. On the face of it, perhaps the most startling findings from these studies is that while some adults were exclusively evolutionist or creationist, many of them endorsed both creationist and evolutionist explanations. Such a result should not, on reflection, be so surprising. Adults, intuitively and reflectively, access both naturalistic and intentional interpretations for biological origins. As proposed earlier, it is the environment that provides the material evidence to extend or suppress such interpretations. Without such support the most reasonable solution is to uphold both explanations, as the one, creationism, offers moral certitude and purpose in life, whereas the other, evolution, offers a compelling natural explanation for biological origins, other than of the human mind. For many of the participants in these studies, as well as for some religious leaders (e.g., John Paul II, 1997), neither explanation is seen to accomplish both objectives. Parents were well aware of the problems that such a solution entails: "One way to avoid two completely contradictory theories is not to think about them," "I don't know what to believe, I just want my kids to go to heaven" (Evans, 1994/1995, p. 105).

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