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The Evolution of Creation Science, Part 1: Vestigial Structures and Biological Degeneration

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Creation science (CS) is a discipline in which evidence is sought to support a literal interpretation of the opening chapters of Genesis. Its technical literature has existed since the 1960s, long enough to test for the presence of temporal trends in attitudes toward and stances on specific topics. Here, we present a study of trends over the past fifty years regarding two topics: vestigial structures as understood by mainstream biologists, and biological degeneration as it is understood within the CS paradigm. Perplexingly, through half a century, CS authors have maintained a general consensus that all "created kinds" of organisms have undergone degenerative changes, and they have simultaneously maintained a general consensus that vestigial biological structures do not exist. Because the claim for biological degeneration implies the existence of vestigial structures, CS authors' denial of their existence is incongruous.

According to the young-earth creationist (YEC) worldview, the earth and all kinds of organisms were independently created about 6,000 years ago, as described in the book of Genesis. This worldview is widespread in North America and Europe,[1] despite the teaching of evolution in public schools and despite the biblical injunction against taking Genesis and the rest of the Pentateuch literally.[2] It is unpopular among mainstream scientists, most of whom accept the physical evidence that the earth is billions of years old and that all organisms evolved from a common ancestor.[3] Nevertheless, long before Darwin wrote *On the Origin of Species*, advocates of the YEC school of thought were already challenging the ideas of biological evolution and an old earth.[4]

Such challenges continued through the twentieth century,[5] and in 1961, two of those advocates, John Whitcomb and Henry Morris, produced a best seller, *The Genesis Flood*, which interpreted the geologic record according to the Genesis account of Noah's flood.[6] The arguments in the book are spurious, and point-by-point refutations have been published.[7] However, the book's popularity galvanized a movement that began at about the same time with the establishment of the Creation Research Society[8] (in the founding of which Whitcomb and Morris were involved[9]) and which has come to be called creation science.

Creation science (hereafter abbreviated CS for concision) is a discipline in which extrabiblical support for the Genesis account in its literal sense is sought. CS practitioners publish their studies in peer-reviewed technical journals that accept only manuscripts that concur with a literal interpretation of Genesis. These journals form the core data source for

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today's anti-evolution movement in North America and other English-speaking areas. Information from the technical journals of CS is fed into the anti-evolution movement's popular, nontechnical publications, which make frequent references to studies published in such journals.[10] A list of the technical journals of CS follows below, with the name of each journal followed in parentheses by the abbreviation used for its name in the endnotes.

In 1964 the Creation Research Society launched the earliest such journal, *Creation Research Society Quarterly* (*CRSQ*), which is still issued quarterly today. The first issue of each volume was titled *Creation Research Society Annual* (*CRSA*) until volume 7 in 1970. In 1974 the Geoscience Research Institute, a Seventh-Day Adventist organization, launched the biannual journal *Origins*, which ceased publication after volume 63 in 2008. In 1984, the Creation Science Foundation launched the journal *Ex Nihilo Technical Journal* (*ENTJ*), which was renamed *Creation Ex Nihilo Technical Journal* (*CENTJ*) in 1991, then *TJ* in 2001, and then *Journal of Creation* (*JC*) in 2006, under which name it is currently published. The journal was first published annually. It became biannual in 1991 and triannual in 1996. The Baraminological Study Group launched *Occasional Papers of the Baraminology Study Group* (*OPBSG*) in 2002. Its last issue was published in 2010, whereupon it was succeeded by the *Journal of Creation Theology and Science, Series B: Life Sciences* (*JCTS*), published by the Creation Biology Society. In 2005 the Center for Origins Research launched the occasional journal *CORE Issues in Creation*. In 2008 Answers in Genesis launched the online, open-access journal *Answers Research Journal* (*ARJ*). In addition to these journals, the technical literature of CS continues within the *Proceedings* volumes of the International Conference on Creation series. The conferences are organized by the Creation Science Fellowship in Pittsburgh, Pennsylvania. The first took place in 1986, and the seventh and latest in 2013.

The corpus of CS technical literature has now become large and long-lived enough to test for the presence of temporal trends in positions on specific topics. Here we present a study of such trends in two interrelated topics: the topic of vestigial biological structures as such structures are understood by evolutionary biologists, and the topic of biological degeneration as it is understood by CS authors. Vestigial biological structures, as they are understood by evolutionary biologists, are structures that have become greatly reduced in function and often in size, in comparison to their ancestral homologs.[11] Examples include the eyes of blind cave fishes and blind cave salamanders, the diminutive hindlimbs of pythons, and the miniscule hindlimbs of baleen whales. Most structures that evolutionary biologists recognize as vestigial retain a minor function of some kind, but usually the term "vestigial" is applied only if at least one major ancestral function has been lost[12]—for example, the ability to form an image, in the case of the eyes of blind cave vertebrates. The existence of vestigial structures is often denied in CS technical literature, but in some cases their existence is acknowledged. CS literature addresses the vestigiality not only of morphological structures but also of genes and other molecular entities such as chemical pathways.

The topic of biological degeneration as it is understood by CS authors bears some resemblance to mainstream science's concept of vestigialization, but there are important differences. Biological degeneration as it is understood by CS authors includes heritable change involving compromised function, morphological reduction, or genome reduction, whether or not it involves a discrete structure that mainstream scientists would recognize as a vestige. According to the YEC paradigm, biological degeneration is not due to natural selection but is a result of the Fall of humankind, that is, Adam and Eve's sin, which introduced the Curse of decay into the created world.[13] Implicit in the YEC concept of biological degeneration is the premise that due to the decay caused by sin, heritable change can be only neutral or degenerative. This means that any heritable change that appears to be advantageous in some way is disadvantageous in some other way(s) that outweighs the advantage, or that any apparent advantage in phenotype is an incidental result of degeneration of the genotype. For example, two CS authors claim that "mutations [that confer antibiotic resistance and other benefits in microbes] frequently eliminate or reduce pre-existing cellular systems and functions."[14]

Within the topic of biological degeneration are several subtopics that are frequently addressed in CS technical literature: (1) biological degeneration as an explanation for the morphology of extinct species of *Homo* (e.g., *H. neanderthalensis* and *H. erectus*), (2) reduction in the human lifespan after the Flood as an example of biological degeneration, (3) pathogenicity or parasitism as the result of biological degeneration, (4) apparently beneficial mutations as examples of biological degeneration, and (5) use of the term "devolution" in reference to heritable changes that are degenerative.

Materials and Methods

We sought to determine whether temporal trends in CS technical literature exist in the topics and subtopics identified in the previous three paragraphs. To limit the analysis strictly to technical literature, we examined only technical articles and conference abstracts from the journals mentioned above. We ignored editorials, letters to the editor, article reviews, book reviews, and such. As for conference abstracts, we examined only those that were published in *OPBSG* and *ARJ*, for two reasons: (1) abstracts published in other CS journals tend to be published afterwards as full-length articles (which would introduce redundancy if they were considered here), whereas those in *OPBSG* and *ARJ* do not, and (2) *OPBSG* and *ARJ* abstracts function as short articles, because they include references and are longer than abstracts usually are.

Most issues of most CS journals have been converted to PDF files, which can be purchased or are posted online for free access. To search these files for articles that addressed the topic of vestigial biological structures we used the search term "vestig" (to find the terms "vestigial," "vestige," and "vestiges") and "rudiment" (to find the terms "rudiment," "rudiments," and "rudimentary"). To search the PDFs for articles that addressed the topic of biological degeneration within the YEC paradigm we used the search terms "degenera" (to find the words "degenerate," "degeneration," etc.), "deteriorat" (to find the words "deteriorate," "deterioration," etc.), "devol" (to find the words "devolve," "devolution," etc.), "de-vol" (to find the words "de-volve," "de-volution," etc.), "de-evol" (to find the words "de-evolve," "de-evolution," etc.), and "decay." PDF files are unavailable for volumes 1, 2, and 4 of *ENTJ*; volumes 5–8 of *CENTJ*; and all volumes of *CORE Issues in Creation*. For those volumes, we searched visually through paper copies. We divided the duration of the CS movement into ten periods: 1964–1970 and nine subsequent periods of five years apiece from 1971–1975 to 2011–2015. We then compared attitudes toward and interest in the chosen topics and subtopics through time, as revealed in the number of authors advocating a given view or addressing a given topic in the CS technical articles of each period. For each period, we also counted the overall number of CS authors and the number of new CS authors (any author whose earliest CS technical article was published during that period), to determine whether any apparent increase in interest in a given topic or subtopic is an artifact of an increase in the overall number of CS authors or of an increase in the number of new CS authors.

For two of the CS technical journals (*CRSQ* and *JC*), the societies that publish the journals mail printed copies to institutional subscribers and to individual members of the societies. We contacted the editorial offices of those two journals and requested the number of individual and institutional subscribers. This was to determine whether the circulation of CS technical journals reaches much (if any) further than the circle of CS authors.

Results

The overall number of CS authors increased from 50 in 1964–1970 to 213 in 2011–2015 (table 1; fig. 1). Sharp rises in the number of new CS authors occurred in 1976–1980 and in 2001–2005, whereas the number of continuing CS authors rose steadily through the decades with no sharp increases (fig. 1).

As of June 13, 2016, *CRSQ* is sent to 165 institutional subscribers (libraries and others) and 1,045 members of the Creation Research Society. Given that there were only 213 CS authors in 2011–2015, it is evident that the circulation of CS technical literature reaches considerably further than the circle of CS authors. The editorial office of *JC* declined to provide subscription numbers.

Table 1. Number of authors publishing articles in the technical journals of creation science through 2015.

	1964–1970	1971–1975	1976–1980	1981–1985	1986–1990	1991–1995	1996–2000	2001–2005	2006–2010	2011–2015
Total number of authors	50	81	150	124	173	174	174	212	221	213
New authors	50	34	101	69	101	103	94	129	121	118
Continuing authors		47	49	55	72	71	80	83	100	95

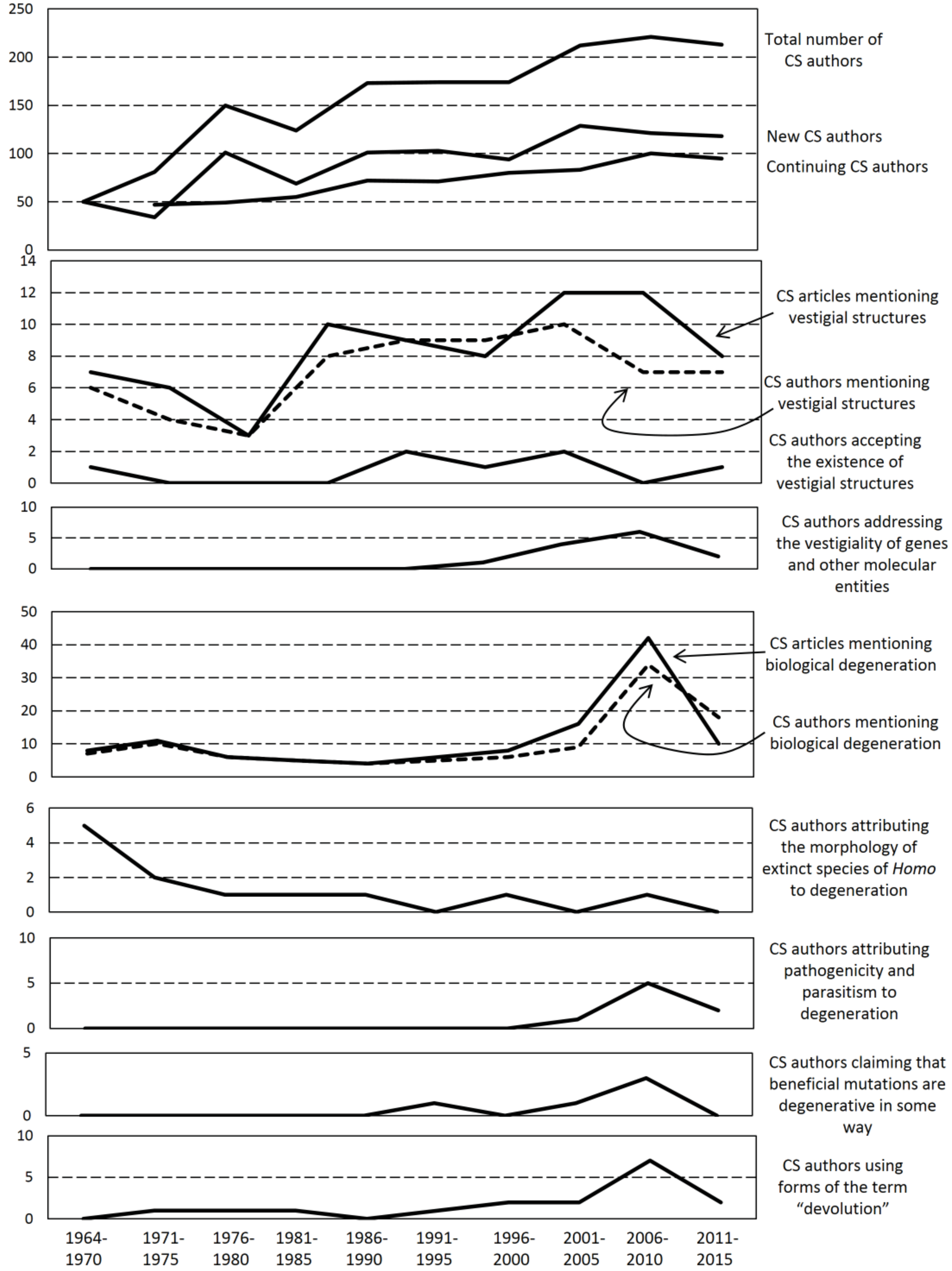

Figure 1. Temporal trends in the technical literature of creation science through 2015: number of authors, and acceptance of and interest in topics relating to vestigial biological structures and biological degeneration.

We found 81 articles that address the evolutionary topic of vestigial biological structures. In most of these, the authors express the opinion that such structures do not exist, but a few authors acknowledge the existence of such structures (table 2; fig. 1). The number of authors that acknowledge the existence of such structures is small (0–2) in all time periods, and there is no overall increase or decrease in the acceptance of the existence of vestigial biological structures by CS authors over time. All authors addressing the topic of vestigial structures addressed only morphology, until the early 1990s, after which a few authors in each period addressed the vestigiality of genes or other molecular entities (table 2; fig. 1).

Table 2. References to vestigial biological structures in the technical literature of creation science through 2015. In the Stance column, "for" indicates acceptance of vestigiality, and "against" indicates rejection of vestigiality.

Author and year	Stance	Biological structure(s) in question
Morris 1964[1]	for	general
Rusch 1966[2]	against	human tonsils, parathyroid glands, thymus, pineal gland, appendix, coccyx, plica semilunaris; snake spurs; mysticete whale teeth
Klotz 1966[3]	for	mutant fruit flies
Howitt 1968[4]	against	coccyx
Marsh 1969[5]	?	sterile pollen of dandelion; blind cavefish eyes
Artist 1969[6]	against	human appendix; python hindlimbs; whale hindlimbs; kiwi wings
Shute 1970[7]	?	hyrax outer toes
Ouweneel 1971[8]	against	general
Turner 1972[9]	against	general
Howitt 1972[10]	against	general
Armstrong 1972[11]	against	pineal gland
Armstrong 1972[12]	against	tonsils
Ouweneel 1975[13]	?	wings of the fly *Termitoxenia*
Woodmorappe 1978[14]	against	septa in cephalopod shells
Smith 1979[15]	against	snake hindlimbs
Licata 1979[16]	against	general
Hedtke 1981[17]	against	general
Howe 1982[18]	against	general
Bergman 1982[19]	against	general
Jones 1982[20]	against	ape and human pinna
Hinderliter 1982[21]	against	general
Meyer 1982[22]	against	general
Hedtke 1983[23]	against	general
Smith 1985[24]	against	caecilian eyes
Meyer 1985[25]	against	general
Smith 1985[26]	against	human appendix, tonsils, thymus, pineal gland
Sanders and Howe 1986[27]	?	mouthparts of non-eating insects
Hamilton 1987[28]	?	eyes of snake ancestor
Hamilton 1987[29]	for	caecilian eyes
Bird 1988[30]	against	general
Glover 1988[31]	against	human appendix
Leslie 1988[32]	against	human appendix, tonsils, fetal yolk sac
Cooper 1988[33]	against	sagittal keel of late *Homo*
Snelling 1989[34]	against	human appendix
Woodmorappe 1990[35]	for	fly wings
Bergman 1992[36]	against	general
Lumsden, Anders, and Pettera 1992[37]	against	nontranscribing and nontranslating DNA
Kaplan 1993[38]	against	human ear muscles
Bergman 1994[39]	against	wisdom teeth
Maas 1994[40]	against	human appendix
Gibson 1994[41]	against	general
Wise 1995[42]	for	whale hindlimbs
Colwell 1996[43]	against	human appendix
Wise 1996[44]	for	goose wings
Wieland 1997[45]	against	"junk genes"
Sarfati 1997[46]	against	thymus
Batten 1998[47]	against	introns
Wieland 1998[48]	against	fly halters
Bergman 1998[49]	against	wisdom teeth
Hedtke 1999[50]	against	general
Bergman 2000[51]	against	mammalian yolk sac
Jerlström 2000[52]	for	wallaby chromosome retroelements
Walkup 2000[53]	against	introns
Menton 2000[54]	against	human plantaris muscle
Bergman 2000[55]	against	human appendix, tonsils, pineal gland, thymus
Bergman 2001[56]	against	general; transposons
Bergman 2001[57]	against	general
Bergman 2001[58]	against	human male nipple
Gurney 2001[59]	against	plica semilunaris
Wood and Cavanaugh 2001[60]	against	general; "junk DNA"
Bergman 2002[61]	against	eye-related glands
Standish 2002[62]	against	noncoding DNA
Bell 2004[63]	against	cytochrome c
Bergman 2004[64]	against	general
Woodmorappe 2004[65]	against	GULO pseudogene
Batten 2005[66]	against	general
Armitage and Howe 2007[67]	against	fungal ascospores and ascoscarps; sucrose metabolism
Bergman 2008[68]	against	prostate accessory structures
Doyle 2008[69]	against	human vomeronasal organ, goose bumps, Darwin's point, coccyx, wisdom teeth
Hendriksen 2008[70]	against	general
Bergman 2009[71]	against	snake spurs
Carter 2009[72]	against	retrotransposons
Wise 2009[73]	for	whale limbs and pelves
Bergman 2010[74]	against	general
Bergman 2011[75]	against	general
Niekirk 2011[76]	against	placental mammal yolk sac
Bergman 2012[77]	against	whale hindlimbs, fetal tooth buds, hairlets
Bergman 2013[78]	against	pseudogenes
McDonald 2013[79]	?	kiwi wings
Hennigan 2014[80]	against	snake spurs
Aaron 2014[81]	for	tyrannosaurid arms

[1] Henry M. Morris, "The Power of Energy," *Creation Research Society Annual* (hereafter *CRSA*) 1 (1964): 18–23.

[2] Wilbert Rusch, "Analysis of So-called Evidences of Evolution," *CRSA* 3 (1966): 4–15.

[3] John W. Klotz, "The Philosophy of Science in Relation to Concepts of Creation vs. the Evolution Theory," *Creation Research Society Quarterly* (hereafter *CRSQ*) 3 (1966): 3–11.

[4] John R. Howitt, "Man, the Upright," *CRSA* 5 (1968): 46–48.

[5] Frank L. Marsh, "The Form and Structure of Living Things," *CRSA* 6 (1969): 13–25.

[6] Russell Artist, "The Concept of Homology," *CRSA* 6 (1969): 55–64, 66.

[7] Evan V. Shute, "Puzzling Similarities," *CRSQ* 7, no. 3 (1970): 147–51.

[8] Willem J. Ouweneel, "The Scientific Character of the Evolution Doctrine," *CRSQ* 8, no. 2 (1971): 109–115.

[9] C. E. A. Turner, "Teleology: Purpose Everywhere," *CRSQ* 9, no. 1 (1972): 38–40.

[10] John R. Howitt, "Some Observations on the Science of Nutrition in the Light of the Scriptures," *CRSQ* 9, no. 1 (1972): 51–53.

[11] Harold Armstrong, "Comments on Scientific News and Views," *CRSQ* 9, no. 2 (1972): 131–39.

[12] ___, "Comments on Scientific News and Views," *CRSQ* 9, no. 3 (1972): 181–83.

[13] Willem J. Ouweneel, "Homoeotic Mutants and Evolution," *CRSQ* 12, no. 3 (1975): 141–54.

[14] John Woodmorappe, "The Cephalopods in the Creation and the Universal Deluge," *CRSQ* 15, no. 2 (1978): 94–112.

[15] E. Norbert Smith, "Another Vestigial Structure Found Useful," *CRSQ* 15, no. 4 (1979): 215.

[16] David P. Licata, "A Unit on Biological Origins for the Secular Classroom," *CRSQ* 16, no. 1 (1979): 60–63.

[17] Randall Hedtke, "The Episteme Is the Theory," *CRSQ* 18, no. 1 (1981): 8–13, 26.

[18] George F. Howe, "Postfire Strategies of Two Chaparral Shrubs (Chamise and Ceanothus) Cast Light on Origins," *CRSQ* 19, no. 1 (1982): 3–10.

[19] Jerry Bergman, "Reality: Real or Conventional?," *CRSQ* 19, no.1 (1982): 67–68, 35, 39.

[20] A. J. Jones, "A Creationist Critique of Homology," *CRSQ* 19, no. 3 (1982): 156.

[21] Hilton Hinderliter, "Professor Frick—and the Theory in Stone," *CRSQ* 19, no. 3 (1982): 175–78.

[22] John R. Meyer, "Vestigial Organs (If They Exist at All) Prove Nothing," *CRSQ* 19 (1982): 190–91.

[23] Randall Hedtke, "The Principle of Applied Creation in an Origin Curriculum," *CRSQ* 20 (1983): 44–46.

[24] E. Norbert Smith, "To See or Not to See," *CRSQ* 21, no. 4 (1985): 198.

[25] John R. Meyer, "Origin of the Kaibab Squirrel," *CRSQ* 22, no. 2 (1985): 68–77.

[26] E. Norbert Smith, "The Role of Creation Research in Modern Biology," *CRSQ* 22, no. 3 (1985): 105–7.

[27] Robert R. Sanders and George F. Howe, "Insects Indicate Creation," *CRSQ* 22, no. 4 (1986): 166–70.

[28] H. S. Hamilton, "The Snake's Spectacular Spectacle," *CRSQ* 23, no. 4 (1987): 177–78.

[29] ___, "Convergent Evolution—Do the Octopus and Human Eyes Qualify?," *CRSQ* 24, no. 2 (1987): 82–85.

[30] W. R. Bird, "The Postulated Evidence for Macroevolution and Darwinism: Darwinian Arguments and the Disintegrating Neo-Darwinian Synthesis—Part II," *CRSQ* 25, no. 2 (1988): 74–81.

[31] J. Warwick Glover, "The Human Vermiform Appendix—A General Surgeon's Reflections," *Ex Nihilo Technical Journal* (hereafter *ENTJ*) 3 (1988): 31–38.

[32] J. G. Leslie, "The Hindrance of Evolutionary Terminology to the Teaching of Science," *Creation ex nihilo Technical Journal* (hereafter *CENTJ*) 3, no. 1 (1988): 59–64.

[33] Bill Cooper, "Rhodesian Man," *ENTJ* 3 (1988): 137–51.

[34] Andrew Snelling, "Australian Publications," *CRSQ* 26, no. 1 (1989): 33–34.

[35] John Woodmorappe, "Causes for the Biogeographic Distribution of Land Vertebrates after the Flood," in *Proceedings of the Second International Conference on Creationism,* ed. Robert E. Walsh (Pittsburgh, PA: Creation Science Fellowship, 1990), 53–66.

[36] Jerry Bergman, "Some Biological Problems with the Natural Selection Theory," *CRSQ* 29, no. 3 (1992): 146–58.

[37] Richard D. Lumsden, Paul C. Anders, and Jeffery R. Pettera, "Genetic Information and McCann's Dual Factor Paradigm for Development and Variation," *CRSQ* 29, no. 2 (1992): 63–69.

[38] John Kaplan, "Functional External Ear Muscles," *CRSQ* 30 (1993): 90.

[39] Jerry Bergman, "The Wisdom of Saving Wisdom Teeth," *CRSQ* 31, no. 2 (1994): 74–77.

[40] Frank Maas, "Immune Functions of the Vermiform Appendix," in *Proceedings of the Third International Conference on Creationism,* ed. Robert E. Walsh (Pittsburgh, PA: Creation Science Fellowship, 1994), 335–42.

[41] L. James Gibson, "Pseudogenes and Origins," *Origins* 21 (1994): 21–108.

[42] Kurt P. Wise, "Towards a Creationist Understanding of Transitional Forms," *CENTJ* 9, no. 2 (1995): 216–22.

[43] Gary Colwell, "Socrates Meets Darwin: A Study in Question Begging," *CRSQ* 33, no. 2 (1996): 127–35.

[44] Kurt P. Wise, "North American Paleontology Convention 96," *CENTJ* 10, no. 3 (1996): 315–21.

[45] C. Wieland, "'Junk'-making Viruses Neutralise an Evolutionary Argument," *CENTJ* 10, no. 3 (1996): 296–97.

[46] Jonathan D. Sarfati, "Blood Types and Their Origin," *CENTJ* 11, no. 1 (1997): 31–32.

[47] D. J. Batten, "'Junk' DNA (Again)," *CENTJ* 12, no. 1 (1998): 5.

[48] Carl Wieland, "Why a Fly Can Fly like a Fly," *CENTJ* 12, no. 3 (1998): 260–61.

[49] Jerry Bergman, "Are Wisdom Teeth (Third Molars) Vestiges of Human Evolution?," *CENTJ* 12, no. 3 (1998): 297–304.

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[51] Jerry Bergman, "The Rise and Fall of Haeckel's Biogenetic Law," *CRSQ* 37, no. 2 (2000): 110–22.

[52] Pierre Jerlström, "Jumping Wallaby Genes and Post-Flood Speciation," *CENTJ* 14, no. 1 (2000): 9–10.

[53] Linda K. Walkup, "Junk DNA: Evolutionary Discards or God's Tools?," *CENTJ* 14, no. 2 (2000): 18–30.

[54] David N. Menton, "The Plantaris and the Question of Vestigial Muscles in Man," *CENTJ* 14, no. 2 (2000): 50–53.

[55] Jerry Bergman, "Do Any Vestigial Organs Exist in Humans?," *CENTJ* 14, no. 2 (2000): 95–98.

[56] ___, "The Molecular Biology of Genetic Transposition," *CRSQ* 38 (2001): 139–50.

[57] ___, "Does Homology Provide Evidence of Evolutionary Naturalism?," *Technical Journal* (hereafter *TJ*) 15, no. 1 (2001): 26–33.

[58] ___, "Is the Human Male Nipple Vestigial?," *TJ* 15, no. 2 (2001): 38–41.

[59] Peter Gurney, "Dawkins' Eye Revisited," *TJ* 15, no. 3 (2001): 92–99.

[60] Todd C. Wood and David P. Cavanaugh, "A Baraminological Analysis of Subtrive Flaveriinae (Asteraceae: Helenieae) and the Origin of Biological Complexity," *Origins* 52 (2001): 7–27.

[61] Jerry Bergman, "The Design of Tears: An Example of Irreducible Complexity," *TJ* 16, no. 1 (2002): 86–89.

[62] Timothy G. Standish, "Rushing to Judgment: Functionality in Noncoding or 'Junk' DNA," *Origins* 53 (2002): 7–30.

[63] Philip B. Bell, "The Non-evolution of Apoptosis," *TJ* 18, no. 1 (2004): 86–96.

[64] Jerry Bergman, "Human Embryonic Gills and Gill Slits—Down but Not Out," *TJ* 18, no. 1 (2004): 71–75.

[65] John Woodmorappe, "Potentially Decisive Evidence against Pseudogene 'Shared Mistakes,'" *TJ* 18, no. 3 (2004): 63–69.

[66] Don Batten, "No Joy for Junkies," *TJ* 19, no. 1 (2005): 3.

[67] Mark H. Armitage and George F. Howe, "The Ultrastructure of Lichen Cells Supports Creation, Not Macroevolution: A Photo Essay and Literature Review—Part II," *CRSQ* 44, no. 2 (2007): 107–18.

[68] Jerry Bergman, "Was the Prostate Gland Poorly Designed?," *CRSQ* 44, no. 3 (2008): 230–35.

[69] Shaun Doyle, "Vestigial Arguments: Remnants of Evolution," *Journal of Creation* (hereafter *JC*) 22, no. 2 (2008): 40–42.

[70] Janet Henriksen, "The Design Paradigm," *JC* 22, no. 2 (2008): 53–59.

[71] Jerry Bergman, "Evidence for the Lack of Snake Evolution," *CRSQ* 45, no. 4 (2009): 258–70.

[72] Kurt P. Wise, "Mammal Kinds: How Many Were on the Ark?," *CORE Issues in Creation* 5 (2009): 129–61.

[73] Robert W. Carter, "The Slow, Painful Death of Junk DNA," *JC* 23, no. 3 (2009): 12–13.

[74] Jerry Bergman, "*Inherit the Wind*: A Lesson in Distorting History," *Answers Research Journal* (hereafter *ARJ*) 3 (2010): 61–69.

[75] ___, "C. Everett Koop—Christian and Darwin Doubter," *JC* 25, no. 3 (2011): 63–67.

[76] E. van Niekirk, "Countering Revisionism—Part 1: Ernst Haeckel, Fraud Is Proven," *JC* 25, no. 3 (2011): 89–95.

[77] Jerry Bergman, "Whale Evolution: A Whale of a Tale," *CRSQ* 49, no. 2 (2012): 122–34.

[78] ___, "The Origins and Genetic Functions of Pseudogenes," *CRSQ* 49, no. 4 (2013): 308–18.

[79] Christine McDonald, "The Kiwi," *JC* 27, no. 1 (2013): 68–70.

[80] Tom Hennigan, "An Initial Estimate toward Identifying and Numbering Extant Tuatara, Amphisbaena, and Snake Kinds," *ARJ* 7 (2014): 31–47.

[81] M. Aaron, "Discerning Tyrants from Usurpers: A Statistical Baraminological Analysis of Tyrannosauroidea Yielding the First Dinosaur Holobaramin," *ARJ* 7 (2014): 463–81.

We found 125 articles that address the topic of biological degeneration within the YEC paradigm (table 3; fig. 1). The number of such articles and the number of authors writing on the topic peaked sharply in the second half of the first decade of the twenty-first century. Because there was no simultaneous spike in the number of new CS authors or in the total number of CS authors (fig. 1), this sharp rise cannot be explained by an increase in the number of CS authors.

The number of CS authors attributing the morphology of extinct species of *Homo* to degeneration was initially high but decreased over time and has remained at zero through the present century (fig. 1). The number of CS authors citing post-Flood reduction in the human lifespan as an example of biological degeneration has always been low: one such citation apiece in 1978, 1998, 2000, and 2009, and two in 1998 (table 3). The number of CS authors attributing pathogenicity or parasitism to degeneration peaked during the period at which the number of CS authors addressing biological degeneration was highest (2006–2010). The number of CS authors claiming that apparently beneficial mutations represent genetic degeneration peaked during the same period. These two spikes may therefore be connected with the increase in the number of CS authors publishing on the topic of biological degeneration during that period. The number of CS authors using forms of the term "devolution" peaked during the same period.

Table 3. References to biological degeneration in the technical literature of creation science through 2015. *Homo* = attribution of morphology of extinct species of *Homo* to degeneration; lifespan = assertion that post-Flood reduction in human lifespans represents degeneration; P&P = attribution of parasitism and pathogenicity to degeneration; BMD = claim that beneficial mutations are degenerative; dev = use of some form of the term "devolution."

Author and year	*Homo*	lifespan	P&P	BMD	dev
Lammerts 1964 [1]					
Tinkle 1964 [2]	X				
Morris 1965 [3]					
Rusch 1966 [4]					
Custance 1968 [5]	X				
Cook 1968 [6]	X				
Tinkle 1968 [7]					
Shaw 1970 [8]	X				
Lockwood 1971 [9]					
Ouweneel 1971 [10]	X				
Morris 1971 [11]					
Moore 1972 [12]					
Williams 1973 [13]					
Telfair 1973 [14]					
Siegler 1974 [15]					X
Clark 1974 [16]	X				
Wheeler 1975 [17]					
Quinn 1975 [18]					
Ouweneel 1975 [19]					
Moore 1976 [20]	X				
Sharp 1977 [21]					
Strickling 1978 [22]		X			
Sigler 1978 [23]					
Licata 1979 [24]					
Ancil 1980 [25]					
Guenter 1981 [26]	X				
Moore 1982 [27]					
Jones 1982 [28]					X
Brown 1983 [29]					
McCluskey 1985 [30]					

Author and year	*Homo*	lifespan	P&P	BMD	dev
Leslie 1986 [31]					
Gentry 1986 [32]					
Marsh 1987 [33]					
Bowden 1988 [34]	X				
Wieland 1991 [35]				X	
Bergman, J. 1992 [36]					X
Brand and Gibson 1993 [37]					
Wieland 1994 [38]		X			
Beasley 1995 [39]					
Bergman, J. 1995 [40]					X
Wieland 1996 [41]					
García-Pozuelo-Ramos 1997 [42]	X				
Bergman, J. 1998 [43]		X			X
Bergman, D. 1998 [44]					X
Cuozzo 1998 [45]		X			X
Walkup 2000 [46]					
Armitage and Lumsden 2000 [47]					
Bergman, J. 2000 [48]		X			
Mastropaolo 2001 [49]					X
Wood 2001 [50]					
Batten 2001 [51]			X		
Bergman, J. 2001 [52]					
Bergman, J. 2001 [53]					
Bergman, J. 2002 [54]					X
Standish 2002 [55]					
Bell 2002 [56]					
Batten 2002 [57]					
Sanders and Wise 2003 [58]					
Wood 2003 [59]					

Author and year	*Homo*	lifespan	P&P	BMD	dev
Batten 2003[60]				X	
Murdock 2004[61]					X
Murdock 2004[62]					
Wood 2005[63]					
Bergman, J. 2005[64]					
Gillen & Sherwin 2006[65]			X		X
Lamb 2006[66]			X	X	
Murdock 2006[67]					X
Liu and Moran 2006[68]					
Lucas and Wood 2006[69]					
Bergman, J. 2007[70]					X
Kim 2007[71]					
Williams 2007[72]					
Wood 2007[73]					
Baldwin 2007[74]					
Wood 2007[75]					
Gillen and Hubbard 2007[76]					
Gillen 2008[77]					
Loucks 2008[78]			X		X
Gillen 2008[79]					
Lightner 2008[80]					
Lightner 2008[81]					
Kim 2008[82]					
Bergman 2008[83]					
Sanford et al. 2008[84]					
Anderson and Purdom 2008[85]				X	
Baumgardner et al. 2008[86]					
Bergman, J. 2008[87]					
Carter et al. 2008[88]					
Doyle 2008[89]					
Williams 2008[90]					
Williams 2008[91]					
Brand 2008[92]				X	
Hennigan 2008[93]					
Liu and Snooper 2009[94]					
Sherwin 2009[95]			X		
Loucks 2009[96]					X
Purdom 2009[97]			X		
Liu 2009[98]					
Bergman 2009[99]					
Larssen 2009[100]		X			
Borger 2009[101]					
Habermehl 2010[102]					X
Lightner 2010[103]					
Sarfati 2010[104]					X
Thomas 2010[105]					
Doyle 2010[106]					
Doyle 2011[107]					
Carter 2011[108]					
Doyle 2011[109]					
Tomkins 2013[110]					
Bergman, J. 2013[111]					
Rupe and Sanford 2013[112]					
Arneigh 2013[113]					X
O'Micks 2013[114]					X
Terborg 2013[115]					
Tomkins 2014[116]					
Williams 2014[117]					
Robinson 2014[118]					
Blaschke 2014[119]			X		
Liu 2015[120]					X
Liu 2015[121]					
Liu 2015[122]					
Gillen et al. 2015[123]			X		
Tan 2015[124]					
Murphy 2015[125]					

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Discussion

During data collection for this study, it became evident that CS authors frequently employ idiosyncratic usage of evolution-related terms, using the terms in ways that mainstream biologists do not. For example, several CS authors insisted that a structure must be completely functionless to be called vestigial. In contrast, mainstream biologists have long maintained that a reduced structure is vestigial, even if it retains a minor function or functions, as long as it has lost a major function or functions.[15] As Darwin put it in his discussion of vestigial structures (which he called "rudimentary" structures), "An organ serving for two purposes, may become rudimentary or utterly aborted for one, even the more important purpose; and remain perfectly efficient for the other."[16] And as Charles Brues noted in 1903, insect wings that have "become vestigial to such an extent that they are no longer available for … flight" in some cases "have suddenly developed characters that make them of use in some other direction."[17] Nevertheless, several CS authors cite any known function in a vestigial structure as evidence that the structure is not truly vestigial or that no truly vestigial structures exist.[18]

Similarly, some insist that non-coding DNA cannot be considered vestigial because, in some cases, it has a known function,[19] and, in other cases, a function might be found in the future.[20] From the standpoint of mainstream biology, such arguments are nonsensical, because functionlessness is not part of the definition of vestigiality.[21] One CS author argued that if any truly functionless structure were ever found, it would be evidence of degeneration, hence special creation.[22] However, heritable changes of any kind, degenerate or not, are congruent with the evolutionary paradigm and are therefore not evidence against it.

Another frequent example of idiosyncratic usage is restriction of the term "evolution" only to heritable changes that cause the addition, augmentation, or improvement of biological structures—as opposed to heritable changes that cause deletion, degeneration, or vestigialization of biological structures.[23] For example, one author argued that vestigial septa in cephalopod shells are "not supportive of evolution" but "may be a genetic-code remnant of the more conchiferous design employed by God elsewhere."[24] In other words, such septa were derived from more fully developed septa in the shells of these animals' ancestors, but the change should not be called "evolution" because it was degenerative. In contrast, mainstream biologists employ a broader definition of evolution and acknowledge heritable changes in general as evolution, whether those changes are degenerative or not. Nevertheless, unlike mainstream biologists, CS authors usually restrict the term "evolution" to additive or augmentative changes. For degenerative changes, such authors use the term "devolution,"[25] a term absent from mainstream biology.

As a general rule, CS authors recoil at the suggestion that vestigial structures exist. One CS author even asserted that the existence of vestigial organs would support creationism but denied their existence nevertheless.[26] However, a few CS authors have acknowledged the existence of vestigial, "rudimentary," or "degenerative" structures,[27] including vestigial genetic sequences.[28] One such author took the position that the vestigial hindlimbs and pelves of extant whales and the small hindlimbs of fossil archaeocete whales (from sediments that he considered post-Flood) indicate that the members of the whale "kind" aboard the Ark had legs and may even have been terrestrial.[29] Two authors frankly acknowledged vestigial structures as a problem for the idea of special creation, proffering the example of mouthparts in insects that do not eat as an example of something that one would not expect God to create.[30] However, according to a subsequent author, this problem is solved by the idea of "devolution," which can cause vestigialization of structures that were created with full function.[31]

Two authors claimed that science has discarded the idea of vestigial structures, arguing that the dwindling of lists of vestigial structures in textbooks through the years, reflects a disowning of the concept by scientists.[32] However, a recent study by mainstream biologists tested that claim and found that it is incorrect. Despite small lists of vestigial structures in textbooks, scientists have explicitly identified hundreds of examples of biological structures as vestigial in the primary scientific literature of the current century.[33]

Some CS authors waxed creative in their functional explanations of structures that mainstream biologists recognize as vestigial. For example, one author explained human ear muscles not as vestigial structures but as pre-adaptations "just in case." He supported this argument by citing the example of an individual whose ear muscles helped him after he lost eardrum function.[34]

Some CS authors pointed out that male nipples and other structures that are functional in only one sex were presumably never functional in the other sex; because such structures are not degenerate they should not be called vestigial.[35] This is, in fact, correct. Although male nipples are sometimes listed as vestigial structures,[36] they are not the degenerate remnants of ancestrally lactiferous male nipples and therefore do not fit the definition of vestigiality. Mainstream biologists would therefore do well to heed these CS authors' point and cease calling male nipples vestigial.

Several twentieth-century CS authors invoked degeneration as an explanation for the morphological features of extinct species of *Homo*.[37] Such authors claimed that *Homo erectus* and *Homo neanderthalensis* were the degenerate descendants of more-ancient *Homo sapiens* and that the ape-like features of *H. erectus* and *H. neanderthalensis* represent degeneration rather than an ancestral state. Two authors even included australopithecine-grade hominids in the list of degenerate human populations.[38] Those two authors claimed that the fossil record shows a pattern in which "degenerate" forms of humanity (*H. erectus*, *H. neanderthalensis*, and australopithecines) are found mainly at the periphery of the Old World, whereas ancient urban populations in the center of the Old World exhibit "advanced" (i.e., undegenerate, as originally created) morphology. These authors explained this by positing that urban existence slowed down the process of degeneracy, enabling settled populations to retain "advanced" morphology, whereas nomads wandering away from Ararat after the Flood gained degenerate morphology, with the greatest degree of degeneracy occurring in the populations that wandered furthest.

Another author identified *H. erectus* and *H. neanderthalensis* as "Hamites" (descendants of Noah's son Ham) and described Hamites as degenerate human populations.[39] He noted that across Eurasia, *H. erectus* and *H. neanderthalensis* remains are found in stratigraphically lower (hence, older) strata than are the remains of modern *H. sapiens*, and to explain this he posited that the descendants of Ham had spread throughout the globe before the descendants of Noah's sons Japheth and Shem did. Interestingly, mainstream paleoanthropologists agree that these data indicate that *H. erectus* and *H. neanderthalensis* spread across Eurasia before *H. sapiens* did. Mainstream scientists disagree, however, with the identification of the extinct species as descendants of a specific son of Noah or of any member of *H. sapiens*, because no remains of *H. sapiens* are known from strata older than those of the extinct species of *Homo*.

Citation of the morphology of extinct species of *Homo* as examples of biological degeneration dropped to almost zero after the 1970s (fig. 1), and the last such citation was in 1997.[40] However, occasional mention of physiological degeneration, particularly in relation to lifespan, has continued into the present century. A few CS authors list—as an example of physiological degeneracy—the shorter lifespans of post-Flood humanity in comparison to pre-Flood lifespans of centuries, as recorded in Genesis.[41] The earliest such listing was in 1978, the latest in 2009.[42]

One CS author provided an interesting spin on degeneration as applied to extinct hominids. Rather than positing that australopithecines are degenerate humans, he posited that they represent the ancestral form of the ape "kind." He therefore explained the quadrupedal knuckle-walking of today's apes as the result of degeneration from the upright locomotion of their australopithecine "ancestors."[43]

Several twenty-first-century CS authors explain pathogenicity of microbes and the parasitic lifestyle of other organisms—both of which are incompatible with a "very good" creation[44]—as a result of degeneration. According to these authors, all viruses and organisms that are now pathogens or parasites were originally harmless, and in some cases may have been beneficial symbionts, and pathological features appeared as a result of genomic deterioration.[45] The CS explanation of pathogenicity as a result of degeneration is relatively new, with the earliest such explanation appearing in 2001.[46]

Interestingly, evolutionary biologists agree that the reduced genomes of some pathogenic bacteria are the results of gene loss. However, reduced genomes resulting from gene loss occur in beneficial symbiotic bacteria also: this indicates that this genomic decay is related to dependency on a host and not to pathogenicity alone.[47] Similarly, genome size reduction due to gene loss is common among eukaryotic parasites including protozoans, fungi, and invertebrates,[48] but the same is also the case in beneficial eukaryotic endosymbionts.[49] Because genomic reduction is therefore related to host-dependence in general, it seems that within the CS paradigm genomic reduction would have occurred in endosymbiotic microbes even without the Fall of humankind and the resulting Curse upon nature. It will therefore be interesting to see whether future CS articles address this issue and attempt to explain genomic reduction in beneficial endosymbionts.

Six CS authors gave examples of apparently beneficial mutations that they claimed represented genomic degeneration. One author explicitly posited that antibiotic resistance in a bacterium was the incidental result of a mutation that involved a loss of genetic information.[50] Another pointed out that the loss of wings in insects inhabiting windy places is advantageous but is nevertheless an example of morphological degeneration.[51] The others identified advantageous mutations in bacteria and humans as incidental results of genomic deterioration.[52]

The topics of vestigial structures and biological degeneration make for a useful introduction to the fascinating world of creation science. Perplexingly, through half a century, CS authors have maintained a general consensus that all "created kinds" of organisms have undergone degenerative changes, and they have simultaneously maintained a general consensus that vestigial biological structures do not exist. Because the claim for biological degeneration implies the existence of vestigial structures, CS authors' denial of their existence is incongruous. It will be interesting to see whether CS authors recognize this internal inconsistency in future CS literature or whether this mutually contradictory pair of claims will continue to persist. ⌖

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Notes

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[2] In the Gospels, Jesus defied the literal sense of regulations from the Pentateuch (Matt. 5:38, 19:3–9; Mark 7:14–19, 10:2–12; Luke 16:18; John 8:1–11) and yet mandated that the entire Law should be followed (Matt. 5:17–19); this seeming contradiction is resolved if he meant that the Law should be followed in a nonliteral sense. In his New Testament epistles, Paul criticized a Jewish faction in the early church that promoted a literal interpretation of the Pentateuch (Galatians 3–5; Colossians 2; 1 Timothy 1; Titus 1–3; see also Acts 15). Paul advocated figurative interpretation of the entire Pentateuch and argued against interpreting Genesis and the rest of the Pentateuch literally (Rom. 2:29, 3:28–31; 1 Cor. 10:1–11; Gal. 3:7, 29; Eph. 5:31–33; Col. 2:16–17; Heb. 3:7–4:11, 9:7–9), even going so far as to call the Pentateuch narratives "myths" (1 Tim. 1:4, 4:7; Titus 1:14). For further explanation, including elaboration on the characterization of Pentateuch narratives as "myths" by Paul and the Apostolic Fathers, see Phil Senter, "Christianity's Earliest Recorded Heresy and Its Relevance to Christian Acceptance of Scientific Findings," *Thinking about Religion,* online journal of the North Carolina Religious Studies Association (forthcoming).

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