



Philip J. Senter

The Evolution of Creation Science, Part 3: Natural Selection and Convergent Evolution

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Creation science (CS) is a discipline in which practitioners seek evidence to support a literal interpretation of the opening chapters of Genesis. A study of CS literature from the past fifty years reveals the following trends regarding the topics of natural selection (NS) and convergent evolution. Rejection of NS or some form of it has exceeded acceptance in both the twentieth and twenty-first centuries. Through both centuries, CS authors have consistently accepted stabilizing selection, have rejected NS as a factor in prebiotic chemical evolution and the evolution of biological complexity, and have disagreed as to whether to accept convergent evolution, directional selection, sexual selection, and NS as a driver of biological diversity within "created kinds." Acceptance of convergent evolution and directional selection within "created kinds" has risen in the twenty-first century among CS authors.

Creation science (CS) is a discipline in which practitioners seek extrabiblical support for the young-Earth creationist (YEC) worldview. According to the (YEC) view, the literal wording of the book of Genesis accurately records past events, including the independent creation of all kinds of organisms about 6,000 years ago. The YEC view remains popular,¹ despite its contradiction by abundant physical evidence that Earth is billions of years old and that all organisms evolved from a common ancestor,² and despite biblical endorsement of a figurative rather than literal approach to Genesis and the rest of the Pentateuch.³

CS is voiced through its technical literature, which consists mainly of peer-reviewed journals that accept only manuscripts written from the YEC viewpoint. The earliest of these, *Creation Research Society Quarterly*, was launched in 1964. In a previous article,⁴ Jared Mackey and I briefly delineated the history of proliferation of CS techni-

cal journals, and this history will not be repeated here.⁵ CS technical literature has now become sufficiently vast and long lived to test for the presence of temporal trends in positions on various topics. Previously, we reported investigations into such trends in the topics of vestigial structures (as mainstream scientists understand them), biological degeneration (as CS practitioners understand it),⁶ and beneficial mutations.⁷ Here, I report an investigation into temporal trends in positions on natural selection and convergent evolution.

Natural selection (NS) is a type of biological evolution in which heritable variation exists in a population, and some variants are more successful than others at survival and reproduction. Through the generations, the traits in a population

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change as the more-successful variants produce more viable offspring than the other variants.⁸ The success of a variant is called its fitness, which has led to the phrase “survival of the fittest” as a short description of natural selection. Traits that increase fitness in one situation may reduce fitness in other situations. For example, longer beak lengths once conferred greater fitness in Hawaiian honeycreepers (*Drepanis coccinea*), which consumed nectar from flowers that had a tubular shape, because the long beak enabled the birds to reach the nectar at the bottom of the tube. However, after deforestation in Hawaii drastically reduced the availability of trees with tubular flowers, forcing Hawaiian honeycreepers to glean nectar from nontubular flowers, longer beaks became a liability; subsequently, shorter beaks conferred greater fitness for Hawaiian honeycreepers.⁹

A few different kinds of NS exist. Directional selection is a form of NS in which a trait changes through the generations (e.g., horns are longer in later generations). Stabilizing selection is a form of NS in which a trait remains constant (e.g., horn length is the same in later generations as it was in earlier generations) by means of the elimination of less-fit variants.¹⁰ Sexual selection is a form of NS in which, within a given sex, certain variants have greater reproductive success than others.¹¹ NS can lead to biological diversity as different environments favor different traits in populations living in different areas.¹² Mainstream scientists have documented¹³ and accept the existence of NS and the forms of it that are listed above, and they hypothesize that NS played a role in the early evolution of macromolecules before the advent of the living cell.¹⁴

Convergent evolution is the acquisition of similar traits in different lineages. It can occur when members of those lineages occupy similar environments; these conditions lead NS to favor similar traits. Convergent evolution is called parallel evolution when closely related species with an identical precursor structure independently evolve similar specializations of that structure.¹⁵

Some CS authors accept the existence of convergent evolution, NS, and the forms of NS listed above, and others do not (tables 1, 2). Some CS authors also dispute the idea that NS is capable of successfully producing biological diversity, complex biological systems (e.g., chemical pathways), or complex anatomical structures. Some assert that NS should make

all organisms identical, or that NS is based on circular reasoning or tautological error (“survival of the fittest,” with the fittest defined as those that survive). Some dispute that NS could have been involved in the evolution of prebiotic macromolecules, the advent of sexual reproduction, the advent of biological symbioses, or the advent of human mental traits such as altruism and the ability to calculate.

Materials and Methods

I sought to determine whether temporal trends exist in CS technical literature in the topics and subtopics identified in the previous two paragraphs. I used the methods described in our previous two articles, limiting the analysis to technical articles in CS literature and to conference abstracts in CS journals in which lengthy, referenced abstracts function as stand-alone articles. I searched through available PDF files of CS technical literature and searched visually through paper copies of journal volumes for which PDFs are not available.¹⁶ For PDF searches, I used the search terms “natural selection,” “mutation and selection,” “survival of the fittest,” “sexual selection,” “converge,” and “parallel.”

As in our previous articles, I 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. I then compared the number of articles and authors accepting or rejecting various positions on the chosen topics and subtopics through time.

I calculated the percentage of twentieth-century articles and authors accepting or rejecting each position, recording percentages with a precision of two significant digits; I repeated the procedure for twenty-first-century articles and authors. I then ran two-tailed z-tests on these proportions, to test for significant differences in the proportions between the two centuries. The z-tests were run with alpha set at a stringent 0.01 and then repeated with alpha set at a less-stringent 0.05 and a lenient 0.1 to account for small sample sizes.

Results

I found 273 CS articles, by 132 authors, in which the authors took positions on NS (tables 1, 2). Rejection of NS in general or some form of it exceeded acceptance through all or most periods (figs. 1, 2). The predominant position (acceptance or rejection) flip-flopped

three times for directional selection and for NS as a driver of biological diversity, and once for sexual selection (figs. 1, 2). Stabilizing selection was consistently accepted. NS as a factor in prebiotic molecular evolution, and NS as a factor in the evolution of biological complexity, were consistently rejected. NS as a factor in the evolution of complex structures was consistently rejected, except for one instance in 2011 (fig. 2), in which an author accepted that antifreeze protein in eelpouts is a product of NS.¹⁷ Acceptance that NS had been observed, assertion that NS should make all organisms identical, and characterization of NS as based on circular reasoning or tautological error remained at low levels (usually ≤ 5 authors) in all periods.

I found 55 articles by 34 authors, in which the authors took positions on convergent evolution (tables 1, 2). Rejection exceeded acceptance except in the period 2010–2015 (fig. 2).

With alpha set at 0.01, the two-tailed z-tests found a significant difference between the two centuries in only one proportion: number of articles rejecting

directional selection (which dropped in the twenty-first century). With alpha set at 0.05, the tests found additional significant differences between the two centuries in proportions of articles accepting directional selection (which rose), articles and authors rejecting sexual selection (which rose), authors accepting its existence (which dropped), and articles rejecting convergent/parallel evolution (which dropped) (fig. 3). With alpha set at 0.1, the tests found additional significant differences between the two centuries in proportions of authors accepting directional selection (which rose), authors rejecting it (which dropped), authors accepting NS as a driver of biological diversity (which dropped), articles accepting sexual selection (which dropped), authors rejecting convergent evolution (which dropped), and authors accepting it (which rose) (fig. 3).

In some cases, the sum of the percentages of CS articles or authors accepting and rejecting a concept exceeds 100% (table 1). This is due to occasional instances in which an author accepts a concept in one passage but rejects it in another passage in the same article (see table 2 for specific instances).

Table 1. Numbers and percentages of CS articles and authors rejecting or accepting concepts related to natural selection and convergent evolution, through 2015.

	1964– 1970	1971– 1975	1976– 1980	1981– 1985	1986– 1990	1991– 1995	1996– 2000	2001– 2005	2006– 2010	2011– 2015
NS or Some Form of It										
Articles accepting	9	7	9	11	5	9	7	16	17	9
Authors accepting	7	7	7	11	5	11	7	11	15	7
Articles rejecting	19	14	10	16	7	15	19	34	33	19
Authors rejecting	11	12	10	10	6	14	11	26	25	11
% of articles accepting	36%	39%	60%	46%	42%	39%	29%	36%	36%	45%
% of authors accepting	54%	50%	54%	69%	45%	52%	44%	38%	48%	48%
% of articles rejecting	76%	78%	67%	67%	58%	65%	79%	77%	70%	55%
% of authors rejecting	85%	86%	77%	67%	55%	67%	69%	90%	81%	65%
NS in General										
Articles accepting	0	1	0	1	1	0	1	0	1	1
Authors accepting	0	1	0	1	1	0	1	0	1	1
Articles rejecting	4	6	4	4	0	4	1	2	11	7
Authors rejecting	3	6	4	4	0	4	1	4	13	6
% of articles accepting	0%	12.5%	0%	25%	100%	0%	50%	0%	9.1%	14%
% of authors accepting	0%	12.5%	0%	25%	100%	0%	50%	0%	7.1%	17%
% of articles rejecting	100%	75%	100%	100%	0%	100%	50%	100%	100%	100%
% of authors rejecting	100%	75%	100%	100%	0%	100%	50%	100%	93%	100%

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Table 1 (cont'd)

	1964– 1970	1971– 1975	1976– 1980	1981– 1985	1986– 1990	1991– 1995	1996– 2000	2001– 2005	2006– 2010	2011– 2015
NS Has Been Observed										
Articles accepting	5	3	1	1	2	2	2	2	5	5
Authors accepting	4	4	1	1	2	2	2	2	6	6
% of articles accepting	20%	17%	6.7%	4.2%	17%	8.7%	8.3%	4.5%	19%	42%
% of authors accepting	31%	29%	7.7%	6.7%	18%	9.5%	12.5%	6.9%	19%	55%
NS as a Driver of Biological Diversity										
Articles accepting	1	2	1	1	1	4	1	1	3	5
Authors accepting	1	3	1	1	1	5	1	1	3	6
Articles rejecting	3	0	0	0	0	0	2	4	3	1
Authors rejecting	3	0	0	0	0	0	2	4	3	2
% of articles accepting	33%	100%	50%	100%	100%	100%	33%	50%	43%	62.5%
% of authors accepting	33%	100%	50%	100%	100%	100%	33%	50%	43%	60%
% of articles rejecting	100%	0%	0%	0%	0%	0%	67%	80%	43%	13%
% of authors rejecting	100%	0%	0%	0%	0%	0%	67%	80%	43%	20%
Directional Selection										
Articles accepting	1	2	1	2	0	5	0	5	4	8
Authors accepting	1	2	1	2	0	5	0	4	5	10
Articles rejecting	4	1	3	4	1	2	2	4	2	2
Authors rejecting	2	1	3	2	1	2	2	3	2	3
% of articles accepting	25%	67%	33%	29%	0%	83%	0%	71%	67%	100%
% of authors accepting	50%	65%	33%	40%	0%	83%	0%	67%	71%	100%
% of articles rejecting	100%	35%	100%	57%	100%	33%	100%	57%	33%	25%
% of authors rejecting	100%	33%	100%	40%	100%	33%	100%	50%	29%	33%
Sexual Selection										
Articles accepting					1	1	2	1	0	0
Authors accepting					1	1	2	1	0	0
Articles rejecting					0	1	2	4	2	1
Authors rejecting					0	1	1	2	2	1
% of articles accepting					100%	50%	67%	25%	0%	0%
% of authors accepting					100%	50%	100%	33%	0%	0%
% of articles rejecting					0%	50%	67%	100%	100%	100%
% of authors rejecting					05%	50%	50%	67%	100%	100%
Convergent Evolution										
Articles accepting	1	0	0	0	0	1	3	4	1	5
Authors accepting	1	0	0	0	0	1	3	3	1	4
Articles rejecting	5	3	2	1	5	4	5	6	8	2
Authors rejecting	3	2	1	1	5	6	5	3	10	1
% of articles accepting	17%	0%	0%	0%	0%	20%	43%	40%	11%	71%
% of authors accepting	25%	0%	0%	0%	0%	14%	43%	60%	10%	80%
% of articles rejecting	83%	100%	100%	100%	100%	80%	43%	60%	89%	29%
% of authors rejecting	75%	100%	100%	100%	100%	86%	43%	60%	100%	20%

Table 2. CS articles that express acceptance or rejection of mutation, natural selection (NS), or convergent evolution.

Author and year	Position on natural selection	Position on convergent evolution	Author and year	Position on natural selection	Position on convergent evolution
Lammerts, 1964 ¹	Reject (DS)		Garrido, 1973 ⁴⁰	Accept (SS), Reject (CoS)	
Tinkle, 1964 ²	Accept (SS: Obs), Reject (Com)		McCone, 1973 ⁴¹	Accept (DS: Obs)	
Zimmerman, 1964 ³	Reject (PCE)		Telfair, 1973 ⁴²	Accept (DS), Reject (G), CR	
Barnes, 1965 ⁴	Reject (PCE)		Lammerts & Howe, 1974 ⁴³	Accept (SS: Obs)	
Howe, 1965 ⁵		Reject, CD	Armstrong, 1975 ⁴⁴	Reject (DS)	
Lammerts, 1965 ⁶	Reject (Sym)		Helmick, 1975 ⁴⁵	Reject (PCE)	
Shute, 1965 ⁷	Reject (CoS: numerous miscellaneous examples; Sym)		Howe, 1975 ⁴⁶		Reject, EA
Howard, 1966 ⁸	Accept (SS, DS)		Lammerts, 1975 ⁴⁷	Reject (G)	
Klotz, 1966 ⁹	Reject (G)	Accept	Murphy & Howe, 1975 ⁴⁸	Reject (Com, CoS: chemical pathways in photosynthesis; bat wing)	
Lammerts, 1966 ¹⁰	Reject (BD)		Ouweneel, 1975 ⁴⁹	Accept (SS), Reject (Com: genetic controls in homeotic phenomena)	
Armstrong, 1967 ¹¹	Accept (SS)		Clark, 1976 ⁵⁰	Reject (HMT)	
Armstrong, 1967 ¹²	Reject (G), CR		Davidheiser, 1976 ⁵¹	Accept (SS: Obs)	
Howe, 1967 ¹³		Reject	Haines, 1976 ⁵²	Accept (SS), Reject (PCE)	
Lammerts, 1967 ¹⁴	Accept (SS: Obs), Reject (DS)		Siegler, 1976 ⁵³	Reject (BD)	
Armstrong, 1968 ¹⁵	Reject (G), CR		Smith, 1976 ⁵⁴	Reject (G)	
Howe, 1968 ¹⁶	Accept (BD)		Tinkle, 1976 ⁵⁵	Accept (SS)	
Tinkle, 1968 ¹⁷	Reject (CoS: flowers)		Lammerts, 1977 ⁵⁶	Reject (G)	
Armstrong, 1969 ¹⁸	Reject (Sym)		Ouweneel, 1977 ⁵⁷	Accept (SS)	
Howe, 1969 ¹⁹	Accept (SS)		Poettcker, 1977 ⁵⁸	Accept (SS), Reject (G)	
Lammerts, 1969 ²⁰	Reject (DS)		Tinkle, 1977 ⁵⁹	Accept (SS), Reject (DS, SR)	
Marsh, 1969 ²¹		Reject, EA	Walton, 1977 ⁶⁰	Reject (G)	
Shute, 1969 ²²		Reject, EA	Howe, 1978 ⁶¹	Accept (SS)	
Tinkle, 1969 ²³	Accept (SS: Obs)		Smith, 1978 ⁶²	Reject (G)	
Tinkle, 1969 ²⁴	Reject (CoS: spadix-and-spathe structure of the jack-in-the-pulpit; differences between larval and adult dragonfly)		Woodmorappe, 1978 ⁶³		Reject, CD
Williams, 1969 ²⁵	Reject (G)		Hedtke, 1979 ⁶⁴	Reject (DS)	
Armstrong, 1970 ²⁶	Reject (CoS)		Howe, 1979 ⁶⁵	Accept (BD)	
Cousins, 1970 ²⁷	Accept (Obs), Reject (PCE)		Ancil, 1980 ⁶⁶	Accept (SS, BD)	
Mosher & Tinkle, 1970 ²⁸	Accept (SS: Obs); Reject (CoS), CR		Roth, 1980 ⁶⁷	Reject (CoS)	
Shute, 1970 ²⁹		Reject, EA	Tinkle, 1980 ⁶⁸	Reject (PCE)	
Smith, 1970 ³⁰	Reject (BD)		Woodmorappe, 1980 ⁶⁹		Reject
Armstrong, 1971 ³¹	Reject (G) <i>Iden</i>	Reject	Wrangham, 1980 ⁷⁰	Accept (DS, SS)	
Armstrong, 1971 ³²	Reject (G)		Cheek, 1981 ⁷¹	Accept (G: Obs)	
Howe & Davis, 1971 ³³	Accept (BD; G: Obs)		Hedtke, 1981 ⁷²	Reject (G)	
Ouweneel, 1971 ³⁴	Accept (BD, SS)		Howe, 1981 ⁷³	Accept (DS)	
Tinkle, 1971 ³⁵	Reject (G)		Lammerts, 1981 ⁷⁴	Reject (DS)	
Armstrong, 1972 ³⁶	Reject (Com), <i>Iden</i>		Tinkle, 1981 ⁷⁵	Reject (Com), <i>Iden</i>	
Holroyd, 1972 ³⁷	Reject (G), <i>Iden</i>		Brown, 1982 ⁷⁶	Accept (SS)	
Morris, 1972 ³⁸	Reject (G)		Howe, 1982 ⁷⁷	Reject (Com: genes that help a plant re-spout after a fire)	
Armstrong, 1973 ³⁹		Reject, EA			

Key: **BD** = biological diversity as a product of NS. **CD** = assertion or implication that apparent convergent evolution is evidence of a common designer. **Com** = biological complexity as a product of NS. **CoS** = complex structures as products of NS. **CR** = assertion that NS or "survival of the fittest" is based on circular reasoning or tautological error. **DS** = directional selection. **EA** = assertion that the idea of convergent evolution is a way to explain away similarities in unrelated organisms. **G** = NS in general. **HMT** = human mental traits as products of NS. **Iden** = assertion or implication that NS should

make all organisms identical. **Obs** = acceptance that the phenomenon has been observed to occur. **PCE** = influence of NS on prebiotic chemical evolution. **SR** = sexual reproduction as a product of NS. **SS** = stabilizing selection. **Sym** = symbioses as products of NS. **SxS** = sexual selection. **Note** that authors who accept SS but reject G usually specify that they reject NS as a driver of macroevolution. Names of biological structures and processes listed after "Com" and "CoS" are those that the author(s) claimed are too irreducibly complex to have evolved by NS.

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Table 2 (cont'd)

Author and year	Position on natural selection	Position on convergent evolution
Jones, 1982 ⁷⁸	Reject (DS)	Reject, <i>CD</i>
Lammerts, 1982 ⁷⁹	Reject (G)	
Moore, 1982 ⁸⁰	Accept (SS)	
Smith, 1982 ⁸¹	Accept (SS)	
Tinkle, 1982 ⁸²	Accept (SS)	
Bluth, 1983 ⁸³	Accept (SS), Reject (DS)	
Lambert, 1983 ⁸⁴	Accept (DS)	
Lammerts, 1983 ⁸⁵	Reject (DS)	
Riss, 1983 ⁸⁶	Reject (G)	
Hedtke, 1984 ⁸⁷	Accept (SS), Reject (CoS)	
Lammerts, 1984 ⁸⁸	Accept (SS), Reject (DS)	
Hamilton, 1985 ⁸⁹	Reject (CoS: cephalopod eye; human eye)	
Lammerts, 1985 ⁹⁰	Reject (Com)	
Smith, 1985 ⁹¹	Reject (G)	
Hamilton, 1986 ⁹²	Reject (CoS: eye of jumping spider)	
Leslie, 1986 ⁹³	Reject (DS)	
Moore, 1986 ⁹⁴	Accept (SS)	
Sanders & Howe, 1986 ⁹⁵	Reject (CoS: food-catching basket of dragonfly; click apparatus of click beetle)	
Butt, 1987 ⁹⁶	Accept (SS, SxS)	
Hamilton, 1987 ⁹⁷	Reject (CoS: cephalopod eye; human eye)	Reject, <i>CD</i>
Glover, 1988 ⁹⁸		Reject, <i>EA</i>
Hamilton, 1988 ⁹⁹	Reject (CoS: tetrapod eye)	
Mehlert, 1988 ¹⁰⁰		Reject, <i>EA</i>
Williams, 1988 ¹⁰¹	Reject (CoS: spider web production and complexity)	
Gish, 1989 ¹⁰²	Accept (SS: Obs)	
von Fange, 1989 ¹⁰³		Reject
Arndts, 1990 ¹⁰⁴		Reject, <i>EA</i>
Bergman, 1990 ¹⁰⁵	Accept (SS)	
Hedtke, 1990 ¹⁰⁶	Reject (CoS)	
Wise, 1990 ¹⁰⁷	Accept (BD, G: Obs)	
Bergman, 1991 ¹⁰⁸	Reject (CoS)	
Culp, 1991 ¹⁰⁹	Accept (SS)	
Davidheiser, 1991 ¹¹⁰	Accept (DS: Obs)	
Hamilton, 1991 ¹¹¹	Reject (CoS: fish eye; tetrapod eye), <i>CR</i>	
Kouznetsov, 1991 ¹¹²	Accept (SS) (DS: Obs)	
Williams, Howe & White, 1991 ¹¹³	Reject (Com: millipede defense system)	Reject, <i>CD</i>
Bergman, 1992 ¹¹⁴	Accept (SxS), Reject (CoS, PCE), <i>CR</i>	
Brand & Carter, 1992 ¹¹⁵	Accept (BD)	
Crofut, 1992 ¹¹⁶	Reject (DS)	
Kofahl, 1992 ¹¹⁷	Reject (G)	
Bergman, 1993 ¹¹⁸	Accept (DS: Obs, SS), Reject (DS, SxS) <i>Iden, CR</i>	
Brand & Gibson, 1993 ¹¹⁹	Accept (BD, SS), Reject (CoS)	
Hamilton, 1993 ¹²⁰	Reject (CoS)	

Author and year	Position on natural selection	Position on convergent evolution
Hoffman, 1993 ¹²¹	Reject (G), <i>CR</i>	
Lumsden, 1993 ¹²²	Reject (CoS: plant alkaloids)	
Mehlert, 1993 ¹²³		Reject, <i>EA</i>
Armitage, 1994 ¹²⁴	Reject (CoS: shapes of diatoms)	
Gibson, 1994 ¹²⁵		Accept
Kaufmann, 1994 ¹²⁶	Reject (CoS: human body)	
Lester, 1994 ¹²⁷	Accept (BD, DS, SS)	
ReMine, 1994 ¹²⁸	Reject (G)	Reject
Bergman, 1995 ¹²⁹	Reject (G)	
Lutz, 1995 ¹³⁰	Reject (CoS: feathers)	
Mehlert, 1995 ¹³¹	Accept (BD, SS)	
Ulm, 1995 ¹³²		Reject, <i>CD</i>
Wise, 1995 ¹³³	Accept (DS)	
Bergman, 1996 ¹³⁴	Accept (SS: Obs), Reject (SR, SxS)	
Calais & Mehlert, 1996 ¹³⁵	Accept (SS)	
Colwell, 1996 ¹³⁶	Reject (G) <i>CR</i>	
Gibson, 1996 ¹³⁷	Reject (BD)	
Sarfati, 1996 ¹³⁸	Reject (PCE)	
Wieland, 1996 ¹³⁹	Reject (CoS)	
Armitage, 1997 ¹⁴⁰	Reject (Sym)	
Bergman, 1997 ¹⁴¹	Accept (SS)	
Deckard, 1997 ¹⁴²	Accept (G)	
Robinson, 1997 ¹⁴³		Accept
Sarfati, 1997 ¹⁴⁴	Accept (BD)	
Wieland, 1997 ¹⁴⁵	Accept (SxS)	
Armitage, 1998 ¹⁴⁶	Reject (Com)	
Batten, 1998 ¹⁴⁷	Reject (Com, PCE)	
Bergman, 1998 ¹⁴⁸	Reject (Sym)	
Bergman, 1998 ¹⁴⁹	Reject (Sym)	
Bergman, 1998 ¹⁵⁰	Reject (CoS)	
Howe, 1998 ¹⁵¹	Reject (Sym)	
McGinley, 1998 ¹⁵²	Accept (BD: Obs)	
Oard, 1998 ¹⁵³	Accept (SS), Reject (DS)	Accept, Reject
Penrose, 1998 ¹⁵⁴	Reject (DS)	
Robinson & Cavanaugh, 1998 ¹⁵⁵		Accept
Sarfati, 1998 ¹⁵⁶	Reject (PCE)	
Wise, 1998 ¹⁵⁷		Reject
Woodmorappe, 1998 ¹⁵⁸		Reject, <i>EA</i>
Hedtke, 1999 ¹⁵⁹	Reject (CoS)	
Kaufmann, 1999 ¹⁶⁰	Reject (PCE)	
Sarfati, 1999 ¹⁶¹	Reject (CoS: double-sieve enzymes)	
Armitage & Lumsden, 2000 ¹⁶²		Reject
Bergman, 2000 ¹⁶³	Reject (PCE)	
Bergman, 2000 ¹⁶⁴	Reject (SxS)	
Woodmorappe, 2000 ¹⁶⁵		Reject

Table 2 (cont'd)

Author and year	Position on natural selection	Position on convergent evolution
Bergman, 2001 ¹⁶⁶	Reject (CoS: transposons)	
Bergman, 2001 ¹⁶⁷	Accept (SS)	
Bergman, 2001 ¹⁶⁸		Reject, <i>EA</i>
Burgess, 2001 ¹⁶⁹	Reject (SxS)	
Gurney, 2001 ¹⁷⁰	Reject (CoS: human eye)	
Laughlin, 2001 ¹⁷¹	Accept (SS)	
Mastropaolo, 2001 ¹⁷²	Reject (BD, CoS)	
Oard, 2001 ¹⁷³		Reject
Oard, 2001 ¹⁷⁴		Reject, <i>EA</i>
Wood & Cavanaugh, 2001 ¹⁷⁵		Accept
Batten, 2002 ¹⁷⁶	Reject (Com: C ₄ chemistry in plants)	
Bergman, 2002 ¹⁷⁷	Accept (SS), Reject (BD)	
Bergman, 2002 ¹⁷⁸	Reject (CoS: giraffe neck)	
Bergman, 2002 ¹⁷⁹		Reject, <i>EA</i>
Gurney, 2002 ¹⁸⁰	Accept (SS)	
Kofahl, 2002 ¹⁸¹	Reject (CoS)	
Leyfield, 2002 ¹⁸²	Accept (BD)	
Wood, 2002 ¹⁸³		Accept
Woodmorappe, 2002 ¹⁸⁴		Reject, <i>EA</i>
Batten, 2003 ¹⁸⁵	Accept (DS)	
Bergman, 2003 ¹⁸⁶	Accept (DS: Obs; SS), Reject (DS)	
Manning, 2003 ¹⁸⁷	Reject (CoS: insect flight systems)	
Swindell, 2003 ¹⁸⁸	Reject (CoS, Com: proteins; chemical pathways in photosynthesis)	
Taylor, 2003 ¹⁸⁹	Accept (DS: Obs), Reject (HMT)	
Truman, 2003 ¹⁹⁰	Reject (PCE)	
Woodmorappe, 2003 ¹⁹¹	Reject (CoS)	
Woodmorappe, 2003 ¹⁹²	Reject (BD)	
Woodmorappe, 2003 ¹⁹³	Accept (DS)	
Wright, 2003 ¹⁹⁴	Reject (SxS)	
Armitage & Howe, 2004 ¹⁹⁵	Reject (Com: vegetative reproduction in lichens; lichens' resistance to low temperatures)	
Batten, 2004 ¹⁹⁶	Reject (Com: protein editing; mRNA editing; the killer T-cell system)	
Batten, 2004 ¹⁹⁷	Reject (Sym)	
Bell, 2004 ¹⁹⁸	Accept (SS), Reject (Com)	
Bergman, 2004 ¹⁹⁹	Reject (SxS)	
Bergman, 2004 ²⁰⁰	Accept (SS, SxS), Reject (SxS)	
Bergman, 2004 ²⁰¹	Accept (SS)	
Harrub & Thompson, 2004 ²⁰²	Reject (SR)	
Khomenko, 2004 ²⁰³	Accept (SS)	

Author and year	Position on natural selection	Position on convergent evolution
May, Thompson, & Harrub, 2004 ²⁰⁴	Reject (G)	
Murdock, 2004 ²⁰⁵	Reject (DS)	
Schragin, 2004 ²⁰⁶	Reject (Sym)	
Thompson & Harrub, 2004 ²⁰⁷	Reject (HMT)	
Thompson & Harrub, 2004 ²⁰⁸	Reject (SR)	
Wilson, 2004 ²⁰⁹	Reject (G)	
Woodmorappe, 2004 ²¹⁰		Accept
Bergman, 2005 ²¹¹	Accept (DS), Reject (DS)	
Bergman, 2005 ²¹²	Accept (SS), Reject (Com: genetic code; PCE)	
Bergman, 2005 ²¹³		Reject
Brand & Schwab, 2005 ²¹⁴	Reject (CoS: sensory structures)	
Catchpoole, 2005 ²¹⁵	Reject (Com: the process of producing flattening in leaves)	
DeWitt, 2005 ²¹⁶	Reject (Com)	
Sarfati, 2005 ²¹⁷	Reject (Com: chemical pathways in photosynthesis)	
Truman, 2005 ²¹⁸	Reject (CoS: ubiquitin protein)	
Williams, 2005 ²¹⁹	Reject (SR)	
Williams, 2005 ²²⁰	Accept (DS)	
Wise, 2005 ²²¹	Accept (SS), Reject (BD)	Accept
Armitage & Howe, 2006 ²²²	Reject (CoS)	
Bergman, 2006 ²²³	Accept (SS)	
Biswas, 2006 ²²⁴	Accept (SS)	
Brand, 2006 ²²⁵	Reject (DS)	
Demme, 2006 ²²⁶	Accept (G)	
Henry, 2006 ²²⁷	Accept (BD)	
Stoltzmann, 2006 ²²⁸	Reject (CoS: human eye)	
Truman, 2006 ²²⁹	Reject (PCE)	
Wise, 2006 ²³⁰		Accept
Armitage, 2007 ²³¹	Accept (DS)	
Bergman, 2007 ²³²	Reject (SxS)	
Borger & Truman, 2007 ²³³	Reject (Com: mRNA regulation)	
Borger & Truman, 2007 ²³⁴	Reject (G)	Reject
Jaronczyk & Doyle, 2007 ²³⁵		Reject, <i>EA</i>
Sarfati, 2007 ²³⁶	Reject (Com: DNA scrunching; PCE)	
Truman & Borger, 2007 ²³⁷	Reject (Com: the DNA code)	
Truman & Borger, 2007 ²³⁸	Reject (Com)	
Truman & Borger, 2007 ²³⁹		Reject
Smith, 2007 ²⁴⁰	Accept (SS), Reject (Sym)	
Williams, 2007 ²⁴¹	Reject (PCE)	
Williams, 2007 ²⁴²	Reject (G)	

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Table 2 (cont'd)

Author and year	Position on natural selection	Position on convergent evolution
Armitage, 2008 ²⁴³		Reject
Anderson & Purdom, 2008 ²⁴⁴	Reject (Com)	
Baumgardner, Sanford, Brewer, Gibson, and ReMine, 2008 ²⁴⁵	Reject (G)	
Bergman, 2008 ²⁴⁶	Reject (CoS: arthropod compound eye; fish eye; human eye)	
Bergman, 2008 ²⁴⁷	Accept (SS: Obs)	
Borger, 2008 ²⁴⁸	Accept (SS), Reject (Com, PCE)	
Borger, 2008 ²⁴⁹	Accept (SS), Reject (BD)	
Lightner, 2008 ²⁵⁰	Accept (DS: Obs)	
Lightner, 2008 ²⁵¹	Reject (BD)	
Liu, 2008 ²⁵²	Reject (Com)	
Purdom, 2008 ²⁵³	Accept (DS: Obs)	
Purdom & Anderson, 2008 ²⁵⁴	Accept (DS: Obs), Reject (Com)	
Sanford, Baumgardner, Brewer, Gibson, and ReMine, 2008 ²⁵⁵	Reject (G)	
Truman & Borger, 2008 ²⁵⁶	Reject (G)	
Truman & Borger, 2008 ²⁵⁷	Reject (Com)	
Williams, 2008 ²⁵⁸	Reject (G)	
Williams, 2008 ²⁵⁹	Accept (BD)	
Criswell, 2009 ²⁶⁰	Accept (DS: Obs), Reject (BD)	
Doyle, 2009 ²⁶¹		Reject, EA
Howe, 2009 ²⁶²	Reject (BD)	
Hennigan, 2009 ²⁶³	Reject (Sym)	
Larssen, 2009 ²⁶⁴	Reject (G), CR	
Lightner, 2009 ²⁶⁵	Reject (G)	
Liu & Soper, 2009 ²⁶⁶		Reject
Oard, 2009 ²⁶⁷	Accept (SS)	
Sarfati, 2009 ²⁶⁸	Reject (SxS)	
Stevens, 2009 ²⁶⁹	Reject (CoS): animal wing plus relevant cerebral circuitry	
Wise, 2009 ²⁷⁰	Reject (G)	
Woetzel, 2009 ²⁷¹	Accept (SS)	
Bartlett, 2010 ²⁷²	Reject (CoS: flagellum)	
Bergman, 2010 ²⁷³	Reject (G)	
Bergman, 2010 ²⁷⁴		Reject
Lightner, 2010 ²⁷⁵	Reject (Com)	
Oard, 2010 ²⁷⁶		Reject
Smith, 2010 ²⁷⁷	Reject (G)	
Catchpoole, 2011 ²⁷⁸	Accept (BD, DS)	
Doyle, 2011 ²⁷⁹	Accept (BD)	
Doyle, 2011 ²⁸⁰	Accept (BD, CoS)	
Lightner, 2011 ²⁸¹	Reject (BD, Sym)	
Oard, 2011 ²⁸²	Accept (BD)	Reject
Oard, 2011 ²⁸³		Reject, EA
Pendragon, 2011 ²⁸⁴	Accept (DS)	

Author and year	Position on natural selection	Position on convergent evolution
Pendragon & Winkler, 2011 ²⁸⁵	Accept (BD)	
Statham, 2011 ²⁸⁶	Reject (SxS)	
White, 2011 ²⁸⁷	Accept (DS)	
Gaskill & Thomas, 2012 ²⁸⁸	Reject (BD, DS)	
Lightner, 2012 ²⁸⁹		Accept
Truman, 2012 ²⁹⁰	Reject (PCE)	
Enyart, 2013 ²⁹¹	Reject (DS)	
Jeanson, 2013 ²⁹²	Reject (G)	
Joubert, 2013 ²⁹³	Accept (BD)	
Lee, Horstemeyer, Seely, & Williams, 2013 ²⁹⁴	Reject (CoS): woodpecker beak	
Lightner, 2013 ²⁹⁵		Accept
Line, 2013 ²⁹⁶	Accept (BD)	
Rupe & Sanford, 2013 ²⁹⁷	Reject (G)	
Arment, 2014 ²⁹⁸		Accept
Carter, 2014 ²⁹⁹	Accept (G: Obs)	
Guliuza, 2014 ³⁰⁰	Reject (G)	
Guliuza, 2014 ³⁰¹	Reject (G)	
Guliuza, 2014 ³⁰²	Reject (G)	
Joubert, 2014 ³⁰³	Reject (G)	
Lightner, 2014 ³⁰⁴	Reject (G)	
Lightner, 2014 ³⁰⁵	Reject (Com: grasshopper mouse immunity to scorpion venom)	
Lightner, 2014 ³⁰⁶	Reject (Com)	
Bergman & Snow, 2015 ³⁰⁷	Reject (CoS: avian respiratory system)	
Cook, 2015 ³⁰⁸	Reject (HMT)	
Gillen, Conrad, & Cargill, 2015 ³⁰⁹	Accept (DS: Obs)	
Lightner, 2015 ³¹⁰	Accept (SS: Obs)	
Stoltzmann, 2015 ³¹¹	Reject (CoS: human eye)	
Liu, 2015 ³¹²	Accept (DS: Obs)	
Liu, 2015 ³¹³	Accept (DS: Obs)	
Tan, 2015 ³¹⁴	Reject (CoS): proteins	Accept
Truman, 2015 ³¹⁵		Accept
Williams, 2015 ³¹⁶	Accept (DS)	
Williams, 2015 ³¹⁷	Accept (SS)	

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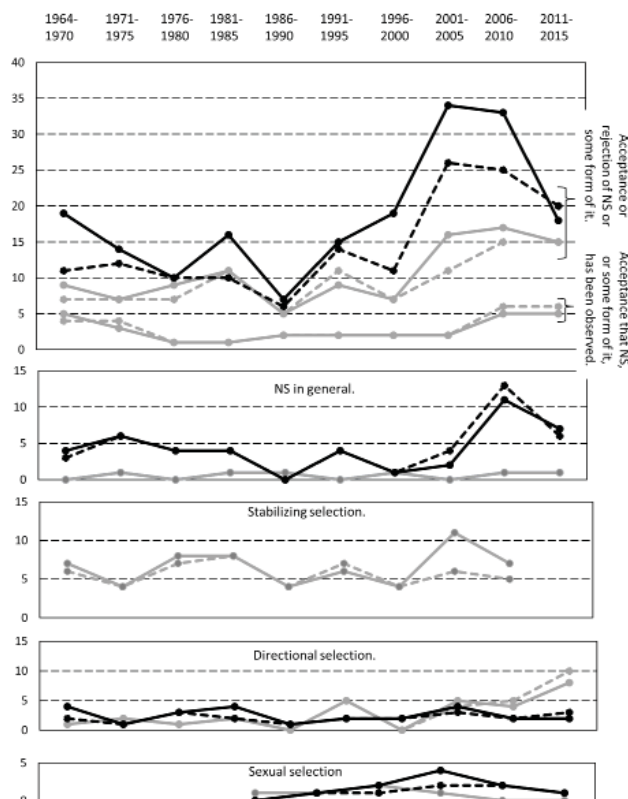
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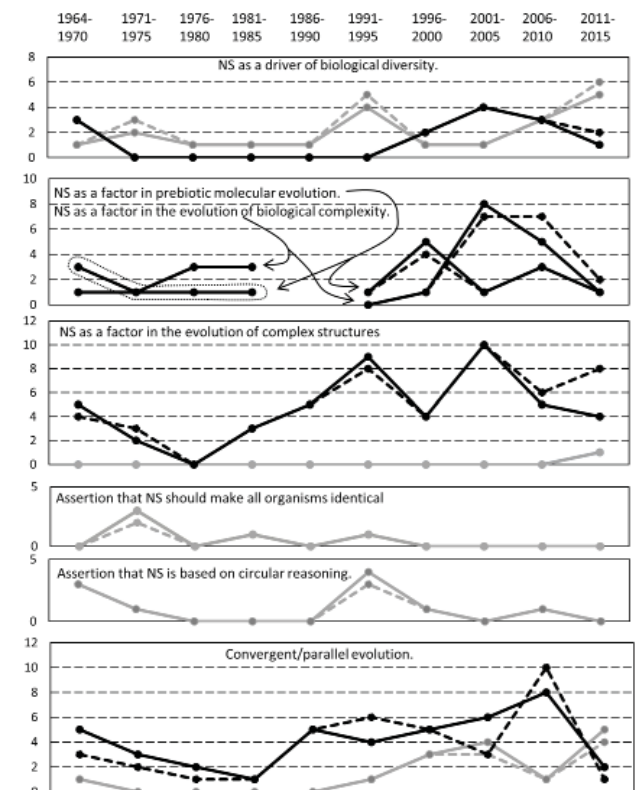
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Figure 1. Temporal trends in the technical literature of creation science through 2015, regarding topics relating to natural selection.



Key for Figures 1 & 2: Solid lines indicate articles, and dashed lines indicate authors; where no dashed line is visible, the number of authors equals the number of articles. Gray indicates acceptance, and black indicates rejection. The absence of data on positions toward stabilizing selection in the period 2010–2015 indicates a lack of authors taking a position on that topic during that period. NS = natural selection.

Figure 2. Temporal trends in the technical literature of creation science through 2015, regarding topics relating to natural selection and convergent evolution.



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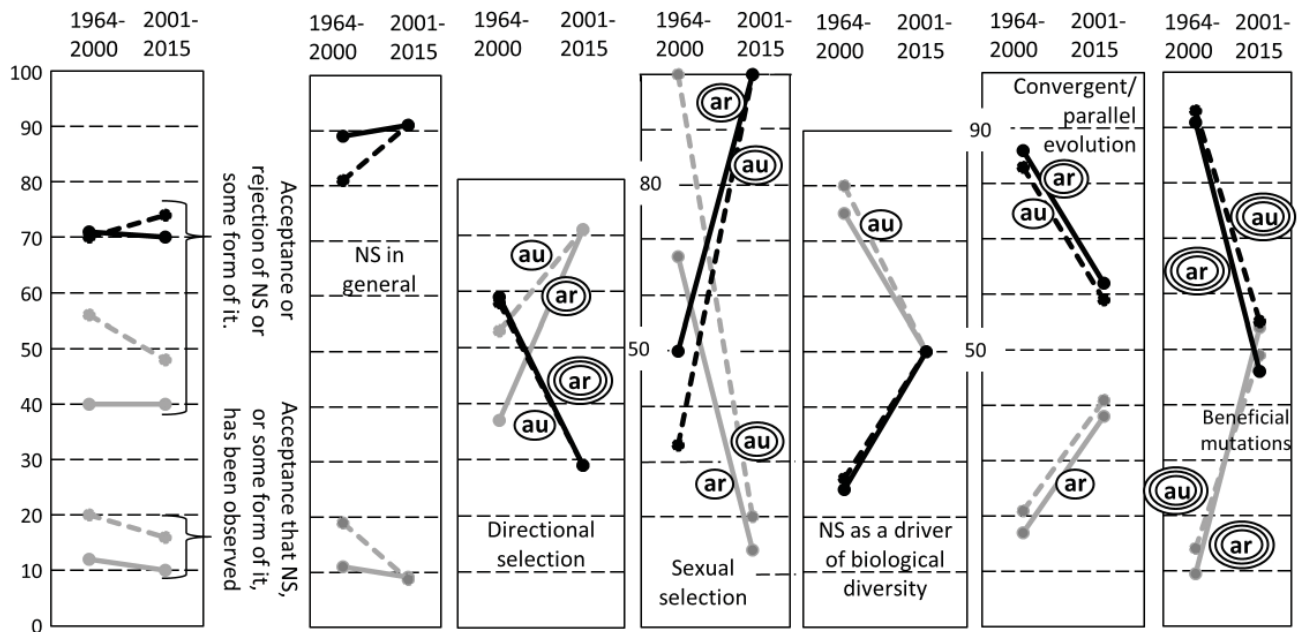


Figure 3. Percentages of articles and authors accepting or rejecting natural selection and related phenomena in the technical literature of creation science in the twentieth and twenty-first centuries, through 2015.

Key: Solid lines indicate articles, and dashed lines indicate authors. Gray indicates acceptance, and black indicates rejection. Lines with a circled “au” (authors) or “ar” (articles) are cases in which two-tailed z-tests found a significant difference in the proportion between the twentieth and twenty-first centuries. For circled “au” and “ar,” a triple circle indicates that two-tailed z-tests found a significant difference between centuries when alpha was set at 0.1, 0.05, and 0.01; a double circle indicates that the tests found a significant difference when alpha was set at 0.1 and at 0.05; a single circle indicates that the tests found significance only with alpha set at 0.1. Data on acceptance vs. rejection of beneficial mutations are from a previous study, in which the difference between centuries was described but not illustrated. See Philip J. Senter and Jared J. Mackey, “The Evolution of Creation Science, Part 2: Beneficial Mutations,” *Perspectives on Science and Christian Faith* 69, no. 2 (2017): 87–97.

Discussion

NS in General and in Relation to Macroevolution

Through both centuries, more CS authors have rejected than have accepted NS. Often, rejection was based on nonsensical arguments. One author rejected NS on the basis that the concept of NS is not intuitively grasped by children,¹⁸ by which reasoning one ought also to reject higher mathematics, particle physics, and molecular genetics. Another argued that “selection would be by characteristics, but inheritance would occur by genes,”¹⁹ neglecting to recognize that genes produce characteristics, and therefore selection occurs on both simultaneously. One author asserted that NS should increase fecundity, and rejected NS because simple organisms often have great fecundity, incorrectly equating “simple” with “less fit.”²⁰ According to another author, some animals have eyes that are better than they need, whereas NS (allegedly) should make only structures that are adequate for current needs.²¹ One author argued that the spread of antibiotic resistance in bacteria cannot be due to NS, because the transference of R-plasmids between bacteria contradicts the (alleged) prediction by NS that an organism will not

give an advantage to its competitors.²² However, that author failed to recognize that directional selection occurs when a trait increases within a population; this is exactly what happens when antibiotic resistance is spread via the transmission of R-plasmids.

Two authors used scripture to justify their rejection of NS. According to one author, NS contradicts Ecclesiastes 9:11: “The race is not to the swift, nor the battle to the strong,”²³ a passage that is a creative bemoaning of the observation that people often get rewards that they do not deserve; the passage is irrelevant to NS among nonhuman organisms. Another author correctly pointed out that NS requires death, and according to the literal sense of scripture, there was no death before the Fall of humans in the Garden of Eden, and so humans could not have evolved by NS if scripture is to be taken literally.²⁴

In some cases, CS authors used misinformation to support denial of NS. One author claimed that NS could not have occurred, because no morphological intermediates are found in the fossil record,²⁵ a false claim that is contradicted by enough examples to fill volumes.²⁶ Another author claimed that, whereas NS theory predicts that predators will select for superior

prey by preying on the weak, in reality, predators select prey randomly.²⁷ That claim is falsified by data from numerous studies that show that predators do tend to preferentially target more-vulnerable prey (the young and the weak,²⁸ eggs in nests that are easier to find,²⁹ etc.). In fact, numerous studies have documented NS-mediated enhancement of antipredator defenses in prey species as a result of selection pressure from predators.³⁰ According to some, most or all mutations are deleterious, and NS would require too many beneficial mutations to be plausible.³¹ However, recent research shows that beneficial mutations occur sufficiently often to drive NS.³²

CS authors often rejected NS for contradictory reasons. One author argued that NS would be too slow to account for macroevolution,³³ whereas another argued that it would be too fast.³⁴ One author asserted that NS would require mutations to accumulate, but instead they get weeded out,³⁵ whereas other authors claimed that NS requires mutations to get weeded out, but instead they accumulate.³⁶ Some authors claimed that differences between organisms were evidence against NS,³⁷ whereas others claimed that similarities between organisms were evidence against NS.³⁸

Authors proffering the third pair of opposing positions often gave specific examples. One author argued that plants that give insects indigestion could not have evolved that defense by NS, because other plants that do not give insects indigestion do exist.³⁹ Another author denied NS because simple organisms still exist, whereas NS (allegedly) should make all organisms complex.⁴⁰ How, asked one author, could NS have produced

the long neck of the giraffe and the short neck of the pig; the hard shells of some turtles and the soft shells of others; the great size of the whale and the small size of the shrew ... the great speed of the jackrabbit and the slow speed of the woodchuck; and so on.⁴¹

Summarizing the position, one author stated that "according to natural selection, all animals would eventually evolve a similar, best type which could survive in a variety of wild situations."⁴²

Authors taking the opposite stance also cited specific examples, expressing doubt that NS could have produced the similarity between monarch and viceroy butterflies (*Danaus plexippus* and *Limenitis archippus*)⁴³

or the similar lifestyles of various lineages of flies that "live in similar ways on crabs."⁴⁴ One author even simultaneously took both opposing positions in a single article, citing similarities between animals (invertebrate and vertebrate eyes) as evidence against NS, and then citing differences between animals (some animals' ears are small while others are large) as evidence against NS.⁴⁵

Numerous CS authors listed various symbiotic relationships as examples of phenomena that NS could not have produced (table 2). Such assertions are based on the implicit assumption that if two organisms are mutually interdependent, then they must have been created at the same time, because neither could have survived if it came into being without the other. However, many examples exist of mutual interdependence in species that, demonstrably, were previously not mutually interdependent because they did not previously inhabit the same area.⁴⁶ Such examples falsify this type of argument against NS.

The concept of irreducible complexity has been a popular argument against NS among CS authors. According to this concept, some biological structures or processes are too complex to have evolved by NS, because intermediate stages would not be viable or useful. Examples cited by CS authors are listed in table 2. It is noteworthy that for several of those examples, the hypothesis that the structure or process is irreducibly complex is falsified by the known existence of intermediate forms, the existence of which demonstrates that intermediate forms are viable (appendix 1).

CS authors who accept NS understandably accept that it has produced changes only within baramins ("created kinds" of organisms). Because CS authors do not accept macroevolution, they consistently deny that NS could have produced macroevolutionary phenomena such as prebiotic molecular evolution, sexual reproduction, complex biological processes and structures, and the evolution of human mental traits from precursor states in nonhuman ancestors. Arguments against NS in prebiotic molecules usually involve incorrect assumptions. Some CS authors asserted that NS can act only on living cells,⁴⁷ an assertion that has been falsified by experimental observations of NS acting on nucleic acids *in vitro*.⁴⁸ One author asserted that prebiotic molecules could not undergo NS because such molecules do not self-replicate, and NS can only act on self-replicat-

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ing entities.⁴⁹ However, recent research shows that some such molecules—including examples of peptides, double-stranded nucleic acids, and RNA—can accomplish self-replication.⁵⁰

CS authors consistently reject NS as compatible with the origin of sexual reproduction. According to such authors, NS would weed out any mutation that caused an organism to undergo “the dilution of 50% of its genes.”⁵¹ As one pair of authors put it, “the Darwinian ‘survival of the fittest’ mantra does not compute with a sexual practice that selectively only passes one half of one’s genes to successive progeny.”⁵²

However, dilution by 50% does not affect the entire genome but affects only those genes for which an organism is heterozygous. An allele for which an organism is homozygous is necessarily passed on by sexual reproduction. Moreover, recent research indicates that sexual reproduction confers advantages upon offspring, in accordance with the naysayers’ expectations of a system that is a product of NS. Genetic recombination during sexual reproduction dramatically reduces the rate of accumulation of deleterious mutations⁵³ and concentrates beneficial mutations, increasing the rate of adaptation.⁵⁴ It also appears to unlink deleterious mutations from beneficial mutations, allowing those deleterious mutations to be selected out of the genome.⁵⁵ In addition, sexual selection, which depends on the presence of sexual reproduction, is advantageous for gene propagation. It decreases mutation load and increases fitness,⁵⁶ and traits that are favored by sexual selection often have survival value.⁵⁷

According to some CS authors, human mental traits could not have evolved by NS. One author claimed that if the mind is a product of NS, then its own conclusions—including the conclusion that NS exists—are unreliable.⁵⁸ That argument is a non sequitur. Another author asserted that human altruism was not a product of NS.⁵⁹ However, recent research indicates that the specifically human forms of altruism confer selective advantages;⁶⁰ this is consistent with their having arisen via NS. Other authors claimed that musical ability, the ability to calculate, and consciousness could not be products of NS because they have no survival value.⁶¹

Recent findings oppose such claims. By definition, NS can act upon a trait if the trait is heritable and

adaptively relevant. A trait is heritable if it is a product of an anatomical structure, which in turn is a product of genes. It is adaptively relevant if it confers an advantage, especially an increased likelihood of survival and/or reproduction. Human musical ability has functions that are adaptively relevant,⁶² and its association with specific brain regions shows that it has an anatomical basis.⁶³ Consciousness⁶⁴ and the ability to calculate⁶⁵ are also adaptively relevant and associated with specific brain regions.

Moreover, potential evolutionary precursors for such “human” traits are known in nonhuman animals. Numerous animals—including even insects⁶⁶ and fishes⁶⁷—have the ability to count, and a rudimentary ability to calculate is known in birds⁶⁸ and primates.⁶⁹ Thus a potential evolutionary precursor to the human ability to calculate exists in nonhuman animals. Likewise, certain aspects of human consciousness exist in some animals;⁷⁰ therefore, human consciousness could have evolved from a nonhuman precursor. In addition, altruism⁷¹ and certain other traits associated with human mentality (e.g., tool use,⁷² cultures,⁷³ planning ahead,⁷⁴ sense of fairness,⁷⁵ theory of mind⁷⁶) are present in other primates; these facts suggest that human mentality could have arisen from a precursor in nonhuman primates.

Some CS authors rejected NS as based on circular reasoning or tautological error (table 2), that is, “survival of the fittest,” with the fittest defined as those who survive. However, NS is not based on circular reasoning. The phrase “survival of the fittest” is a simplistic *description* of the theory of NS, not the *basis* of the theory of NS. The basis of the theory of NS is the pair of observations that heritable variation exists and that different variants have different chances of survival and reproduction. These observations are facts that have been documented⁷⁷ and do not relate to each other circularly.

One CS author who characterized NS as based on circular reasoning, applied circular reasoning of his own. His argument against NS that environmental pressure can create variation within “created kinds” but cannot produce new “kinds”⁷⁸ is circular, because “created kinds” are defined as having arisen by special creation and not by NS or by evolution.⁷⁹ Using the same circular argument, some CS authors who accepted the existence of directional selection within baramins stated that the resulting changes were not evolution, because no new “kinds”

were produced.⁸⁰ Such assertions demonstrate not only circular reasoning but also a difference in the use of the word “evolution” between CS authors and mainstream biologists. To the latter, heritable changes even within species fall under the umbrella of “evolution.”⁸¹

NS within Baramins

Through both the twentieth and twenty-first centuries, while most CS authors have denied NS, others have insisted that NS occurs and that instances of it have been observed and recorded within baramins (figs. 1, 2; table 2). In particular, there has been wide acceptance among NS authors that stabilizing selection occurs (fig. 1; table 2) and prevents evolution by keeping organisms the same through the generations. One author even made the astute observation that artificial selection, which perpetuates lineages with traits that would be lethal in the wild, is the prevention of stabilizing selection, which would have occurred in the absence of human interference.⁸²

Numerous CS authors accepted stabilizing selection while denying directional or sexual selection or the role of NS in biological diversification (table 2). To support denial of directional selection, one author argued that it would end all life on Earth, because eventually a superspecies would outcompete all the others and drive them to extinction, following which, competition within that species would eliminate all but one of its members, which would subsequently die.⁸³

Other CS authors accepted a role of NS in diversification within baramins. Regarding plant diversification, one author said that

after the Flood the Creator may ... have allowed such processes as gene mutation, natural selection, and polyploidy to equip these plants further for their new roles of clothing the earth with its diverse network of nascent habitats.⁸⁴

According to another author, directional selection by carnivory was probably necessary in the post-Flood world, to increase fitness in a harsh environment.⁸⁵ Other CS authors asserted that directional selection had been documented, citing the examples of antibacterial resistance in bacteria,⁸⁶ pesticide resistance in insects,⁸⁷ the favoring of the dark morph of the peppered moth (*Biston betularia*) during the Industrial Revolution,⁸⁸ and changes in the genome of HIV.⁸⁹

Mainstream scientists have recorded a plethora of other examples of observed and documented directional selection that appear to have gone unnoticed by CS authors. Some particularly showy cases involve observed morphological changes in microbes⁹⁰ and multicellular organisms⁹¹ in response to selection pressure. The latter include instances in which new ecotypes have appeared in recent decades,⁹² sometimes with reproductive isolation that defines the new ecotype as a new species, according to the biological species concept. Other cases involve observed physiological changes⁹³ in response to selection pressure, or demonstrations from genetic studies that NS has recently occurred.⁹⁴ Instances in which microbes have been observed to acquire endosymbiosis⁹⁵ or multicellularity⁹⁶ in the laboratory in response to selection pressure, provide support for the feasibility of such events in the past macroevolution of eukaryotes.

Of seven CS authors who took a position on the existence of sexual selection, three accepted its existence (table 2) and proffered it as a potential explanation of specific biological phenomena: the preference of female crickets for males with larger nuptial offerings,⁹⁷ differences in vocalizations between two closely related bat species,⁹⁸ and a recent increase in height among human males⁹⁹ (table 2). Four authors rejected sexual selection as an explanation for other specific phenomena (table 2), such as human schizophrenia and the peacock's tail, citing work by mainstream biologists that casts doubt on the role of sexual selection in those cases.

The author who tentatively attributed the human male height increase to sexual selection later rejected the existence of sexual selection in general (table 2), arguing that “natural selection would select against sexual selection. Mates who are choosy about their mates are less likely to mate, and less likely to pass on their traits to their offspring.”¹⁰⁰ Recent research indeed suggests that choosier females are likely to mate less often,¹⁰¹ but it also shows that female choosiness is a plastic trait that is reduced when conditions would prevent mating by overly choosy females, as for example when there is low mate availability,¹⁰² immanence of oocyte release,¹⁰³ or other conditions that make it costly to delay mating;¹⁰⁴ this plasticity ensures that choosy genes do not prevent reproduction but instead get passed on. The same author also objected that “If sexual selection caused the development of the male beard ... why do women often

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prefer clean-shaven males?”¹⁰⁵ Inherent in that question is the assumption that women generally do prefer clean-shaven males, an assumption that recent research shows is unlikely.¹⁰⁶ Furthermore, rejection of the existence of sexual selection contradicts evidence from myriad examples in which sexual selection has been documented.¹⁰⁷

Although some CS authors rejected NS as a contributor to biological diversity, others accepted that NS contributes to diversification within baramins. According to two authors, extinct hominid species may represent diversity generated by NS within the human baramin.¹⁰⁸ According to others, NS is responsible for diversity among modern humans¹⁰⁹ or within other baramins,¹¹⁰ including the fossil horse series¹¹¹ and the ceratopsian dinosaur clade.¹¹²

Convergent Evolution

Numerous CS authors dismissed convergent evolution as an invention by evolutionists to explain away similarities in unrelated organisms (table 2). Some authors attributed such similarities to common design and claimed them as evidence of a common Designer (table 2). Others used arguments with unsupported assumptions, for example,

Convergent evolution should be nearly impossible within the evolutionary paradigm, because no two environments remain the same for long periods to “evolve” similar structures in very different animals.¹¹³

Nonetheless, some authors recognized that within a given (alleged) baramin were organisms with similarities that must have arisen in parallel and not by inheritance from the (alleged) originally created ancestor. Examples include parallel mutations of eye color in different lineages of fruit flies,¹¹⁴ parallel gene duplications in flies,¹¹⁵ parallel similarities in cytochrome *b* genes in turtles,¹¹⁶ and various similarities between different species of the cat family.¹¹⁷ Others noted that organisms in different (alleged) baramins had independently acquired similar characteristics and that this must be called convergent evolution. Examples include the independent acquisition of *C*₄ physiology in sixteen plant families,¹¹⁸ saber-tooth morphology in four mammal families,¹¹⁹ similarities between elephant shrews and ruminants,¹²⁰ and similarities between Old and New World vultures.¹²¹

One author argued that “shared mistakes” in pseudogenes between humans and other primates were due to parallel molecular evolution rather than common ancestry.¹²² Another argued that *Homo erectus* represented ancestral human morphology, that *H. erectus* populations in different areas had convergently evolved *H. sapiens* morphology, and that this was an example of a biological trajectory that had been programmed into genes at creation and which is evidence of common design.¹²³ Another author even tried to have it both ways, explaining that the similarities between the dinosaur *Deinonychus* and the early bird *Archaeopteryx* were due to convergent evolution, so as to cast doubt upon the evolution of birds from dinosaurs, while denying—in the same article—that convergent evolution exists.¹²⁴

Final Thoughts

CS authors deny macroevolution. It is therefore unsurprising that they consistently deny that NS contributed to macroevolutionary processes such as the evolution of prebiotic molecules, the advent of complex biological structures and systems, and the advent of sexual reproduction. They also consistently deny that NS has contributed to symbioses. However, CS authors cannot be said to have achieved consensus regarding other aspects of NS. Some CS authors deny the existence of NS in general, directional selection, sexual selection, convergent evolution, and/or a role for NS in biological diversification. Others accept that those phenomena and stabilizing selection exist—and in some cases have been observed—within “created kinds.” It will be interesting to see whether CS authors achieve agreement on these topics in future decades, or whether disputation regarding these topics will continue to prevent consensus.

It is also important to note that for much of the twentieth century, the naysaying CS authors had a point. The explosion in documentation of directional selection, sexual selection, and the influence of NS on biological diversification is mostly a phenomenon of the most recent three decades. Therefore, in previous decades, deniers of these phenomena were correct in that there was minimal or no observational evidence for such phenomena. However, now that a plethora of instances of these phenomena have been observed and documented, there is no longer any excuse to deny them.

Appendix 1:

Falsification of Claims of Irreducible Complexity

The claim that a biological structure or system is irreducibly complex is falsified if forms intermediate between the structure/system and its simpler counterpart(s) exist (hence, are viable) in extant or fossil organisms, or if viable counterparts with missing components exist in extant or fossil organisms.

a. Flagella

The proteins that compose and operate bacterial flagella differ across taxa, with different proteins missing in different taxa, thus showing that bacterial flagella are not irreducibly complex.¹²⁵ A simpler counterpart with homologous proteins exists: the bacterial type III secretion system.¹²⁶

Unlike prokaryotic flagella, eukaryotic flagella contain two-part (basal body and axoneme) skeletons of microtubules. The components of the basal body differ across taxa, with different components missing in different taxa,¹²⁷ demonstrating that eukaryotic flagella are not irreducibly complex. A simpler counterpart exists: the pole of the mitotic spindle, which appears to have given rise to the eukaryotic flagellum by elongation.¹²⁸

b. The Shapes of Diatoms

Diatoms exhibit a continuous spectrum of morphology and therefore do not lack intermediate forms.¹²⁹ Aspects of diatom morphology are functionally significant¹³⁰ and therefore subject to NS.

c. Chemical Pathways in Photosynthesis

Among prokaryotes is a spectrum of complexity—from simple to complex—in the morphology and chemistry of photosynthetic housing structures, reaction centers, antennae, pigments, and electron transport chains.¹³¹ Also, in extant prokaryotes, simpler counterparts to photosynthetic pathways exist: light-driven, ion-pumping systems that convert light into chemical energy but are not involved in carbon fixation.¹³²

d. C₄ Chemistry

Numerous plant species exhibit photosynthetic physiology that is intermediate between the C₃ and C₄ types.¹³³

e. The Flower

Fossil¹³⁴ and extant¹³⁵ plants are known that exhibit reproductive structures with morphology intermediate between gymnosperm strobilae and simple flowers.

f. Spathe and Spadix of Jack-in-the-pulpit (Arisaema triphyllum)

A spectrum of morphology intermediate between unmodified bracts and bracts that are modified into a spathe exists among extant members of the family Araceae, to which the jack-in-the pulpit belongs.¹³⁶ Inflorescences with morphology intermediate between a simple branching pattern and a spadix are common among extant plants.¹³⁷

g. Compound Eyes

A spectrum of complexity and morphology of ommatidia (the units of compound eyes)—from simple to complex, with numerous intermediate forms—is present across the phyla Mollusca, Annelida, and Arthropoda.¹³⁸ Intermediate numbers of ommatidia also exist in compound eyes of different species, with the number varying from one to several thousand.¹³⁹

h. Jumping Spider Eyes

The anterior median eyes of jumping spiders possess a corneal lens, a multilayered retina, muscles that move the retina, ultraviolet photoreceptors, photoreceptors for colors that humans can see, a fovea, and an elongated shape.¹⁴⁰ However, all but the last two traits are present in other spiders.¹⁴¹ Jumping spider eyes are therefore derivable from other spider eyes and are not too complex to have arisen from them by NS.

i. Spider Web Production and Complexity

Simpler precursor structures to spinnerets are known from early fossil arachnids.¹⁴² A spectrum with numerous intermediate forms exists between the simplest and most complex webs of extant spiders.¹⁴³

j. Millipede Defense Systems

A variety of defense systems are present in extant millipedes, and intermediate states abound.¹⁴⁴ Defensive rolling-up varies from the production of a

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Appendix 1: Falsification of Claims of Irreducible Complexity (cont'd)

sphere to a spiral, and the intermediate form (a planar disk) exists. Chemical defenses vary from none to multiple secreted compounds, and various intermediate numbers and combinations of compounds exist. Defensive spines vary in thickness, complexity of branching, and number of rows, and intermediate combinations of these traits exist.

k. Click Apparatus of Click Beetles

The apparatus that click beetles use to right themselves involves an enlarged muscle and a peg-and-notch arrangement on two exoskeletal plates.¹⁴⁵ The bodies of most other insects possess the homologous muscle and the homologous exoskeletal plates and therefore possess counterparts with missing components (muscle enlargement and a peg-and-notch shape).

l. Large Difference between Larval and Adult Dragonflies

The morphological difference between larva and adult in insects varies from almost none to extreme, with numerous intermediate magnitudes present—and therefore viable—in various species.¹⁴⁶

m. Food-Catching Basket of Dragonflies

The dragonfly's food-catching basket is simply the first four legs. They are generic insect legs that lack the specializations present in other insects.¹⁴⁷ Other than their close spacing,¹⁴⁸ there is nothing particularly remarkable about them, and they are no more complex than the legs of other insects.

n. Cephalopod Eyes

A nearly continuous spectrum, with numerous intermediate forms, exists between the simplest molluscan photoreceptors and cephalopod eyes.¹⁴⁹

o. Killer T-cell System

A comparison of protochordates, jawless fishes, jawed fishes, and tetrapods reveals a spectrum of complexity within the immune system and within its T-cell system. Fishes exhibit states intermediate between those of protochordates and tetrapods.¹⁵⁰

p. Eyes of Humans, Other Tetrapods, and Fishes

A nearly continuous morphological series links the simple photoreceptors of protochordates to human eyes via the extant diversity¹⁵¹ within mammals, non-

mammalian tetrapods, jawed fishes, jawless fishes, and recently discovered fossils that fill in morphological gaps between fish groups¹⁵² and between protochordates and jawless fishes.¹⁵³

q. Giraffe Neck

Fossil members of the giraffe family exhibit a spectrum of neck lengths and vertebral morphology intermediate between those of short-necked ungulates and extant giraffes.¹⁵⁴

r. Avian Respiratory System

Recent research shows that various extant reptiles have respiratory systems that, in morphology and airflow, are intermediate between simple lungs with bidirectional flow and the complex, avian system of unidirectional flow-through lungs-plus-air-sacs.¹⁵⁵

s. The Feather

Fossil precursors of avian feathers exhibit a spectrum of morphologies intermediate between a simple filament and a primary flight feather.¹⁵⁶ Despite the erroneous claim that the simpler fossil "proto-feathers" are actually degraded collagen fibers from within the dermis,¹⁵⁷ new research demonstrates that they contain melanosomes, the pigment-bearing organelles in the cells of feathers.¹⁵⁸

t. The Human Musculoskeletal System

A long and detailed fossil series of intermediate forms shows the derivation of the location and arrangement of human muscle attachment sites from those of early tetrapods, via fossils of early amniotes, early synapsids, early mammals, and early primates.¹⁵⁹

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Nelva Hamelink (G. M. Elliott Library, Cincinnati Christian University), and John Rush (Emmaus Bible College Library). Diane Anderson of the Creation Research Society provided the number of CRS members and institutional subscribers to CRSQ. **

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- ⁴Philip J. Senter and Jared J. Mackey, "The Evolution of Creation Science, Part 1: Vestigial Structures and Biological Degeneration," *Perspectives on Science and Christian Faith* 69, no. 1 (2017): 27–41.
- ⁵But it will be useful to list here the abbreviations used in subsequent endnotes for the names of the CS journals: ARJ (*Answers Research Journal*), CENTJ (*Creation Ex Nihilo Technical Journal*), CRSA (*Creation Research Society Annual*), CRSQ (*Creation Research Society Quarterly*), ENTJ (*Ex Nihilo Technical Journal*), JC (*Journal of Creation*), JCTS (*Journal of Creation Theology and Science, Series B: Life Sciences*), and OPBSG (*Occasional Papers of the Baraminology Study Group*). The names of the CS journals *Origins*, *TJ*, and *CORE Issues in Creation* are not abbreviated in these endnotes, nor are the titles of the *Proceedings* volumes of the International Conference on Creation series. The current journal JC was previously ENTJ, then CENTJ, then TJ, before being named *Journal of Creation*. Likewise, the current journal JCTS was previously OPBSG.
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