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Science for Survival: The Modern Synthesis of Evolution and the Biological Sciences Curriculum Study

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Science for Survival: The Modern Synthesis of Evolution and The Biological Sciences Curriculum Study

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by

Lisa Anne Green

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ABSTRACT OF THE DISSERTATION

Science for Survival: The Modern Synthesis of Evolution and the
Biological Sciences Curriculum Study

by

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Dr. Margaret Nash, Chairperson

In this historical dissertation, I examined the process of curriculum development in the Biological Sciences Curriculum Study (BSCS) in the United States during the period 1959-1963. The presentation of evolution in the high school texts was based on a more robust form of Darwinian evolution which developed during the 1930s and 1940s called “the modern synthesis of evolution.” Building primarily on the work of historians Vassiliki Smocovitis and John L. Rudolph, I used the archival papers and published writings of the four architects of the modern synthesis and the four most influential leaders of the BSCS in regards to evolution to investigate how the modern synthetic theory of evolution shaped the BSCS curriculum.

The central question was “Why was evolution so important to the BSCS to make it the central theme of the texts?” Important answers to this question had already been offered in the historiography, but it was still not clear why every citizen in the world needed to understand evolution. I found that the emphasis on natural selection in the

modern synthesis shifted the focus away from humans as passive participants to the recognition that humans are active agents in their own cultural and biological evolution. This required re-education of the world citizenry, which was accomplished in part by the BSCS textbooks. I also found that BSCS leaders Grobman, Glass, and Muller had serious concerns regarding the effects of nuclear radiation on the human gene pool, and were actively involved in informing the public. Lastly, I found that concerns of 1950s reform eugenicists were addressed in the BSCS textbooks, without mentioning eugenics by name. I suggest that the leaders of the BSCS, especially Bentley Glass and Hermann J. Muller, thought that students needed to understand genetics and evolution to be able to make some of the tough choices they might be called on to make as the dominant species on earth and the next reproductive generation in the nuclear age. This was science for survival.

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Introduction

In this dissertation, I examine the process of curriculum development in the Biological Sciences Curriculum Study (BSCS) in the United States during the period 1959 to 1963. I am particularly interested in the subject of evolution in the BSCS texts. The presentation of evolution in the texts is based on a more robust form of Darwinian evolution which developed during the mid-20th century called "neo-Darwinism" or "the modern evolutionary synthesis."[1] I assert that the leaders of the BSCS considered the modern evolutionary synthesis to be critical knowledge for an informed citizenry, not only of the United States, but of the entire world. The prominence of evolution in the BSCS texts provoked a reaction from religious fundamentalists which has continued to affect science education and school/community relationships until this day.

The modern synthesis of evolution, with the establishment of natural selection as its primary mechanism, made evolution more complete, coherent, and transferable than it had been before that time. While biologists had widely accepted the theory of common descent since Darwin's day, they did not reach a general consensus on evolutionary mechanisms until the 1940s, marginalizing the importance of evolution in the discipline of biology itself. [2] Historians Edward J. Larson, John L. Rudolph, and Vassiliki B. Smocovitis acknowledge the importance of the modern synthesis to the BSCS

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[1] John L. Rudolph, *Scientists in the Classroom: The Cold War Construction of American Science Education* (New York; Palgrave, 2002), 148.

[2] The theory of common descent says that all living things ultimately descended from one or a few original living organisms. Bowler, Peter J., *The Non-Darwinian Revolution: Reinterpreting a Historical Myth* (Baltimore, MD: Johns Hopkins University Press, 1992).

curriculum, but I go one step further in developing *how* the modern synthesis of evolution was critical to the BSCS mission.[3]

The BSCS was organized in 1958 by the American Institute of Biological Sciences (AIBS), an umbrella organization created to unify the large number of independent professional societies within the discipline of biology. Backed by funding from the National Science Foundation (NSF), biologists and science educators organized in a massive effort to reform K-12 biology curriculum during the Cold War. This effort was largely in response to the so-called "life-adjustment curriculum," common in schools of the 1940s and 1950s, which had been highly criticized for its lack of rigor and was deemed inadequate to produce the scientific human-power needed for the national defense.[4] While several organizations were already looking at biology education reform by the mid-1950s, it took public anxiety over the launch of Sputnik in 1957 to pass the National Defense Education Act of 1958 (NDEA) which funded the BSCS.[5] The BSCS patterned their curriculum on the "structure of the disciplines" approach advanced by Jerome Bruner in the late 1950s.[6] This approach asserted that each discipline has a

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[3] See Edward J. Larson, *Evolution: The Remarkable History of a Scientific Theory* (New York: Modern Library Chronicles, 2004), 252-253; Rudolph, *Scientists in the Classroom*, 148; and Vassiliki B. Smocovitis, *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology* (Princeton, NJ: Princeton University Press, 1996),179-182.

[4] Arthur E. Bestor, *Educational Wastelands* (Urbana, IL: University of Illinois Press, 1953).

[5] Rudolph, *Scientists in the Classroom*, 101.

[6] Jerome Bruner, *The Process of Education* (Cambridge, MA: Harvard University Press, 1960).

conceptual structure associated with it, and that effective learning is based on understanding that structure. In modern biology, that structure was evolutionary theory.[7]

Early plans had included producing one high school biology textbook, but the BSCS Steering Committee decided that producing three tenth-grade high school textbooks served several purposes. Three versions, each with a different emphasis, provided a choice for teachers and districts in curriculum adoption, softening the appearance of a national curriculum. Federal involvement in education was a sensitive subject in this era of mandated school desegregation after *Brown v. Board of Education* in 1954. Creating three textbooks also relieved the difficulties posed by trying to synthesize one textbook approach from all the various sub-disciplines of biology. These textbooks have formal titles, but they are commonly referred to by their color. The Blue Version has a molecular emphasis, the Green Version an ecological emphasis, and the Yellow Version a cellular emphasis.[8] Evolution was to be the overarching theme in all three textbooks.

According to historian Edward J. Larson, evolution had been deemphasized in many high school textbooks after the Scopes Trial in 1926 as publishers sought to avoid controversy.[9] The word "evolution" was often avoided or replaced by terms such as

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[7] Theodosius Dobzhansky, "Nothing Makes Sense Except in the Light of Evolution," *The American Biology Teacher* 35 (1973): 125-29.

[8] Joseph J. Schwab, *The Biology Teachers' Handbook, Biological Sciences Curriculum Study* (New York: John Wiley and Sons, Inc., 1963), 15.

[9] Edward J. Larson, *Trial and Error: The American Controversy over Creation and Evolution*, Updated ed. (New York: Oxford University Press, 1989), 84-88. The assertion that evolution largely disappeared from the textbooks after the Scopes Trial is contested by Ronald P. Ladouceur in "Ella Thea Smith and the Lost History of American High School Biology Textbooks", *Journal of the History of Biology* 41 (2008): 435-71. Ladouceur asserts that the BSCS overstated the effect of anti-evolutionary forces on the high school

"racial development," even though evolutionary concepts such as natural selection or adaptation might be included. Some authors (notably Ella Thea Smith) did an admirable job of integrating an up-to-date understanding of evolution into high school textbooks.[10] However, according to historian Gerald Skoog, the use of the word evolution had sunk to new lows in textbooks by the 1950s, even though the theory of evolution had attained much greater disciplinary significance because of the modern synthesis of evolution which developed during the 1930s and 1940s .[11] The synthesis was made possible by advances in genetics and population biology, and was accomplished by the consensus building of Theodosius Dobzhansky and other "architects of the modern synthesis."[12] The synthesis sought to unite disparate sub-disciplines of biology around a central theoretical core, and, in the process, increase the legitimacy of biology as a unified science.[13] In addition, the synthesis resulted in the shedding of metaphysical elements that were still present in the discipline of biology as a whole, securing biology's position as a mature science along with chemistry and physics.[14] The acceptance of the modern synthesis

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biology curriculum in the 1930s through 1950s in order to promote its own mission and avoid more difficult questions associated with evolutionary progress.

[10] Ladouceur, "Ella Thea Smith," 435-371.

[11] Gerald Skoog, "The Contributions of BSCS Biology Textbooks to Evolution Education" in *BSCS: Measuring Our Success*, ed. Rodger W. Bybee (Dubuque, IA: Kendall/Hunt Publishing Company, 2008), 45-71.

[12] Smocovitis, *Unifying Biology*, 133-38.

[13] Ibid., 206.

[14] Ibid., 169.

emboldened evolutionary biologists to extend the influence of the synthesis to the general populace through high school biology textbooks.

The factual transfer of evolutionary knowledge was a stated primary goal of the BSCS curriculum, but transfer of scientific culture was also important to its leaders. As Rudolph asserts, the leaders of the BSCS sought to spread an understanding of scientific inquiry that would advance a rational way of approaching the world's biological and social problems. In my analysis, I look more deeply into how concerns of the architects and supporters of the modern synthesis became established in the curriculum itself. I assert that key leaders of the BSCS, without overtly challenging religious ways of thinking in the textbooks, advanced a naturalistic worldview with evolutionary thinking at its core. This worldview pointed to the desirability, if not the necessity, of intervention in human reproduction and humankind's genetic future.

Of secondary importance to this study is the effect of the reform eugenics of the 1930s, 1940s, and 1950s on the representation of evolution and race in the BSCS curriculum. Eugenics was of significant interest both in the U.S. and abroad during the 1920s and 1930s when the early work of the biometricians provided the mathematical framework for the modern evolutionary synthesis. One of them, Ronald A. Fisher, was very involved in the eugenics movement in England.[15] While many historians regard the influence of eugenics to have faded rapidly after the world became aware of the atrocities of Nazi Germany in the 1930s and 1940s, the desire for human betterment did not abate

[15] Daniel J. Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity* (Berkeley, CA: University of California Press, 1985), 165.

in the minds of many inside and outside of biological circles. Reform eugenics, which publicly eschewed the political uses of reproductive science for racial or class discrimination, developed to take the place of the discredited old "mainline" eugenics which was flagrantly racist and classist. Reform was necessary not only because of the popular revulsion to eugenics engendered by Nazi atrocities but because of improvements in the understanding of hereditary mechanisms afforded by modern genetics. Mathematical population genetics made it clear that forced sterilization of the "unfit" would not accomplish desired long-term eugenic goals. Within the context of the modern synthesis, reform eugenicists paved the way for the greater acceptance of population control, a new understanding of racial differences, and voluntary participation in medical genetics programs.[16] The influence of reform eugenicists on the BSCS curriculum is an important part of this study.

Nobel Laureate Hermann J. Muller voiced the sentiments of the BSCS biologists at the 1959 Darwin Centennial Celebration in his address entitled "One Hundred Years without Darwinism Are Enough."[17] While evolution had not been entirely absent from high school biology classes in the 1930s, 1940s, and 1950s, the acceptance of the modern synthesis of evolution by the biological community opened the door for spreading the not so new but definitely improved theory of evolution. There is limited information on exactly how the modern evolutionary synthesis influenced the BSCS curriculum, however. Therefore, I sought to learn: 1) Who were key members of the BSCS and in

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[16] Ibid., 164-192.

[17] Hermann J. Muller, "One Hundred Years without Darwinism Are Enough," *School Science and Mathematics* 59 (1959): 304-16.

what ways were they part of relational networks outside of the BSCS? 2) How did the BSCS operate as a unit of curriculum deliberation regarding the inclusion of evolution? 3) How did the modern evolutionary synthesis and reform eugenics influence the representation of evolution in the BSCS curriculum? 4) How does the influence of the modern evolutionary synthesis on the BSCS curriculum relate to larger historical, cultural and socio-political contexts?

This dissertation consists of six chapters. In Chapter One, I explore the historiography of the modern synthesis of evolution with regards to the BSCS. I draw on both the history of science and the history of education as background to the current study. Of particular importance is the work of Vassiliki B. Smocovitis regarding the modern synthesis and John L. Rudolph's work regarding the BSCS as part of the curriculum study movement in the United States during the Cold War. I introduce key leaders of the BSCS who form the focus of this study.

In Chapter Two, I focus on the issue of evolution directly, asking the question, "Why was evolution so important to the BSCS that they made it the most pervasive theme of the text?" I provide a short history of evolutionary thought with the intent of contextualizing the decision of the BSCS biologists to center on evolution education. I assert that while evolution was the central unifying theme of biology at that time, the architects of the modern synthesis and other prominent biologists were ultimately concerned with the future of humankind. They believed that knowledge of evolution, both biological and cultural, was essential knowledge for citizens of the United States and also the world. The BSCS textbooks were one means of propagating this message.

In Chapters Three and Four, I answer the question, “Who were the key members of the BSCS?” In Chapter Three, I consider Hermann J. Muller, and in Chapter Four, I present Bentley Glass, Arnold Grobman, and John A. Moore. The object of these chapters is to understand the background of some of the key members of the BSCS and why they were personally committed to evolution education.

Chapter Five addresses the curriculum deliberation process and how evolution became the central theme of the curriculum. I present evidence that while evolution was proposed to members of the BSCS as the central theme of the curriculum as early as June, 1959, there was a diversity of opinion among the biologists and conflicting priorities among teachers who were members of the writing teams. While historian Ronald Ladouceur credits Hermann J. Muller’s objections at the BSCS Steering Committee Meeting in February, 1961 as the critical point at which evolution began to be taken seriously as the central theme of the texts, I suggest that Glass, Grobman, and Moore were committed to the centrality of evolution in the curriculum from the beginning, and solicited Muller’s help in advancing that goal. The final negotiated curriculum reflects the centrality of evolution moderated by the diversity of opinion among the writers and the Steering Committee.

Chapter Six examines the role of eugenics in the BSCS textbooks. Mainline eugenics had been a staple in high school biology textbooks of the early twentieth century, but as coverage of evolution waned after WWII, so did the coverage of eugenics. The one counter-example noted by scholars is the continued discussion of eugenics in *Modern Biology* by Moon, Mann, and Otto, even though there is no mention of evolution in the index of the 1956 version of the text.[18] I suggest that even though the word "eugenics" was not used in the 1963 versions of the BSCS textbooks, the controversial issues which the BSCS committed to address were a reflection of persistent eugenic concerns among biologists regarding the future of humankind and the quality of its gene pool.

Significance

The significance of this work is threefold. First, it contributes to the historiography of biology education, providing insights into the thinking of the leaders of the BSCS and the process of curriculum development, and providing disciplinary and cultural context for the work of the BSCS. Second, it illuminates the influence of the modern synthesis of evolution on the BSCS curriculum, showing how changes in scientific theory can result in not only a change in curricular content, but changes in the form and purpose of the curriculum as well. Lastly, improved understanding of how and why evolution took a central role in the BSCS curriculum advances our historical understanding of the evolution-creation debate, which continues to challenge science education today.

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[18] See Steven Selden, "Biological Determinism and the Narrative of Adjustment: The High School Biology Textbooks of Truman Jesse Moon, c. 1921-1963," *Curriculum Inquiry* 37, no. 2 (June 2007): 159-96; Truman J. Moon, Paul B. Mann, and James H. Otto, *Modern Biology* (New York: Henry Holt and Company, 1956).

Chapter 1

Historiography

> "All representations of science in schools embody social and political ends."
> --John Rudolph, *Scientists in the Classroom*

This study builds on both the history of science and the history of education. Within the history of science, the history of evolutionary thought has been an especially active area of research since the 1960s. Within that area, the modern synthesis of evolution of the 1930s and 1940s provides an important framework for understanding the discipline of biology at the time. The modern evolutionary synthesis was (and still is) the dominant theoretical platform in the biological sciences. It formed the basis for the college textbooks in the 1950s and contributed significantly to the tacit knowledge shared by the biologists in the BSCS.[19] While there is a large body of literature on the modern synthesis of evolution, almost all of this literature stops short of mentioning the modern synthesis in the context of the BSCS or K-12 education. John L. Rudolph, Vassiliki B. Smocovitis, and Edward J. Larson are the only historians of science I know to bridge this gap. Their contributions will be discussed in some detail.

The history of education also provides critical information for understanding the work of the BSCS. The curriculum studies movement of the 1950s and the 1960s included an unprecedented attempt to integrate academic scientists into the curriculum development process. The scientists had the final say on all subject matter decisions

[19] Two examples of these college textbooks include Moore, John A., *Principles of Zoology* (New York: Oxford University Press, 1957), and George G. Simpson, Colin S. Pittendrigh, and Lewis H. Tiffany, *Life: An Introduction to Biology* (New York: Harcourt, Brace & World, 1957).

because of contractual control they had been given in their agreement to do the project.[20] Philosophical, historical and cultural influences which had previously been diluted by the influence of publishers could now have full expression. This study examines key leaders of the BSCS including their disciplinary and philosophical commitments and traces how the representation of evolution in the curriculum was negotiated through the curriculum development process. Since the modern evolutionary synthesis is central to understanding the contributions of both the history of science and the history of education, I will begin by presenting some background history on the synthesis and then examine some of the relevant literature from both the history of science and the history of education.

The Modern Evolutionary Synthesis

The term "modern evolutionary synthesis" is used in the literature to represent both the improved theoretical understanding of evolution that developed during the 1930s and 1940s and the closer relationship between sub-disciplines of biology that resulted from this improved understanding of evolution. In the late 1800s, Darwinian evolution functioned in society as a simple, unified understanding of the origin of humans which fit well with the Victorian idea of progress. The concept of evolution by natural selection was used to support social and political causes, including social Darwinism, laissez faire capitalism, and eugenics, often without concern for the scientific justification for doing so. Within the scientific community, however, evolution caused many questions around

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[20] John L. Rudolph, *Scientists in the Classroom: The Cold War Construction of American Science Education* (New York: Palgrave, 2002), 146.

the turn of the century, and controversy over evolutionary mechanisms contributed to the fragmentation of biology as a science.[21]

In the 1920s and 1930s, developments in several fields began to form the groundwork for a more stable understanding of evolution and to pave the way for the unification of biology as a science. Research by R.A. Fisher, J.B.S. Haldane, and Sewall Wright provided advances in theoretical population genetics including a sophisticated mathematical framework on which to build a new understanding of Darwin's work.[22] There was a move to integrate Darwin's theory of natural selection with new understandings from genetics and population biology in order to explain how new traits appear, how they are inherited, and how change occurs on the population level. As a part of this process, distant factions of biologists, including experimental geneticists, (e.g., Dobzhansky and Muller) and naturalists (e.g., Ernst Mayr and Bernhard Rensch) were brought together through the understanding of theoretical population genetics.[23]

The list of scientists credited with creating the modern evolutionary synthesis varies with the historian. The synthesis is clearly something that would have been impossible to accomplish by one scientist. Scientists often mentioned include Sewell Wright, Ronald Fisher, J.B.S. Haldane, Julian Huxley, Bernard Rensch, Ledyard Stebbins, George Gaylord Simpson, Theodosius Dobzhansky, and Ernst Mayr. Julian Huxley was an experimental zoologist and reform eugenicist who wrote *Evolution, the*

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[21] Peter J. Bowler, *Evolution: History of an Idea,* 3rd ed. (Berkeley, CA: University of California Press, 2003), 196-202.

[22] Ibid., 327-33.

[23] Ibid., 325-28.

Modern Synthesis (1942) and is credited with originating the idea of an evolutionary synthesis.[24] Importantly, Julian Huxley was the grandson of T. H. Huxley, who championed Darwin's work in the late 1800s. Julian Huxley was an atheist who saw evolution as supportive of scientific humanism.[25] In contrast, Dobzhansky was an Eastern Orthodox Christian who struggled with the implications of natural selection for faith in God, but did not reject faith as a result. In a letter to historian John Greene, Dobzhansky asked not to be grouped with Huxley with regards to his philosophical attitudes toward evolution, even though they both championed the modern synthesis.[26] Dobzhansky is cited by evolutionists as evidence that acceptance of evolution does not require a rejection of faith.[27] Nonetheless, Smocovitis sees the modern synthesis as part of the process by which biology shed its previous metaphysical attachments to natural theology to become a mature scientific discipline.[28] I will discuss the significance of this in the Conclusion.

Stebbins, Simpson, Dobzhansky and Mayr are often referred to as "the architects of the modern evolutionary synthesis," or alternately, "the four horsemen of the modern

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[24] Ernst Mayr and William B. Provine, *The Evolutionary Synthesis: Perspectives on the Unification of Biology* (Cambridge, MA: Harvard University Press, 1980), 39.

[25] For Huxley's religious views, see Julian S. Huxley, *Religion without Revelation* (London: C. A. Watts & Co. Ltd., 1967).

[26] John C. Greene, *Debating Darwin: Adventures of a Scholar* (Claremont, CA: Regina Books, 1999), 93.

[27] For example, see Nick Matzke, "Serbia Bans, Unbans, Evolution," National Center of Science Education (posted September 9, 2004), http://ncseweb.org/news/2004/09/serbia-bans-unbans-evolution-00537 (accessed October 10, 2009).

[28] Vassiliki B. Smocovitis, *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology* (Princeton, NJ: Princeton University Press, 1996), 100.

evolutionary synthesis."[29] They are credited with uniting a wide range of biological fields of research under the banner which is sometimes known as 'neo-Darwinism.'[30] They were each invited to give the prestigious Jesup lectures at Columbia University, and their work was also published as part of the Columbia Biological Science Series.[31] This series of lectures and the resulting books served to disseminate the ideas of the architects among the scientific community and legitimate the synthetic process.

As a result of the modern synthesis, some biologists began to identify themselves as evolutionary biologists in addition to their other affiliations, especially biologists who worked with whole organisms such as zoologists and botanists. New conferences, societies and journals dedicated to evolution arose in the 1940s and 1950s to foster communication and professional identification among the evolutionary biologists. Ernst Mayr was essential in shaping the field of evolutionary biology, as a key founder of the Society for the Study of Evolution and as first editor of its journal, *Evolution.*[32]

Over the years, some biologists and historians of science (including Ernst Mayr, an architect of the synthesis) have questioned the degree to which the modern

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[29] American Philosophical Society, "Theodosius Dobzhansky Papers, Background Note," American Philosophical Society, http://www.amphilsoc.org/mole/view?docId=ead/Mss.B.D65-ead.xml#bioghist (accessed October 10, 2009).

[30] The term neo-Darwinism has also been used to describe the work of August Weismann in the late 1800s. Use of the term indicates a commitment to the idea that natural selection is the only driving mechanism of evolution. Darwin himself had allowed for other driving mechanisms including Lamarckian inheritance. See Bowler, *Evolution*, 251.

[31] Smocovitis, *Unifying Biology*, 132-38.

[32] Ibid., 157.

evolutionary synthesis succeeded as a unifying agent for the science of biology.[33] For example, there was persistent disagreement about the unit of selection - was it the gene, the organism, or the population? Smocovitis indicates that after the peak acceptance of the synthesis in the mid-1950s, the rising emphasis on biochemistry and molecular biology threatened to reduce biology to the study of chemistry and physics.[34] Since the 1960s, there have been other significant challenges to the modern synthesis of evolution.[35] These challenges have, for the most part, been integrated within mainstream evolutionary theory.

The History of Science and the Modern Evolutionary Synthesis

The modern synthesis has been investigated by a number of historians of science.[36] However, few references have any mention of the BSCS whatsoever. The only examples I have found are the works of Vassiliki B. Smocovitis and Edward J. Larson. Smocovitis has specialized in the history of the modern synthesis of evolution. Starting in the 1980s, Smocovitis worked carefully to bridge the many areas which informed her work, including history and philosophy of biology, cultural studies, sociology of science,

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[33] Dudley Shapere states that William Provine "suggested that what was accomplished was not a positive or logical unification of these different areas, but rather only a negative achievement, the removal of barriers to the ultimate achievability of such a synthesis." In other words, a full synthesis was not accomplished at that time, although necessary steps had been taken in that direction. See Mayr and Provine, *The Evolutionary Synthesis*, 390.

[34] Smocovitis, *Unifying Biology*, 174.

[35] Depew and Weber, *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection* (Cambridge, MA: MIT Press, 1995), 359-91.

[36] See Smocovitis, *Unifying Biology*, 1996; Mayr and Provine, *The Evolutionary Synthesis*, 1980; Depew and Weber, *Darwinism Evolving*, 1996; Bowler, *Evolution*, 2003; and Michael Ruse and Joseph Travis, *Evolution: The First Four Billion Years* (Cambridge, MA: Belknap Press of Harvard University Press, 2009).

and literary studies. In *Unifying Biology*, Smocovitis documents the process of the modern synthesis, emphasizing the power of narrative as a unifying force. Her book "is especially concerned with grand narratives-all embracing, universalizing, originary stories told about the universe, life and humanity, and about the grandest narrative of Western culture, the modern theory of evolution."[37] To Smocovitis, the creation narrative established by the modern theory of evolution is a grand narrative of immense scientific and cultural importance. She conceptualizes evolutionary biology as "a profoundly cultural enterprise," and desires to honor the perspective of scientists who saw themselves "to be in a collective enterprise seeking transcendence."[38] Her project seeks to understand the influence of the synthesis on biological thought and practice.

In another work, Smocovitis details how the Darwin Centennial Celebration of 1959 also served to legitimate and popularize the modern synthesis of evolution. Through the event and its news coverage, the importance of the modern evolutionary synthesis was broadcast to a large audience, including the K-12 education community.[39] Teachers were essential to the organizers' goal of reestablishing evolution in the high school biology curriculum, and special meetings were held for them at the Centennial. The organizers legitimated the celebration by featuring the architects and advocates of the modern synthesis (including Theodosius Dobzhansky, Hermann Muller and Julian

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[37] Smocovitis, *Unifying Biology*, xi.

[38] Ibid., 63.

[39] An NSF grant was obtained by the organizers to bring a teacher delegate from each state to the event. The grant also provided the publication of a thirty-six page booklet and its wide distribution to high schools. See Vassiliki B. Smocovitis, "The 1959 Darwin Centennial Celebration in America,' *Osiris* 2nd Series 14 (1999): 294.

Huxley), and inviting the grandson of Darwin, Leonard Darwin, as honorary speaker.[40] Money secured from the NSF and NIH further legitimized the event and permitted an increase in scale. While most of the event was considered a success, the event was marred by evolutionary humanist Julian Huxley who gave a notorious convocation on the last day. This speech will be discussed in more detail in Chapter Two. As a result, the celebration was a two-edged sword. It promoted the respectability and legitimacy of the modern synthesis of evolution. But it also advertised the objectionable views of some of the most prominent supporters of the synthesis.[41]

The BSCS promoted and legitimated the modern evolutionary synthesis by making evolution the central organizing principle of its high school textbooks. According to Smocovitis, the BSCS would "aid the professionalization of incipient biologists and…promote the biological sciences to the growing population of the postwar baby boom generation" as well as "discipline an entire generation of new professional biologists to the belief in biology as unified science."[42] Through the BSCS curriculum, therefore, biologists sought to transfer the ideas and the culture of post WWII biology to a new generation. Smocovitis discusses the cultural aspects of the modern synthesis and notes the function of the BSCS in transferring biological culture to the next generation, but does not examine how this cultural transfer was enacted within the curriculum itself, leaving a gap that this study seeks to fill.

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[40] Smocovitis, *Unifying Biology*, 207.

[41] Vassiliki B. Smocovitis, "The 1959 Darwin Centennial Celebration in America," *Osiris* 2nd Series 14 (1999): 313-317.

[42] Smocovitis, *Unifying Biology*, 179-80.

In *Evolution: The Remarkable History of a Scientific Theory*, Edward J. Larson presents a history of evolutionary thinking and the ensuing cultural reactions. He highlights the efforts of evolutionist Julian Huxley and architect of the modern synthesis George G. Simpson to advance evolutionary humanism, and yet asserts that “acceptance of the modern synthesis coexisted with all manner of religious faith.”[43] Larson mentions that the 1963 issuance of the BSCS textbooks triggered “an unexpected backlash” from fundamentalist Christians, and explains how this reaction developed.

> The modern synthesis was less readily compatible with spiritual belief than earlier Lamarckian and theistic theories of evolution. Indeed, where many prominent American evolutionists once sought to reconcile their science with Christianity, by the second half of the twentieth century most neo-Darwinian biologists either repudiated or dismissed the effort.[44]

Combined with “the growing dominance of theologically conservative churches,” the stage was set for an extended conflict.[45] While Larson notes the influence of naturalism on the BSCS textbooks, he does not provide details as to how and why this influence occurred. I address those questions as part of this dissertation.

From the history of science, it is clear that the modern evolutionary synthesis had both scientific and cultural implications for high school biology education. From its function as a unifying theory for the biological sciences to its role in cultural transformation, the modern synthesis has been perceived as a potent agent for change within the history of science. Historians of science have used the BSCS as an example of

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[43] Edward J. Larson, *Evolution: The Remarkable History of a Scientific Theory* (New York: Modern Library, 2004), 251.

[44] Ibid., 252-53.

[45] Ibid., 253.

how biologists transferred the modern synthesis to future scientists and the public, but have not gone into detail as to how this happened or why it was imperative to do so. I seek to fill this gap with the present study.

History of Education and the BSCS

The research describing the internal dynamics of the BSCS as an organization is limited. Several of the original members of the BSCS wrote historical accounts of BSCS activity, including Arnold B. Grobman, Joseph Schwab, John A. Moore, and Paul DeHart Hurd. As important as these studies are, however, they were all published by the BSCS and reflect institutional bias to varying degrees.

In his 1968 BSCS publication, *The Changing Classroom*, Arnold B. Grobman documents the history of the BSCS during his tenure as its first director.[46] He does not hide the fact that significant difficulties were a part of the process of curriculum development. However, he lacks specifics in some areas and emphasizes positive, rational solutions when problems are discussed. Besides writing for the purpose of historical documentation, Grobman wrote this book to answer persistent questions about the organization. The book's honest but positive tone supports its mission to reassure educators and the public that the BSCS was still a viable entity in the late 1960s, a period of challenge for science education due to public disenchantment with the federal government and increasing demands for curricular relevancy.

In *The Biology Teachers' Handbook*, Joseph Schwab describes the three BSCS textbooks, including the relative emphasis on the nine main themes in each textbook,

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[46] Arnold B. Grobman, *The Changing Classroom: The Role of the Biological Sciences Curriculum Study* (Garden City, NY; Doubleday & Company, Inc., 1969), ix.

including evolution.[47] Schwab also presents a brief history of high school biology textbooks in general, which he divided into three phases. In the first phase (1890-1929) a basic textbook model was developed which emphasized current, accurate information appropriate for college preparation. The second phase (1929-1957) reflected a reduced emphasis on providing the most up-to-date information and increased emphasis on what could be adequately taught to a student population which was rapidly increasing in size and diversity. In the third phase (referring to the BSCS), a collaborative of professors, university researchers, and teachers formed to produce textbooks which reflected current scientific knowledge. The new phase was based on the 'structure of the disciplines' approach to curriculum development, but would also consider the needs and attitudes of youth.[48] Besides providing historical background for teachers, Schwab's account is a justification for work of the BSCS. He did not address the internal workings of the BSCS.

John A. Moore wrote an article for the BSCS Newsletter in which he reported on the actions and rationale of the BSCS.[49] While providing interesting information on the goals and progress of the BSCS, this article contains no information on individual interactions or controversies within the BSCS. His writing style is almost "nectar-like" at times, presenting the organization and its activities in the best possible light. For example, Moore writes: "We believe that the data and concepts of our science not only

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[47] Joseph J. Schwab, *The Biology Teachers' Handbook, Biological Sciences Curriculum Study* (New York: John Wiley and Sons, Inc., 1963), 3-8.

[48] Ibid.

[49] John A. Moore, "A Statement of the Objectives of the BSCS," *BSCS Newsletter No. 3* (May 1960), 2, BSCS Archives.

possess great intrinsic interest they can also be intellectually stimulating, economically important, and aesthetically pleasing to all men."[50] While probably reflecting the enthusiasm with which Moore approached his task, this statement is also an example of the type of promotional rhetoric common in the 1950s and 1960s. Moore's public writings usually involved issues of curriculum and instruction but did not discuss the human aspects of curriculum development.

Paul DeHart Hurd provides an excellent survey of biology curriculum development and classroom learning in the United States from 1890 to 1960.[51] Hurd was commissioned by the BSCS to conduct this study in preparation for their curriculum work. Emphasis is on documentation and coherence rather than extensive analysis. His book is divided into two parts. The first part has a historical emphasis and is based on the reports of a variety of committees which addressed biology education up to and including the 1960 BSCS Summer Writing Conference. Hurd's book provides important information on influential committees in the development of the BSCS. The second part of Hurd's book covers research studies on various relevant aspects of curriculum and instruction. Hurd also makes the interesting observation that from 1890 to 1920 university biologists were "usually in the majority on all national and regional curriculum committees," whereas in the period from the 1920s to the 1950s, they "had little direct involvement in the improvement of high school biology education."[52] According to Hurd,

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[50] Ibid.

[51] Paul DeHart Hurd, *Biological Education in American Secondary Schools 1890-1960* (Baltimore, MD: Waverly Press, Inc., 1961).

[52] Ibid., 158.

the involvement of university biologists in high school education reached an unprecedented level with the work of the BSCS.

The accounts by Grobman, Schwab, Moore, and Hurd are insider accounts and were all published by the BSCS. The only independent educational historians I have found who have considered the internal processes of the BSCS are John L. Rudolph and Gerald Skoog. Skoog uses word counts and thematic analyses to compare the treatment of evolution in the BSCS and other biology textbooks from 1900 through the BSCS texts of the present day, with the goal of demonstrating the influence of the BSCS on the biology curriculum at large.[53] There is little mention of individuals or organizational dynamics. On the other hand, John L. Rudolph contributes many important insights into the curriculum studies movement of the 1950s and 1960s, including the BSCS. Since my work is a direct extension of Rudolph's work, I will discuss *Scientists in the Classroom* in some detail in the next section and explain how my study will add to our understanding of the BSCS.

Rudolph's *Scientists in the Classroom*

Historian John L. Rudolph's book *Scientists in the Classroom* is a groundbreaking look at the NSF sponsored curriculum study movement of the 1950s and 1960s. Rudolph discusses the origins, function and purposes of the Physical Science Study Committee (PSSC) and the BSCS within the educational context of disciplinarity, and the political context of the Cold War. Rudolph's story of the BSCS serves as a counterpoint to his

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[53] Gerald Skoog, "The Contributions of BSCS Biology Textbooks to Evolution Education," in *BSCS: Measuring Our Success*, Rodger W. Bybee, ed. (Dubuque, IA: Kendall/Hunt Publishing Company, 2008), 45-71.

account of the PSSC, illuminating the similarities and differences between these two approaches to curriculum study.[54] Both the PSSC and the BSCS were examples of the discipline-centered curriculum advocated by Jerome Bruner and part of the larger reaction to the life-adjustment curriculum of the 1950s. Under the life-adjustment curriculum, professional educators had been seen as the most capable of creating curriculum focused on the needs of students, and they wrote most of the high school curriculum. The new disciplinary emphasis elevated the influence of scientists and limited the influence of professional educators.[55]

Rudolph describes how famous biologists were originally recruited to lead the BSCS program, following the practice of the PSSC. This was desirable not only to have the "best minds" devoted to the project, but for the prestige which would aid the project in its mission. In contrast with the experience of the PSSC, however, many of the most famous biologists were unavailable or left once they realized the magnitude of the undertaking. According to Rudolph, Bentley Glass chose to "settle for those scientists who were willing simply to put in the necessary time and effort to do the job well…' instead of wasting time with big shots."[56] The group that they "settled for" turned out to be a group of well-respected biologists, although turnover was significant during the five

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[54] The PSSC was built on the foundations of big science already in place from WWII, when large numbers of physicists had become involved in the Manhattan Project and other wartime research programs. The National Science Foundation had confidence in the ability of physicists to develop effective curriculum innovations. In contrast, relatively few biologists were involved in federal research projects during WWII. The second class status of biology as a discipline in the eyes of the NSF delayed full funding until after the launch of Sputnik in 1957. See Rudolph, *Scientists in the Classroom*, 100-4.

[55] Daniel Tanner and Laurel Tanner, *Curriculum Development; Theory into Practice, 3rd edition* (Upper Saddle River, NJ: Prentice Hall, 1994), 431-36.

[56] Rudolph, *Scientists in the Classroom*, 103.

years it took to publish the first textbooks. John A. Moore, evolutionary biologist and Columbia University Professor of Zoology, was one of the biologists who was recruited by Glass and was exceptionally devoted to the project.[57]

Moore served as the Chairman of the Committee on the Content of the Curriculum and also served on the Executive and Steering Committee Meetings. Rudolph mentions Moore on several occasions in connection with his leadership in the BSCS, but gives minimal information on his personal or professional background. Moore is of interest to me because of his involvement with the actual writing of the BSCS textbooks. Through my work with the Moore Collection at the Rivera Library of the University of California Riverside, I have discovered that Moore was highly regarded in academia for his commitment to teaching at all educational levels.[58] He was the primary author of the Yellow Version of the BSCS textbooks, an adversary to creationism in the classroom, and an activist for education throughout his life. Of special interest is his close friendship with Ernst Mayr, and his working relationship with Theodosius Dobzhansky, both principal architects of the modern evolutionary synthesis. I examine how they influenced Moore's approach to evolution in the curriculum in Chapter Four.

Rudolph examined the role of evolutionary biology in the BSCS curriculum in his book *Scientists in the Classroom*.

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[57] John A. Moore to Ernst Mayr, August 9, 1991, Box 69, Folder: Letters of Mayr 1989-1991, John A. Moore Papers, University of California, Rivera Library Special Collections, Riverside, CA.

[58] F. James Rutherford to the Presidents' Committee of the National Science Foundation on the National Medal of Science, April 10, 1997, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside, CA.

> Evolution as an organizing idea was too valuable to the project in which they [the BSCS] were engaged to be allowed to lay fallow-it provided the key unifying framework that served to define the science of biology and, at the same time, provided perhaps the greatest test of the public's willingness to embrace the scientific rationalism of the postwar world.[59]

Rudolph stressed the integral importance of evolutionary theory for unifying the diverse subdisciplines of biology within the curriculum, which is important in my analysis, but also emphasized the role of evolution in combatting "postwar irrationalism." According to Rudolph, scientists saw their rational worldview as superior to worldviews controlled by religious or political agendas. Many biologists had deep concerns over the irrational and ideologically driven conflicts which had plagued most of the 20th century.[60] Tensions with the Soviet Union after WWII fostered anticommunism in the United States resulting in the persecution of a number of scientists. Notably, influential BSCS member Hermann J. Muller was watched by the FBI because of his leftist politics.[61] Others faced suspicion simply for being German or Soviet immigrants. At the same time, biologists in the Soviet Union were persecuted for promoting evolution by natural selection. Stalin preferred the neo-Lamarckianism of the politically powerful geneticist, Trofim Lysenko, and purged Soviet science of evolutionists and their ideas.[62] During the Cold War, ideologies on both sides of the Atlantic threatened academic freedom.

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[59] Rudolph, *Scientists in the Classroom*, 148.

[60] Ibid., 52.

[61] Elof Axel Carlson, *Genes, Radiation, and Society: The Life and Work of H. J. Muller* (Ithaca, NY: Cornell University Press, 1981), 176.

[62] Depew and Weber, *Darwinism Evolving*, 242.

As the McCarthy era waned in the late 1950s, American biologists were eager to restore academic freedom in American universities, and to use their position of influence to assert the superiority of a rationalistic worldview. To them, the modern synthesis of evolution was a supreme example of the fruit of academic freedom.[63] While physicists had provided the technological weapons to preserve democracy during WWII and the Cold War, the biologists of the BSCS were keen to deploy the weapon of rationalism to fight ideological oppression at home and abroad. The launch of Sputnik in 1957 provided the necessary motivation for the federal government to support their goals of spreading scientific rationalism through K-12 curriculum reform. While I agree with Rudolph's emphasis on the advancement of rationalism through the BSCS curriculum, I also think that naturalism was a significant factor, and explore that connection in the Conclusion.

Rudolph also rightly emphasized the concern of the BSCS for the application of biological knowledge to social issues and furthering human progress. In contrast to previous curriculum efforts to make biology relevant,

> BSCS placed its emphasis not on the intersection of biology with the personal or social needs of the student, as one might find in the discredited life-adjustment education program, but rather on the intersection of the biological sciences with broader social issues of national interest. Indeed there was a feeling among those involved that in the absence of sound biological understanding, the future of civilization might well be in jeopardy.[64]

Rudolph continued to explain that the education provided for by the BSCS curriculum was what was necessary for an educated citizen, especially in light of "the rapid advancement of science as the very cause of the most pressing social problems of the

[63] Rudolph, *Scientists in the Classroom*, 149.

[64] Ibid., 153.

day," as reflected in a 1956 American Association for the Advancement of Science report.[65] Rudolph also noted the importance of biological and cultural evolution as separate entities in the BSCS texts, and how understanding these concepts was necessary to an informed approach to biological and social problems. He stated that "discussions of biological evolution graded, almost imperceptibly, into descriptions of the progressive cultural phases of the human species...Students were invited to consider what the future might hold for humanity."[66] In Chapter Two, I will examine how this concern for the future of humanity can be found in the writings of the architects of the modern synthesis, and how that concern motivated calls for improved evolution education. Furthermore, in Chapter Three, I will expand on Hermann J. Muller's interest in directed biological and cultural evolution. Rudolph correctly notes that "the BSCS curriculum itself was to become, in a small way, part of the mainspring that would help drive the future evolution of humankind."[67] However, Rudolph stops short of relating this concern with the future to eugenics. As eugenics will play an important role in my analysis, I will give some general background here.

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[65] Ibid., 154.

[66] Ibid., 159.

[67] Ibid., 158.

Mainline and Reform Eugenics

In his landmark book *In the Name of Eugenics*, Daniel J. Kevles chronicles the history of eugenics in the United States.[68] English scientist and statistician Francis Galton originated the study of human betterment in 1865, and he coined the phrase "eugenics" in 1883. Galton, cousin of Charles Darwin, wanted to improve human stock much in the way selective breeding is used in animals. Now that humans understood that they evolved, it seemed like the next step would be to control the process to maximize the number of people with high abilities in various areas. His project was inherently racist and classist, as he used reputation as an index of ability and ignored the part that social opportunity had in creating those of high repute.[69] Social Darwinism emerged in England and the United States, explaining that social stratification was created by natural selection, and bemoaning the intervention of state and charitable organizations in assistance to the "unfit." In the late nineteenth century, social-Darwinists increasingly claimed that "heredity determined not simply physical characteristics but temperament and behavior," and therefore criminality and mental illness was the result of bad blood.[70] Hereditarian views asserted that most human characteristics were determined by heredity and were impervious to environmental influences. Therefore support for the economically disadvantaged was a waste of money at best, and at worst interfered with the process of natural selection.

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[68] Daniel J. Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity* (Berkeley, CA: University of California Press, 1985).

[69] Ibid., 4-5.

[70] Ibid., 71.

Over time, the definition of biological fitness in Darwin's theory was gradually replaced with the concept of eugenic fitness, which, in the words of eugenicist Edgar Schuster meant "in good condition or of good quality, physical and mental . . . a sort of biological ideal of what man should be."[71] Natural selection was the process that produced the Darwinian fit, but that process was no longer operating unhindered in humans. Only human intervention, with government help if necessary, could increase the number of the eugenically fit.[72] This idea saw fruition in the policies of racial segregation and segregation of mental defectives and moral deviants, as well as the policies of forced sterilization in the United States. It is this hereditarian, overtly racist and classist version of eugenics, the eugenics of Charles B. Davenport and Edward M. East, that I will refer to in this dissertation as "mainline eugenics."[73] "Positive eugenics" refers to eugenic practices designed to increase the number of eugenically fit in the population, and "negative eugenics" refers to practices designed to decrease the number of the unfit.

As a result of the rise of the science of genetics after 1900 and the rise of population genetics in the late 1920s, criticism of mainline eugenics began to appear in the 1930s. In 1932, Nobel Laureate geneticist Hermann J. Muller shocked the Eugenics Congress with his views that "genetic worth is a practically continuous variant, and there is no hard and fast line between the fit and the unfit, nor does relative fitness in the great

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[71] Edgar Schuster, *Eugenics* (ClearType Press, 1912), 77-78 as quoted in Kevles, *In the Name of Eugenics*, 91.

[72] Kevles, *In the Name of Eugenics*, 91.

[73] For more on the eugenics of Davenport and East, see Bentley Glass, "Geneticists Embattled: Their Stand Against Rampant Eugenics and Racism in American During the 1920s and 1930s," *Proceedings of the American Philosophical Society* 130, no.1 (March 1986): 130-54.

majority of individuals depend on one or a few pre-specified genes." He also asserted that social and economic forces, beyond the control of eugenicists, were also important in the creation of the unfit. Muller's statements set the stage for a reconsideration of eugenic ideas, especially as time brought to light the Nazi atrocities committed in the name of the eugenic ideal. There was popular support, however, for racial segregation, sterilization, and other eugenic practices despite the brewing re-evaluation of mainline eugenics in scientific circles.

Reform eugenics developed in the 1930s as critics of mainline eugenics recognized that "advances in anthropology, psychology, and genetics had utterly destroyed the 'scientific' underpinnings of the mainline doctrine and that any new eugenics had to be consistent with what was known about the laws of heredity."[74] Kevles describes how eugenics organization leaders in England and the United States "steadily moved their organizations a sanitizing distance away from the right- especially the pro-Nazi right…[and] turned their societies from propaganda promising universal social redemption to sober educational efforts concerning heredity and health."[75] As part of this process, C.P. Blacker in England and Frederic Osborn in the United States "painstakingly reshaped their [eugenic] societies as older members retired…in order to reduce the influence of lay eugenicists and strengthen the hold of professionals in eugenically relevant fields," such as genetics, medicine, psychology and demography.[76] This move later included the recruitment of geneticists Bentley Glass and Theodosius Dobzhansky

[74] Kevles, *In the Name of Eugenics*, 170.

[75] Ibid., 171-72.

[76] Kevles, *In the Name of Eugenics*, 172.

to the Board of Directors of the American Eugenics Society.[77] Reform eugenicists "rejected in varying degrees the social biases of their mainline predecessors, yet remained convinced that human improvement would better proceed with...the deployment of genetic knowledge."[78]

While there was a range of opinion on many issues, reform eugenicists generally felt that biological research supported "the inherent diversity and [biological] inequality of man,"[79] but that environmental factors such as diet, healthcare, housing, and education were also important in the development of characteristics such as character and intelligence. Therefore "until basic environmental conditions were equalized among all socio-economic strata … no one had any right to say that one stratum differed from another solely by the force of heredity**."[80]** In fact, equalization of environmental opportunities was essential before accurate assessment could be made of hereditary racial or group differences. According to Wendy Kline, "The shift in the 1930s to a more environmental approach also permitted positive eugenics to emerge as a popular

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[77] Bentley Glass was on the Board of Directors of the American Eugenic Society from 1958-1968. Theodosius Dobzhansky was on the same Board from 1964-1968. See front matter in the *Eugenic News* for those dates.

[78] Kevles, *In the Name of Eugenics*, 173.

[79] Julian Huxley, as quoted by Kevles, *In the Name of Eugenics*, 173. While the issue of genetic diversity and social inequality were sometimes conflated, Theodosius Dobzhansky asserted that equality was a sociological phenomenon (e.g. equality under the law), and should be kept separate from discussions of biological identity and diversity. Theodosius Dobzhansky, "Introduction," in *Science and the Concept of Race*, ed. Margaret Mead, Theodosius Dobzhansky, Ethel Tobach, & Robert E. Light (New York: Columbia University Press, 1968), 78-79.

[80] Kevles, *In the Name of Eugenics*, 173.

movement in the 1940s and 1950s."[81] As one example, Kline asserts that, during this time, reform eugenics moved away from the reproductive sterilization and toward marriage and family counseling.[82]

Reform eugenicists realized that participation in eugenic programs needed to be voluntary.[83] According to historian Alexandra Stern, postwar eugenicists shifted away from state coercion, and towards two other directions: individual choice through medical genetics, and population control. But according to Kevles, "for Hermann Muller, J.B.S. Haldane, and Julian Huxley, reform genetics pointed, as the original version had for Frances Galton, to a more distant goal – in Muller's words, 'the conscious social direction of human biological evolution.'"[84] In Chapter Six I will explore the connection between the BSCS interest in future human evolution and the reform eugenic vision as it existed in the 1950s and early 1960s.

Sources

The primary sources for this project are the original letters, papers, books, and writings of BSCS leaders and the architects of the modern synthesis. Institutional sources, such as the current Biological Sciences Curriculum Study in Colorado Springs, Colorado, were also important. From the work of Rudolph and Grobman, it was possible to identify

[81] Wendy Kline, *Building a Better Race: Gender, Sexuality, and Eugenics from the Turn of the Century to the Baby Boom* (Berkeley, CA: University of California Press, 2001), 4.

[82] Ibid.

[83] Kevles, *In the Name of Eugenics*, 167.

[84] Ibid., 176.

some of the key individuals with regards to curriculum decisions. Those individuals include the following:

Hermann J. Muller: Muller was the most vocal advocate for the strongest possible treatment of evolution in the BSCS textbooks. His papers reside at the University of Illinois in Bloomington, Illinois.

Arnold B. Grobman: Grobman, a herpetologist, was the first director of the BSCS. He was a strong leader involved in every stage of the curriculum development process. His papers reside at the Smithsonian Institution Archives in Washington, D.C. I was also able to interview Dr. Grobman at his residence in Gainesville, Florida.

Bentley Glass: Glass was the first Chairman of the Steering Committee. Glass and Grobman personally recruited BSCS steering Committee members and the leaders of other committees. Glass developed the genetics collection at the American Philosophical Society, which includes the papers of many famous geneticists and evolutionary biologists. He was a graduate student under Hermann J. Muller. His papers reside at the American Philosophical Society in Philadelphia, Pennsylvania.

John A. Moore: Moore was a Columbia University zoologist and Chairman of the Committee on the Content of the Curriculum. He was also primary author of the Yellow Version. He worked closely with two architects of the modern synthesis – Ernst Mayr and Theodosius Dobzhansky. His papers reside at the University of California, Riverside.

Marston Bates: Bates was a widely published ecologist. He was the primary author of the Green Version. His papers reside at the University of Michigan in Ann Arbor, Michigan.

Archie Carr: Archie Carr was a prominent herpetologist and ecologist. He was a member of the thematic team which reviewed the 1961 BSCS textbook versions for inclusion of evolution and other themes. His papers reside at the University of Florida in Gainesville, Florida.

I also consulted the papers of the architects of the modern synthesis, which included the following:

Theodosius Dobzhansky: Dobzhansky was a geneticist and first architect of the modern synthesis. His papers reside at the American Philosophical Society in Philadelphia, Pennsylvania.

Ernst Mayr: Mayr was a naturalist who specialized in ornithology. His papers reside at Harvard University.

George Gaylord Simpson: Simpson was a paleontologist and contributed important works on the meaning of evolution. His papers reside at the American Philosophical Society in Philadelphia, Pennsylvania.

George Ledyard Stebbins: Stebbins was a botanist and the theoretical architect that brought botany into the modern synthesis. His papers reside at the University of California, Davis.

Periodicals were also useful in the analysis including the following:

AIBS Bulletin, 1957-1963

Baltimore Evening Sun 1956-1957

BSCS Newsletter, 1960-1964

Mendel Newsletter 1968-current

New York Times, 1957-current

Science, 1957-1964

The American Biology Teacher 1938-1988

Time Magazine 1923-current

Chapter 2

Why Evolution?

> We need…to recognize the supreme importance of knowledge of organic and of social evolution. Such knowledge provides most of what we know of our place in the universe and it must guide us if we are to control the future evolution of mankind.
>
> --George Gaylord Simpson, *The Meaning of Evolution*

Ever since I began my research, one question has kept coming back to me: Why was evolution so important to the BSCS to make it the most important theme of the text? The official BSCS answer was that evolution was the most important unifying theme within biology. As Theodosius Dobzhansky famously said, "Nothing makes sense except in the light of evolution."[85] But I always felt there was more than this. Why was evolution so important that every citizen had to know and understand it? And not only in the US, but in the whole world? Educators had been "pussyfooting" around evolution for years, and the leaders of the BSCS wanted to see that stop.[86] Why was evolution critical knowledge?

In this chapter I explore the development of the modern synthesis of evolution, including the meaning of the theory of evolution for its architects. I suggest that a reason why Nobel Laureate in Physiology or Medicine Hermann J. Muller and other BSCS biologists felt an urgent need to educate the populace regarding evolution was because of their concern for the future of humankind. The Darwin Centennial Celebration of 1959

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[85] Theodosius Dobzhansky, "Nothing Makes Sense Except in the Light of Evolution," *The American Biology Teacher* 35 (1973):125-29.

[86] John L. Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education* (New York, Palgrave, 2002), 147.

was a window on evolutionary thinking in the very year that the BSCS was beginning its deliberations over what should be in a high school biology textbook. Human evolution was understood to include both organic and cultural evolution, and the explosion of biological knowledge was quickly illuminating the human role in both types of evolution on the planet. Evolution told humans who they were, and that they were not done evolving.

In *Scientists in the Classroom*, John Rudolph also asserts that the BSCS biologists were concerned about the future of humanity, highlighting the importance of evolution education in that regard. He also mentions the importance of the Darwin Centennial Celebration of 1959, and the role of organic and cultural evolution in the BSCS textbooks. What Rudolph does not explore is *how* the modern synthesis opened up the possibility of conscious, effective intervention in biological and cultural evolution. What was it about the modern synthesis of evolution, as it was understood in the context of the Cold War, that made intervention not only conceivable, but desirable? In order to answer this question, I will begin by tracing the rise of natural selection within the development of modern evolutionary theory, and then demonstrate how this affected the concerns of the architects of the modern synthesis for the future of humankind. I suggest that the reification of natural selection in the modern synthesis at this time eventually led to the emphasis on evolution and a naturalistic worldview within the BSCS curriculum.

Evolution in the 19th Century

Evolutionary ideas were common among scientists and the public before Darwin's *Origin of Species,* but they were highly speculative and lacked adequate empirical support. As a result of Darwin's work, most scientists and the general populace eventually accepted the idea that living things evolve. This idea fit well with the Victorian notion of progress. But accepting natural selection as the primary mechanism for evolution was a different story.

Before Darwin, the study of natural history and natural theology went hand in hand as scientists searched for God's revelation in the natural world. Protestant Christian understanding of God's creation at the time included that God had separately created each type of animal and plant "according to their kinds."[87] There is no indication in the book of Genesis that one species has any kinship relationship to any other. While Darwin stated in *The Origin of Species* that an original Creator breathed life into one or more original primitive organisms on the earth, Darwin saw all of life as arising from these primitive organisms through natural selection. In a very tangible way, all living things were related to each other, from bacteria to humans. Darwin's theory of common descent seemed to rule out the fixity of species.[88] The time requirement for natural selection also contradicted a literal interpretation of the six-day biblical story of creation in Genesis. Even among those who were not tied to biblical literalism, the idea of a vital force,

[87] Gen. 1: 21-25. Michael Ruse asserts "The grip of the Bible … proved very tight. It may have loosened a little toward the end of the seventeenth century, but in Britain, particularly, it clamped down hard again in the eighteenth, a direct result of the evangelicalism sparked by John Wesley. The Bible remained a major factor in the nineteenth century." *The Darwinian Revolution: Nature Red in Tooth and Claw* (Chicago: The University of Chicago Press, 1999), 4.

[88] David Masci, "Darwin and His Theory of Evolution," The Pew Forum on Religion and Public Life, http://www.pewforum.org/Science-and-Bioethics/Darwin-and-His-Theory-of-Evolution.aspx (accessed April 4, 2012).

guiding evolution from within an organism, was an important concept.[89] So in Darwin's time, many people, scientists as well as laymen, held the view that either an internal or external supernatural force was necessary to propel the history of life forward.

Natural selection did not require a supernatural force to do its work- it was a process inherent in the material world. This caused conflict with Oxbridge Tory clerics who saw Darwin's theory as reducing God's influence in the natural order.[90] Some scientists postulated that other mechanisms were at work in addition to natural selection.[91] The scientific community, including Darwin, didn't really understand how heredity worked since Mendel's work was not yet widely known. So while organic evolution was commonly accepted soon after Darwin published *Origin of Species*, the concept of natural selection faced challenges both within and outside the scientific community for a very long time. Since natural selection was central to Darwin's theory of evolution, the uncertainty led to a period from about 1880 to 1920 which science historians call "the eclipse of Darwinism,"[92] where evolution was generally accepted but alternative evolutionary mechanisms were proposed.

In the late 1800s, various subfields of biology arose, each with their own sets of theory and practice. While previously zoology and botany were the two primary sub-

[89] Vitalism originated with the early Greeks but was influential in the 19th century through the works of Karl Ernst von Baer and others. See David J. Depew and Bruce H. Weber, *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection* (Cambridge, MA: MIT Press, 1996), 42-43.

[90] Ibid., 141-44.

[91] Michael Ruse, "The History of Evolutionary Thought," in *Evolution: The First Four Billion Years*, ed. Michael Ruse and Joseph Travis (Cambridge, MA: Belknap Press of Harvard University Press, 2009), 25.

[92] See Bowler, Peter J., *The Non-Darwinian Revolution: Reinterpreting a Historical Myth* (Baltimore, MD: Johns Hopkins University Press, 1992).

disciplines of the science of biology, newer specialized fields began to appear such as embryology, cytology, and ecology.[93] Mendel's work on inheritance was rediscovered around 1900 and served as the basis for the new discipline of genetics.[94] Two different schools of thought arose regarding the mechanisms of evolution. The Mendelians, such as Hugo de Vries and William Bateson, rejected both natural selection and the gradualism of Darwin's theory, focusing instead on the occurrence and inheritance of large differences between organisms that arose in a single generation (sometimes called saltations), and they generalized to the whole of evolution from that perspective. The other school was the biometricians, including Karl Pearson, who studied the inheritance of small differences between individuals over long periods of time and used frequency distributions of characteristics in populations to study them. The biometricians were generally more sympathetic to the theory of natural selection than the Mendelians.[95] At the time of the Scopes Trial in 1925, the mechanisms of organic evolution, including the role of natural selection, were still disputed among scientists.

The Modern Synthesis of Evolution

A reconciliation of these two schools of thought took place when R.A. Fisher, J.B.S. Haldane, and Sewall Wright demonstrated in the early 1930s that natural selection could operate in conjunction with Mendelian genetics. The modern synthesis of evolution began with the work of these three population geneticists. They showed mathematically

[93] Ernst Mayr and William B. Provine, *The Evolutionary Synthesis: Perspectives on the Unification of Biology* (Cambridge: Harvard University Press, 1980), 6.

[94] Mark Ridley, *Evolution*, 3rd ed. (Malden, MA: Blackwell Publishing, 2004), 13.

[95] Ibid., 14.

that "natural selection could work with the kinds of variation observable in natural populations and the laws of Mendelian inheritance. No other processes are needed."[96] First, genetic variation was provided by small random differences called mutations in the genes of reproductive cells, which were passed on to progeny. These genes provided the variations in the characteristics of organisms among which natural selection could choose.[97] The process of recombination of genes which naturally occurs during meiosis also greatly amplified the variety available within a population. Gradually, over long periods of time, those variations and the action of natural selection created all the diversity of living things, and it's still going on. The implication was that there was no need of other processes, natural or supernatural, to explain how evolution occurs. Put simply, there was no "god variable" in the mathematical equations that explained how characteristics varied in populations or changed over time.

As they began to comprehend the importance of this complex mathematical framework proposed by the population geneticists, biologists began to test it in natural populations. The first and most notable of these was geneticist Theodosius Dobzhansky, who collaborated with Sewell Wright and tested these ideas in populations of fruit flies (Drosophila). He found that the mathematics was consistent with what could be seen in the laboratory and in natural populations.[98] Dobzhansky eventually wrote *Genetics and*

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[96] Ibid., 15.

[97] National Academy of Sciences and Institute of Medicine, *Science, Evolution, and Creationism* (Washington, DC: The National Academies Press, 2008), 4-5.

[98] Ridley, *Evolution*, 16.

the Origin of Species.[99] E. B. Ford did comparable research in the UK, working closely with R.A. Fisher. Ford's work was not published until considerably later.[100]

It was Julian Huxley,[101] however, who named the new understanding "the modern synthesis" in his 1942 book. He described how the synthesis unified biology:

> Biology in the last twenty years, after a period in which new disciplines were taken up in turn and worked out in comparative isolation, has become a more unified science. It has embarked upon a period of synthesis, until to-day it no longer presents the spectacle of a number of semi-independent and largely contradictory sub-sciences, but is coming to rival the unity of older sciences like physics, in which advance in any one branch leads almost at one to advance in all other fields, and theory and experiment march hand-in-hand. As one chief result, there has been a rebirth of Darwinism.[102]

According to historian Smocovitis, "Huxley made it clear that natural selection - based on a deductive logical step for Darwin - was now a 'fact of nature capable of verification by observation and experiment'…With this fundamental principle…evolution and Darwinism were 'reborn' like a "mutated phoenix risen from the ashes of the pyre.'"[103] To Huxley and the architects of the modern synthesis, natural selection was no longer just a theory which Darwin conceived, but a fact which had mathematical language to describe it and empirical evidence to support it. It seemed to

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[99] Theodosius Dobzhansky, *Genetics and the Origin of Species* (New York: Columbia University Press, 1937).

[100] Ridley, *Evolution*, 16.

[101] Julian Huxley was the grandson of T.H. Huxley, who is often referred to as "Darwin's Bulldog." Julian Huxley was also the brother of Aldous Huxley, who wrote *Brave New World* (New York: Harper & Brothers, 1932).

[102] Julian Huxley, *Evolution: The Modern Synthesis* (New York: Harper & Brothers, Publishers, 1942) 26.

[103] Vassiliki B. Smocovitis, *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology* (Princeton, NJ: Princeton University Press, 1996), 143.

make other driving mechanisms for evolution, scientific or supernatural, no longer necessary. As Ernst Mayr asserted

> The unified interpretation of the evolutionary process had a highly beneficial impact on the standing of evolutionary biology in the whole field of biology. By eliminating all interpretations that signaled an implicit conflict with physico-chemical explanations (namely those theories that were vitalistic or teleological), evolutionary biology became far more respectable than it had been during the preceding period, when it was maligned by the experimentalists as speculative.[104]

There were still biologists, however, who were not ready to accept that natural selection was sufficient to explain all the variation seen in nature. Some still held on to the idea that new species were formed by large macromutations rather than the slow accumulation of small differences modeled in the equations of the population geneticists. This viewpoint was held by eminent geneticist Richard Goldschmidt.[105] It was refuted by the second "architect of the modern synthesis," Ernst Mayr, through the next classic work of the synthesis, *Systematics and the Origin of Species* (1942).[106]

Mayr's major contribution to the synthesis was in redefining our understanding of the nature of species and his championing of "biological species concept."[107] An important development in the synthesis at this time was the overthrow of the typological species concept which had been centrally important in the fields of taxonomy and systematics. Up until the modern synthesis, species were thought to be composed of an

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[104] Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* (Cambridge, MA: Belknap Press of Harvard University Press, 1982), 572.

[105] Ridley, *Evolution*, 17.

[106] Ibid.

[107] Margaret B. Ptacek and Shala J. Hankison, "The Pattern and Process of Speciation," in *Evolution: the First Four Billion Years*, ed. Michael Ruse and Joseph Travis (Cambridge, MA: Belknap Press of Harvard University Press, 2009), 179.

ideal "type" plus deviants from that ideal type. This idea originated with Plato and his concept of ideal forms.[108] A newly discovered organism was classified based on how close it was (mainly morphologically) to a known ideal type of a species. With the new understanding of species, the idea of an ideal type was no longer appropriate. What mattered now was the whole population of "interbreeding organisms, who exchange genes when they reproduce."[109] The biological concept of species now referred to a group of organisms that had the ability to interbreed to produce fertile offspring. Variants were now not considered to be "deviants" from the ideal type, but merely variations within a species. This populational thinking was important to the understanding that humans, no matter what race, are all still part of the same species (See Chapter Six). The empirical study of speciation became increasingly popular in the late 1930s and early 1940s, leading to the formation of an informal Society for the Study of Speciation in 1940 and the establishment of the Committee on Common Problems of Genetics, Paleontology and Systematics in 1943 by the National Research Council. World War II hampered the ability of these organizations to meet but communications between members continued, revealing the need for a larger more permanent organization after the war.[110]

Another architect of the modern synthesis, George Gaylord Simpson, brought paleontology in line with the modern synthesis in his work *Tempo and Mode in Evolution*

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[108] Ernst Mayr, "Typological versus Population Thinking," in *Conceptual Issues in Evolutionary Thinking*, ed. Elliot Sober (Cambridge, MA: MIT Press, 1993), 157.

[109] Ridley, *Evolution*, 18.

[110] Ernst Mayr, "History", The Society for the Study of Evolution, http://www.evolutionsociety.org/history.asp (accessed March 9, 2012). See also Vassiliki Betty Smocovitis, "Organizing Evolution: Founding the Society for the Study of Evolution (1939-1950)," *Journal of the History of Biology* 27, no. 2 (Summer, 1994): 241-309.

(1944).[111] Here again another major vitalistic concept, orthogenesis, was undermined. Orthogenesis was described by Ernst Mayr as the postulation of "a nonphysical (perhaps even nonmaterial) force which drove the living world upward toward ever greater perfection."[112] It had almost mystical connotations.[113] Simpson asserted that the fossil record did not require the concept of orthogenesis, therefore removing another scientific concept which suggested the idea of a supernatural force in nature. Historian William Provine indicated that, while evolutionists may have still disagreed about the variables that were present in evolutionary processes, they all agreed that the modern synthesis of evolution "drove from evolutionary biology all of the purposive theories of evolution that had been so common and popular before 1930."[114]

Propagation of the Synthesis

By the mid-1940s the modern synthesis had penetrated most sub-disciplines of biology. A new scientific society was formed by those interested in studying evolution across biological disciplines. The Society for the Study of Evolution (SSE) was organized on March 30, 1946. Fifty-seven biologists attended as founding members, including Dobzhansky, Mayr, Simpson, Hermann J. Muller, Alfred Kinsey and BSCS Director Arnold Grobman.[115] Within the next year over 500 members joined SSE, including future

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[111] Ridley, *Evolution*, 18.

[112] Mayr, *The Growth of Biological Thought*, 50.

[113] Ridley, *Evolution*, 18.

[114] William B. Provine, "Progress in Evolution and Meaning in Life," in *Evolutionary Progress*, ed. Matthew H. Nitecki (Chicago: The University of Chicago Press, 1988), 62.

[115] Ernst Mayr, "History," Society for the Study of Evolution, http://www.evolutionsociety.org/history.asp (accessed March 9, 2012). Alfred Kinsey performed genetics research with fruit flies (Drosophila) and wrote a high school biology textbook before becoming interested in human sexuality research.

BSCS leaders John A. Moore and Marston Bates, and an international research journal, *Evolution*, was authorized.[116] Mayr was the first editor of *Evolution*. In his history of the SSE, Mayr stated: "The aims of the Society, through its journal and otherwise reflect the conviction that the evolutionary approach will clarify many unsolved biological problems and will provide common goals and mutual comprehension among all the life sciences."[117] Thus the modern synthesis of evolution was to unify the life sciences by providing the theoretical framework which could guide the research program of the biological sciences and also providing an organization to legitimate and further its mission.

A special conference at Princeton in 1947 is considered to be the landmark for when the synthesis had spread throughout biology.[118] However, historian Smocovitis comments that some biological fields had not been represented at all, notably embryology, which would later cause problems with the synthesis. Despite some criticisms, "evolutionists continued to revel in their 'modern' synthesis," as its unifying influence continued to grow.[119] The American Institute of Biological Sciences (AIBS), parent organization of the BSCS, was organized in 1948. The AIBS's one objective was the "promotion of unity and effectiveness of effort among all who are devoting

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[116] Ernst Mayr, "History," Society for the Study of Evolution, http://www.evolutionsociety.org/history.asp (accessed March 9, 2012); "1947 Roster of the Society for the Study of Evolution", Series V, Box 14, Folder: SSE 1946-1949, Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[117] Ernst Mayr, "History," Society for the Study of Evolution, http://www.evolutionsociety.org/history.asp (accessed March 9, 2012).

[118] Smocovitis, *Unifying Biology*, 21.

[119] Ibid., 23.

themselves to the biological sciences by research, by teaching, or by application of biological data."[120] While not limited to the promotion of evolution in research and teaching, the AIBS was definitely part of the larger move to unify the biological sciences in which evolution was centrally important.

The Hardening of the Synthesis

Biologist Stephen J. Gould argued that the modern synthesis "underwent a major change in intent between its formulation in the 1930s and its hardening in the late 1940s."[121] The mechanism of natural selection became of overarching importance, greatly diminishing consideration given to any other mechanism for evolutionary change, including genetic drift. Genetic drift had been a minor mechanism proposed by Sewall Wright to explain the behavior of variation in very small populations. In genetic drift, the direction of change in evolution is dependent on "random changes in gene frequency in small populations due to the vagaries of breeding."[122] In other words, variations in a species may appear to "drift" in a certain direction by chance, especially in very small populations, unrelated to any process of adaptation. While Dobzhansky originally thought this was an important mechanism in 1937, his later works reserved a smaller and smaller

[120] American Institute of Biological Sciences, *A Decade of Growth in Biology . . . 1948-1958,* (Washington, DC: American Institute of Biological Sciences, Incorporated, 1958), Box 148, unfiled, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[121] Stephen J. Gould, "Hardening of the Modern Synthesis," in *Dimensions of Darwinism: Themes and Counterthemes in Twentieth-Century Evolutionary Theory*, ed. Marjorie Grene (Cambridge: Cambridge University Press, 1983), 73.

[122] Michael Ruse and Joseph Travis, ed. *Evolution: The First Four Billion Years,* (Cambridge, MA: Belknap Press of Harvard University Press, 2009), 32.

role for genetic drift.[123] In the 1940s, natural selection leading to adaptation of the organism to its environment became increasingly seen throughout biology as the central mechanism by which genetic variation was translated into evolutionary change, "eventually … insisting to the point of dogma and ridicule that selection and adaptation were just about everything."[124] However, according to Ernst Mayr,

> Not all other biologists were completely converted. This is evident from the great efforts made by Fisher, Haldane and Muller as late as the late 1940s and 50s to present again and again evidence in favor of the universality of natural selection, and from some reasonably agnostic statements on evolution made by a few leading biologists such as Max Hartman.[125]

Historian Stephen Brush notes that in a survey of biological publications in the decade 1941-1950, less than 40% of biologists had a "hardened" view of the synthesis, about 13% rejected natural selection entirely and the rest accepted some combination of natural selection and other factors. By the next decade (1951-1960), about 60% accepted the hardened view of natural selection acting on small mutations as the primary or only mechanism of evolution. Only two publications rejected natural selection entirely.[126] So by the time the BSCS was formed in 1958, we can assume that, while the synthesis had hardened and while a majority accepted natural selection as the primary or only mechanism of evolution, there

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[123] Stephen J. Gould, "Hardening of the Modern Synthesis," 89.

[124] Ibid., 75.

[125] Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution and Inheritance* (Cambridge, MA: Harvard University Press, 1982), 568-69.

[126] Stephen G. Brush, *Choosing Selection: The Revival of Natural Selection in Anglo-American Evolutionary Biology 1930-1970* (Philadelphia, PA: American Philosophical Society, 2009), 97-98.

were still hold outs among biologists who believed that other mechanisms could not be ruled out.

The Modern Synthesis at the 1959 Darwin Centennial Celebration

It was this hardened form of the synthesis that provided the understanding of evolution in the 1950s which was celebrated by the Darwin Centennial of 1959 and eventually influenced the BSCS curriculum. The Darwin Centennial Celebration of 1959 held at the University of Chicago celebrated the 100th anniversary of the publishing of the *Origin of Species* by Charles Darwin.[127] According to anthropologist Sol Tax, primary organizer of the Centennial, the purpose was to celebrate Darwin's accomplishment by "bringing to bear on the subject of evolution current knowledge from a variety of relevant fields, thus advancing once more our understanding of the world and man."[128] Through events and news coverage, the importance of the modern evolutionary synthesis was broadcast to a large audience.

Julian Huxley declared that "The evolution of life is no longer a theory; it is a fact and the basis of all our thinking."[129] Indeed, communicating this to high school teachers was a key goal, and a special conference for high school biology teachers was held in conjunction with the celebration. Teachers at the conference were "strongly impressed by the scientists' complete acceptance of evolution as a fact," which indicates that the

[127] Vassiliki B. Smocovitis, "The 1959 Darwin Centennial Celebration in America," *Osiris* 1999, no. 14: 294.

[128] Sol Tax, *The Evolution of Life,* vol. 1 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), v.

[129] Julian Huxley, from "The Evolution of Life," a panel discussion at the Darwin Centennial Celebration of 1959, in *Issues of Evolution*, vol. 3 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), 111.

teachers had previously thought evolution was less well established within the scientific community.[130] Indeed, papers written by the teachers after the conference indicated that "many high school teachers would risk losing their jobs if they discussed evolution in their classrooms the way evolution was discussed at the Darwin Centennial," according to Richard Boyajian, director of the teacher conference. "Many of these teachers are afraid of recriminations from local school administrations and fellow teachers which might result from their teaching evolution as an accepted fact, instead of as a theory."[131] But the organizers were insistent. Sol Tax stated: "No matter what gets done about our religious beliefs … (w)e cannot deal with the difficult problems of the world unless our education takes account of the demonstrated fact" of evolution.[132]

It is important to remember that this celebration occurred just two years after the launch of Sputnik, and a year after the organization of the Biological Sciences Curriculum Study. Biologists in the BSCS were debating what should be included in high school biology textbooks. The status given to scientific knowledge by the public at that time was very high as the nation sought to improve its scientific standing in relationship to the Soviet Union. Therefore, the ideas of the scientists at the celebration about evolution were of great interest to many.

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[130] John C. Mayfield, D. Bob Gowin, Richard Boyajian, "Using Modern Knowledge to Teach Evolution in High School," *The American Biology Teacher* 22, no.7 (October, 1960), 409.

[131] "Biology Teachers Meet," *Chicago Maroon*, December 4, 1959, Box 8, Folder 10, Darwin Centennial Celebration Records, Special Collections Research Center, University of Chicago, Chicago, IL.

[132] Sol Tax, quoted in "The Darwin Centennial Celebration," Special Collections Research Center of the University of Chicago Library, http://www.lib.uchicago.edu/e/webexhibits/DarwinCentennial/ (accessed Sept 3, 2012).

The panelists included all the architects of the modern synthesis, as well as Julian Huxley, Hermann J. Muller, L.S.B. Leakey, and BSCS Green Version Supervisor, Marston Bates. The panel discussions at the celebration included “The Origin of Life,” “The Evolution of Life,” “Man as Organism,” “The Evolution of Mind,” and “Social and Cultural Evolution.”[133] The participation of the grandson of Charles Darwin further legitimated the event.[134] The process of writing and collecting papers, peer review, and the panel discussions can be seen as an effort to promote the modern synthesis and extend evolutionary ideas to the field of anthropology.[135]

Julian Huxley, Biological Evolution and Cultural Evolution

Not limited to biological evolution (also called organic evolution), the proceedings of the celebration extended the concept of evolution back to the origin of the cosmos and forward into human cultural evolution. This extension of evolution beyond biological evolution was discussed by Julian Huxley in his paper for the Darwin Centennial Celebration.

> Biological evolution is only one sector or phase of this total process. There is also the inorganic sector and the psycho-social or human sector. The phases succeed each other in time, the later being based on and evolving out of the earlier. The inorganic phase is pre-biological, the human is post-biological. Each sector of phase has its own characteristic method of operation, proceeds at its own tempo, possesses its own possibilities and limitations, and produces its own characteristic results.[136]

[133] Sol Tax, *Issues in Evolution*, vol. 3 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), vii-viii.

[134] Smocovitis, *Unifying Biology*, 207.

[135] The set of collected papers from the Centennial called *Evolution after Darwin* has three volumes. These are titled *The Evolution of Life*, *The Evolution of Man*, and *Issues in Evolution*. They were edited by anthropologist and organizer of the celebration, Sol Tax.

[136] Sir Julian Huxley, “The Emergence of Darwinism,” in *The Evolution of Life*, vol. 1 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), 18.

While Darwin's theory and the modern synthesis itself were originally concerned with only biological evolution, now some scientists extended its reach backwards into astronomy and cosmology, and forwards into the social sciences. The inorganic (or cosmic) phase of evolution was considered to be everything before the inception of life, and the psycho-social sector can best be understood as cultural evolution. Biological evolution can be seen as the foundation for cultural evolution, since cultural evolution is dependent on the evolution of the human brain. But cultural evolution goes beyond this, and cannot be "reduced to biological entities."[137] Centennial organizer and anthropologist Sol Tax commented:

> The term evolution is applied to both socially transmitted culture and gene transmitted biology because neither can establish an exclusive claim. However, there is no identity between the two usages. The cultural processes of continuity and change are different, and it is only by analogy, if at all, that one can speak of "natural selection," for example, in the development of cultures.[138]

Whereas early on biological evolution had been most important in the adaptation of humans to their environment, now cultural evolution was recognized as almost superseding natural selection in the case of humans. The understanding of these processes led to the realization that human cultural evolution had ramifications for all of life. Huxley asserted:

> In the light of these facts and ideas, man's true destiny emerges in a startling new form. It is to be the chief agent for the future of evolution on this planet. Only in and through man can any further major advance be achieved-though equally he

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[137] Franz M. Wuketits, *Evolutionary Epistemology and Its Implications for Humankind* (Albany, NY: State University of New York Press, 1990).

[138] Sol Tax, "The Celebration: A Personal View", in *Issues in Evolution*, vol. 3 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), 281.

> may inflict damage or distortion on the process, including his own evolving self.[139]

Huxley envisioned these advances coming about as humans would use "Darwin's naturalistic approach" in understanding the issues of biological and cultural evolution. But whereas humans had previously influenced evolution without knowledge or understanding, now there was the possibility of rational control: "Human destiny need no longer be merely an affair of hopes and fears. In principle, it can be rationally defined on the basis of scientific knowledge, and rationally pursued by the aid of scientific methods."[140] While the control of evolution had been tried before through eugenics, both the science of evolution and the ideals of eugenics had undergone significant changes since the Social Darwinism of the early 20th century. The influence of reform eugenics on the BSCS will be discussed in Chapter Six. Since the dawn of the atomic age, scientists were now acutely aware of the implications of scientific intervention in natural processes. They realized that the consequences of their actions on the future survival of humankind could be more serious than could ever have been imagined before the advent of nuclear weapons.

While Huxley was advancing his evolutionary vision, there were voices of concern. In the panel discussion on The Evolution of Life, Dobzhansky stated: "I should like to emphasize, not how much we know about selection, but how little we

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[139] Sir Julian Huxley, "The Emergence of Darwinism," 19.

[140] Ibid., 21.

know…more research is really what we need."[141] And indeed, natural selection had been studied in only a very limited number of plant and animal species. Gene interactions and the effect of development were very poorly understood. But this did not deter Huxley. There were "alarming monsters in our evolutionary path" that needed to be actively confronted. These monsters included the "threat of superscientific war, nuclear, chemical, biological;" the "threat of overpopulation;" "the rise and appeal of Communist ideology, especially in underprivileged sectors of the world's people;" "failure to bring China into the United Nations;" the "erosion of the world's cultural variety;" the "general preoccupation of means over ends, with technology and quantity rather than creativity and quality;" and the "revolution of expectation caused by widening gap between haves and have nots."[142] There was no time to waste:

> Man's destiny is to be the sole agent for the future evolution of this planet … He will succeed only if he faces it consciously and if he uses all his mental resources-of knowledge and reason, of imagination, sensitivity, and moral effort. And he must face it unaided by outside help. In the evolutionary pattern of thought there is no longer need or room for the supernatural. [143]

The future of the world was dependent on humankind's rational approach to the world's problems, and humans could expect no help from supernatural sources.

> Evolutionary man can no longer take refuge from his loneliness in the arms of a divinized father-figure whom he has himself created, nor escape from the responsibility for making decisions by sheltering under the umbrella of Divine

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[141] Theodosius Dobzhansky, from "The Evolution of Life," a panel discussion at the Darwin Centennial Celebration of 1959, in *Issues of Evolution*, vol. 3 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), 121.

[142] Julian Huxley, "The Evolutionary Vision," in *Issues in Evolution*, vol. 3 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), 255.

[143] Ibid., 252.

> Authority, nor absolve himself form the hard task of meeting his present problems and planning his future by relying on the will of an omniscient, but unfortunately inscrutable, Providence.[144]

Huxley's words, delivered in the massive gothic Rockefeller Chapel at the University of Chicago, rang out as those of a prophet of the religious order of secular humanism. Now that scientists understood the mechanisms of evolution, they had a responsibility to make sure that evolution proceeded in the direction of progress for humankind. Otherwise, there was no one at the wheel except the blind, mechanistic process of natural selection. For some, Huxley had gone too far, crossing the line between science and religion. Huxley was criticized for being neither a noted philosopher nor theologian and told that he should stick to his specialty of biology.[145] Theologian Henry P. Van Dusen pointed out that "a long list of British scientists…have been led from similar premises to almost opposite conclusions, finding evolution not only compatible with but a strong support for and great enrichment to belief in God."[146]

Was Huxley alone – a rogue scientist out to establish a new "religion without revelation" based on evolutionary theory? He was not alone, but neither was he representative of the majority. According to historian Edward J. Larson, the difficulties of reconciling the modern synthesis of evolution with Christianity caused most neo-Darwinian biologists to give up on the effort by the second half of the twentieth

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[144] Ibid., 253.

[145] Monsignor Matthew Smith, "Listening In: Science Doesn't Defeat Religion," *Catholic Telegraph-Register*, December 11, 1959, Box 8, Folder 10, Darwin Centennial Celebration Records, Special Collections Research Center, University of Chicago, Chicago, IL.

[146] Henry P. Van Dusen, "Huxley on Evolution," The New York Times, n.d. but after December 4, 1959, Box 8, Folder 9, Darwin Centennial Celebration Records, Special Collections Research Center, University of Chicago, Chicago, IL.

century.[147] But Huxley was a controversial figure, the first director of UNESCO, and president of the British Eugenics Society at a time when most biologists distanced themselves from involvement in eugenic causes because of the atrocities of Nazi Germany.[148] He had a kindred spirit in Hermann J. Muller, who also saw a need for humankind's conscious intervention in its own evolution. Muller will be the subject of the next chapter.

But what about the architects of the modern synthesis: Theodosius Dobzhansky, Ernst Mayr, George Gaylord Simpson, and George Ledyard Stebbins? What did evolution mean to them? For the answers, I looked not at their technical works, but at books written for general audiences, where they were more likely to reflect on the meaning of evolution for the future of humans.

Theodosius Dobzhansky

Dobzhansky was the most cautious about Julian Huxley's point of view. An Eastern Orthodox Christian, he rejected Huxley's atheism, but still envisioned evolution from inside the methodologically materialistic viewpoint of the scientist. He wrote to historian John C Greene:

> I do not doubt that at some level evolution, like everything in the world, is a manifestation of God's activity. All I say is that as a scientist I do not observe anything that would prove this. In short, as scientists Laplace and myself "have no need of this hypothesis," but as a human being I do need this hypothesis![149]

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[147] Edward J. Larson, *Evolution: The Remarkable History of a Scientific Theory* (New York: Modern Library Chronicles, 2004) 253.

[148] Timson, John, "Portraits of the Pioneers: Sir Julian Huxley, FRS," Galton Institute, http://www.galtoninstitute.org.uk/Newsletters/GINL9912/julian_huxley.htm (accessed October 20, 2012).

[149] Theodosius Dobzhansky to John C. Green, Nov. 23, 1961, in John C. Greene, *Debating Darwin: Adventures of a Scholar* (Claremont, CA: Regina Books, 1999), 100.

Dobzhansky was saying that as a scientist, he had no need of God as an explanation of what was being seen in evolution – that could be done adequately from a naturalistic viewpoint. But as a human being, Dobzhansky felt that he did need God. According to Dobzhansky, "Both [religion and evolution] have to be somehow integrated in one's philosophy of 'ultimate concern.'"[150] The work of scientist and Jesuit mystic Pierre Teilhard de Chardin became important to Dobzhansky as an integrator of science and religion. Teilhard de Chardin had an expansive, metaphysical view of evolution:

> Is evolution a theory, a system, or a hypothesis? It is much more-it is a general postulate to which all theories, all hypotheses, all systems must henceforward bow and which they must satisfy in order to be thinkable and true. Evolution is a light which illuminates all facts, a trajectory which all lines of thought must follow – this is what evolution is.[151]

Evolution was all important – a metatheory which encompassed all others.

Teilhard de Chardin believed that all evolution was moving towards "The Omega Point," which was

> A harmonized collectivity of consciousnesses, equivalent to a kind of superconsciousness. The Earth is covering itself not merely by myriads of thinking units, but by a single continuum of thought, and finally forming a functionally single Unit of Thought of planetary dimensions.[152]

This goal gave evolution meaning. Dobzhansky shared the significance that this concept had for him: "To modern man, so forlorn and spiritually embattled in this vast and ostensibly meaningless universe, Teilhard de Chardin's evolutionary idea comes as a ray

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[150] Ibid.

[151] Pierre Teilhard de Chardin as quoted in Theodosius Dobzhansky, *Mankind Evolving: The Evolution of the Human Species* (New Haven, CT: Yale University Press, 1962), 347.

[152] Ibid., 347-48.

of hope. It fits the requirements of our time."[153] Dobzhansky spoke of another source of hope, this time involving Darwin himself:

> The most important point in Darwin's teaching was, strangely enough, overlooked. Man has not only evolved, he is evolving. This is a source of hope in the abyss of despair…Man and man alone knows that the world evolves and that he evolves with it. … Evolution need no longer be a destiny imposed from without; it may conceivably be controlled by man, in accordance with his wisdom and values.[154]

So while Dobzhansky believed in God and Huxley did not, they both saw that humans, understanding the mechanisms of evolution, had achieved the place where they conceivably had the ability to control the path of evolution. Was this a common theme with the other architects of the modern synthesis?

Ernst Mayr

In a 1960 article appropriately titled "Where Are We?" regarding the history and current status of evolutionary theory, Ernst Mayr characterized the synthetic theory of evolution by two postulates:

> (1) That all the events that lead to the production of new genotypes, such as mutation, recombination, and fertilization are essentially random and not in any way whatsoever finalistic, and
> (2) That the order in the organic world, manifested in the numerous adaptations of organism to the physical and biotic environment, is due to the ordering effects of natural selection.[155]

In other words, the sources of genetic variation are essentially random, without any discernible purpose or end goal, and the order we see in the natural world is due to the

[153] Theodosius Dobzhansky, *Mankind Evolving: The Evolution of the Human Species* (New Haven, CT: Yale University Press, 1962), 348.

[154] Ibid., 346.

[155] Ernst Mayr, "Where Are We?" *Cold Spring Harbor Symposia on Quantitative Biology 24 (1959)*, 4.

action of natural selection, which explains the direction that evolution takes apart from any supernatural intervention. Mayr was personally concerned with promoting and defending the synthesis and with persistent theoretical and research questions.

Mayr concluded the 1960 article with several important points which reveal his priorities. "The first is that in spite of the almost universal acceptance of the synthetic theory of evolution, we are still far from fully understanding almost any of the more specific problems of evolution….There is still a vast and wide open frontier."[156] Far from seeing our understanding of evolution as complete, Mayr highlighted the need for more research, as did Dobzhansky. Mayr's second point was that

> the very survival of man on this globe may depend on a correct understanding of the evolutionary forces and their application to man. The meaning of race, of the impact of mutation, whether spontaneous or radiation-induced, of hybridization, of competition, - all these evolutionary phenomena are of the utmost important for the human species…we must acquire an understanding of the operation of the various factors of evolution for the sake not only of understanding our universe, but indeed very directly for the sake of the future of man.[157]

Here again we see the reason that knowledge of evolution was critical; understanding of evolutionary processes was essential for "the future of man." Our very existence depended on it. Based on my readings, Mayr did not seem to emphasize the interventionist role of humans in their own evolution, however. According to historian and philosopher Michael Ruse, Mayr was "much influenced by Julian Huxley's Religion

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[156] Ibid., 13.

[157] Ibid.

without Revelation. He told me that he felt with Huxley and with others . . . that it is possible to be a deeply religious person in the complete absence of theology."[158]

George Ledyard Stebbins

Architect of the modern synthesis and botanist George Ledyard Stebbins was in agreement with Mayr and Huxley regarding the place of the supernatural, stating that "a religion suitable for modern times must discard all explanations of the nature of the cosmos, of our planet, or of life that depend on the intervention of a supernatural force."[159] Stebbins framed the problem of the future of humankind differently. "The only major enemy of contemporary man is mankind himself. Such a situation has never before existed on this planet."[160] Stebbins emphasized the role of cultural evolution, which he saw as out of his area of expertise as a biologist. But he did venture a vision of the future from his perspective, emphasizing the effect of humankind on the planet:

> As I see it, evolution in the future is destined to be dominated by the cultural evolution of mankind. To an increasing degree, other animals and plants will spread and evolve, become extinct, or remain stagnant, either according to the will of mankind, or because they can take advantage of the environments which man has created without being checked by him. The evolution of man himself will continue to be dominated by cultural evolution, with organic evolution assuming an increasingly subordinate role.[161]

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[158] Michael Ruse, "Obituary: Ernst Mayr 1904-2005" *Biology and Philosophy* 20 (2005): 623-31, http://www.stephenjaygould.org/people/mayr_inremembrance.html [accessed March 2, 2009].

[159] G. Ledyard Stebbins, "Evolution and Religion," in *Cry of the Environment: Rebuilding the Christian Creation Tradition* (Santa Fe, NM: Bear & Company, 1984), 194.

[160] G. Ledyard Stebbins, *Processes of Organic Evolution* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1966), 174.

[161] Ibid., 175-76.

Stebbins also had two cautions to those who would consider the direction of future human evolution. First: "No amount of guidance which we might attempt to give to the evolutionary process will be of any use to humankind until he has learned how to control the explosive increase of his population."[162] Stebbins continues:

> Secondly, this evolutionist believes that little will be gained by trying to breed a race of intellectual supermen…If, therefore, natural selection has been operating to keep man's intelligence in a harmonious balance with his other characteristics, we must think twice before tampering with this trend…Perhaps when we have come somewhat nearer to making the most of our opportunities for improving mankind through conditioning, training, and teaching the younger generation under optimal conditions for their social development, we can then consider whether anything can be done about the genetic aspects of social development.[163]

So Stebbins advised attending to the cultural problems of humankind, especially the problem of overpopulation, before even considering intervention in the genetic evolution of humans. That put him at odds with some of the more interventionist ideas of Hermann J. Muller. Still, he was in concert with the other architects in seeing this particular time as unique in the history of humankind: we were on the threshold of the ability to consciously control our own evolution, both cultural and organic, because of the huge increase in knowledge within the biological sciences.

George Gaylord Simpson

Perhaps the most articulate architect of the modern synthesis on this point was paleontologist George Gaylord Simpson. To understand his argument, it is important to know that Simpson did not think that there was any intrinsic or extrinsic purpose inherent in organic evolution, which he also called "old evolution." He called cultural evolution

[162] Ibid., 176-77.

[163] Ibid., 177.

“new evolution,” and in that type of evolution, purpose was given by acts of human will. In order to show that there are limitations to any analogy that would compare organic and cultural evolution, Simpson considered an important difference. Whereas mutations are the primary source of variability in organic evolution, variations in cultural evolution arise as ideas or

> elements in consciousness…They arise in relationship to needs and desires of individuals and commonly in relationship to the individual’s perception and judgments of the needs and desires of a social group. Once they have arisen, their further evolutionary role is not mechanistically determinate and is subjected to the influence not only of the actual needs and desires of the group and of volitions extremely complex in basis but also of an even more complex interplay of emotions, value judgments, and moral and ethical decisions.[164]

While organic evolution and cultural evolution both have similarities in terms of a large scale change over time, the particulars between the two are very different, with the source of variability in each being the most important difference. New ideas are the source of variability in cultural evolution, whereas organic evolution depends on mutation (a random source of variability). Rather than natural selection, which is the driving force in organic evolution, new ideas and inventions become important in human cultural evolution by being selectively learned and taught to the next generation. Simpson continues:

> Through this very basic distinction between the old evolution and the new, the new evolution becomes subject to conscious control. Man, alone among all organisms, knows that he evolves and he alone is capable of directing his own evolution. For him evolution is no longer something that happens to the organism regardless but something in which the organism may and must take an active hand. *The possibility and responsibility spread from the new evolution to the old.*

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[164] George Gaylord Simpson, *The Meaning of Evolution: A Study of the History of Life and Its Significance for Man* (New Haven, CT: Yale University Press, 1952), 289.

> [italics mine] The accumulation of knowledge, the rise of a sense of values, and the possibility of conscious choice, all typical elements in the new evolution, also carry the means of control over organic evolution, which is determinate but is determined, in part, by factors that can be varied by the human will…The infantile fantasy of becoming whatever we wish as fast as we please is simply unrealistic in a material cosmos, but this is obviously no argument against the fact that we do have a measure of conscious control over what becomes of us.[165]

Humankind was alone capable of directing its own evolution, and that applied now not only to cultural evolution, which is obviously dependent on human actions, but to organic evolution as well. Darwin showed that humans evolved through organic evolution. The modern synthesis of evolution provided the crucial beginnings of knowledge necessary to intervene directly in both cultural and organic evolution. This can especially be seen in human relations to other species. Simpson asserts: "He is rapidly coming to hold the power of life and death. He has casually caused the extinction of numerous other sorts of organisms and seems likely to devise means for causing extinction at will."[166] Out of this comes the need for a new ethics consistent with the knowledge of evolution and an evolutionary understanding of humanity's place in nature. "Man has choice and responsibility…he must choose and he cannot place responsibility for rightness and wrongness on God or on nature."[167] Simpson summarizes the problem with Cold War humanity:

> The present chaotic stage of humanity is not, as some wishfully maintain, caused by lack of faith but by too much unreasoning faith and too many conflicting faiths within these boundaries where such faith should have no place. The chaos is one that only responsible human knowledge can reduce to order. It is another unique

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[165] Ibid., 290-91.

[166] Ibid., 329.

[167] Ibid., 346.

> quality of man that he, for the first time in the history of life, has increasing power to choose his course and to influence his own future evolution. It would be rash, indeed, to attempt to predict his choice. The possibility of choice can be shown to exist. This makes rational the hope that choice may sometime lead to what is good and right for man. Responsibility for defining and for seeking that end belongs to all of us.[168]

Here we see the reason why it is important for everyone to understand evolution. For the first time in history, humankind has become fully conscious of its evolution, both organic and cultural, in a way that would allow it to choose the direction of future evolution. This could not be a power left to the few. Everyone needed to understand the facts about evolution and the possibilities of future intervention for good or harm.

This led to Simpson's conviction that evolution needed to be central in high school biology:

> Evolution has fundamental human significance for everyone. Of course, I realize that …grand generalizations, presented just so, would be incomprehensible, incredible, or virtually meaningless for most high school students. Nevertheless, the implications are there, and some, at least, of them will eventually be glimpsed by anyone who acquires even a modest grasp of evolutionary facts and principles.[169]

So the plan should be to teach the principles of evolution so that the implications could be "glimpsed" by everyone. Simpson suggests how this could be accomplished in a key speech that echoed the ideas of Hermann J. Muller on teaching evolution in high schools.

> Evolution underlies every aspect of biology and is one form of explanation for every biological fact, from protein synthesis to, say, zoogeography. As each topic is taken up, from the very first one-whatever that may be in the particular

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[168] Ibid., 348.

[169] George Gaylord Simpson, *This View of Life: The World of an Evolutionist* (New York: Harcourt, Brace & World, Inc.,1964), 39-40.

> approach used – it can be shown to involve relationships best understood as results of evolution. Followed through, one topic after another, that builds up to a convincing demonstration of the fact of evolution…The broader implications…will then begin to appear almost automatically.[170]

This is exactly what Muller was advocating within the BSCS, and why he took such exception to the first preliminary versions of the texts. None of them treated evolution throughout, and therefore the implications of evolution would not be understood.

Conclusion

In this chapter, I have argued that the architects of the modern synthesis of evolution thought that knowledge of evolution, both biological and cultural, was essential knowledge for citizens of the United States and also the world. Going beyond the call for improved science education for the defense of the United States during the Cold War, the architects felt that knowledge of evolution was critical for the future of humankind. The hardening of the modern synthesis of evolution and the rising importance of natural selection resulted in the rejection, by most biologists, of supernatural or vitalistic causes for the direction of biological evolution. This left biologists with the realization that while natural selection had gotten humankind to the present, there were no guarantees for the future. With the specter of a nuclear holocaust looming large during the Cold War, any knowledge related to the successful continuance of the human race was critical knowledge. Whether or not God existed, it looked more and more like the future direction of evolution for all species on the planet would be up to humankind. Through the Darwin Centennial Celebration and the works of the architects of the modern synthesis, educators

[170] Ibid., 40.

were admonished to provide the knowledge of the biological world necessary for the ordinary citizen to consider the future choices that would have to be made regarding evolution and the future of humankind.

Chapter 3

Hermann J. Muller and Reform Eugenics

> It is necessary to use education…to reinforce the value system which, in the light of the humanistic scientific world view, will arouse in people the will to stem genetic deterioration and even to effect genetic improvement.
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> --Hermann J. Muller, "The Role of Science Education in Value Formation"

Geneticist Hermann J. Muller (1890-1967) was one of the most influential members of the Biological Sciences Curriculum Study (BSCS) during its early years. He was a widely known Nobel Laureate who discovered the mutagenic effects of ionizing radiation in 1926 and who was instrumental in elevating the importance of the modern synthesis of evolution within the BSCS. He also was a reform eugenicist who rejected the use of eugenics for race discrimination purposes, but still advocated the use of genetics for human betterment.[171] I assert that his concern over the mutational effects of atomic radiation, from both medical and weapons sources, fueled his desire for worldwide understanding of evolutionary processes. I also assert that Muller's interest in the BSCS was related to his interest in eugenics, and that he saw evolution education as essential knowledge for the common person so that they could be inspired to make reproductive choices which would improve the human gene pool over time. This chapter contains biographical background, examines Muller's ideas regarding evolution, education, and eugenics and shows how Muller propagated these ideas through various articles and

[171] For a discussion of reform eugenics, see Daniel J. Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity*, (Berkeley, CA: University of California Press, 1985), 164-175.

conference presentations during the early years of the BSCS. This information provides a richer understanding of Muller's views as they relate to his call for pervasive treatment of evolution in the BSCS texts.

In *Scientists in the Classroom*, John L. Rudolph presents Muller's approach to evolution education as rational and progressive.[172] Muller thought that through evolution education, the BSCS had a chance to combat ideological threats to the pursuit of science, such as those posed by Lysenkoism in the Soviet Union and religious fundamentalism in the United States.[173] Rudolph states that Muller supported the use of an "enlightened combination of directed biological and cultural evolution," as part of his progressive vision for humanity but does not explore Muller's reform eugenic ideas or how these ideas fueled his involvement in the BSCS.[174] Arnold Grobman in *The Changing Classroom* also documents Muller's involvement in the BSCS but also does not discuss his eugenic views.[175]

In his compelling biography, Muller's graduate student Elof A. Carlson traces Muller's contributions to genetics, including his time in the Soviet Union, his famous work with mutations and X-rays, and his devotion to eugenics. Carlson calls eugenics

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[172] John L. Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education* (New York: Palgrave, 2002).

[173] Ibid., 149-50.

[174] Ibid., 158.

[175] Arnold B. Grobman, *The Changing Classroom; The Role of the Biological Sciences Curriculum Study*, (Garden City, NY; Doubleday & Company, Inc., 1969).

"the leitmotif of Muller's life."[176] Carlson discusses Muller's ideas on evolution education including his work with the BSCS, but does not link this involvement with Muller's eugenic interests. Likewise, historian Daniel J. Kevles chronicles Muller's involvement with eugenics, including Muller's criticism of mainline eugenics, leadership role in reform eugenics, and work on genetic load, artificial insemination and germinal choice, but does not mention Muller's involvement with the BSCS.[177] Therefore the historiography has studies of Muller's work with the BSCS and studies of Muller's interest in eugenics, but the current histories do not make the link between the two. The current chapter addresses this gap. I also examine reactions to Muller's ideas regarding germinal choice among other biologists and the public as a way of contextualizing the curriculum debate over evolution within the BSCS.

Biographical Background

Hermann J. Muller was born in New York City in 1890. His father, Hermann, Sr., a businessman with intellectual interests, came from a German Catholic background, but abandoned Catholicism for a more "liberal outlook towards religion."[178] He married Frances Lyons, whose ancestry included "Sephardic Jews who had left Portugal in the fifteenth century and who had intermarried with Catholics and Protestants since then."[179] Hermann Muller, Jr., was raised as a Unitarian, but converted to atheism as a teen.

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[176] Elof A. Carlson, *Genes, Radiation, and Society: The Life and Work of H. J. Muller* (Ithaca, NY: Cornell University Press, 1981), 393.

[177] Kevles, *In the Name of Eugenics*.

[178] Carlson, *Genes, Radiation, and Society*, 11.

[179] Ibid.

Although schooled in evolution by his father and nature study by his mother, evolution was "conspicuously absent from his biology class."[180] He was highly influenced by trips to the American Museum of Natural History and the depiction of evolution there in his young years. He was valedictorian for his high school graduation in 1907, and his speech was entitled "The Need for Higher Ideals in Business and Politics."[181] Muller had a lifelong interest in values and ethics.

Muller attended Columbia University as an undergraduate, and after two years of graduate work at Cornell Medical College, returned to Columbia to work with the famous geneticist, Thomas Hunt Morgan, where he studied linked genes and crossing over.[182] He was interested in eugenics, although he had some reservations due to his "socialist sympathies." After finishing his work for his PhD in 1915, he joined Julian Huxley at the Rice Institute where Muller began his work on mutation.[183] This began a long association with Huxley, who held similar views to Muller on education, evolution, and eugenics. Muller returned to Columbia in 1918 as an instructor, and developed quantitative methods for the study of mutations. His prospects at Columbia were not encouraging, so he went to the University of Texas at Austin as Associate Professor in 1920, doing mutation research and teaching genetics and evolution. This led to an understanding of

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[180] Ibid., 24.

[181] Ibid.

[182] Nobel Foundation, "The Nobel Prize in Physiology of Medicine 1946: Hermann J. Muller," from *Nobel Lectures*, *Physiology or Medicine 1942-1962* (Amsterdam: Elsevier Publishing Company, 1964), http://nobelprize.org/nobel_prizes/medicine/laureates/1946/muller-bio.html, [accessed August 24, 2009]. Theodosius Dobzhansky was also a protégé of Thomas Hunt Morgan.

[183] Muller's PhD. Degree was not conferred until 1916. See Elof A. Carlson, *Genes, Radiation, and Society*, 92.

spontaneous genetic mutations and of the concept of the gene as the basis of life in conjunction with evolution.[184] Gene research was in its early years, as Mendel's research had only been appreciated since about 1900. Muller's discovery of the production of genetic mutations and chromosome changes as the result of X-ray exposure formed the basis of the work for which he received the Nobel Prize.[185]

Muller has been described as "a man of political convictions and an argumentative disposition, which severely hindered his career."[186] At the University of Texas, Muller was faculty sponsor for the leftist National Student League, where he wrote an article for its newsletter, *The Spark*. Muller wrote the article knowing he would be leaving on a Guggenheim scholarship to study at a premier genetics laboratory, the Institute of Brain Research in Berlin, which was run by a Soviet émigré, N. V. Timofeeff-Ressovsky.[187] Concerned about his leftist associations, the FBI infiltrated the National Student League at the University of Texas and reported on his activities.[188]

Muller left for Germany in 1932, but Hitler soon came to power, so Muller went to the Academy of Sciences of the U.S.S.R in 1933, which was closer to his political leanings. While Stalin was in power, Trofim Lysenko advanced incorrect genetic theories

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[184] Nobel Foundation, "The Nobel Prize in Physiology of Medicine 1946: Hermann J. Muller," from *Nobel Lectures*, *Physiology or Medicine 1942-1962* (Amsterdam: Elsevier Publishing Company, 1964), http://nobelprize.org/nobel_prizes/medicine/laureates/1946/muller-bio.html, [accessed August 24, 2009].

[185] Ibid.

[186] Soylent Communications, "Hermann J. Muller" Notable Names Data Base, http://www.nndb.com/people/073/000128686/ [accessed November 4, 2009].

[187] Carlson, *Genes, Radiation, and Society*, 166-67.

[188] Ibid, 431.

which promised huge increases in crop productivity.[189] These theories were politically useful to Stalin during the famines of the 1930s, and geneticists who objected to Lysenko and his methods were imprisoned or disappeared. This influence was called Lysenkoism.[190] Muller was opposed to Lysenko and his ideas, and sought a way to leave the U.S.S.R without endangering his Russian colleagues. He left for Spain, where he worked on a new form of blood transfusion during the Spanish Civil War, and relocated to the University of Edinburgh in 1937.[191]

When Muller returned to the U.S. in 1940, he "was seen both as one of the world's foremost geneticists and as a political pariah."[192] On the one hand, he was suspect because of his leftist political statements and time spent in the Soviet Union, and on the other hand, he was suspect for his outspoken criticism of Stalin based on his personal experience in Russia.[193] Once back in the United States, Muller was active in finding positions for Soviet geneticists who wished to emigrate because of Lysenkoism. Elof A. Carlson states that Muller was a Communist from the 1920s through 1936, but that he was not a member of the Communist Party.[194]

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[189] Lysenko opposed western genetics, which he thought provided no practical applications. His own theories were based on Lamarckism, or the inheritance of acquired characteristics. His theory of wheat vernalization suggested that "environmental 'education'" could transform winter wheat into summer wheat. His theory of vegetative hybridization predicted that hybrids could be produced through grafting. See Audra Wolfe, "What Does It Mean to Go Public? The American Response to Lysenkoism, Reconsidered," *Historical Studies in the Natural Sciences* 40, no. 1 (Winter, 2010): 53.

[190] Carlson, *Genes, Radiation, and Society*, 184-234.

[191] Ibid., 236-37.

[192] Soylent Communications, "Hermann J. Muller" Notable Names Data Base, http://www.nndb.com/people/073/000128686/ [accessed November 4, 2009].

[193] Ibid.

After returning to the United States in 1940, Muller spent several years as a zoology instructor at Amherst College. He then became a professor at Indiana University in 1945, and stayed there until his retirement in 1964. After winning the Nobel Prize in 1946, Muller's improved career stability and positive visibility gave him a platform to advance his ideas on radiation, evolution, eugenics and humanism. Along with numerous honors, he was President of the 8th International Congress of Genetics in 1948 and President of the American Humanist Association (AHA), 1956-1958. He was selected Humanist of the Year by the AHA in 1963.

Muller was concerned with the growing exposure of the human genome to radiation from the proliferation of nuclear weapons, industrial uses of radiation such as nuclear reactors, and medical uses of radiation such as X rays.[195] In the beginning, Muller supported government testing of nuclear weapons as justified in fighting Communism, but later revised his views as testing increased worldwide. Muller felt that if the tests lessened the possibility of global nuclear war that they could be justified. But since he thought the tests were as capable of starting a nuclear war as preventing one, the tests should be stopped "as one small step toward fostering of international good will."[196] After his experiences with the Russians, he was opposed to the propagation of Communist ideology in college classrooms, and supported the ouster of Communist

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[194] Elof A. Carlson, *Times of Triumph, Times of Doubt: Science and the Battle for Public Trust* (Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2006), 75. See also Elof Carlson, *Genes, Radiation, and Society*, 431.

[195] Carlson, *Times of Triumph*, 75-76.

[196] Hermann J. Muller, as quoted by Tino Balio, "The Public Confrontation of Hermann J. Muller," *Bulletin of the Atomic Scientists* 23, no. 9 (November, 1967): 9.

faculty after a hearing of their peers.[197] However, according to Elof Carlson, “his anti-Soviet views after 1948 were looked upon in the 1950s as a ruse to carry out a secret mission to sabotage U.S. weapons development by raising concerns about radiation damage.”[198] The FBI remained suspicious of Muller for some time, as evidenced by his interrogation by the House Committee on Un-American Activities in 1953.[199] Other governmental organizations were also leery. The Atomic Energy Commission (AEC) prevented Muller from presenting a paper at the International Conference on Peaceful Uses of Atomic Energy in Geneva in August, 1955 because he was going to oppose nuclear testing. When he attended a session, however, he was given a standing ovation by the attendees. In 1956, the AEC again allowed Muller to present at international conferences, but made it clear they did not share Muller’s views.[200]

Muller, Evolution and Education

Muller’s writings of the 1950s and early 1960s show his interest in evolution education. As did many biologists during this time, Muller understood evolution as having three phases: physical, biological, and cultural. Physical evolution involved the origin of the physical universe, including stars, planets, elements and basic chemical reactions. Starting with the origin of life, biological evolution became most important. Through biological evolution, a dazzling array of species filled the earth, including

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[197] Carlson, *Genes, Radiation and Society*, 331-32.

[198] Carlson, with reference to interview with Willard F. Libby, *Times of Triumph*, 75.

[199] Carlson, *Genes, Radiation and Society*, 372-74.

[200] Tino Balio, “The Public Confrontation of Hermann J. Muller,” *Bulletin of the Atomic Scientists* 23, no.9 (November 1967): 8-12.

humans. At some time in early human development, superior intellect and ability to cooperate allowed them to partially escape the influence of natural selection, evolving complex ways of adapting to changing environments through cultural evolution. For example, humans started using animal hides for warmth and did not need to remain in tropical climates. Biological evolution still occurs with humans, but cultural evolution is far faster. Whereas major biological changes can take millions of years, major cultural changes can occur in a single generation. The complex adaptations of cultural evolution are not transmitted through the genes, however, and must be transmitted through the education of each new generation. Therefore, education is critical for human survival, providing the knowledge and dispositions for present and future adaptive challenges. These ideas were generally accepted among biologists then as they are now.

Muller developed these ideas further, however. He felt that evolution was not simply a biological theory, but the central fact of all of life. Everyone, not just future biologists, needed to understand the nature of evolution, including mutations and natural selection, to be able to understand nature and the position of humankind in nature.

Muller's greatest concern in the education of K-12 students was that they be taught the "modern view of life," which to him was materialistic and humanistic.[201] This modern view included a thorough understanding of physical and biological evolution, but

[201] Hermann J. Muller, "Remarks Concerning the Content of a High School Biology Course (with particular reference to the treatment of genetics and evolution)," enclosure in a letter from Hermann J. Muller to John A. Moore, April 2, 1960. Series V, Box 3, Folder: AIBS High School Course Materials, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN. Also see Hermann J. Muller, "Integrational Role of the Evolutionary Approach Throughout Education," address presented to the Philosophy of Education Society Annual Meeting, Columbus, Ohio, April 12, 1960, Series III, Box 3, Folder: 1960 Apr 12 Philosophy of Education Society, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

had important implications for cultural evolution as well. Humans are the only creatures who can reflect on their own evolution, and for Muller that reflection had implications for culture. Muller wanted to use education to cause a cultural change that reflected human awareness of the importance of evolutionary processes. This cultural change would consist in a change in values that were consistent with scientific understanding of the nature of humans and their place in the universe, and would enable humans to confront the many challenges of the modern world.

Cultural evolution in values had been taking place since prehistoric times. "The religious and ethical systems of nonscientific peoples expressed the values that they overtly recognized," and which led to "the survival and extension of the group."[202] Values such as "veracity, integrity, self-control, industry, and courage" supported group survival and cohesiveness, as did the practice of "ecstatic emotional experiences" that fostered the individual's identification with a larger family "dominated by a greater father, who provided greater rewards and more frightful punishments."[203] With the rise of empires about 2500 years ago, "doctrines of brotherhood among all mankind began to gain increasing acceptance."[204] Abstract conceptions, such as goodness, beauty, and truth, became values, but could be interpreted in many ways. Muller thought it was time for another revolution in values, a revolution that privileged scientific ways of knowing.

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[202] Hermann J. Muller, "Human Values in Relation to Evolution," in *Man's Future Birthright: Essays on Science and Humanity by H. J. Muller*, ed. Elof Axel Carlson (Albany, NY: State University of New York Press, 1973), 107.

[203] Ibid.

[204] Ibid.

> It is high time for modern man, everywhere, again to revise his concepts of values, in accord with the utterly new view that science, and especially evolutionary science, has given him of the nature of the world and of his actual and potential relations to it. We must admit that it is much too early for detailed formulations of the place to be accorded to the diverse major and minor values that flow out of his numerous inherent affective tendencies and out of the possibilities of interconnecting them…Yet we can already discern clearly certain major features that lead to important conclusions…[205]

While Muller admitted that a full delineation of values would be premature, he also asserted that the primary values that had led to human dominance among species should serve to direct future changes in values in conjunction with modern human needs and scientific knowledge:

> Each man must more strongly identify himself with humanity in general. The visions that he has obtained of the unimaginable progression already accomplished in past evolution, of the unprecedented powers which he himself has now gained through science, and of the fathomless reaches to which man may go, in terms of greater life, by the rational use of these powers in behalf of himself and posterity, afford an overall directive for his efforts that is in accord with the objective end of the species – namely, its survival and extension- and also with most of his own more immediate subjectively based values…we find in our own line of descent the two groups of psychological characteristics that have been the most important in putting us into our dominant position were those making for intelligence and those making for cooperative behavior[206]

Human powers should now be used to enhance intelligence and cooperative behavior in present and future generations, through cultural and genetic means. These would allow humans to more capably fulfill their physical and psychological needs as a species and also as individuals.

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[205] Ibid., 108.

[206] Ibid., 109-10.

> Through the unprecedented human faculty of long-range foresight, jointly serviced and exercised by us, we can, in securing and advancing our position, increasingly avoid the missteps of blind nature, circumvent its cruelties, reform our own natures, and enhance our own values.[207]

Muller argued that psychological needs which should now have highest value include the search for truth by scientific methods, the fulfillment of love of various kinds, the "exercise of freedom, creativity, variety, and adventure, and the appreciation of nature, art, and artifice."[208]

Through human efforts on the basis of these values, the species could continue to thrive and the individual could achieve personal fulfillment in the process, without reliance on supernaturally-based forms of religion.

> Enough can thereby be gained for the individual, in enhanced richness and harmony of life, to recompense him on a personal basis to a degree unparalleled in the past, especially if we will take advantage of already existing psychology and psychiatry. At the same time, he can attain a sense of participation in a joint endeavor far greater than his own that is more solidly based and more buoying to his spirits than that gained by obedience to a tenuous superior power.

Muller thought that there was no evidence for the existence of the supernatural. It was important in the teaching of evolution that students realize that "the mind, with its feelings, emotions, and intelligence, represents entirely the functioning of the brain, [which] should be brought out, leaving no room for dualism."[209] In other words, Muller

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[207] Ibid., 111.

[208] Ibid., 110-11.

[209] Hermann J. Muller, "Remarks Concerning the Content of a High School Biology Course (with particular reference to the treatment of genetics and evolution)," enclosure in a letter from Hermann J. Muller to John A. Moore, April 2, 1960. Series V, Box 3, Folder: AIBS High School Course Materials, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

wanted evolution taught so as to leave no room for the idea of a life force or spirit separate from the body. He thought that religion was a cultural adaptation based on the physically-based religious emotions of humans, and was understanding of religion per se, but he was opposed to any world view that would substitute supernatural revelation for scientific discovery. Students needed to understand the basis of life as discovered by science, that humans were the dominant species over all others and as such had responsibility for their knowledge and actions. A humanistic, ethical attitude must be developed towards the problems faced by humankind.

Of significant concern to society during the Cold War was the effect of nuclear radiation on the genetic material of all living species, especially humans. Muller was a premier authority in this area, and was widely consulted for his expertise.[210] While radiation could produce death and disease in those exposed to nuclear bombs, of greatest concern was the effect on human reproductive cells. Many mutations in these cells would be lethal for the next generation, causing miscarriages or still births, but some recessive mutations could be carried on resulting in cumulative pathology in later generations. Muller was concerned with the problem of genetic load, or the accumulation of mutations in a species over time. Spontaneous mutations in reproductive cells happen naturally under normal conditions, but nuclear and chemical exposure could further increase the human genetic load. There was controversy, however, as to the level of mutational load carried by the average person and how much that was increased by the use of chemical and nuclear weapons in tests and war. In any case, Muller thought students should

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[210] Carlson, *Times of Triumph*, 75.

understand the genetic effects of nuclear radiation and its potential for altering human evolution as a basis for a rational response to this new threat of the 20th century.

Muller and Eugenics

For Muller, consideration of human biological problems included eugenics. He first became interested in eugenics as an undergraduate. As time went on, Muller recognized that the American eugenics movement was deeply flawed because it targeted "the poor, the central- and southern-European immigrants, the criminal, and the insane," whose problems were mainly social and that negative eugenics was an insufficient means of addressing the matter.[211] In 1932, Muller publicly denounced the movement as "unworkable and its premises as fallacious."[212] Muller wrote a book on eugenics in 1935, which suggested that a socialist system was the only system in which human betterment could be effectively and safely initiated.[213] Although his idealism for socialism waned after his experiences in Russia, Muller "never abandoned hope that genetics would be applied to human betterment," according to Elof Carlson.[214] The kind of eugenics that Muller espoused after his denouncement of mainline eugenics has been called "reform eugenics" by historian Daniel J. Kevles. It will be discussed in more detail in Chapter Six.

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[211] Carlson, *Genetics, Radiation and Society*, 434-35.

[212] Ibid., 435.

[213] Hermann J. Muller, *Out of the Night: A Biologist's View of the Future* (London: Victor Gollancz Ltd, 1936). At this time Muller thought that eugenics could only be properly implemented in a socialist system. See Elof A. Carlson, *Genes, Radiation, and Society*, 179.

[214] Carlson, *Genes Radiation, and Society*, 393.

As with most biologists, Muller's eugenic views became submerged during World War II and the 1940s, but the atomic bomb "jolted him, perhaps more than most of the physicists who worked on it, because he realized the real meaning of the radiation damage it had inflicted on the descendants of the survivors for hundreds of generations to come."[215] Muller concentrated his work on the study of radiation effects in humans. In response to growing public interest in human mutations in 1954, he proposed eugenic controls, and cautioned against wholesale rejection of eugenic propositions.

> Procreation should be brought under better control. The fact that the so-called eugenics of the past was so mistaken in some of its main attitudes is no more argument against eugenics as a general proposition than, say, the failure of democracy in ancient Greece is a valid argument against democracy in general.

In the later 1950s he was deeply concerned about the population explosion, and about human cultural practices that supported reproduction and survival of less intelligent and robust individuals. "The real issue here is not whether society should in this way help the individuals themselves to live better, but whether the acts of society should be so ordered as actually to facilitate the perpetuation of defective genetic equipment into later generations."[216] He advocated negative eugenics, meaning the reduction of the frequency of certain undesirable genes in a population. For humans, this involved counseling of individuals as to their genetic risks and potential reproductive choices which would reduce the numbers of those born with genetic diseases and the propagation of mutations in the gene pool. This was to be voluntary, decided by the parents with genetic

[215] Ibid., 396.

[216] Hermann J. Muller, "Should We Weaken Our Genetic Heritage?" *Daedalus* 90, no. 3 (Summer 1961): 434.

counseling. Some geneticists objected that while it would prevent certain births, it would be impossible to reduce the frequency of undesirable recessive mutations in a population to zero. But Muller thought it was still a step in the right direction, and that in evolution, trends were important. Muller also supported a form of positive eugenics, or human selective breeding for desirable traits, called germinal choice.[217]

Germinal choice was Muller's pet cause in his mature years. Advances in the freezing of sperm and artificial insemination in the 1950s made it possible for couples to choose to have children conceived from frozen donor sperm. For Muller, these donors should be individuals of unusually high intelligence, desirable behavioral characteristics and/or physical robustness. Couples could choose to have superior children by knowingly choosing the sperm donor. Freezing the sperm for 20 years would allow an extended time to assess the donor's suitability. Sperm could even be used from deceased donors to mitigate jealousy on the part of the new father. According to Muller this would all be done voluntarily and the practice would become widespread once the advantages to parents were evident.

Germinal choice seemed too close to the eugenics of Nazi Germany to many, and provoked heated reactions from some social scientists and the public, as will be discussed shortly. Others, particularly geneticists and humanists, thought that human control of our genetic future was an ethical response to problems of inheritable deformities and diseases. Muller did not think these practices would be problematic in a properly functioning society, but acknowledged that authoritarian imposition of eugenic practices

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[217] Carlson, *Genes, Radiation. and Society*, 6.

for political goals was a cause for concern.[218] In *Out of the Night*, published in 1936, Muller thought that "the positive biological improvement of mankind" was possible "provided the social reconstruction occurs first."[219]

Later Muller believed that democratic societies could develop cultural values for voluntary reproductive decisions that were based on the best information science could provide. Muller strongly opposed the use of eugenics to support ethnocentricism, racism, or classism. But he did think that human selective breeding for intelligence and cooperation of even a limited number of individuals had potential for providing the great men and women of the future whose intellect could be essential to the survival of civilization. The production of even limited numbers of superior children would fuel the desire of other parents for their own improved children, without the need for political coercion.[220]

Muller Takes It On the Road

In the late 1950s, Muller began to publish and give presentations at conferences and professional meetings advocating his views on education, humanism, and reform eugenics. In 1958, Muller addressed the Central Association of Science and Mathematics Teachers, and the presentation was reprinted in School Science and Mathematics, April 1959. The title of both was "One Hundred Years Without Darwinism Are Enough."[221] In

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[218] Muller, "Should We Weaken or Strengthen Our Genetic Heritage?" 447.

[219] Muller, *Out of the Night*, 8.

[220] Muller, "Should We Weaken or Strengthen Our Genetic Heritage?" 445.

this paper, Muller defended evolution as fact, and shamed teachers for their avoidance of the controversial topic by naming ways in which this avoidance took place:

> It ill befits our great people…to turn our backs on [evolution], to pretend that it is unimportant or uncertain, to adopt euphemistic expressions to hide and soften its impact, to teach it only as an alternative theory, to leave it for the advanced course where the multitudes cannot encounter it or, if it is dealt with at all in a school or high school biology course, to present it as unobtrusively and near the end of the course as possible, so that the student will fail to appreciate how every other feature and principle found in living things is in reality an outgrowth of its universal operation.[222]

Later his tone becomes more stringent:

> We have no more right to starve the masses of our people intellectually and emotionally because of the objections of the uninformed than we have a right to allow people to keep their children from being vaccinated and thus to endanger the whole community physically.[223]

Muller thought that by understanding the true order of nature, students would come to understand their own place in it, and look forward towards the greater fulfillment made possible through modern science. For Muller, understanding of biological evolution had moral implications as well. "Individual freedom soon turns into caprice, disillusionment, and decadence unless the individual sees himself as an integral part of a greater whole, working with others in the pursuit of the higher freedoms of his community."[224] For

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[221] Muller, "One Hundred Years Without Darwinism Are Enough," *School Science and Mathematics* 59 (April 1959): 304.

[222] Ibid., 305.

[223] Ibid., 309.

[224] Ibid., 312.

Muller, the study of biological and cultural evolution allowed individuals to see their place in the larger world and to value cooperative activity for the common good.

Muller also made the case in this paper that American scientists now had the upper hand over Soviet biologists because of their acceptance of modern evolutionary theory (the modern synthesis of evolution). The Soviets had been distracted by Lysenko's bogus theories, and the number of Darwinian biologists in the Soviet Union had been significantly reduced by persecution and defection. Americans were in a position to make the most of their superiority in biology. The development of the modern synthesis in the United States and European countries rather than in the Soviet Union was an indication of the superiority of democratic government over Stalinist rule. Evolution represented the fruit of academic freedom, which was being severely limited in the Soviet Union.[225] Muller reminded his audience that Americans had rejected the notion that "the masses should continue, for the good of the existing social structure, to be indoctrinated wholly with the ancient superstitions."[226] For Muller, it followed that everyone should have the privilege of learning about "the most stirring and significant discovery that man has ever made."[227]

When Muller's paper was later published, I noticed that three paragraphs were added to the speech version which expanded on the need for the type of work undertaken

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[225] This point is well developed by John L. Rudolph in *Scientists in the Classroom: The Cold War Reconstruction of American Science Education* (NY: Palgrave, 2002).

[226] Muller, "One Hundred Years," 316.

[227] Ibid.

by the BSCS.[228] In this section Muller writes, "The most immediate need is for the preparation and adoption of high quality texts that give evolution its due axial position and deal with it outspokenly and adequately."[229] These paragraphs reflected Muller's growing interest in the work of the BSCS as a vehicle for the transformation in public attitudes towards evolution and humanism.

Muller and the Darwin Centennial

Another venue which Muller used to advance his views was The Darwin Centennial Celebration of 1959 held at the University of Chicago celebrating the one hundredth anniversary of the publishing of the *Origin of Species* by Charles Darwin.[230] Through events and news coverage, the importance of the modern evolutionary synthesis was broadcast to a large audience, including the K-12 education community. Muller entitled his paper for the Centennial "The Guidance of Human Evolution," and set forth his basic eugenic arguments with some special emphases. His thesis was that man would become extinct "before the earth grows too cold or too hot to support him" unless there were changes in cultural attitudes that would allow genetic practices permitting survival of the human species.[231] Muller implied that neither biological evolution nor cultural

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[228] Ibid, 315.

[229] Ibid, 314.

[230] Vassiliki B. Smocovitis, "The 1959 Darwin Centennial Celebration in America," *Osiris* 2nd Series 14, (1999): 294.

[231] Hermann J. Muller, "The Guidance of Human Evolution," in *The Evolution of Man: Man, Culture and Society*, vol. 2 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), 424.

evolution as they had functioned up until that time would automatically guarantee man's survival. Conscious human control of evolution was required.

> From now on, evolution is what we make it, provided we choose the true and the good…If we hold fast to our ideal, then evolution will become, for the first time, a conscious process. Increasingly conscious, it can proceed at a pace far outdistancing that achieved by trial and error – and in ever greater assurance, animation, and enthusiasm. That will be the highest form of freedom that man, or life, can have.[232]

In order for that to occur, education needed to change so that people would recognize the need for cultural change, especially in the area of values related to reproduction. Whereas children had traditionally been conceived for the glory of parents or ancestors, now the genetic well-being of children in future generations must be the primary goal in conception decisions.

> What is most needed … is an extension of the feeling of social responsibility to the field of reproduction…This is, to be sure, a higher type of mutual aid, a superior moral code, than exists at present, but it can be just around the corner for people who from early youth have had the facts of genetics and evolution made vivid to them and who have been imbued with a strong sense of their participation in the attainment of human well-being.[233]

Muller's program hinged upon the education of youth "with the facts of genetics and evolution made vivid to them."[234] It is my assertion that Muller's desire to advance his reform eugenic agenda was a central part of his motivation for involvement in the BSCS.

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[232] Ibid., 460-61.

[233] Ibid., 436.

[234] Ibid.

Reception of Muller's ideas was understandably mixed. His ideas were discussed in Panel Five on Social and Cultural Evolution on the last day of the conference. The panelists included three biologists (Edgar Anderson, Sir Julian Huxley and Muller), four anthropologists (Clyde Kluckhohn and Alfred L. Kroeber, Julian H. Steward, and Leslie A. White), and philosopher Robert M. Adams, futurist Fred Polak and archeologist Gordon R. Wiley. Discussion point #15 summarized the issue under consideration, and voiced the generally recognized concerns:

> The very historization of understanding in science… involves greater awareness of evolution and of the future as well as the past. This awareness will no doubt produce efforts to direct the course of evolution. No precedent exists for predicting what success such efforts may have…The use of these [modern tools] with insufficient foresight could have undesirable and even disastrous biological and cultural consequences. Conversely, their use with foresight would offer possibilities of human evolution both cultural and biological far exceeding those of the past.[235]

These scientists realized that greater understanding of evolution would necessarily bring attempts to control it, and reflected on the importance of foresight in determining the consequences of such intervention.

Anthropologist Leslie A. White commented that the concept of cultural evolution had been eschewed in anthropological circles until the Darwin Centennial because it was derived from Darwinism (presumably social Darwinism), but that now the concept of cultural evolution "is becoming respectable and therefore popular."[236] Sir Julian Huxley

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[235] See Discussion Question #15, "Panel Five: Social and Cultural Evolution" in *Issues of Evolution*, vol. 3 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960), 210-11.

[236] Ibid., 234.

agreed with Muller, emphasizing a humanist outlook, stressing the need for a “new kind of educational system to prepare the new generations to take their place” in the new, science-based world.[237] Conversely, Julian H. Steward objected that attempts at eugenic control were unwise or at least premature.

> It would be extraordinarily dangerous to place our future in the hands of men who claim wisdom and conscience…The role of the scientist is to analyze and interpret... Until we know more about…cultural evolution, attempts to control cultural evolution through manipulation of human genetics would be rash.[238]

Steward would later have even stronger objections to Muller’s views at the American Academy of Arts and Sciences Conferences on Evolution and Man’s Progress, held one year later.

Articles in newspapers and periodicals took varying approaches to reporting on Muller’s ideas as presented at the Centennial which varied from straight forward reporting with minimal comment to public censure. Abraham Raskin in *The Science Teacher* described Muller’s ideas as “perhaps the most provocative” presented at the Darwin Centennial panel discussions.[239] Raskin simply reported on Muller’s plan for the guidance of evolution, including germinal choice and human cloning as solutions for human genetic deterioration, but did not raise any objections. In *The University of Chicago Reports,* Albert Geller rather glibly summarized Muller’s proposition: “Man can produce a race of geniuses if he will only put aside old-fashioned ideas in human

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[237] Ibid., 242.

[238] Ibid.. 240-241.

[239] Abraham Raskin, “Special Report on the Darwin Centennial Celebration,” *The Science Teacher* 27, no.2, March 1960, 31-37, Box 8, Folder, 9, Darwin Centennial Celebration Records, Special Collections Research Center, University of Chicago, Chicago, IL.

breeding."[240] Tino Balio described the generally negative reactions which Muller received from the general public. He reported the reaction of poet Robert Frost on September 29, 1959: "Even though science may enable mankind to control his own evolution, the test tube will never replace passionate preference."[241] Balio also reported on responses in the *Indiana Star* solicited from five clergymen and a psychiatrist. The general response was that Muller's plan was immoral, and that, in the words of Rabbi William P. Greenfield, "We may succeed in producing a generation of brilliant but immoral people. Some of the most ruthless despots in the world have been known to be 'brilliant'."[242] In a later letter to the editor, Muller objected that the respondents ignored his discussion of values and his call to a "higher basis of morality."[243] There is no doubt that Muller's views were highly controversial, challenging moral and religious views of the time.

Muller's Most Controversial Paper

Probably the most controversial paper Muller presented was entitled "Shall we Weaken or Strengthen Our Genetic Heritage?"[244] which he presented at a conference of

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[240] Albert Geller, "Can Man Create Life?" *The University of Chicago Reports* 10 no. 1 (October, 1959). This was published by the Office of Public Relations.

[241] Tino Balio, "The Public Confrontation of Hermann J. Muller," *The Bulletin of the Atomic Scientists,* 23, no. 9 (November 1967): 10.

[242] Ibid., 11.

[243]"Muller Replies to Criticism of Eugenics Plan" *Indiana Star*, November 5, 1959, Box 8, Folder 9, Darwin Centennial Celebration Records, Special Collections Research Center, University of Chicago, Chicago, IL.

[244] Hermann J. Muller, "Should We Weaken or Strengthen Our Genetic Heritage," *Daedalus 90,* no.3 (Summer 1961), 432-450. [This paper was an abridged version of "The Guidance of Human Evolution" in

the American Academy of Arts and Sciences (AAAS) in the Fall of 1960, around the time Muller became a member of the BSCS Steering Committee. Since abridged transcripts of the proceedings were published in the journal *Daedalus*, we can see some of the reactions of the scientific community to Muller's eugenic ideas.

The AAAS conference had three separate parts. The first was on genetic evolution, the second was on social and cultural evolution, and the third was on evolution and the individual. Only two papers were read at each part, and the conference participants consisted of several dozen luminaries in relevant fields. The discussion was transcribed, edited, and published. The participants for the first part on genetics was heavily attended by biologists, including Muller, Bentley H. Glass, and three of the architects of the modern synthesis, Dobzhansky, Simpson, and Mayr. The participants for the second part on social evolution were mostly social scientists, although Muller and the architects were there, and the third part on evolution and the individual had mostly psychologists and psychiatrists as participants, although Ernst Mayr and Muller also participated in this third part as well.

For the genetics part of the conference, James F. Crow, a colleague of Muller's, presented one paper on current evolutionary genetics, while Muller presented the second paper, highlighting his own prescription to stop genetic deterioration of the human species which he called "Operation Bootstrap."[245] His arguments were similar to those in his other papers, stressing the importance of the future of humans as a species and calling

The Evolution of Man: Man, Culture and Society, vol. 2 of *Evolution after Darwin*, ed. Sol Tax (Chicago: The University of Chicago Press, 1960).]

[245] Ibid., 450.

for improvement in evolution education. Evolution education should underscore paramount values which humans already cherish and which would be even more necessary in the future : "warmth of fellow feeling, cooperative disposition, depth and breadth of intellectual capacity, moral courage and integrity, appreciation of nature and art, and aptness for expression and of communication."[246] While there was no objection to Muller's lists of values in the edited discussion which appears in *Daedalus,* there was reaction to Muller's assumption that these desirable human characteristics were necessarily genetically determined. Social scientists thought that environment was more important than genetics in forming human intelligence and dispositions. Geneticist Crow and paleontologist George Gaylord Simpson were generally supportive of Muller's ideas and thought that scientists knew enough to start voluntary positive selection in the near future.[247] But geneticist Dobzhansky had reservations, stating "Muller's utopia makes [Aldous] Huxley's *Brave New World* seem tame by comparison."[248] Dobzhansky saw the value of reducing the genetic load through genetic counseling, however. Most biologists, including Ernst Mayr, seemed intrigued by Muller's proposition, but were concerned that there was inadequate information available at the time to predict the results of such a program, both from a biological and cultural perspective and that more research was needed. Biologist Hudson Hoagland and AAAS Executive Officer Ralph W. Burhoe

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[246] Ibid., 445.

[247] James F. Crow commented that contemporary human geneticists knew more than animal breeders did two hundred years before when they were making striking progress. "Comments on Genetic Evolution," *Daedalus 90,* no.3 (Summer 1961), 462.

[248] Ibid., 470.

summarized the response to the genetics papers by the attendees by saying that "discussants …point to certain doubts about the adequacy of the theory, but its major features seem to stand. They also raised doubts concerning the practical and ethical problems of following Muller's suggested program of progress. The reader can judge for himself."[249]

For the second part of the conference, two papers from social scientists were discussed. The audience was somewhat different than the audience for the first part of the conference.[250] Julian H. Steward and Demitri B. Shimkin gave the first paper entitled "Some Mechanisms of Sociocultural Evolution."[251] Steward had been on Panel Five with Muller at the Darwin Centennial and strongly objected to Muller's ideas at that time. Neither Steward or Shimkin had been present at the first conference on genetics, but they later read the transcripts. In a series of letters to Ralph W. Burhoe, Steward and Shimkin objected to Muller's paper. The most serious objections were 1) human characteristics such as cooperation had not been demonstrated to be genetically determined and therefore plans to induce societal change through genetics was unsupported by evidence, and 2) any attempt to delineate desirable human characteristics and to develop programs to increase those characteristics in the general population through genetic means would be inherently racist. Shimkin's first letter to Burhoe was quite blunt: "To put it very

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[249] Hudson Hoagland and Ralph W. Burhoe, "Introduction to the Issue 'Evolution and Man's Progress,'" *Daedalus* 90, no. 3 (Summer 1961): 413.

[250] Lists of attendees at the AAAS "Conferences on Evolutionary Theory and Human Progress" can be found in *Daedalus 90,* no. 3 (Summer 1961): 610.

[251]Julian H. Steward and Demitri B. Shimkin, "Some Mechanisms of Sociocultural Evolution," *Daedalus 90,* no. 3 (Summer 1961): 477-97.

simply, the entire overtone of that conference is, in my mind, little removed from neo-Naziism. I spent six years of my life helping to rid the world of another would-be breeder of supermen."[252] In a subsequent letter, Shimkin expressed concern that the conference discussion indicated that Muller's views were more widely held by geneticists. In support of this assertion, Shimkin quotes Bentley H. Glass regarding how the ideas under discussion might appear in the new BSCS textbooks.

> In our new courses which we hope will be widely adopted, if they prove successful, there is a great deal more emphasis upon population genetics and upon the study of mutations, and the evaluation of human mutations in terms of socially desirable and undesirable characteristics. Genetic considerations are given place, and I think it's not beyond possibility that discussion of sperm banks might actually be introduced into the revision of these textbooks.[253]

While discussing sperm banks would not be going so far as to explicitly advocate germinal choice in the textbooks, this information would be needed by the public if germinal choice were to be popularized. What better way to start to change public opinion on reproductive issues than through the high school biology textbooks? Shimkin's concern was that the geneticists were not critically evaluating the proposal for "overall validity, socio-ethical soundness, and desirability of the program,"[254] but were instead concerned with how soon it could be implemented.

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[252] Demitri B. Shimkin to Ralph W. Burhoe, December 8, 1960, Series III, Box 4, Folder: 1960 American Academy of Arts and Sciences, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[253] Bentley H. Glass, from unedited transcript for Conference A, as quoted in Demitri B. Shimkin to Ralph Burhoe, January 4, 1961, Series III, Box 4, Folder: 1960 American Academy of Arts and Sciences, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN..

[254] Ibid.

Margaret Mead and Talcott Parsons felt that Steward and Shimkin had overreacted to their readings of discussion transcripts. In a letter to Burhoe, Parsons commented that he thought that Muller was naïve in not thinking through the sociological effect of his proposals, but that it was "utterly ridiculous" to accuse Muller of being a racist, and the controversy was basically "a tempest in a teapot."[255] Mead commented that we don't have any evidence that individual differences within a culture are *not* genetically determined and that "it is a measure of the danger of misunderstanding that a statement as extraordinarily humane, imaginative and gentle as the first day of Conference A can lead to such violent responses."[256] When the papers and edited discussion were finally published in *Daedalus*, the quote from Glass did not appear in the edited discussion, and an introduction was added that made it clear that social scientists had reservations about Muller's views.[257]

In an article in *The New York Times*, the writer highlighted Muller's desire to see his plan implemented. "The time, he concludes, has come to start getting a genetic 'Operation Bootstrap' incorporated into mores of the world community."[258] There was no

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[255] Talcott Parsons to Ralph Burhoe, January 24, 1961, Series III, Box 4, Folder: 1960 American Academy of Arts and Sciences, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[256] Margaret Mead to Ralph Burhoe, December 22, 1960, Series III, Box 4, Folder: 1960 American Academy of Arts and Sciences, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[257] Hudson Hoagland and Ralph W. Burhoe, "Introduction to the Issue 'Evolution and Man's Progress,'" *Daedalus* 90, no. 3 (Summer 1961): 411- 15.

[258] "Genetic Choosing of Humans Urged: Nobel Physiologist Fears 'Defectives' in Population," *The New York Times*, Sunday July 16, 1961.

attempt by the writer to challenge Muller's ideas or present opposing viewpoints. Muller's status as a Nobel Prize winner enabled him to be heard as authoritative.

Values in Education

In a paper delivered at a 1963 symposium concerning values in education, Muller focused on the change in American value systems necessary to support an increasingly scientific and technological worldview, and the role of education in bringing about this change. According to Muller, goals should include a scientific understanding of cosmic, biological, and cultural evolution, as well as the acquisition of an evolutionary outlook. Muller stated, "For it is in the light of this view that the individual becomes most vividly aware of his participation in the march of all humanity. Thereby he is most effectively prepared for a value system that places its first emphasis on the welfare of the whole species."[259] No longer should values be based on the good of the individual, family, or even society. Nor should values be determined by antiquated religions. Values should be determined by the good of humans as a species. Muller saw evolution education as prerequisite for individual understanding of one's true place in the biological world. Only with that understanding could a humanistic, scientific world view be developed in students.

Muller asserted, "A worthy life…must be one that plays some conscious part in the advancement of humanity at large, and that achieves self-fulfillment in the realization

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[259] Hermann J. Muller, "The Role of Science Education in Value Formation," *Values in American Education*, ed. Theodore Brameld and Stanley Elam (Bloomington, IN: Phi Delta Kappa, Inc., 1963): 88-89.

that it is doing so."[260] Humanity was becoming a world society, and the future of that society would rest on "find[ing] joy in working harmoniously with others," which would be essential for developing "cognizant voluntarism and meaningful democracy. The ultimate alternative would be a dictatorship."[261] But Muller feared that even these advances towards cooperation would not be enough to ensure that the human species would survive and thrive.

> It is necessary to use education … to reinforce the value system which, in the light of the humanistic scientific world view, will arouse in people the will to stem genetic deterioration and even to effect genetic improvement…Also needed is the idealistic realism based on a scientific outlook, which is not averse to employing advanced techniques even in so hallowed a realm as reproduction, and which is willing to reconsider hoary usages and attitudes that have outlived their functions.[262]

Muller then again presented his case for genetic counseling and germinal choice as cases in point. In the paper, Muller praised the work of the BSCS in the realm of reproductive education, but said that more needed to be done.

> Our youth should also be brought to realize vividly the biological functions of the enhancement of sexual and reproductive processes that is provided, especially in some higher mammals and man, by the psychological phenomena involved in sexual and parental love, the family system, and its extension to include cooperation among families. In this way the biology of reproduction will be seen in its wider setting.[263]

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[260] Ibid., 81.

[261] Ibid., 89.

[262] Ibid., 90.

[263] Ibid., 86.

Human biology education based on a scientific worldview should not stop at presenting "the facts of life" as it were, but present human sexuality in a more comprehensive way. For example, while antiquated value systems encouraged producing many descendants as a way of honoring ancestors, a modern view would require intelligent consideration of the circumstances in which children were being conceived and their effect on the good of society as a whole, redefining the value of sexuality as separate from procreation.[264]

Conclusion

I have shown that Hermann J. Muller saw evolution as essential knowledge for the common person for several reasons. First, students needed to have a correct view of nature and understand the dominant, yet dependent, relationship humans have with all living things. Second, by studying physical, biological, and cultural evolution, humans would be the first biological organism to understand that it is not static, but evolving. This would necessitate a re-consideration of values in line with "a modern view of life," which was humanistic and based on a scientific view of humankind within nature. Key objectives should be human survival and extension of the species, with highest value placed on intelligence and cooperative behavior. Third, this scientific, humanistic view of the world would be used to face problems which had to be addressed for the future of the species. High priority was to be given to maintaining the quality of the human gene pool, especially in response to the danger of nuclear radiation. Genetic counseling and

[264] Muller's ideas on the decoupling of reproduction and human sexuality were complementary to the ideas of Alfred Kinsey, noted biologist and sex researcher who also was a professor at Indiana University when Muller was there. Both being biologists, they certainly would have known each other, but I have found no evidence that they worked closely together.

germinal choice were two reform eugenic responses to the problem of increasing genetic load.

Muller shared his views widely through speeches and in print. While he was greatly respected for his life's work in genetics, his views on eugenics were controversial. Biologists were sympathetic to his championing of evolution education and the spread of a scientific, humanistic viewpoint, and some, such as architect of the modern synthesis George G. Simpson, were supportive of Muller's eugenics programs. Others, like Theodosius Dobzhansky, thought more research was needed first. Muller put his hope in education to help people understand the nature of evolution, reinforce a value system based on a humanistic scientific worldview, and "arouse in people the will to stem genetic deterioration and even effect genetic improvement"[265] through advanced reproductive techniques. It is little wonder that the BSCS textbooks was an attractive vehicle for Muller to share his evolutionary vision.

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[265] Hermann J. Muller, "The Role of Science Education in Value Formation," 90.

Chapter 4

H. Bentley Glass, Arnold B. Grobman, and John A. Moore

> Politically it has been demonstrated that a house divided against itself cannot stand. I affirm that it must also be true, that a nation of microscopically few scientists molding and altering the lives of people, and a populace uncomprehending, superstitious, and resisting likewise cannot endure. Somehow, and soon, mankind must become truly scientific in spirit and in endeavor. Otherwise, oligarchy, and eventual collapse.
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> --H. Bentley Glass, "The Responsibilities of Biologists"

In my estimation, the three most important leaders of the BSCS were H. Bentley Glass, Arnold B. Grobman, and John A. Moore. They were all committed to evolution education for the average citizen. After being recruited in 1958, Grobman served as the Director of the BSCS from 1959 to 1965 and Glass served as the Chairman of the Steering Committee for the same period.[266] John Moore was the original Chair of the Committee on the Content of the Curriculum, the next most powerful position in the

[266] Historical Note, Smithsonian Institution Finding Aid, Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, http://siarchives.si.edu/findingaids/FARU7389.htm (accessed September 7, 2011). Grobman succeeded Bentley Glass as Chairman of the Steering Committee, 1965-1969; Audra Wolfe, "Bentley Glass, Century's Son," *Mendel Newsletter* 12 (February, 2003), http://www.amphilsoc.org/mendel/2003.htm#wolfe (accessed August 30, 2011).

organization, and became supervisor of the Yellow Version of the BSCS textbook. Moore remained with the BSCS as supervisor for the Yellow Version and its revisions for over 15 years. All three were part of the powerful Executive Committee of the BSCS, which handled administrative decision making between Steering Committee meetings, which met only two or three times yearly. All three were evolutionists; Glass was a geneticist, while Grobman and Moore were herpetologists with genetics research experience. Together, Glass, Grobman, and Moore guided the BSCS from its earliest days through the publishing of the first commercial versions of the textbooks in 1963 and beyond. An understanding of their backgrounds and commitments is important to understanding the path that the BSCS took during its early years.

In this chapter, I will describe their backgrounds including key relationships that link these individuals to each other and to the architects of the modern synthesis. I am particularly interested in their thinking on evolution education. I assert that Bentley Glass, Arnold Grobman and John Moore saw evolution education as a primary responsibility of biologists. There was urgency on this issue because they perceived that the scientific and technological developments of the 1940s and the 1950s placed the future evolution of the planet, more than ever before, into the hands of mortal men.

H. Bentley Glass

Glass was born in China in 1906, the son of Baptist missionary parents. He graduated from Baylor University (A.B. 1926, M.A. 1929) and studied genetics with Hermann J. Muller at the University of Texas (Ph.D. 1932). A National Research Council Fellowship and his first teaching assignments in Missouri and Maryland led to an appointment as a biology professor at John Hopkins University, a position which he held from 1948 to 1965.[267] Glass stated that his range of interests served a central goal: "educating laymen in the questing spirit of science and reminding science of its social responsibility."[268] He communicated with scientists and the public frequently through lectures, a newspaper column, scholarly articles, and books. His editorship of *The Quarterly Review of Biology*, his leadership in major professional societies, and his consulting activities with organizations as diverse as the Atomic Energy Commission and the National Council of Churches put him in constant contact with a broad range of scientific and other policy makers.

According to historian of science Audra Wolfe, Bentley Glass was a "classic 1950s liberal," working for desegregation in the Baltimore Public Schools, serving as President of the Maryland Chapter of the American Civil Liberties Union (ACLU), 1955-1965 and President of the American Association of University Professors, 1958-1960.[269] Historian Howell Baum also characterized the members of the Baltimore school board of which Glass was a part as "classical liberals." According to Baum, emphasis by 1950s liberals on the expansion of government was tempered by an emphasis on individualism

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[267] Ibid.

[268] Adam Bernstein, "Outspoken Geneticist H. Bentley Glass Dies," *Washington Post*, January 21, 2005, http://www.washingtonpost.com/ac2/wp-dyn/A25321-2005Jan20?language=printer (accessed September 14, 2011).

[269] Audra Wolfe, conversation with author, July 28, 2011.

and individual choice.[270] Wolfe presents Glass in the *Mendel Newsletter* as a rare combination of scientist, Democrat, and Baptist whose complex affiliations defined his choices on such issues as loyalty oaths and desegregation. Wolfe obtained access to Glass's FBI file and found that it contained mostly of background checks for visa applications and Atomic Energy Commission activities.[271] However, even though repeatedly portrayed by informants as a loyal American, Glass found himself classified as a "possible security risk" based on "a $5 donation to the Baltimore Chapter of the American Youth for Democracy, an organization with alleged ties to the Communist Party."[272] Glass apparently spoke at a luncheon and signed a petition for the group both supporting desegregation in the military. The FBI seemed more concerned about this nominal connection than his support of academic freedom and his opposition to loyalty oaths. His record was finally cleared in 1955, although "the FBI continued to collect information on Glass's views on genetic mutation, nuclear proliferation, and the Soviet threat throughout the 1960s" according to Wolfe.[273]

Glass became known for his work on the Baltimore School Board, where he supported the racial desegregation of Baltimore schools. Newspaper reporter Edwin Diamond points out that

[270] Howell Baum, "School Desegregation and the Limits of Liberalism: The Case of Baltimore" (paper presented at the annual meeting of the History of Education Society, Cambridge, MA, November 4-7, 2010).

[271] Wolfe, "Bentley Glass, Century's Son," http://www.amphilsoc.org/mendel/2003.htm#wolfe (accessed August 30, 2011).

[272] Ibid.

[273] Ibid.

> Religious fundamentalists who might have argued the issue on Biblical grounds were less certain of their case because schoolboardman Glass had taught a class in the Gregory Memorial Baptist Sunday School for nineteen years.[274]

Glass was conversant in both science and religion, and therefore did not fit the atheist-evolutionist stereotype. The combination of evolutionary biologist and Baptist Sunday School teacher was probably a rare combination. What did go together was Glass's support of evolution education and desegregation. Glass had analyzed segregationist thinking in Maryland and found that those opposed to school integration were also usually opposed to the teaching of evolution.[275] Glass was decidedly on the side of both school desegregation and evolution education.

Glass and Evolution

An early piece of evidence of Glass's interest in evolution education is a memorandum in his papers dated October 6, 1936 from the Biology in Secondary Schools Committee of the Union of American Biological Societies, of which Glass was a member. This committee, chaired by endocrinologist Oscar Riddle, was formed in response to the "widespread feeling among professional biologists that life science is not

[274] Edwin Diamond, "Biologist in Society's Laboratory," *Saturday Review*, Nov 2, 1957, 47. The Gregory Memorial Baptist Church was a large Southern Baptist Congregation which was cited by the News Service of the Southern Baptist Convention for voting to accept people of all races for membership in the church in 1964. See "2 Baltimore Churches to Welcome Negroes", *Baptist Press,* February 5, 1964. http://media.sbhla.org.s3.amazonaws.com/1859,05-Feb-1964.pdf (accessed 9/30/11).

[275] Ibid.

receiving due attention in the education of youth."[276] The preliminary report of this committee noted that:

> In many schools the principle of organic evolution is either not taught or very incompletely taught. Many other teachable developments of recent decades are not taught though these developments within the life-science have exceptional educational value and much social importance.[277]

In 1942, this committee (then entitled the Committee on the Teaching of Biology of the Union of American Biological Societies) published the results of a survey of high school biology teachers in the United States.[278] This survey indicated that less than half of the teachers taught organic evolution. "A conclusion of the committee was that there is a tendency 'to teach biology not as a science, but (a) as a way to pleasing hobbies, or (b) as a series of practical technologies.'"[279] Although this was only one of at least a dozen committee reports commenting on biological education in the 1940s, this committee's results were particularly important in framing the prominent idea that evolution was poorly treated in high school biology textbooks, which was a key assumption of the

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[276] Benj Gruenberg, "Memorandum on Projected Work of 'Biology in Secondary Schools' Committee of the Union of American Biological Societies," Oct 1936, Box 1, Committee on Biological Teaching/Secondary 1936-38, Glass Papers.

[277] Memorandum "To the Union of American Biological Societies, Prof. W. C. Curtis, President, The University of Missouri, Columbia, Mo." n.d., Box 1, Committee on Biological Teaching/Secondary 1936-38, Glass Papers.

[278] Oscar Riddle, ed., *The Teaching of Biology in the Secondary Schools of the United States: A Report of Results from a Questionnaire* (The Committee on the Teaching of Biology of the Union of American Biological Societies, 1942).

[279] Paul D. Hurd, *Biological Education in American Secondary Schools 1890-1960* (Baltimore, MD: Waverly Press, Inc., 1961), 81.

BSCS in planning their new textbooks.[280] Oscar Riddle later released a provocative book on his ideas about science education called *The Unleashing of Evolutionary Thought.*[281] In this book, Riddle predicts that naturalism will win out over supernaturalism in the war over evolution teaching. See Chapter Five for more on Riddle's work and its influence on the BSCS.

Glass felt that high school biology textbooks showed much need for improvement. In a 1961 article for the *American Scientist*, Glass asserted:

> Most high school biology textbooks are twenty years behind the advancing front of knowledge, and in some very significant matters, because of social or religious opposition, fully a century in arrears. We [members of the BSCS] were in unanimous agreement that appropriate scientific treatment must be accorded such "controversial" subjects as organic evolution, the nature of individual and racial differences, sex and reproduction in the human species, and the problems of population growth and control.[282]

These controversial subjects were all parts of the biological knowledge that Glass felt biologists had an ethical responsibility to teach to the next generation. The tendency, both in textbooks and instruction, was to minimize coverage. For Glass, their controversial nature was ever the more reason why they needed to be addressed. See Chapter Six for more on this topic.

Glass and Values

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[280] Arnold Grobman mentions Oscar Riddle's work in "Recent Advances in Secondary-school Biological Education," *Proceedings of the Conference on Progress in Nuclear Education,* Oak Ridge, TN, 1962, Report TID-7638.

[281] Oscar Riddle, *The Unleashing of Evolutionary Thought* (New York: Vantage Press, 1954).

[282] Bentley Glass, "A New High School Biology Program," *American Scientist* 49, no. 4, December, 1961, 525.

Glass's values are seen in the purposes he defined for education. The first purpose of education was the transmission of knowledge from one generation to the next, so that an edifice of knowledge could be built for the benefit of humankind. For Glass, knowledge was inextricably linked to power. He asserted that human power had increased from prehistoric times until today, mainly because of the increase in knowledge and upon the transmission of that increasing knowledge to each new generation through education.[283] Knowledge was growing much faster than in earlier times, making it all the more imperative for every scientist to make what he finds available for future generations to build upon. In addition to scientific knowledge, the nature of science had to be understood by future citizens. Glass asserted, "A democracy rests secure only upon a basis of enlightened citizens who have imbibed the spirit of science and who comprehend its nature as well as its fruits. In fulfilling the requirement of our age for the public understanding of science the scientist must shirk no duty."[284] Glass thought that knowledge and the power it conveys should not remain sequestered with a few, but be available to all, because of the potential of human beings to use knowledge for harm as well as good. In a democracy, citizens needed to be able to understand, appreciate and use scientific knowledge in deliberating public issues.

The other primary purpose of education in Glass's view was "to enlarge the comprehension of man of his place in the universe."[285] This was the philosophical aspect

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[283] Bentley Glass, *Science and Liberal Education*, (Baton Rouge, LA: Louisiana State University Press, 1959), 54-56.

[284] Ibid., 96.

[285] Ibid., 56.

of education which "began in magic, superstition, and primitive religion," but which had been replaced by a more sophisticated understanding of the world based in science and enriched and protected by the humanities.[286] With Galileo's proclamation of the truth of the Copernican system "was man's claim to central position in the created universe shaken" and with Darwin, the "ancient scheme" of "Creator God in heaven and Man the Created in prime position on earth" had become "untenable."[287] Power that we once attributed to supernatural forces were increasingly being understood and harnessed by humans.

Glass thought that as we are freed from fear engendered by impotency and superstition, we need to face the dangers from within that come from the increase in human power. The dangers brought upon the world by atomic weapons were a prime example of the darker side of human knowledge and power. The use of power needed to be guided by human values. Glass stated, "Science creates knowledge and knowledge generates power, but knowledge resides only in the minds of men who first must learn and be taught, and power is tyranny unless it be guided by insight and wisdom, justice and mercy."[288] There was a deep need for teachers "who can teach science not as authoritative body of facts, principles and concepts, but instead as an imaginative way of systematically exploring the unknown aspects of nature, a way of integrating experience

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[286] Ibid. 83-85.

[287] Ibid., 57-58.

[288] Bentley Glass, "The Scientist and the Science Teacher," *AAUP Bulletin* 50, no. 3 (September 1964): 268.

and developing a workable philosophy of life, based on an appreciation of one's participation in a great social enterprise, and pervaded with beauty."[289] Scientific knowledge itself was not enough. Students need to use this knowledge to develop an integrated understanding of their place in the world. Glass also asserted: "What is most important is that every man, if he is to avoid confusion of spirit, must create for himself an integrated view of himself and his world. This is the function of philosophy, and in carrying out that function it must work within the framework of scientific knowledge and concepts."[290] This meant that whatever worldview was decided upon, it had to be consistent with scientific naturalism. Glass felt humanity had a long way to go in integrating scientific knowledge into a coherent worldview. What was available, this "edifice of science and philosophy," is "a mere foundation, and not the completed structure it will some day be. For we hope to build of our ideas and conceptions a cathedral, vast and beautiful, time-tested, wherein the human spirit may find strength and courage, peace and wisdom."[291] Glass did not go so far as to propose that science would do away with religion or form the basis of a new religion, but that philosophical knowledge, especially ethics, needed to integrate what was known about the world through science.

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[289] Glass, *Science and Liberal Education,* 66.

[290] Ibid., 83.

[291] Ibid., 84.

Glass wrote four books that addressed the topic of ethics.[292] The first of these, *Science and Liberal Education*, was based on a series of lectures given in 1958 just before Glass began his work with the BSCS. Glass was especially concerned with the exponential growth of biological knowledge within the 20th century. Education was critical not only for society to reap the benefits of scientific knowledge, but to preserve the freedoms of its individuals in the face of such growth in human power.

> Only education can preserve in human society the freedom of the people, for their freedom to think, their freedom to choose – and above all, to choose wisely – depends on their knowledge. All their knowledge must relate human power, acquired through science, to all their world of values.[293]

The world of values was not to be diminished by science, but must be integrated with it. With all new scientific knowledge comes potential power over the natural world and our fellow human beings. At the same time that knowledge grants power, it requires choice as to how that power is to be used, for good or harm. These choices are made by individuals and societies based on their values. Therefore, the function of values is critical in a society.

It was unacceptable that these decisions should be made by scientists alone, because they did not necessarily possess the wisdom to see all the larger issues facing humankind. In the keynote address at the Annual Meeting of the American Institute of Biological Sciences in 1957, Glass stated: "I would feel no confidence in asking the

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[292] In addition to the previously mentioned *Science and Liberal Education,* Bentley Glass wrote three other books on this topic: *Science and Ethical Values* (Chapel Hill, NC: The University of North Carolina Press, 1965), *The Timely and the Timeless* (New York: Basic Books, Inc., 1970), and *Progress or Catastrophe: The Nature of Biological Science and Its Impact on Human Society* (New York: Praeger Publishers, 1985).

[293] Glass, *Science and Liberal Education*, ix.

profession of biology to take over the regulation of our government and our society. There are so few biologists who endeavor to make their biology count for anything outside the laboratory."[294] The public would need to be the informed decision makers.

The biological knowledge that most concerned Glass was the knowledge of genetics and evolution, since how this knowledge would be used could determine the future survival of humans and other forms of life:

> Through genetics and the experimental study of evolutionary process now possible, man possesses the power to remold all life, including his own nature, for incalculable good or incalculable harm… What is most needed, therefore is good judgment of values that still lie outside the scope of the sciences – in other words, wisdom.[295]

Glass acknowledged that science alone was not enough. Humans must use their values to evaluate scientific knowledge and its uses.

Glass made it clear that the understanding of evolution established by the modern synthesis was necessary for informed judgment in a 1969 article entitled "Evolution in Human Hands."[296] The knowledge of evolutionary mechanisms placed power in human hands to willfully intervene in human evolution. This knowledge was too important to be held by only a small circle of biologists: "It is certainly not for the geneticist to decide what evolutionary goals man should seek."[297]

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[294] "Awareness and Atoms", *Newsweek*, Science Section, September 8, 1959, as quoted in a Notice by Hiden T. Cox, n.d. GP7389, Box 3, Cox, H.T.

[295] Glass, *Science and Liberal Education*, vii-viii.

[296] Bentley Glass, "Evolution in Human Hands," The Phi Delta Kappan 50, no. 9 (May 1969): 506-10.

[297] Ibid., 506.

Glass could see that knowledge of genetics and evolutionary mechanisms would present many future quandaries to human society, and he began to undertake an almost prophetic role, warning people about the decisions that would need to be made as science advanced. For example, Glass was concerned with the possibility of public exposure to radiation from nuclear power plant leakage and accidents. He sought to alert the public to the dangers of induced mutations from ionizing radiation in an article in *Science* entitled "The Genetic Hazards of Nuclear Radiation."[298] Glass also served with Hermann J. Muller on the National Academy of Science Committee on the Biological Effects of Atomic Radiation in 1956. Both geneticists asserted that there was no safe level of nuclear radiation when it came to the possible effects on future generations. They had an ally in Arnold B. Grobman who also was committed to informing the public about the dangers of nuclear radiation.

Arnold B. Grobman

Arnold Grobman was director of the BSCS from 1958 to 1965. He, too, was committed to evolution education for everyone. Arnold Grobman was born in Newark, New Jersey in 1918. In July, 2011, I had the privilege of interviewing him at his home in Gainesville, Florida close to the University of Florida where he spent the early years of his professional career.. A tall distinguished man in his nineties, he shared many stories of his younger self and the BSCS. His early interest in the natural world was encouraged by a trip to the American Museum of Natural History (AMNH) in New York City, which was full of dioramas of animals, contemporary and extinct, in their native habitats. The

[298] Bentley Glass, "The Genetic Hazards of Nuclear Radiation," *Science* 126 no. 3267 (August 9, 1957): 241-46.

AMNH has played an important role in the history of evolution research and education, and was home to two of the architects of the modern synthesis, Ernst Mayr and George G. Simpson. Grobman found a brown snake in his neighborhood, which he decided to keep in a wooden box in the ground to approximate the snake's natural habitat. His early experiences in trying to identify his snake led to his correspondence with a herpetologist at the AMNH and his eventual study at the University of Michigan with the author of one of the taxonomic keys he consulted.[299]

Grobman received his Ph.D. in 1943 in Zoology from the University of Rochester, under the famous geneticist Curt Stern. Grobman became a Zoology Instructor at Rochester, teaching anatomy classes to Navy and Marine students during WWII. In 1946, he became Assistant Professor in the Department of Biology of the University of Florida, and in 1951 became Director of the Florida State Museum. He took the "moribund" museum, a unit of the University, from a staff of four people to "the largest natural history museum south of the Smithsonian Institution."[300] Grobman was a talented administrator, and in 1958 he was invited by Hiden Cox to become Director of the BSCS, moving to the University of Colorado in Boulder, Colorado, to start that position in early 1959.[301] After his work with the BSCS he would become Dean of the College of Arts and Sciences of Rutgers University, and Chancellor at the University of Missouri.[302]

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[299] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

[300] Arnold Grobman, Biographical Sketch, Nomination for McGraw Prize in Education, April 10, 1989, Box 6, Folder: Moore, John A. (#2), Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

[301] Hiden Cox to Arnold Grobman, December 23, 1958, Box 3, Folder: Cox, H.T., Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

Early in Arnold Grobman's career he was involved with genetics and radiation research. In 1944, while at the University of Rochester, he was recruited to work as a research associate at the University of Rochester Medical School on a Manhattan District Contract. This study determined that there was a dose related increase in hereditary abnormalities in the offspring of male mice exposed to ionizing radiation. This work suggested that there was really no safe level of radiation for humans. The results of this particular study were not published in the years following the war, but Grobman felt that they should be made known. He wrote a book entitled *Our Atomic Heritage,*[303] and sought permission of the Department of Energy to publish the book. While he was not prevented from publishing, representatives of the AEC made several attempts to try to dissuade him. They were concerned that the results might alarm the public, especially those people working with radiation.[304] Grobman first attempted to have the book published by Alfred A. Knopf Incorporated, but they felt there were already too many books "about atomic energy and its faults."[305] Grobman persevered, and the book was published by the University of Florida Press in 1951. Grobman asserted that there was no

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[302] Arnold Grobman, "Rationale", part of a nomination for McGraw Prize in Education, April 10, 1989, Box 6, Folder: Moore, John A. (#2), Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

[303] Arnold Grobman, *Our Atomic Heritage* (Gainesville, FL: University of Florida Press, 1951).

[304] Arnold Grobman to Freedom of Information Act Officer at the Department of Energy, April 14, 1998, Box 1, Folder: Department of Energy, Record Unit 04-007, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC. Grobman mentions the names of Max Zelle and Jim Neel as two people who tried to dissuade him from publishing the book.

[305] Harold Straus to Professor Grobman, October 19, 1949, Box 5, Folder: Knopf, Alfred, Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

dose at which humans could be assured of safety from hereditary damage. The book attracted the attention of Hermann J. Muller, who won a Nobel prize for demonstrating that X-rays cause mutations in the genes of fruit flies. Muller expressed his relief in a letter that Grobman had not been deterred in writing the book,[306] and demonstrated his support by writing an endorsement for the dust jacket.

Correspondence in 1955 indicates that Muller considered Grobman to be an ally against attempts "to soft pedal the airing of the facts concerning the genetic damage produced by radiation."[307] Grobman provided additional information to Muller about his work on the Rochester project and his work at the Oak Ridge National Laboratory as a Research Associate in the summer of 1950 on a related project. These communications establish that Grobman and Muller shared a common concern about radiation dangers and were both working to publicize those risks in the years prior to their work together at the BSCS. They were fulfilling the mandate expressed about the same time by Bentley Glass that a scientist has the responsibility to educate the public, not only about the benefits of new science and technology, but also the risks.

Grobman and Evolution

Arnold Grobman went to Southside High School in Newark, New Jersey in the 1930s. While evolution was not covered in his high school class, the teacher mentioned that Darwin's *Origin of Species* was a book about evolution. In the summer after he had

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[306] Hermann Muller to Arnold Grobman, May 8, 1951, Box 6, Folder: Muller, H.J., Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

[307] Hermann Muller to Arnold Grobman, September 30, 1955, Box 6, Folder: Muller, H.J., Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

high school biology, Grobman obtained the book and studied it during his job as a pool attendant.

> And, it seemed to me, that natural history, natural selection, could pave the way for all the arising of, of all the different kinds of animals and plants, you didn't a need supernatural guidance – natural selection would do it…If a giraffe liked to eat leaves from a tree, if another giraffe had a longer neck and could reach a little higher it was likely to survive a little longer and produce more young. And so, giraffes would tend to get longer necks. That all made sense to me, and I became enthralled with the whole idea…So that…evolution, its central part in biology, was part of my understanding from early days.[308]

As had Hermann J. Muller and architect of the modern synthesis George Gaylord Simpson before him, Grobman found in his high school years that evolution "made sense" of the natural world. Grobman's interest in evolution continued during his work at the natural history museum at the University of Michigan and resulted in Ph.D. dissertation work at the University of Rochester on the geographic distribution of North American salamanders. Mapping the geographic distribution of closely related species helps to understand the evolutionary process. Grobman also demonstrated interest in evolution through his membership in several organizations. He was a member of the Genetics Society of America and a charter member of the Society for the Study of Evolution started by Ernst Mayr in 1945.[309] The Society for the Study of Evolution was part of the unifying efforts of the architects of the modern evolutionary synthesis,

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[308] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

[309] "Personnel Security Questionnaire," US Atomic Energy Commission, January 12, 1950, Box 1, Folder: Department of Energy, Record Unit 04-007, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

legitimizing and advancing the field of evolutionary biology, while uniting biologists from various sub-disciplines with interest in evolution research.

John A. Moore was another primary figure in the BSCS who had a background in herpetology and evolution. Grobman knew Moore in the early 1940s, and he was especially fond of Moore's work on frog genetics in the Journal of Heredity.[310] Grobman tried to interest Moore in joining him in Rochester on the Manhattan District project, but Moore was already committed to teach at Barnard College.[311] Grobman later recruited Moore to be the Chair of the BSCS Committee on the Content of the Curriculum.[312] As creationists began to challenge evolution as presented in the BSCS textbooks, both Moore and Grobman sought ways of presenting evolution that still left room for religious beliefs, even though they were both heavily committed to the superiority of naturalistic methods for determining knowledge about the world. In 1986, Grobman sent Moore a draft of an article about creationism and evolution which clearly shows Grobman's attitude towards science and religion.

> Two major domains of human thought have been particularly directive as we have been striving to understand the universe in which we live. One is a system of beliefs (religions, ethics, superstitions) sometimes referred to as supernatural and the other is a collection of observations and experiences (science, trial and error) sometimes referred to as naturalism…There has been an increasing dominance of naturalistic views over systems of beliefs in the course of the development of

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[310] Arnold Grobman to John Moore, April 1, 1943, Box 6, Folder: Moore, John A. (#1), Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

[311] John Moore to Arnold Grobman, August 24, 1943, Box 6, Folder: Moore, John A. (#1), Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

[312] John Moore to Arnold Grobman, January 12, 1986, Box 6, Folder: Moore, John A. (#2), Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

> Western Civilization. By describing that change I would not wish to discourage anyone from those personal beliefs that may provide solace, comfort, satisfaction, or peace of mind. Such discouragement need not be associated with a realization that creationism is simply the most recent of a long series of losing skirmishes in the battle for men's minds. The prevailing historic trend is the decline of anthropocentrism.[313]

Grobman traced the history of the rise of naturalism and concluded that the defeat of creationism was inevitable, part of a losing attempt to "deflect the relentless and surging tide of naturalism."[314] While Grobman attempted to leave room for personal religious beliefs, he saw evolution as essential knowledge and the increasing influence of naturalism on men's minds as inevitable. He did not attempt to reconcile fundamentalist religion and scientific accounts of the origins of life. Grobman pointed out in a 1973 letter that inclusion of religious creation stories in textbooks in addition to evolution might actually "drive students to accept evolution as the most rational and convincing of the points of view offered."[315] In my interview of Dr. Grobman, I asked him whether he thought that all scientists at the time of the early days of the BSCS accepted evolution. He said that anyone he would call a scientist accepted evolution. He acknowledged, however, that many scientists had religious beliefs as well, but there could be no question about the fact, then or now, that evolution had occurred and is continuing to occur.[316]

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[313] Arnold Grobman, n.d., attachment to John Moore to Arnold Grobman, June 6, 1986, Box 6, Folder: Moore, John A., (#2), Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC. While this was written in 1986, it is consistent with the Grobman's remembrances of his earlier self in the interview I conducted with him.

[314] Ibid.

[315] Arnold Grobman to Frederic Le Clercq, August 13, 1973, Box 7, Folder: NABT, Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

[316] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

In an article submitted for the NEA journal in 1966, Grobman outlined a sequence from lower elementary grades leading to "a modern concept of evolution appropriate for a senior high student."[317] This sequence was designed to prepare students for "public policy decisions of the future." This sequence built a foundation in the earlier grades for the in-depth presentation of evolution at the senior high level.

> Lower Elementary Grades: Handling of many inanimate and living objects leading to ideas of groups, groups within groups, and relationships.
>
> Upper Elementary Grades: Broad classifications of animals and plants as classroom exercises; identification of specimens of animals and plants, both living and fossil; geographic distribution of animals and plants.
>
> Junior High: Classroom experiments involving simple Mendelian genetics; dissection of a vertebrate animal; studies in sedimentation and erosion based on pilot laboratory experiments.
>
> Senior High: Consideration of Hardy-Weinberg Law; study and discussion of Darwinism; laboratory investigation of radiation-induced mutations; laboratory study of developing embryos with consideration of implications of recapitulation theory; discussion of modern concept of evolution.[318]

This sequence made sure that students had preparatory experiences before they were presented with modern evolutionary theory. In Grobman's plan, students would learn basic information in elementary schools to prepare them for an in-depth experience with evolution in high school which would then be a foundation for informed decision making as an adult. He stated, "The matter is extremely crucial because tomorrow is already

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[317] Arnold Grobman, "Science Education Today and Public Policy Tomorrow", attachment to letter to Mildred Fenner, December 20, 1966, Box 7, Folder: National Education Association, Record Unit 7389, Arnold B. Grobman Papers, Smithsonian Institution Archives, Washington, DC.

[318] Ibid.

here." The kind of topics citizens were already being expected to confront included population control, conservation of natural resources, pesticides, atomic energy, and government support of scientific research. No one could predict what citizens of the future would be called upon to decide, so simply trying to make more room in the curriculum for many specific topics was not feasible. Therefore, Grobman felt a strong basic foundation in the concepts of biology with evolution at the center would best fit the needs of tomorrow's citizens.

John A. Moore

Arnold Grobman and Bentley Glass recruited John A. Moore to the next most important position in the BSCS – the Chairman of the Committee on the Content of the Curriculum. Moore was a prominent zoologist and evolutionary biologist whose education and career spanned most of the 20th century. Although not as well-known as other scientists involved in educational reform during the 1950s and 1960s such as physicist Jerrold Zacharias or geneticist Bentley Glass, Moore was an academic zoologist who authored or edited more than 180 articles and books, including an article in the ornithological journal *Auk* when he was 16.[319] He held professorships at Barnard College and Columbia University, where he was chairman of the zoology department from 1949 to 1952. He became a fellow of the American Academy of Arts and Sciences in 1960 and was elected to the National Academy of Sciences in 1963. Later Moore would serve as President of the Society for the Study of Evolution, President of the American Zoological

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[319] Wilfred Elders, "John A. Moore: A Champion of Evolution," National Center for Science Education http://ncseweb.org/book/export/html/2863 (accessed December 18, 2008).

Society, and Professor at the University of California Riverside.[320] He was known for his humor and enthusiasm.[321]

Moore was born in Charles Town, West Virginia, in 1915, where he began his appreciation of the natural world. At the age of four his mother divorced and moved with John to Carson City, Nevada. He also lived in briefly in Oakland, California, before his mother remarried and they settled in Markham, Virginia. Moore developed an early interest in birds, which he shared with his biological father who lived in Charleston, West Virginia. His senior year of high school was spent in New York City at Haaren High School in Hell's Kitchen. Moore volunteered at the AMNH, performing basic tasks such as recording the numbers of whale bone specimens or locating journal articles. He met architect of the modern synthesis Ernst Mayr at AMNH in 1932.[322] This meeting was memorable for Moore, the beginning of a life-long friendship.

Moore also entered Columbia University in 1932, specializing in embryology and genetics, and received his B.A., his M.A., and eventually his Ph.D. in 1940. During that time, he met Betty Clark, a fellow zoology graduate student who also studied under Lester Barth. They married in 1938 and Betty received her Ph.D. in

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[320] Charles H. Smith, "Some Biogeographers, Evolutionists and Ecologists: Chrono-Biographical Sketches. Moore, John Alexander (United States 1915-2002)," http://www.wku.edu/~smithch/chronob/MOOR1915.htm (accessed April 30, 2007).

[321] Wilfred Elders, "John A. Moore," http://ncseweb.org/book/export/html/2863.

[322] Rudolfo Ruibal, Vaughn H. Shoemaker, and Margaret M. Stewart, "Historical Perspectives: John A. Moore," *Copeia*, 2001, no.4: 1155.

1949.[323] There is evidence that she worked as a Ph.D. examiner for the Zoology Department at Columbia, co-authored papers with her husband, and was indispensable to John's laboratory and field work in California.[324] The Moores and the Mayrs (Ernst and Gretl) saw each other frequently during their years in New York, both professionally and socially. Their relationships lasted throughout their lives, leading Gretl Mayr to characterize the relationship between Mayr and Moore as "best friends."[325]

Moore's entire university education and professional career until 1969 was based in New York City, including the first 10 years of his association with the BSCS. His first positions as a college instructor were at Brooklyn College and Queens College from 1939 to 1943.[326] He also was a research associate at the AMNH from 1942 onward.[327] But the bulk of his time was spent as a professor at Columbia University or its sister institution, Barnard College, from the early 1940s until 1969. This has dual significance. On the one hand, Moore was initiated into the historic research tradition of genetics and embryology at Columbia. On the other hand, Moore

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[323] Ruibal, Shoemaker, and Stewart, "Historical Perspectives," 1155-56.

[324] List of Ph.D. Committee Members for Margaret Parr, February 10, 1966, Box 10, Folder: Parr, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside; Ruibal, Shoemaker, and Stewart, "Historical Perspectives," p.1156; John A. Moore to Bryan Shorrocks, November 23, 1982, Box 10, unfiled, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[325] Gretl Mayr to Betty C. Moore, November, 1987, Box 69, Folder: Ernst Mayr 1941-91, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[326] Ruibal, Shoemaker, and Steward, "Historical Perspectives," p.1156.

[327] Smith, "Some Biogeographers, Evolutionists, and Ecologists" http://www.wku.edu/~smithch/chronob/MOOR1915.htm.

was greatly involved in teaching, and developed strong opinions about science education. Personal circumstances during the 1950s also influenced the trajectory of Moore's career. Examination of these three aspects of Moore's experience at Columbia--research, teaching and personal--will provide insights into Moore's participation in the BSCS and K-12 education reform.

Columbia University and the Modern Synthesis of Evolution

In the late 1800s, biology was a fragmented discipline. Darwinian evolution was widely accepted, but there were differing viewpoints on natural selection. Hereditary mechanisms weren't known, and even Darwin thought some acquired traits could be inherited. Disunity over philosophical and methodological issues was so widespread that unification of biology as a science seemed impossible.[328]

Within this disciplinary context, the Department of Biology at Columbia was formed in 1891. Henry Fairfield Osborn, a renowned evolutionist and noted eugenicist, was Columbia's first professor of biology. He also established Columbia's association with AMNH. He was joined at Columbia by Edmund B. Wilson and later Thomas Hunt Morgan, known for their work in embryology and cytology.[329]

Genetics did not become a discipline until the early twentieth century since the value of Mendel's work was not recognized until 1900. The work of Morgan and his associates, Alfred Sturtevant and Calvin Bridges, led to the discovery that genes were

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[328] Smocovitis, *Unifying Biology*, 97.

[329] Grayson Kirk, John A. Moore, Benjamin J. Buttenwieser, and Maurice T. Moore. *The Life Sciences: The $200 Million Campaign*, a fundraising brochure (Columbia University, 1967), Box 57, Folder: J's Reprints, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

located on chromosomes and coded for specific observable characteristics.[330] Morgan's groundbreaking work with *Drosophila* (fruit flies) brought him fame as well as brilliant protégés, including Theodosius Dobzhansky and Hermann J. Muller.[331] Dobzhansky and Muller would have important roles in establishing the modern synthesis of evolution in the 1930s and 1940s, and also in the reintroduction of evolution to the K-12 curriculum in the 1960s. Morgan and most of his associates (including Dobzhansky) left Columbia University in 1928 and moved to the California Institute of Technology where they continued their work on *Drosophila* (fruit fly) genetics.[332]

By the time Moore started his studies at Columbia in 1932, Morgan and his group had been gone for several years. But their ghosts remained in Schermerhorn Hall. Moore was "surrounded by the discoveries of Morgan, Sturtevant and Bridges"[333] according to his wife, Betty Moore. The aging E. B. Wilson continued to appear on crutches in the halls. Betty Moore writes, "Wilson would come on his crutches, up the elevator to the 9th floor…a distinguished white haired, white whiskered old gentleman– walking down the hall to his office, opposite a graduate student lab. I was saddened by his death in 1939, as

[330] For more information on Morgan and his work, see David J. Depew and Bruce H. Weber, *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection* (Cambridge, MA: MIT Press, 1996), 240-52.

[331] Michael Ruse and Joseph Travis, eds., *Evolution: The First Four Billion Years* (Cambridge, MA: Harvard University Press, 2009), 745-53.

[332] Barbara Land, *Evolution of a Scientist: The Two Worlds of Theodosius Dobzhansky* (New York: Thomas Y. Crowell Company, 1973), 164-68.

[333] Betty Moore, explanatory note, October 21, 2003, Box 30, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

of course John was, too."[334] John Moore saved many of the ancient reprints and books which his famous predecessors left behind.[335]

In the 1920s and 1930s, developments in population genetics laid the groundwork for the unification of biology. The work of Sergei Chetverikov in Russia, J. B. S. Haldane and R. A. Fisher in Britain, and Sewall Wright in the United States resulted in mathematical models for the genetic changes in populations. This work in population genetics formed the basis of the modern evolutionary synthesis. As a result of the synthesis, the science of biology would undergo a season in which various sub-disciplines would recognize evolution by natural selection as the central organizing concept of biology.[336] Moore had a ring-side seat for seeing the development of the synthesis from the 1930s until the 1960s because of his position at Columbia and his association with AMNH.

Dobzhansky was familiar with Chetverikov's work and was intrigued by the work of Haldane, Fisher and Wright. He was interested in combining their ideas with his own work with *Drosophila*, and sought the help of Sewell Wright.[337] In the mid-1930s, L. C. Dunn at Columbia learned of Dobzhansky's work and invited him to return to Columbia University to deliver the Jesup Lectures in the fall of 1936. Dobzhansky applied the

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[334] Betty Moore, explanatory note, October 1, 2003, Box 26, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[335] Betty Moore, explanatory note, October 21, 2003, Box 30, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[336] Depew and Weber, *Darwinism Evolving*, 299. See also Ruse and Travis, *Evolution*, 483.

[337] Mark Ridley, *Evolution*, 3rd ed. (Malden, MA: Blackwell Publishing, 2004), 16. See also Barbara Land, *Evolution of a Scientist*, 204.

mathematical models of Haldane, Fisher and Wright to natural populations, "making natural selection viable again" as the primary mechanism for evolution.[338] Dobzhansky's book on the same topic, *Genetics and the Origin of Species,* was published by Columbia University Press in 1937.[339] This book was the neo-Darwinian equivalent of Darwin's *Origin of Species* published in 1859.

Moore was an undergraduate until 1936, and it is not known if he attended the Jesup Lectures given by Dobzhansky. However, Dunn's invitation to Dobzhansky had been part of an effort to recruit Dobzhansky back to Columbia. According to Joe Cain, Dunn was interested in building an integrated research center for plant and animal genetics, and was also looking for ways to modernize and stimulate the zoology department as a whole.[340] Dobzhansky returned to Columbia University as a professor in 1940, and became a critical influence on Moore, second only to Ernst Mayr.

Ernst Mayr was impressed by Dobzhansky's ideas and appreciative of his ability to see things from the perspective of a naturalist as well as a geneticist. Mayr had extensive experience working with bird populations on several continents, and was interested in integrating the work of population geneticists with his own work in avian systematics. Mayr used his understanding of systematics and his new understanding of population biology to extend the modern synthesis of evolution, concentrating on how new species are formed. Mayr was invited to give the Jesup

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[338] Smocovitis, *Unifying Biology*, 121.

[339] Land, *Evolution of a Scientist*, 205.

[340] Joe Cain, "The Columbia Biological Series, 1894-1974: A Bibliographical Note," *Archives of Natural History* 28, no. 3 (2001): 356.

Lectures at Columbia University in 1940. His book, *Systematics and the Origin of Species*, was the second pillar in the construction of the modern synthesis of evolution.[341]

Two other architects of the modern synthesis also gave Jesup Lectures and published books in the Columbia Biological Series but seem to have had less personal impact on Moore. The third pillar of the modern synthesis was provided by George Gaylord Simpson, a paleontologist at AMNH. Moore wrote, "I have had many contacts with GGS over the years but I cannot say that he is a close friend."[342] Moore knew Simpson but did not have the same relationship with Simpson as he had with Mayr or Dobzhansky. The fourth architect, botanist G. Ledyard Stebbins, brought botany into the synthesis in 1950. Moore knew Stebbins through his work with the BSCS, as Stebbins was one of the writers of the first BSCS experimental versions. Therefore Moore knew all four architects of the modern synthesis. I assert that the work of the architects shaped Moore's understanding of evolution and its importance in biology education.

Moore's own scientific contributions at Columbia included his work on speciation in *Rana pipiens*. This work was related to the work of Mayr in that it investigated mechanisms of speciation. Moore discovered that *Rana pipiens*, the meadow frog, occupies a tremendous geographical range in North America. In order to exist under such a variety of temperature conditions, *Rana pipiens* developed a number of subspecies, or

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341 Ernst Mayr and William B. Provine, eds., *The Evolutionary Synthesis: Perspectives on the Unification of Biology* (Cambridge: Harvard University Press, 1980), 420.

342 John A. Moore to Professor Laporte, May 14, 1979, Box 10, unfiled, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

temperature races. Individuals in geographically adjacent areas could successfully breed and reproduce, but when individuals from distant areas bred, defective hybrids resulted. In some cases the hybrids would all die. Moore concluded that the breeding pair represented individuals from two separate species, the result of Darwinian evolution.[343] In the laboratory, Moore was involved in sophisticated nuclear transfer techniques similar to those used in modern cloning experiments.[344]

So what is the significance of these relationships? Moore was certainly proud to be identified with the early greatness of the Columbia University Department of Zoology. Working in the building where T. H. Morgan and E. B. Wilson did their historic work connected him to the early Columbia giants in a tangible way. Moore's long-term relationships with Dobzhansky and Mayr, the first two architects of the modern synthesis of evolution, had tremendous influence on him. While Moore was not an architect of the modern synthesis, it is tempting to think of him as a disciple of the modern synthesis. He was present at the historic Princeton conference in 1947 which was critical in the acceptance of the synthesis. But this implies that Moore's acceptance of the synthesis was dependent on his relationships to Mayr and Dobzhansky. However, had Moore been at another institution when he learned of the modern synthesis, he probably would have accepted it wholeheartedly-- most biologists did. I wonder, though, if the nature or the extent of Moore's involvement in the BSCS and its mission to reestablish evolution in the

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[343] John A. Moore, "The Development of Evolutionary Thought," *The University of Kansas Science Bulletin*, Supplement to Vol. 42, no.2 (June 28, 1962).

[344] Transcription of Oral History Interview with John A. Moore, University of California, Riverside, September 23, 1998, Oral History Project, University of California, Riverside, http://www.ucrhistory.ucr.edu/pdf/moore.pdf (accessed September 25, 2009).

K-12 curriculum would have been different. Would Moore have spent over 15 years with the BSCS and continued to write about evolution in education for the rest of his life without these relationships? Before attempting to answer this question, it will be helpful to consider the other parts of Moore's experience at Columbia University.

The Importance of Teaching

As a university professor, Moore spent a significant amount of his time teaching university students:

> My first post was at Brooklyn College and I had 16 contact hours in the day and an evening course for 8 hours...When I was hired at Barnard, it was to teach the full year of first-year zoology and two one semester courses…A more difficult problem arose when I was made chair at Columbia – with no relief in course loads at Barnard. It was not right for those giants at Columbia to dump on that dwarf."[345]

While Moore felt his early teaching loads were excessive, he valued the teaching role immensely. By the admission of his peers, he was unusually devoted to science education at all levels. Rutherford (1997) notes:

> Twenty years after his departure from Barnard and Columbia, he remains something of a legend – not for his scientific prowess (which, as I have noted was substantial) but as the faculty scientist who most strenuously insisted that teaching science was every bit as important as doing science, and acted accordingly."[346]

[345] John A. Moore to Ernst Mayr, August 9, 1991, Box 69, Folder: Letters of Mayr 1989-91, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[346] F. James Rutherford to the President's Committee of the National Science Foundation on the National Medal of Science, April 10, 1997, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

Moore took his responsibility seriously, creating innovative lessons[347] and writing an important college textbook, the *Principles of Zoology*, published in 1957.[348] Moore strongly believed in a conceptual approach to teaching biology, and evolution was the central organizing concept. Biology without evolution was a mass of facts. He felt that if K-12 teachers did not have adequate science backgrounds, the responsibility laid at the feet of university professors who had not adequately prepared them:

> You see, the key to educational reform in the K-12 years is really not for the colleges to bash the K-12 educational system but to vastly improve the quality and the education of the students that we have who aspire to [a career] in K-12 education. And if we bash them, I mean, after all, who educated them? Well, we did, but they didn't get the point, or something. We are at the crux of it, and that seems to be a nut that's very, very difficult to crack.[349]

Moore had particular interest in the student who would not become a professional scientist. He viewed biology as a liberal art,[350] something that any properly educated individual should know. Knowledge of evolution was critical for understanding the natural world, and for solving the multiple medical, environmental, and social problems that faced mankind. While not all students would become biologists, all would need to support scientific efforts to solve human problems.

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[347] One lesson in Zoology 1-2, 1965 entitled "The Historical Foundations of Science: The Ancient World" introduced students to biology by sending them to the Metropolitan Museum of Art in New York City where they looked for particular artworks which illustrated aspects of nature and human interaction with nature in early civilizations. Box 57, Folder: J's Reprints, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[348] John A. Moore, *Principles of Zoology* (New York: Oxford University Press, 1957).

[349] Erikson, Jan. "Transcription of Oral History Interview with John A. Moore", July 23, 1998, http://www.ucrhistory.ucr.edu/pdf/moore.pdf. (accessed August 15, 2012).

[350] Ibid.

In the 1980s during a serious recession in the United States and national concerns about the poor educational performance of American students in comparison to other countries, Moore expressed a more elitist viewpoint towards education. In a report to the Commission on Human Resources of the National Research Council, Moore asserted that "the direction and substance of civilization comes from the nation's educated elite"[351] and "excellence is what it is all about, so the effort expended on an individual student should reflect to some degree the probable attainments of that student."[352] These statements reflect Moore's concern that schools at this time were not requiring enough from their students. "We lost our nerve and standards in the '60s and '70s, and it has become imperative that we regain them in the '80s."[353] Standards needed to be raised and special consideration given to the most promising students if the United States was to be competitive internationally.

Personal Circumstances

The 1950s was a pivotal decade for Moore. By the end of his thirties, he had attained recognition as a researcher, professor, and administrator. He had the energy of youth and a true commitment to his field. In this decade he would do nuclear transfer research,[354] publish his first college textbook, receive Fulbright and Guggenheim

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[351] John A. Moore, "Reforming Education in America: A Critical National Need," Report to the Commission on Human Resources of the National Research Council, Washington, DC, 1981, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[352] Ibid.

[353] John A. Moore, "Commentary: Evolution and Public Education," *Bioscience* 32, no. 7 (July-August, 1982), 611.

[354] Ruibal, Shoemaker, and Stewart, "Historical Perspectives," 1157.

scholarships, be elected to the American Association for the Advancement of Science, and be asked to take leadership roles in the American Society of Zoologists and the American Institute of Biology.[355] But another, more personal event was to have long-lasting influence. Moore was afflicted by a virus which caused paralysis in his hands.[356] He was no longer able to do the sensitive nuclear transfer work which was the basis of his laboratory research.[357] It is not clear how long this paralysis lasted or to what extent it affected his other work.

During this time, a shift began to occur as Moore spent increasing amounts of time on projects for professional organizations. This change was so noticeable that Mayr was to comment to Moore in 1991: "You virtually sacrificed your scientific career in the service of Academic [*sic*] education."[358] Moore responded, "Under other circumstances maybe I would have done more in field and lab but, from the very start, I held positions that left little time for research."[359] After discussing his many teaching and administrative responsibilities, Moore continues:

> You may recall (but maybe you would not because you had gone to Harvard) I had some virus, at the time said to be coxsackie that left my hands paralyzed. That put a halt to transplanting frog nuclei between species. Then two events started

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[355] Smith, "Some Biogeographers, Evolutionists, and Ecologists," http://www.wku.edu/~smithch/chronob/MOOR1915.htm.

[356] John A. Moore to Ernst Mayr, August 9, 1991, Box 69, Folder: Letters of Mayr, 1989-1991, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[357] Ibid.

[358] Ernst Mayr to John A. Moore, June 18, 1991, Box 69, Folder: Letters of Mayr, 1989-91, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[359] John A. Moore to Ernst Mayr, August 9, 1991, Box 69, Folder: Letters of Mayr 1989-91, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

> and, had I not said yes, a more vigorous research program was a possibility. Al Romer asked me to work on the Zoological Congress (and who can say "no" to that wonderful man) and Bentley Glass asked me to help with the Biological Sciences Curriculum Study. Both proved to be enormously time consuming…In spite of all this I suspect that things would not have been all that different. I still feel that education is vitally important and that we in the universities do far less than we should.[360]

Moore's health problems in the mid-1950s interrupted his research, and new commitments made it difficult for him to return to research at a later date. While he did not set out to "sacrifice his scientific research" as Mayr remarked, Moore felt that his commitment to education was "vitally important."[361]

Discussion

The biographical information above views John A. Moore from three perspectives. The first perspective shows Moore as an heir to the lineage of great zoologists at Columbia University and as a promising young biologist mentored by Ernst Mayr and Theodosius Dobzhansky, architects of the modern synthesis of evolution. The second perspective depicts Moore as a professor with commitments to biology education at all levels. The third perspective shows Moore as responding to life circumstances, including a physical limitation which affected his life choices. How does this information inform our understanding of Moore's participation in the BSCS?

Moore's availability to work in the BSCS may have been related to the interruption of his research due to his hand paralysis. This is implied by the letter of

[360] Ibid.

[361] Ernst Mayr to John A. Moore, June 18, 1991; John A. Moore to Ernst Mayr, August 9, 1991, Box 69, Folder: Letters of Mayr 1989-91, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

August 9, 1991 from Moore to Mayr. Moore reports that he joined the BSCS because he was asked by Bentley Glass.[362] It is not known if Moore expressed interest in the BSCS before his recruitment by Glass, but Moore's background and interest in education were probably attractive to Glass, who was himself a geneticist and strong evolutionist.

The full impact of Moore's association with Dobzhansky and Mayr on the BSCS curriculum is difficult to assess. Moore certainly had the opportunity to disseminate the ideas of Mayr and Dobzhansky in the curriculum development process. But early in the BSCS, evolution appeared to be tacit knowledge. Arnold Grobman, the first Director of the BSCS, stated:

> At the early meetings of the BSCS Steering Committee the question of whether or not evolution should be included in the BSCS courses was not discussed. It was obviously assumed by everyone present that evolution would be a major constituent of the BSCS course of study. After the preliminary editions of the Versions were printed, and Steering Committee members had had a chance to study them, the Versions were criticized rather severely by Dr. Muller and other Steering committee members because they did not contain enough material about evolution. It was generally agreed that evolution should be a pervasive theme.[363]

Moore supervised the writing of the preliminary edition of the Yellow Version, which was deemed unacceptable along with the Green and Blue Versions. Moore certainly was committed to evolution as an organizing concept. Was the treatment of evolution diluted as the result of teacher input on the writer teams? Did biologists on the writing teams

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[362] John A. Moore to Ernst Mayr, August 9, 1991, Box 69, Folder: Letters of Mayr 1989-91, John A. Moore Papers, Rivera Library Special Collections, University of California, Riverside.

[363] Arnold B. Grobman, *The Changing Classroom: The Role of the Biological Sciences Curriculum Study* (Garden City, NY: Doubleday & Company, Inc., 1969), 204.

decide that extensive treatment of evolution was unnecessary or ill-advised? I address the BSCS curriculum development process in Chapter Five.

Moore was a critical defender of evolution as the fruit of rational inquiry. In a 1966 article, Moore encourages teachers to use the topic of evolution to teach the concept of controversy. He argues that teaching students to make rational approaches to controversy is a life skill best learned at the feet of a knowledgeable, caring teacher.[364] But over the years he became increasing resolute about the superiority of scientific ways of knowing and the inappropriateness of any form of creationism in the classroom. In conference presentations, books and journal articles, Moore presented his case with teachers. In this 1982 article, Moore states:

> It is more necessary than ever to come to grips with mankind's most powerful device for solving problems – science. Science controlled by the few could make slaves of the many but, harnessed as our handmaiden, it can allow us to reach the lofty humane goals of our dreams…Thus it becomes ever more important to understand what is science and what is not…we must accept the fact that, today, most Americans do not seem to know… Maybe we should try to tell them. If we succeed, creationism will become a minor problem of antiquarian interest.[365]

In Moore's mind, science should be the servant of the humane goals of world peace and the eradication of human suffering. In fact, there was no hope for the world without a scientific worldview. In the preface to his book, *Science as a Way of Knowing*, Moore states:

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[364] John A. Moore, "Patterns of Cellular and Organismic Evolution," *The Science Teacher* 33, no. 7 (October, 1966), 71.

[365] John A. Moore, "Commentary: Evolution and Public Education," 611-12.

> There can be no future for the human experiment unless a critical mass of involved people understands that the laws of nature constrain our activities and that our solutions to these problems must be based on knowledge and not blind adherence to fads.[366]

According to Moore, we must understand the laws of nature and how to apply them to human problems if the human race is to survive. This was a concern strong enough to sustain Moore in a life-long commitment to education.

Summary

Bentley Glass, Arnold Grobman, and John Moore were committed to evolution as the central theory of the biological sciences. They saw those who resisted evolution as well-meaning but scientifically ignorant people who needed to be educated. Students needed to understand how humans and all life evolved. They needed to be aware of the recent discoveries about how DNA and genes worked, and be prepared for a future in which reproductive choices would mushroom. Citizens needed to be instructed on how mutations occurred and why nuclear radiation was a danger to the future evolution of humankind. Students needed to understand the consequences of unbridled population growth. They needed evolutionary theory for understanding racial differences and the place of humans in the universe. Glass, Grobman, and Moore thought that high school biology was the primary place that this education should take place. Through the curriculum, scientists would communicate the advantages and dangers of scientific knowledge to students so that they would become citizens prepared to freely participate in societal deliberations about pressing biological concerns. In the next chapter, I

[366] John A. Moore, *Science as a Way of Knowing: The Foundations of Modern Biology* (Cambridge, MA: Harvard University Press, 1993), viii.

examine how evolution became important within the BSCS curriculum itself through the efforts of Bentley Glass, Arnold Grobman, John A. Moore, and Hermann J. Muller.

Chapter 5

Curriculum Deliberation

> Evolution is a fact…It ill befits our great people, four generations after Darwin and Wallace published their epochal discovery of evolution by natural selection, to turn our backs on it, to pretend that it is unimportant or uncertain … or, if it is dealt with at all in a school or high school biology course, to present it as unobtrusively and near the end of the course as possible, so that the student will fail to appreciate how every other feature and principle found in living things is in reality an outgrowth of its universal operation.
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> –Hermann J. Muller, "One Hundred Years without Darwinism are Enough"

In the preceding chapters, I demonstrated the commitment of BSCS leaders to the modern synthesis of evolution and their concern for the genetic future of humankind. In this chapter I will demonstrate how evolution became the central theme of the BSCS curriculum. I will discuss the reliance of the BSCS on the previous work of the National Research Council of the National Academies of Science (NAS-NRC), the formation of the BSCS, its conceptualization of its task, and the development of evolution as the central theme in the BSCS Curriculum. The unifying aspects of the modern synthesis of evolution were evident in the organizing of the American Institute of Biological Sciences and the BSCS, and eventually permeated the high school curriculum that they produced. This chapter complements earlier histories of the BSCS by providing more detail regarding the curriculum deliberation process and confirming the central importance of the modern evolutionary synthesis in the curriculum.

In order for the BSCS to justify the enormous expense in terms of time and money that a biology curriculum study required, it was necessary to form a coherent critique of why existing curriculum was inadequate. I suggest that this critique of high school biology education, specifically in regards to the teaching of evolution, began much earlier than the work of the BSCS and can be seen in the writings of zoologist Oscar Riddle. I confirm that while all the earliest preliminary versions of the BSCS textbooks addressed evolution, the emphasis on evolution grew considerably in the second round of preliminary versions and the first commercial editions. I also assert that Muller's efforts to have evolution pervade the BSCS textbooks was related to his concern over mutational load and the desire to promote his reform eugenic project of germinal choice.

Organizational Precursors to the BSCS

This history of the BSCS begins in the National Research Council of the National Academies of Science (NAS-NRC) in the late 1940s. The National Academies of Science created the National Research Council to inform government decision making in matters of science, engineering, technology and health. In the 1940s, the NAS-NRC was made up of several divisions including the Division of Biology and Agriculture. Within this division, the American Institute of Biological Sciences (AIBS), parent organization of the BSCS, organized in 1947 as a "voluntary association of organizations having in common an interest in the life sciences."[367] Its general purposes included "the advancement of the

[367] Clarence Hylander, "The American Institute of Biological Sciences: A Historical Resume," *AIBS Bulletin* 1, no. 1 (January 1951): 6.

biological sciences and their application to human welfare."[368] The NAS-NRC saw the value of an umbrella organization for biological societies which could help with numerous interests that the societies shared, and could represent the biological sciences before government agencies. It was formed because of concerns that biology was far more fractured than chemistry and physics, and was becoming increasingly so as technological advances created new specialties within the biological sciences. Biology needed a unified voice in order to be effective in influencing government decision making. Each biological society interested in becoming a member of the new umbrella organization sent a representative member to the Governing Board of AIBS. Bentley Glass was the representative from the Genetics Society of America on the original Organizing Board of AIBS. The Organizing Board of AIBS met on April 11, 1947 and the Governing Board of AIBS held its first meeting on February 20, 1948.[369]

In the early years of AIBS, its activities centered on communications, including the publishing of the *AIBS Bulletin*, and the organization of an annual meeting composed of smaller society meetings. The AIBS grew gradually as various specialized societies saw the advantages of a unifying organization. It took some convincing on the part of biologists in some societies who did not want to send a portion of the individual society's local dues to a national umbrella organization.[370] While AIBS was getting its feet on the

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[368] Ibid.

[369] See Clarence Hylander, "The American Institute of Biological Sciences: A Historical Resume," *AIBS Bulletin* 1, no. 1 (January 1951): 6-7 and *AIBS Bulletin* 1, no. 2 (April, 1951):13-15. Also see "The AIBS Story" at the American Institute of Biological Sciences website, http://www.aibs.org/about-aibs/resources/AIBS_25th_An_History.pdf (accessed October 14, 2011).

[370] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

ground, the Division of Biology and Agriculture of the NAS-NRC continued to play its policy role, examining the needs of biological education in the Post WWII era.

These policy efforts are documented in a book commissioned by the BSCS in its early days. Paul DeHart Hurd was hired as a BSCS consultant to discover what attempts at biology reform had been undertaken prior to the BSCS. Hurd wrote *Biological Education in American Secondary Schools, 1890-1960,*[371] which chronicles early reform efforts and positions the work of the BSCS within its 20th century educational context. Hurd was Associate Professor of Education at Stanford University, having a background in high school science teaching.[372]

Hurd documents that a crisis had emerged by the 1950s: the field of biology was practically exploding with new knowledge and textbooks at all levels were challenged to catch up. While local and regional efforts were also undertaken, the problem was addressed on a national level by the NAS-NRC which held a conference on biological education on March 10, 1953. The question discussed was, "How can the educational system in biology adjust itself most properly to the change of emphasis taking place in the biological sciences away from preoccupation with specific living forms into the

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[371] Paul D. Hurd, *Biological Education in American Secondary Schools, 1890-1960* (Baltimore, MD: Waverly Press, Inc., 1961).

[372] "Personnel," *BSCS Newsletter*, no. 1, (September 1959): 5-8, BSCS Archives, BSCS, Colorado Springs, CO. While research biologists outnumbered academic educators on the BSCS Steering Committee, several educators had influential positions as consultants and committee chairman within the BSCS, especially Paul Hurd, Joseph Schwab, Paul Brandwein and Haven Kolb. Joseph Schwab, educational theorist, worked on teacher preparation and supervised *The Teachers'* the gifted students program. Haven Kolb was a high school biology teacher who took over the supervisor position from Marston Bates for the Green Version during its final revision.

direction of principles and mechanism of life processes?"[373] The question itself reflects the shift away from a descriptive or natural history approach in biological research and a shift towards experimental biology that had become important in the preceding decades in the United States.[374] The outcome of this meeting was the creation of the Committee on Education Policies of the NAS-NRC in 1954. This committee decided on a set of needs to be addressed in biology education, culminating in the recommendation of the creation of a "committee composed of biologists, educators, textbook publishers, science writers, and representatives of industry to cover the whole spectrum of biological education from the high school up."[375] Two needs mentioned included the need among educators and scientists to agree on what should be taught at the high school level and above, and the need for improved teacher preparation. AIBS also became independent from the NAS-NRC in 1954,[376] and started its own Committee of Education and Professional Recruitment in 1955 which was eventually responsible for organizing the BSCS in 1959. This committee used the recommendations of the NAS-NRC Education Committee in designing the Biological Sciences Curriculum Study.

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[373] Hurd, *Biological Education in American Secondary Schools 1890-1960*, 115.

[374] Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago: The University of Chicago Press, 2005), 185-86.

[375] Hurd, *Biological Education in American Secondary Schools 1890-1960*, 116.

[376] See Clarence Hylander, "The American Institute of Biological Sciences: A Historical Resume," *AIBS Bulletin* 1, no. 1 (January 1951): 6-7 and *AIBS Bulletin* 1, no. 2 (April, 1951):13-15. Also see "The AIBS Story" at the American Institute of Biological Sciences website, http://www.aibs.org/about-aibs/resources/AIBS_25th_An_History.pdf (accessed October 14, 2011).

Hurd highlights the values of the Committee on Education Policies of the NAS-NRC, which can be seen later in the values of the BSCS. These included the belief that everyone should have a basic knowledge of biology, and appreciate the field as "open and growing" with "profound implications for man's life." It should also give students experience and confidence to the scientific approach to problem solving, and introduce them to the significance of biological pursuits, both vocational and avocational.[377] This view represents a broader approach to biology education than a narrow focus on developing scientific humanpower for defense purposes.[378]

In the NAS-NRC, early plans to create a board of review for current textbooks were scrapped in deference to providing some general guidelines for selecting and preparing textbooks. The Committee on Educational Policies rejected the idea of a review board as "unrealistic and potentially dangerous":

> The creation of any such group takes the menace implicit in any action that tends to standardize ideas-the threat of imposing a straight-jacket upon the intellectual life, where vitality demands freedom, and the only proper discipline is self-discipline. The burden therefore falls upon those who select texts. Selectors in the past have simply not applied sufficiently demanding criteria. If they did so, "economic sanctions" would require that authors and publishers meet higher standards.[379]

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[377] Hurd, *Biological Education in American Secondary Schools 1890-1960*, 116.

[378] See John L. Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education* (New York: Palgrave, 2002), 61-63.

[379] Subcommittee on Instructional Materials and Publications, Committee on Education Policies, Division of Biology and Agriculture, National Academy of Sciences-National Research Council, "Criteria for Preparation and Selection of Science Textbooks," *AIBS Bulletin* 7, no. 5 (November 1957): 27.

Instead of critiquing individual existing biology textbooks, the committee chose to emphasize a "point of view" regarding all science textbooks which called for an emphasis on the nature of science and such general guidelines as "up-to-datedness" and "logical coherence."[380] The focus shifted from examining current textbooks to developing new curriculum that better met these general guidelines. This decision to focus on new curriculum rather than old curriculum was carried through to the BSCS.[381] It freed BSCS leaders from being bound to conventional treatments of subject matter and to advance their own agendas about what should be emphasized in high school texts. As members of the biological research community, they felt their subject knowledge was unquestionably better than anything which already existed in textbooks written by educators and publishers.

The Subcommittee on Instructional Materials and Publications of the Committee on Educational Policies of the NAS-NRC emphasized the need for increasing quantity and quality of laboratory work in biology courses, many of which did not include laboratories at all. A "two-fold importance" was attached to laboratory work. First, it would educate future citizens in the "problems, methods, accomplishments, and values of the biological sciences," and second, the challenges, opportunities and human significance of biology would entice students to pursue careers in the life sciences.[382] To

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[380] Ibid.

[381] While there are many pronouncements about the inadequacies of high school textbooks by members of the BSCS, I have seen no evidence that a comprehensive study was organized to document the strengths and weaknesses of specific available textbooks prior to the BSCS.

[382] Hurd, *Biological Education in American Secondary Schools 1890-1960*, 126.

this end, the *Sourcebook of Laboratory and Field Studies in Biology* was published which became a model for the laboratory block program of the BSCS. The *Sourcebook* was produced during a two-month summer writing conference at Michigan State University in 1957, was composed of twenty high school biology teachers and ten biologists from colleges and universities. The Summer Writing Conferences for the BSCS textbooks in 1960 and 1961 would be patterned on this writing conference, except that there was approximately one academic biologist for every high school teacher.[383]

The Biological Sciences Curriculum Study Takes Shape

The Biological Sciences Curriculum Study (BSCS) was officially organized by the American Institute of Biological Sciences (AIBS) and started with a grant from the National Science Foundation (NSF) in 1959. AIBS had created the Committee on Education and Professional Recruitment in 1955, the first standing committee of the newly independent AIBS,[384] and therefore the stage was already set before the launch of Sputnik in 1957 for major curriculum reform. The launch of Sputnik, however, provided the impetus for Congress to pass the National Defense Education Act in 1958 which provided funds through the National Science Foundation for the funding of the BSCS.[385]

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[383] Ibid.

[384] Arnold Grobman, "The Biological Sciences Curriculum Study," *AIBS Bulletin* 9, no. 2 (April 1959): 21-23.

[385] For more information on the creation of the BSCS and especially its relationship to other curriculum studies, see John L. Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education,* (NY: Palgrave, 2002), 100-11.

In September 1958, the AIBS Education Committee prepared an NSF proposal for the creation of the BSCS. The proposal submitted that knowledge of the biological sciences is a necessary part of education for every person, at least as necessary as a basic understanding of physics: "Every educated person must be able to count among his philosophical resources an understanding of evolution, of genetics, of energy relationships, as well as the principles of optics and mechanics."[386] Here is the earliest mention of evolution I found in BSCS documents. Of all the concepts in biology that could have been mentioned, evolution, genetics, and energy relationships were singled out as critical knowledge for the citizen, not just for potential scientists. The proposal asserted that an adequate level of understanding of the biological sciences could not be seen in the general population, despite the fact that three out of four tenth grade students took biology at the time. Evidence for the inadequacy of biology education included

> the billions of dollars spent annually on fake medicines and quack doctors…the regrettable tensions and misunderstandings between race groups…the conflicts and cold wars traceable to inefficient, wasteful use of natural resources by burgeoning human populations...[387]

The proposal infers that these problems would not be apparent if citizens had a proper biological education. Responsibility was placed at the feet of biologists, who have "not measured up to their opportunity to present to the student what he must know to be able

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[386] "A Proposal for Establishment of a 'Biological Sciences Curriculum Study Group' Within The American Institute of Biological Sciences," n.a., September 17, 1958, Box 165, Folder: BSCS Origins, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA. Note: While no author is given on the proposal, Arnold Grobman stated that the 1958 proposal for the BSCS which was presented to the NSF was written by Dr. Hiden Cox. See Arnold B. Grobman, *The Changing Classroom: The Role of the Biological Sciences Curriculum Study* (Garden City, NY; Doubleday & Company, Inc., 1969), 10.

[387] Ibid.

to lead a satisfying and productive life." But the proposal acknowledged that science of biology had special problems. "The science itself is greatly fragmented and workers in different sub-disciplines frequently have difficulty in communicating with one another. In consequence, students often get the impression that biology is a diffuse, uncorrelated science which is uninteresting and very likely unimportant."[388] The fragmentation of biology, the very reason that AIBS was created, was having consequences in the classroom. The fragmentation of the field had led to a poor impression of biology by high school students, burdened with too many particulars. The current curriculum obscured "fundamental underlying principles…by the emphasis that is placed on comparisons between groups of organisms, or upon different levels of organization, or upon terminology and classification schemes, all considered as ends in themselves."[389] A biology curriculum study was needed to improve biology education by placing the emphasis on fundamental principles, including evolution, which would act to further unify the field of biology in the minds of students and the public. Therefore, the creation of the BSCS was a direct extension of the unification of biology undertaken by AIBS as a larger organization. As pointed out by historian Vassiliki Smocovitis, an entire generation would be disciplined to see biology as a unified science through the BSCS curriculum.[390]

The proposal for the creation of the BSCS provides other important insights into the early action of the fledgling organization. The proposal notes that Bentley Glass had

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[388] Ibid.

[389] Ibid.

[390] Vassiliki Smocovitis, *Unifying Biology* (Princeton, NJ: Princeton University Press, 1996), 179.

accepted the position of Chairman of the BSCS, having been the unanimous first choice of the education committee. The proposal also notes that Glass's involvement was important to the growing enthusiasm for a curriculum study in the biological community.[391] Glass had been the first president of the independent AIBS in 1954-56 and was deeply interested both in education and in the need for biology to operate as a unified science.[392] Glass was joined by Arnold Grobman who became Director of the BSCS with primary administrative responsibilities. Grobman had distinguished himself as a science administrator while Director of the Florida State Museum and during his work in AIBS and other professional organizations, including the Chairmanship of the 1954 AIBS Annual Meeting.[393] Glass was originally concerned about this two-headed authority structure, but on retrospect felt that he and Grobman rarely disagreed.[394]

Grobman and Glass were primarily responsible for recruiting individuals for the original Steering Committee and the Executive Committee.[395] Glass was particularly important in recruitment, according to Grobman. As Editor of the *Quarterly Review of*

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[391] See fn 20.

[392] American Institute of Biological Sciences, "The AIBS Story" American Institute of Biological Sciences, http://www.aibs.org/about-aibs/resources/AIBS_25th_An_History.pdf (accessed October 14, 2011).

[393] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

[394] Bentley Glass, "BSCS Early Days," attachment to letter from George M. Clark to Bentley Glass, August 4, 1976, BSCS Reflections, Box 163, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[395] The Executive Committee was a small committee which had the responsibility of making policy decisions in between the meetings of the larger Steering Committee and thus had considerable power. The original Executive Committee consisted of Drs. Hidden T. Cox, Arnold Grobman, Paul Klinge, William Steere and Bentley Glass. Grobman to BSCS Executive Committee, November 10,1960. Executive Committee Memoranda 1959-1962, BSCS Archives, BSCS, Colorado Springs, CO.

Biology, Glass was well acquainted with those publishing biology books and papers, and with those who reviewed them, and therefore was well positioned to ask for their support.[396] Grobman indicated that he and Glass were not trying to represent the average biologist or his views in recruiting Steering Committee members, but trying to get top research scientists who had vision for this type of project and were willing to work with each other. Specific scientists and educators were recruited for specific purposes, all with a very task oriented goal of producing the most up-to-date high school biology textbooks possible. Grobman stated that while concerns about population growth and other pressing biological concerns were undoubtedly shared by the biologists, it was not something that was formally discussed. They were all there to focus on the task at hand of producing the new biology curriculum.[397]

Critical Assumptions

In order for the BSCS to justify the enormous expense in terms of time and money that a biology curriculum study would require, it was necessary to form a coherent critique of why existing curriculum was inadequate. While historians tend to focus on a 1959 paper by Hermann J. Muller as a primary source of criticism on the treatment of evolution in high school textbooks, I suggest that a formal critique of the teaching of evolution in high school biology began much earlier than this, before the Cold War and the creation of AIBS. This critique was documented in a study led by biologist Oscar

[396] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

[397] Ibid.

Riddle and sponsored by The Committee on the Teaching of Biology of the Union of American Biological Societies, which predated AIBS. This study, published in 1942, influenced both Bentley Glass and Hermann J. Muller in their construction of what was wrong with biology education.

Oscar Riddle was a zoologist who spent most of his professional career as a researcher at the Carnegie Institution's Station for Experimental Evolution at Cold Spring Harbor, Long Island, under the direction of Charles B. Davenport, noted eugenicist. A *Time* magazine article from January 9, 1939 touted Riddle as "one of the half-dozen top biologists in the country," and as "more than any other U. S. biologist, a crusader for the propagation of biologic truth among plain people." In this article, he expressed exasperation that opposition to evolution teaching still existed, and was committed to the idea that

> All men are created unequal. No politics or poetry or dogma in this; just a straight clean fact of prime importance to decent thinking on human social problems; and possibly a fact that must be learned, digested and assimilated . . . before unreason ceases to be a threat to all forms of democratic government.[398]

Genetic inequality was stressed by eugenicists at the time as a basis for programs to increase reproduction among those with desirable characteristics and suppressing reproduction among the genetically "unfit." However, I have found little connection of Riddle to the eugenic activities at Cold Spring Harbor. Co-worker George W. Corner stated that Riddle "worked in relative intellectual isolation . . . on a research program not intimately related to the studies on chromosomes and statistical genetics that interested

[398] "Pituitary Master," *Time* 33. No. 2 (January 9,1939): 29-33.

his chief, C. B. Davenport, and the rest of the staff."[399] While Riddle's involvement in Davenport's eugenic projects may have been limited, Riddle had become an evolutionist and an atheist at a young age. He was known for his criticism of religious dogmatism which suppressed the teaching of evolution in high schools, and was one of the founders of the National Association of Biology Teachers (NABT),[400] an organization also committed to supporting evolution education.

Bentley Glass was a member of Riddle's study team, and was one of the authors of the subsequent report, *The Teaching of Biology in Secondary Schools of the United States: A report of Results from a Questionnaire,* published in 1942.[401] This study focused not on textbooks, per se, but on the backgrounds of teachers and what was actually being taught in the classroom as reported by the teachers themselves. Topics considered by Riddle to have highest priority included the genetic inequality of human beings, sex education, and organic evolution.[402] These three topics were critical knowledge to those who would encourage citizens to accept eugenic interventions. Regarding evolution, Riddle concluded that 53.7% of teachers taught evolution in an acceptable way, either as fact or as the principle underlying plant, animal and human origins. Except for about 4.7% of teachers who totally omitted or openly denied evolution

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399 George W. Corner, "Biographical Memoir of Oscar Riddle (1877-1968)," National Academy of Sciences, Washington, D.C., 1974. http://books.nap.edu/html/biomems/oriddle.pdf (accessed July 2, 2012).

400 American Philosophical Society, "Background Note," Oscar Riddle Papers, American Philosophical Society, http://amphilsoc.org/mole/view?docId=ead/Mss.B.R43-ead.xml (accessed July 1, 2012).

401 Riddle, Oscar, ed., *The Teaching of Biology in Secondary Schools of the United States: A Report of Results from a Questionnaire* (Union of American Biological Societies, 1942).

402 Ibid., 66-73.

and 3.4% who did not reply, the rest of the teachers (about 38.2%) taught evolution, but did so in a compromised fashion, such as teaching evolution by inference only, as a scientific hypothesis rather than fact, or as only applying to sub-human organisms . Rather than seeing these treatments of evolution as representative of attempts to integrate evolution with cultural beliefs at the time, Riddle considered these alternate approaches scientifically unacceptable, and therefore completely discounted them. The report concluded that "evolution is taught in notably less than half of the high schools. Even when 'taught' this principle is frequently diluted beyond recognition, or it is so joined to traditional beliefs as to preclude a new ripple of thought."[403] Hermann J. Muller referenced these results in his famous 1959 paper, "One Hundred Years Without Darwinism Are Enough," with the addition that "there has been little evidence of improvement since that time."[404] Bentley Glass also built upon Riddle's conclusions in a December, 1961 description of early BSCS deliberations. Moving the discussion from what was taught in classrooms to what appeared in textbooks, Glass asserted:

> Most high school biology textbooks are twenty years behind the advancing front of knowledge, and in some very significant matters, because of social or religious opposition, fully a century in arrears. We [BSCS]were in unanimous agreement that appropriate scientific treatment must be accorded such "controversial" subjects as organic evolution, the nature of individual and racial differences, sex and reproduction in the human species, and the problems of population growth and control.[405]

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[403] Ibid., 76.

[404] H. J. Muller, "One Hundred Years Without Darwinism Are Enough," *School Science and Mathematics* 59, no. 4 (April 1959): 308.

[405] Bentley Glass, "Perspectives: A New High School Biology Program," *American Scientist* 49, no. 4, (December 1961): 525.

This was written after the 1961 Summer Writing Conference. While Glass carefully noted that *most* high school biology textbooks were out of date, he left room for exceptions. However, he generalized that the biology curriculum in secondary schools as a whole was antiquated, especially with regards to organic evolution, and this was a primary reason that the new BSCS curriculum was developed. But was that a correct assumption? Did good textbooks that included evolution already exist?

Biology Textbooks before the BSCS

According to historian Ronald P. Ladouceur, evolution did not disappear from all of the prominent high school biology textbooks in the period between the Scopes Trial in 1925 and the 1960s. This was largely a myth originating with the BSCS in order to "differentiate, defend, and promote its work."[406] While many textbooks from early in the 20th century included evolutionary principles and eugenics, Ladouceur credits the textbook *Exploring Biology* with being the first high school textbook which presented the modern synthesis of evolution in 1949, where the word evolution was used liberally. Ladouceur was not the only critic of Glass's assertion that the BSCS was responsible for "the bold introduction of modern evolutionary theory" into the high school biology curriculum. In 1968, G. G. Simpson, one of the architects of the modern synthesis, criticized Glass for ignoring Smith's work:

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[406] Ronald P. Ladouceur, "Ella Thea Smith and the Lost History of American High School Biology Textbooks" *Journal of the History of Biology* 41 (2008):435.

> You seem to be claiming that the BSCS first introduced forthright discussion of the evidence for evolution and the theory of natural selection into a high school biology text. That simply is not true. With your special knowledge of high school curricula I do not see how you can help knowing that it is false, and I am baffled by your repetition of this claim.[407]

Simpson knew Smith, and he felt that Glass was ignoring her contributions to evolution education. However, Simpson also acknowledged in his own 1961 article that there were problems in evolution education, and that most textbooks in the 1950s "relegate[d] evolution to a single section, preferably in the back of the book, which need not be assigned."[408] So while evolution may have been presented in high school biology textbooks, it was all too easy for teachers to avoid the topic completely.

The modern synthesis of evolution is fully present in the 1949 version of Smith's textbook, but publishers' pressures to limit the treatment of evolution eventually affected this textbook as well, and the word evolution only occurs once in the index of the 1959 version. Not only did the 1949 version of *Exploring Biology* fail to start a revolution in the treatment of evolution in the field of biology textbooks, it retreated in its subsequent revision by drastically reducing the use of the term evolution. An editor at Harcourt Brace later admitted in a letter that the 1959 version of *Exploring Biology* had been edited to compete better with another text, *Modern Biology*, the most popular high school text in the U.S. at that time.[409] The authors of *Modern Biology* had avoided the word

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[407] George G. Simpson to H. Bentley Glass, March 7, 1968, Series I: Correspondence, Box 24, Folder: Glass, Bentley, George Gaylord Simpson Papers, American Philosophical Society, Philadelphia, PA.

[408] G. G. Simpson, "One Hundred Years without Darwin are Enough," *Teachers College Record* 60 (1961): 617-626, http://www.stephenjaygould.org/ctrl/simpson_evolution.html.

[409] Ibid., 436, fn 4.

“evolution” entirely, substituting the concept of “racial development,” and the texts were therefore more acceptable in some school districts.[410] Historian Gerald Skoog states that the reduction in evolution coverage in the 1950s was a general phenomenon: “Overall, textbooks that were revised in the 1950s tended to reduce the already meager treatment of evolution and, as a result, tended to give evolution less emphasis than the textbooks of the 1940s.”[411]

Therefore, in the period from the Scopes Trial until the BSCS texts of 1963, there was a range of what was being presented to students about evolution, both in textbooks and in the classroom. When interacting with the public, Grobman, Moore, Glass, Muller, and the BSCS chose to discount previous textbooks as a group because of the inadequacies of even the best textbooks in the 1950s. These biologists wanted to see evolution presented as fact, and as the central, pervading theme of the biological sciences.[412]

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[410] Truman J. Moon, Paul B. Mann, and James H. Otto, *Modern Biology*, (New York: Henry Holt and Company, 1956). *Exploring Biology* and *Modern Biology* accounted for about 75% of U.S. high school biology textbook sales. Paul Hurd thought that a third textbook by Curtis, Caldwell and Shermann was superior to these two, although it had a small portion of market share. Grobman to Content Committee, February 9, 1960, Box 9, Folder 9-3, Marston Bates Papers, Bentley Historical Library, University of Michigan, Ann Arbor, MI.

[411] Gerald Skoog, “The Contributions of BSCS Biology Textbooks to Evolution Education,” in *BSCS: Measuring Our Success*, ed. Roger Bybee (Dubuque, NJ: Kendall/Hunt Publishing Company,2008): 49.

[412] I studied Ella Thea Smith’s *Exploring Biology* (1959) and its competitor *Modern Biology* (1956), to see how they compared in terms of evolution treatment. *Modern Biology’s* discussion of Darwin’s theory of natural selection is brief and leaves doubts in the reader’s mind as to its sufficiency to explain all the known facts. The word evolution is avoided entirely even though Darwin’s theories and evidences for “change over time” of species were discussed. The Smith’s 1959 edition of *Exploring Biology* does a better job of describing the modern theory of evolution and other evolutionary topics, but again, the use of the word evolution itself is minimized, and is listed in the index only once. For comparison, the 1954 edition of *Exploring Biology*, cited more than 30 pages as relevant to evolution. So in reality, while aspects of evolution were covered by the two most widely used textbooks in the late 1950s, the avoidance of the use

Interestingly, Ella Thea Smith was a member of the original BSCS Steering Committee, so these BSCS leaders were aware of her work. While Ladouceur notes that Smith said little in BSCS Steering Committee meetings, I discovered that Smith provided her own written list of objectives for a high school biology course in response to a general request by John Moore. Of first importance was a set of understandings which included interdependence of living things, unity and diversity, energetics, evolution, genetics, the self-correcting nature of science, and intellectual history.[413] These are very similar to themes later settled on by the BSCS. Smith did not list evolution as the single central organizing theme of biology, however. If any theme was to be the central one, she indicated that "an understanding of the nature and role of genes as coded messages passed along from generation to generation…MIGHT WELL BE THE CENTRAL THEME RUNNING THROUGH THE WHOLE COURSE."[414] Smith saw genetics as more important than evolution. This is probably in part because genetics had made so many important contributions in the 20th century, including its contributions to the

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of the word "evolution" in the index was especially noticeable. This was untenable to the biologists of the BSCS, and resulted in their discounting what treatment had been given to evolution in the textbooks of the 1950s as completely inadequate. The self-conceptualization of the BSCS as the "reintroducers" of evolution to high school biology curriculum began to take hold. The BSCS did greatly increase use of the term evolution in its textbooks, as well as coverage of evolution related topics. Ladouceur would appear justified however in pointing out that the BSCS was not "reintroducing" evolution in the sense that evolution was reappearing after a long absence in the curriculum at large. Evolution was still present in various forms in the high school biology textbooks between the Scopes Trial and the 1960s. But the teaching of evolution had apparently decreased to the point that both geneticist Hermann J. Muller and paleontologist George Simpson wrote articles about the inadequacies of evolution education in the late 1950s. See H. J. Muller, "One Hundred Years Without Darwinism Are Enough," School Science and Mathematics 59, no. 4 (1959): 304-16, and G. G. Simpson, "One Hundred Years without Darwin are Enough," Teacher's College Record 60 (1961): 617-26.

[413] Ella Thea Smith, "Biological Sciences Curriculum Study," January 16, 1960, Box: H. Bentley Glass's Papers 1959-1970, Folder:1960 Jan-May, BSCS Archives, BSCS, Colorado Springs, CO.

[414] Ibid. The capitalization is from the original.

modern synthesis of evolution. And, of course, the idea of genetic continuity is fundamental to Darwinian evolution.

***A* Central Theme or *The* Central Theme?**

According to Arnold Grobman, the validity of evolution as a scientific theory was not questioned by the early members of the BSCS.[415] Evolution was listed as one of nine early themes decided upon by the Steering Committee. What has not been clear is whether or not evolution was seen early on as *the* central theme of biology and the BSCS curriculum, as called for by both Muller and Simpson in their critiques of evolution education, or if there was more diversity of opinion among members of the BSCS. Ladouceur asserts that evolution was not originally cast as *the* central theme of the BSCS curriculum, and didn't even appear to be *an* organizing theme in the 1960 test versions of the textbooks. Ladouceur writes: "It was not until Hermann J. Muller criticized the group for not taking full advantage of the opportunity to fully promote evolution in its textbooks that the group's self-conception began to change and its after-the-fact history began to be written."[416] I contend that the idea of evolution being the central theme of the textbooks was not "after-the fact-history," having been introduced by at least June, 1959, and that it was central in the minds of Glass, Grobman, Moore, and Muller from the beginning. There was some difference of opinion among BSCS members as to the prominence evolution should have within the curriculum, however, and the whole idea of themes being woven throughout the material was simply lost in the practical demands of

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[415] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

[416] Ronald P. Ladouceur, "Ella Thea Smith and the Lost History of American High School Biology Textbooks" *Journal of the History of Biology* 41 (2008): 441.

producing three experimental textbooks in the summer of 1960. Nevertheless, I will show that during the textbook writing process a consensus emerged which eventually elevated evolution (within at least the Blue and Yellow Versions) to central place, and that therefore it is not appropriate to classify the BSCS account of its own approach to evolution as being "after-the–fact history."

Ladouceur asserts that evolution was not cast as the central theme of the BSCS curriculum at the first BSCS Steering Committee meeting. According to the minutes, a list of eight major divisions of subject matter were "rather generally agreed upon," including evolution.[417] "It was also suggested by several members that general themes, as distinct from subject matter, run through-out the entire study of biology," including "change through time- evolution." So evolution was considered as both a subject matter area and a general theme. This would appear to have given evolution more weight. But evolution was not listed as the overall theme of the curriculum.

Likewise, evolution was not settled upon as *the* central theme for the curriculum in the second BSCS Steering Committee meeting, at least not according to the notes. In the minutes Glass states that "in several high school texts some major principles are completely missing," presumably referring to evolution and unspecified other principles. BSCS Steering Committee member Paul Brandwein replied, "True, but there are 26 textbooks available for high school biology. No reason to choose a bad one."[418] For

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[417] BSCS Memoranda No. 3, Minutes of the First Meeting of the Steering Committee, Feb 5-7, 1959, 7, Notebook: BSCS Steering Committee Memoranda 1-25, BSCS Archives, BSCS, Colorado Springs, CO.

[418] BSCS Memorandum No. 10, Minutes of Second Steering Committee Meeting, June 9-11, 1959, 4-5, Notebook: BSCS Steering Committee Memoranda 1-25, BSCS Archives, BSCS, Colorado Springs, CO.

Brandwein at least, not all of the then current high school biology textbooks were bad. He was a former high school teacher, editor and consultant for Harcourt Brace and World, so he would not necessarily have been as critical of textbooks as the research biologists were.[419]

While neither the First nor Second Steering Committee Meeting notes discuss evolution as *the* central organizing concept of the BSCS curriculum, there is evidence in the Minutes of the Meeting of the Committee on Innovation in Laboratory Instruction, June 12-13, 1959, that evolution as *the* central theme was proposed during the middle of 1959. At this meeting, Richard Paulson (National Science Foundation), Glenn Richards (entomologist from the University of Minnesota), Walter Auffenberg (Assistant Director of the BSCS), and Addison Lee (botanist from the University of Texas and supervisor of the committee) discussed the idea of evolution as an over-arching theme for the new curriculum. Bentley Glass was a member of this committee, but was not present at the time.

> PAULSON: We heard statements about evolution being the major theme in biology. (Committee seemed to agree that evolution is not the theme of biology; it is a theme of biology.) If we really believe that, should evolutionary aspects of organisms be woven into them?
> RICHARDS: Evolution is not so important as to have everything woven into it.
> PAULSON: The process of evolution has had to be treated discretely somewhere. One of the questions asked about the phenomena is what is the whole process from which this has come. This kind of thing might be a point to be made.

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[419] It was never the intent of the BSCS to settle for what was already available, anyway. The BSCS was constrained from recommending particular textbooks by the NSF because specific recommendations would be considered giving unfair advantage to a particular publisher, and could be met with a charge of trying to create a national biology curriculum. Any efforts to create a national curriculum were heavily resisted in this era of racial desegregation with its sensitivity to federal interference in education.

> AUFFENBERG: On a number of occasions in certain parts of the country, certain sects might be opposed to having a class in which evolution was a major portion.
> PAULSON: You couldn't understand biology without taking into account that there has been an evolution.
> LEE: We agreed that evolution is not <u>the</u> theme all the way through. I don't believe that evolution must be <u>the</u> theme of the course. It is very important and is <u>a</u> theme.[420]

From this June 1959 conversation, it appears someone was advocating evolution as being *the* major theme in biology, and the necessity of making it the major theme in the texts. However, these committee members felt that evolution was *a* theme, not *the* central theme of biology, and Paulson and Auffenberg expressed concerns about opposition to evolution. Note that none questioned that evolution should be addressed. Evolution by this time was widely accepted as a biological principle. But at some time, possibly during the 2nd Steering Committee Meeting which was held immediately prior to this Laboratory Innovations Committee Meeting, the idea of making evolution the main theme of the course must have been breached. The resistance of these BSCS members to using evolution as the central unifying theme is an indicator that support for the idea was mixed within the organization at the time.

In a letter to Arnold Grobman, Steering Committee Meeting Member Herbert S. Zim reflected on the Second Steering Committee Meeting:

> Important decisions have already been made – i.e., to retain the emphasis on biology as a 10th grade subject; to organize a program in terms of biological concepts; to integrate the concepts through a fundamental theme of evolution and

[420] BSCS Minutes of Meeting of the Committee on Innovation in Laboratory Instruction, June 12-13, 1959, Box 167, unfiled, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

> ecology; and to make the program practical and adaptable to many situations by a richness of specific examples and suggestions.[421]

This indicates that, in Zim's mind at least, "a fundamental theme of evolution and ecology" was decided upon during the Second Meeting of the Steering Committee, whereas this is not seen in the minutes. There is reference in the minutes to a verbatim transcript which was available on request, but this verbatim transcript is no longer available at the BSCS. It leaves open the possibility that evolution was discussed and not mentioned in the minutes, or discussed at a more informal setting where minutes were not taken. Zim also makes the comment, "I don't think that your Steering Committee is going to steer. It's too large and too diverse a group."[422] This evidence makes it clear that the idea of using evolution as *the* unifying theme for the curriculum had been breached, but leaves open how much of a consensus really existed at the Second Steering Committee Meeting on this issue.

This picture is further complicated by the minutes of a later meeting of the Committee on Innovation in Laboratory Instruction, August 5-8, 1959. While the same eight subject matter divisions were listed, now eleven tentative themes were listed in addition to eleven "viewpoints or attitudes," and five concepts of presentation.[423] Glass explains that the thinking was still

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[421] Herbert Zim to Arnold Grobman, June 22, 1959, Box 147, BSCS Steering Committee 1959, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[422] Ibid.

[423] The list of eleven themes, eleven viewpoints or attitudes and five concepts of presentation were generated at a meeting of the BSCS Committee on the Content of the Curriculum on June 12, 1959. Grobman to Content Committee, June 16, 1959, Box 9, Folder 9-3, Marston Bates Papers, Bentley Historical Library, University of Michigan, Ann Arbor, MI.

> quite preliminary…what will emerge from such a serious undertaking is assuredly not a textbook or a series of textbooks, but may be the basic materials from which a variety of textbooks and supplementary volumes utilizing different choices of material in different sequence might be compiled.[424]

At this point, curriculum deliberation seemed to have been reduced to the level of brainstorming. BSCS members were not even settled on what form their curriculum product would take: subject matter pamphlets, a textbook, or several textbooks. The members of the BSCS knew that they wanted something different than the high school biology textbooks which were available at the time, but they had not yet decided what the new curriculum would look like.

Despite this, or maybe because of it, a memorandum was issued by Grobman to all committees assigning responsibilities and setting up a timetable for completion. The committee on the Content of the Curriculum was assigned the task of constructing a basic content outline for a tenth grade high school general biology course, to be ready by the Steering Committee Meeting in January, 1960.[425]

The Committee for the Content of the Curriculum met October 30-31, 1959 under the leadership of John A. Moore, and came up with a preliminary outline for a single textbook. The outline does not identify one particular central theme. Except for minor reference to evolutionary concepts like adaptation at earlier parts of the outline, evolution

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[424] Bentley Glass, "Minutes of Meeting of the Committee of Innovation in Laboratory Instruction, August 5-8, 1959," p 3, Box 137, Folder American Institute of Biological Sciences Biological Science Curriculum Study, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[425] Arnold Grobman, BSCS Memorandum No. 16, November 9, 1959, Steering Committee Memoranda 1-25, BSCS Archives, BSCS, Colorado Springs, CO.

was not formally discussed until the eighth chapter of the book (out of nine chapters), placing evolution near the end of the book.[426] Ernst Caspari, geneticist and member of the Content Committee, expressed concern that the outline was not significantly different than current texts.[427] He favored a more novel way of organizing the material suggested by botanist and architect of the modern synthesis, G. Ledyard Stebbins, but Stebbins' outline was not adopted.

When Moore discussed the proposed outline with the Executive Committee on December 12, 1959, they were concerned that the Committee for the Content of the Curriculum had come up with an outline specifically for a single textbook. The main reason this was a problem was that the Physical Sciences Study Group had experienced "considerable resistance on the part of teachers and school administrators to the notion that one group was saying 'this is how it should be done." The production of a single high school textbook was interpreted as an overly authoritative approach to curriculum reform. The BSCS Executive Committee mandated that the Content Committee plan for separate monographs on different topics "rather than one integrated book."[428] The idea was that high school teachers could create their own courses from the monographs, much as

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[426] However, the first draft of the evolution chapter was assigned to G. Ledyard Stebbins, one of the architects of the modern synthesis and member of the Content Committee. Stebbins, a botanist, was also to write an earlier chapter entitled "Variety in the Plant Kingdom." It could be expected that he would do a thorough job with evolution.

[427] Ernst Caspari to John Moore, November 23, 1959, Box 137, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[428] John Moore, "BSCS Memorandum No. 40, December 21, 1959," Steering Committee Memoranda 26-46A, BSCS Archives, BSCS, Colorado Springs, CO.

college professors designed their own courses. The possibility that the material would eventually be made into a single book was left for future consideration.

At the Third Meeting of the Steering Committee held in New Orleans on January 28-29th, 1960, Moore expressed the thought that members of the Content Committee "were deeply concerned with their ability to function effectively under the new plan." After an extended discussion, "a very clear consensus was reached…that the Content Committee pursue its own program and that the Steering Committee's suggestions be reviewed by the Content committee and be incorporated or not as the Content Committee saw fit."[429] This was probably the only practical course at the time since the discussion was so intense Moore later called the meeting "the Second Battle of New Orleans."[430] He reflected on the New Orleans meeting:

> I sensed the feeling that many individuals were opposed to setting the pattern for the course this early and would prefer much more exploratory work to be done. To be sure, in the end it was decided to let the Committee on Curriculum Content work out these problems but this decision could have been as much the result of fatigue as of wisdom.[431]

Since the Steering Committee could not decide, Arnold Grobman sent out a letter on February 2, 1960 to about a dozen "top-notch people (mostly biologists)" asking them to meet with a few colleagues and a few high school teachers and come up with a brief

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[429] Arnold Grobman, *The Changing Classroom: The Role of the Biological Sciences Curriculum Study* (Garden City, NY: Doubleday & Company, Inc., 1969), 16.

[430] John A. Moore, "Remembering the Old BSCS Days," September 22 1997, John A. Moore Papers, Rivera Library, University of California, Riverside, CA.

[431] John A. Moore to Steering Committee Member, March 15, 1960, Box: H. Bentley Glass's Papers 1959-1970, Folder: 1960 Jan –May, BSCS Archives, BSCS, Colorado Springs, CO.

outline of topics and a list of themes that should run through the course.[432] Possibly in response to one of Grobman's letters, Muller sent reprints to BSCS Executive Committee Member Paul Klinge for the textbook writers, which Grobman acknowledged on March 3, 1960.[433] Moore, for his part, sent out a corresponding letter to about 100 high school biology teachers asking their ideas on major topics and sequence. Moore's letter asked teachers about "special problems you have faced in teaching biology and how you have solved them" with the examples of evolution and mammalian reproduction, which indicates the importance of those issues in Moore's thinking. Moore also wrote to the Steering Committee members to put down their ideas in writing about topics, sequence, and novel approaches.[434]

Nobel Laureate and Glass's dissertation advisor Hermann J. Muller was one of biologists not already part of the BSCS that Moore contacted. On March 16, 1960, four months after the Darwin Centennial, John Moore sent a letter to Muller, who replied on April 2, 1960 including a 3 page essay on his ideas.[435] This letter shows that Muller was already involved in advocating evolution as the central unifying theme for the curriculum before the first Summer Writing Conference in 1960. The first paragraph was a concise

[432] Grobman to Glass, February 2, 1960, Box: H. Bentley Glass's Papers 1959-1970, Folder: 1960 Jan – May, BSCS Archives, BSCS, Colorado Springs, CO.

[433] Arnold B. Grobman to H. J. Muller, March 3, 1960, Series V, Box 3, Folder: AIBS High School Course Materials, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[434] John A. Moore to Steering Committee Member, March 15, 1960, Box: H. Bentley Glass's Papers 1959-1970, Folder: 1960 Jan – May, BSCS Archives, BSCS, Colorado Springs, CO.

[435] Hermann J. Muller, "Remarks Concerning the Content of a High School Biology Course (with particular reference to the treatment of genetics and evolution)," an enclosure in a letter from Hermann J. Muller to John A. Moore, April 2, 1960, Series V, Box 3, Folder: AIBS High School Course Materials, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

explanation of "the modern viewpoint on living things," which was his outline of the modern synthesis of evolution.[436] Muller thought that nature and health study should be taught to younger children in preparation for developing an appreciation of evolutionary theory, and was concerned that students have adequate chemistry preparation to be able to grasp the physical and chemical basis for life. As part of a thoughtful consideration of scope and sequence, Muller gave special attention to genetic load. His eugenic interests were evident but subdued. He made the case that selection, natural or voluntary, was necessary to "avoid genetic degeneration. It would be explained [in the course] why a forward-looking humanity will increasingly regard it as an obligation to practice voluntary genetic selection for the benefit of later generations."[437] It was clear that Muller wanted the textbooks to support his views on germinal choice without necessarily mentioning it by name. Muller's essay was well received by Moore and Grobman, who separately welcomed his contribution.[438] They sought to involve Muller more closely with the BSCS and discussed the possibility of Muller visiting the 1960 summer writing conference. Letters indicate that he considered visiting, but I have not established that he actually did.

Arnold Grobman stated that the problem of how to organize the curriculum was largely resolved in the next month by "deciding to produce three different versions of a

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[436] Ibid.

[437] Ibid.

[438] John A. Moore to H. J. Muller, April 5, 1960 and Arnold B. Grobman to H. J. Muller, April 11, 1960, Series V, Box 3, Folder: AIBS High School Course Materials, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

biology course."[439] This decision was made by an ad hoc committee composed of Grobman, Glass, Moore, and Walter Auffenberg, who was Assistant Director of the BSCS.[440] Having three versions would give teachers and school districts a choice, and would make the statement that there was no authoritative way to teach biology. It would also give multiple publishers opportunity to profit from the enterprise. In a *New York Times* article, John Moore made clear that these texts would not take a "parade of life" approach, but would take a more "intellectual approach to biology teaching" emphasizing "genetics, evolution and historical development."[441] Moore's commitment to the centrality of the modern synthesis of evolution is evident in this quote.

Prior to the 1960 Summer Writing Conference, the three versions were characterized as follows in the *BSCS Newsletter No.4*:

1) One version (which would become the Blue Version) took a physiology/biochemical approach, emphasizing experimental methods instead of "cataloguing and discussing the wide range of living organisms." This version clearly would emphasize experimental biology rather than descriptive biology. It was originally supervised by Ingrith Deyrup of Barnard College.

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[439] Grobman, *The Changing Classroom*, 16.

[440] Grobman to Members of the BSCS Executive Committee, March 14, 1960. BSCS Correspondence Alpha 1958-1961, Folder 9-3, Marston Bates Papers, Bentley Historical Library, University of Michigan, Ann Arbor, MI.

[441] Gene Currivan, "Teaching of High-School Biology Facing Drastic Modernization," New York Times, May 23, 1960, Box: H. Bentley Glass Papers, Folder: 1960 June-Dec, BSCS Archives, BSCS, Colorado Springs, CO.

2) A second version (which would become the Green Version), would use a natural history or ecological approach, emphasizing “the essential unity or interrelatedness of living things.” This version reflected a growing ecological concern within the biological community. It was originally supervised by Marston Bates of the University of Michigan.
3) The third version (which would become the Yellow Version) would have a more traditional approach, but would emphasize major concepts, including evolution, rather than detailed taxonomy. It was supervised by John Moore of Columbia University.[442]

The Versions were called Yellow, Blue, and Green because those were the colors of binding available for the preliminary versions. The green binding was given to the ecological approach, and Moore allowed Deyrup to have her preference of blue, leaving him with the color yellow for his version.[443] Laboratory manuals to supplement each version were supervised by Bentley Glass, and a separate series of more intensive laboratory blocks were developed by Addison E. Lee at the University of Texas. Teacher commentaries were prepared under the supervision of Joseph Schwab.[444] The task had greatly expanded to include three versions all with different approaches which still needed to include the eight areas of subject matter and integrate the nine themes. Its complexity grew to the point that it was difficult to accomplish all that was hoped in the

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[442] Arnold Grobman, *The Changing Classroom: The Role of the Biological Sciences Curriculum Study* (Garden City, NJ: Doubleday & Company, Inc., 1969), 16.

[443] Ibid., 64.

[444] Ibid., 17.

first Summer Writing Conference in 1960, including adequate attention to the nine themes originally outlined. While evolution was covered, it did not function effectively as an organizing theme of the books. None of the other themes were prominent, either.

The Importance of Teachers

An important factor in the early trial versions of the BSCS textbooks was the integration of teachers into the writing and piloting process. The involvement of teachers complicated the writing process since the teachers had their own priorities. However, their involvement also enabled the BSCS to develop buy-in with the teachers who would be piloting the material. The PSSC had not been sensitive to this issue to its own detriment. The PSSC curriculum was "designed by a small group of MIT professors, shown to a group of high school teachers; it was then announced that high school teachers had participated in its design. Large numbers of high school teachers and administrators are fully aware of this subterfuge and feel negatively toward the PSSC."[445] Anxious not to make the same mistake, the BSCS resolved to integrate teachers into the curriculum design process. In my interview with him, Arnold Grobman stated that the original teachers were selected by reviewing the applications of teachers for NSF grants, which he convinced Richard Paulson of the NSF to let him see.[446] The leaders of the BSCS knew that any course was only as good as the teacher who taught it, and that these applicants were research minded and probably high quality, experienced teachers. Even so, teacher training would be necessary for the new approaches to be successful in the

[445] Grobman to Hiden Cox and Bentley Glass, March 13, 1961, Box 148, Unfiled, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[446] Arnold Grobman, interview by author, Gainesville, FL, July 25, 2011.

classroom. Teachers were paired one-on-one with research biologists in writing teams during the summer, giving teachers extensive ownership in the new curriculum. Grobman commented on the enthusiasm of the 1960 Summer Writing Conference:

> It is difficult to give a clear indication of the extremely high spirit that enveloped the first Writing Conference. Virtually everyone present was convinced that the BSCS was embarked upon a mission of singular importance and that his own particular role would be a key factor in its success. I have never before, nor since, observed a group of people work with more energy and dedication toward a common goal.[447]

Others have commented on the esprit de corps of the first writing conference, including Betty Moore, the wife of John Moore.[448] Biologists, teachers and their families lived and worked together for six weeks during the summer at the University of Colorado, Boulder, Colorado where comraderie was built among families as well as among teachers and biologists. Many of the summer writing conference teachers piloted the textbooks in their own classrooms, and assisted other teachers who had not been part of the writing process. This continuity was important in the success of the first experimental version.

A six-day briefing session was provided for additional teachers who would be piloting the new textbooks in high schools around the country. This briefing session was especially important in developing and communicating the philosophy of the new curriculum and building enthusiasm for the project. Bentley Glass gave an address entitled "Revolution in Biology," in which he called his audience "the most selected group of teachers of biology" and "pioneers of this effort to reorganize and reinvigorate

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[447] Grobman, *The Changing Classroom*, 91-92.

[448] Betty Moore, personal communication, June, 2009.

the teaching of biology and give it new direction."[449] He recognized the importance teachers had for the successful introduction of the curriculum into the schools. One hundred five schools across the country were organized into fifteen test centers, each headed by a research biologist from the Summer Writing Conference who met weekly with the teachers involved. Extensive feedback was collected and organized for use by the 1961 Summer Writing Conference. Teachers worked very hard to make the project succeed, and were supported in this by the collegial assistance of biologists and other teachers through the testing centers.[450] The process was publicized through "the BSCS Newsletters, in professional journals and in a variety of articles in the public press including a number of commendatory editorials in major newspapers."[451] Local newspapers highlighted some of the classrooms where the new curriculum was being piloted, elevating the local visibility and status of teachers and schools by their association with this cutting-edge curriculum.

The first experimental versions of the textbooks issued in the fall of 1960 had multiple problems, however. There was poor coordination of laboratory exercises and textbooks. Evolution was treated primarily in a chapter near the end of the books, not unlike earlier textbooks. In the efforts to produce three textbooks during the 1960 Summer Writing Conference, the idea of themes interwoven throughout the curriculum

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[449] Bentley Glass, "Revolution in Biology," *BSCS Newsletter 9 and 10,* Sept 1961 and Nov 1961, Box 137, BSCS, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[450] BSCS Memorandum 66, Minutes of the Fourth Meeting of the Steering Committee, February 2-3, 1961, Steering Committee Memoranda 47-70, BSCS Archives, BSCS, Colorado Springs, CO.

[451] Grobman, *The Changing Classroom*, 18.

took a back seat to simply producing coherent texts in a timely manner. Enthusiasm for the inquiry-based curriculum carried teachers and students through the early days of piloting, however. There was almost no resistance from the public to the treatment of evolution in the early versions, possibly because the textbooks were issued in three separate parts and evolution was treated mostly in the last part. If the evolution chapters had been available in the beginning of the year, they may have been subject to more scrutiny. The only resistance was the request of a few students in one classroom to be exempted from the evolution part of the course.[452]

Muller Joins the BSCS

Grobman invited Muller to become a member of the Steering Committee in late 1960. With his acceptance letter, Muller offered to send his recent paper entitled, "The Integrational Role of the Evolutionary Approach Throughout Education," when it became available.[453] In this paper, Muller asserted that the "chief integrating principal… both in the science and the humanities…is that of evolution."[454] By interweaving cosmic, biological and cultural evolution throughout the study of the sciences and the humanities, students could be brought to a "unified, truly modern world view."[455] Muller also stated that, "Hereafter, if man is to succeed, he must take evolution into his own hands," a call

[452] Rudolph, Scientists in the Classroom (NY: Palgrave, 2002): 152.

[453] Hermann J. Muller to Arnold Grobman, November 18, 1960, Series V, Box 3, Folder: American Institute of Biological Science 1947-1960; Hermann J. Muller, "The Integrational Role of the Evolutionary Approach Throughout Education," presented to the Philosophy of Education Society Annual Meeting, Columbus, Ohio, April 12, 1960, Series III, Box 3, Folder: 1960 April 12 Philosophy of Education Society, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[454] Ibid., 2.

[455] Ibid.

to reform eugenic practices.[456] Keep in mind that for Muller this conclusion was based on his scientific, humanistic world view, and that he eschewed the use of eugenics for purposes of racial discrimination. After Grobman read the paper, he requested 40 reprints from Muller to distribute to Steering Committee members and other BSCS leaders, stating "I am, at the philosophical level, in full agreement."[457] When Muller reviewed the first early sections of the early textbooks in the winter of 1961, he was dismayed that there was so little treatment of evolution, which he had already clearly communicated should be in the beginning and all the way through. Muller insisted at the Fourth Meeting of the Steering Committee on February 2-3, 1961 that evolution be *the* central organizing theme of the textbooks. Bentley Glass responded that "evolutionary theory depends upon genetics and until genetics was introduced it seemed difficult to introduce evolution. This is one place where the theme needs to be woven from the beginning."[458] Grobman added that "I think we all agreed that these themes should be woven through the versions. We talked about this long before the writing conference. I would say that if we had had seven more weeks we could have woven these themes through the versions. The pressure of some high school teachers to have certain kinds of information was another factor we had

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[456] Ibid., 10.

[457] Arnold Grobman to H. J. Muller, December 13, 1960, Series V, Box 3, Folder: American Institute of Biological Science 1947-1960, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[458] Memorandum No. 66, Minutes of the Fourth Meeting of the Steering Committee, February 2-3, 1961, 4, Box 169, BSCS Steering Committee, Feb 2-3, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA. Glass was also concerned about criticism received that the texts were too teleological in nature and the difference in this point of view from adaptation by natural selection should be treated early in the text.

to accommodate."[459] Grobman transferred some of the blame to teachers for having their own agendas for the textbooks. Educational theorist Joseph Schwab indicated that he thought evolutionary ideas were introduced earliest in the Green Version, with the chapter at the end of the book merely tying loose ends together. Nevertheless, Muller was not satisfied with the adequacy of the treatment of evolution in the Green Version, either.

Later in this meeting the discussion returned to the issues of themes. Muller was even more adamant about evolution being "the bottom, the top and everything." He went on to propose that there were "not nine separate themes. The evolution of change is the trunk." This emphasis on evolution had at least two important roles for Muller. First of all, by organizing biology around evolution, the BSCS could "give ourselves and the world a logical science." Muller advocated evolution in its unifying and explanatory role in the often-fragmented biological sciences. The emphasis on evolution was needed for the field of biology as much as for those they were trying to educate. The second role of this emphasis on evolution was political. Muller asserted that the modern theory of evolution developed in the West was superior to the conception of evolution promulgated in the Soviet Union, called, which was based on Lamarckism.[460] "The other side of the world doesn't recognize competition and the continuity of genetic material. To get this across would be our great contribution. This is why I think we need a meeting before the

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[459] Ibid., 5.

[460] While Stalin was in power, Trofim Lysenko advanced incorrect genetic theories which promised huge increases in crop productivity. These theories were politically useful to Stalin during the famines of the 1930s, and geneticists who objected to Lysenko and his methods were imprisoned or disappeared. This influence was called Lysenkoism, and was active in the Soviet Union until the 1960s. See Audra Wolfe, "What Does It Mean to Go Public? The American Response to Lysenkoism, Reconsidered," *Historical Studies in the Natural Sciences* 40, no. 1 (Winter, 2010), 48-78.

Writing Conference. Parts 3 [of the 1960 versions] are not out. We should meet after we have these in our hands."[461] While not stated at this time, I think that it is clear from other writings that Muller had a third reason why evolution must be emphasized in the curriculum: young people on the brink of their reproductive years needed to be able to understand the problem of genetic load and be prepared to participate in reform eugenic programs.

Harvard paleontologist Alfred Romer tried to balance Muller's viewpoint by saying that he was more interested in the "flavor" of the versions, such as the physiological orientation of the Blue Version, and "did not insist that evolution must be the main trunk." The majority of respondents agreed with Muller however, especially Glass and Brandwein. The Steering Committee discussed how to change the versions to make evolution more prominent, and considered starting a fourth version that emphasized an evolutionary approach. They decided, 22 to 0, that it would be better to modify the existing versions than to start a fourth textbook.[462]

After the meeting, Muller sent reprints of four of his articles and an accompanying letter to each of the textbook writers.[463] In the letter, he stated that Bentley Glass, chairman of the Steering Committee, was completely in accord with his

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[461] Memorandum No. 66, Minutes of the Fourth Meeting of the Steering Committee, February 2-3, 1961, 39, Box 169, BSCS Steering Committee, Feb 2-3, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[462] Ibid., 45.

[463] Hermann J. Muller to undisclosed members of the BSCS (form letter), February 23, 1961 and Arnold B. Grobman to H. J. Muller, March 3, 196 Series V, Box 3, Folder: AIBS High School Course Materials, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN. The titles of the four articles were "Life," "Evolution by Mutation," "Evolution and Genetics," and "Genetic Nucleic Acid: The Key Material in the Origin of Life."

recommendations for the biology course. Remember that Muller was Glass's dissertation advisor, and that Glass was on the Board of Directors of the American Eugenics Society at the time.[464] In the letter, Muller asserted:

> The genetic-evolutionary point of view should be presented as the central theme, or "trunk," preceding and running through all the other topics of biology, interconnecting them, and providing a unifying interpretation of them….It was the consensus of the meeting that much could and should be done to implement it.[465]

Thus Muller continued to advocate for evolution as the central fact of life presented to high school biology students, which would provide the basic scientific understanding necessary for the voluntary genetic selection.

The Second Revision

The Fifth Steering Committee meeting was scheduled on May 13 and 14, 1961, giving members more time to study the versions, including the third sections with the evolution chapters, and come up with detailed input for the 1961 Summer Writing Conference. On June 21, 1961, Glass wrote an elegant explanation of the nine themes, which included the following:

1. The nature of scientific inquiry
2. The intellectual history of biological concepts
3. Genetic continuity
4. Regulation and homeostasis

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[464] Bentley Glass is listed as a member of the Board of Directors of the American Eugenics Society in each issue of *Eugenics Quarterly* from 1958-1968.

[465] Hermann J. Muller to undisclosed members of the BSCS (form letter), February 23, 1961 and Arnold B. Grobman to H. J. Muller, March 3, 196 Series V, Box 3, Folder: AIBS High School Course Materials, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

5. Complementarity of structure and function
6. The biological roots of behavior
7. The relation of organism to environment
8. Diversity of type and unity of pattern
9. Change through time – evolution.

Glass commented at this time that evolution "may well be regarded as the most pervasive, most significant biological theme of all."[466] While not negating the importance of the other themes, Glass elevated evolution to the place afforded it by a majority of the members of the Steering Committee. A process of curriculum development over the period of two years had finally solidified the intention of the BSCS to have evolution at the center of its curriculum reform efforts. Now the task was to see this mission fulfilled in the textbooks. Glass decided to create a "theme team" to review the textbooks and make recommendations as to how the themes, especially evolution, could be better integrated and highlighted within the texts.

In a May 17, 1961 memorandum in preparation for the 1961 Summer Writing Conference, Grobman lists the members of the thematic team as Bentley Glass, paleontologist Ned Colbert, and biology teacher Richard Aulie.[467] A later list of the

[466] Bentley Glass, "The Pervading Biological Themes," June 21, 1961, Box 147, Folder: BSCS Steering Committee 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[467] There were originally to be six members of the theme team. Recruiting memorandum were sent to Alex Novikoff, Garrett Hardin, Collin Pittendrigh, Frits Went, Ralph Gerard, and Ralph Cleland. (Glass to Grobman, February 11, 1961, Box 148, Unlabeled folder, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.) I found letters in this folder where Hardin, Pittendrigh, and Cleland declined. Gerard reviewed the Blue Version, possibly away from the writing conference. (Gerard to Glass, July 12, 1961, Box 168 Pervading Themes, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.) Frits Went attended the conference briefly. (Frits Went, "Introductory Remarks" n.d., Box 168, Pervading Themes, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.)

participants in the 1961 summer writing conference lists also includes herpetologist Archie Carr.[468] Some of the memoranda generated by members of the theme team still exist. A particularly interesting one was written by Carr about natural selection. Natural selection, as seen in Chapter Two, was central to Darwinism and the modern synthesis of evolution. Natural selection

> is the one concept in biology that has universal carryover. It was at work on the chemicals of earth long before they came alive, and on the matter of the solar system before that; and afterwards throughout organic history it was the "force" that in each time-set, each "generation," of entities made some of these better survivors than others and so forced the progression that we look back on as evolution. This is so important to a broad grasp of biology, and so necessary if a student is to get something solid to replace his fetal teleology…Natural selection began neither with Darwin nor with the advent of the capacity for replication. It has been here all the time; and it is the responsibility of biology to put this notion across, because nobody else will.[469]

Beyond its importance to understanding biology, Carr considered natural selection to be essential knowledge for the student "to replace his fetal teleology."[470] I interpret this to mean that an understanding of natural selection was necessary in order for students to give up immature notions of design in the universe. Rather than say an organism changes over time because of a vital force or supernatural purpose, random variations persist only because of natural selection, which is a materialistic process. Carr thought it important

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[468] Walter Auffenberg to All Summer Writing Conference, June 22, 1961, Series 4, Box #2, Folder 11 BSCS-Foreign Utilization Program 1961-1963, Archie F. Carr, Jr. Papers, Smathers Libraries, University of Florida, Gainesville, FL.

[469] Archie Carr to All Versions, July 6, 1961, Box 169, Folder: Steering Committee May 13-14, Chicago 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[470] Ibid.

that students allow the concept of natural selection to replace their teleological thinking, so that students could develop a scientific worldview.

In a reply to Glass's memo in which he spelled out the themes, botanist Frits Went also referred to teleology. "Regardless of teleological or crude anthropocentric considerations, there is no doubt that all organisms have, in form and function, achieved a very close relatedness to their surroundings."[471] This 'relatedness' is the adaptation between species and their environments worked out through the process of natural selection. Some people may use the adaptations of organisms as an indicator of supernatural design and purpose, but Went was trying to disregard this interpretation. Teleological explanations were shunned by most science educators at the time. As botanist A. J. Bernatowicz stated in 1958, "For most teachers of science, teleology and anthropomorphism are not issues to be debated but to be deplored – we stand against the evil."[472]

Edwin Harris ("Ned") Colbert, a prominent vertebrate paleontologist, was also a member of the theme team and commented on evolution in the BSCS first versions. Colbert agreed with the criticism of evolution teaching by paleontologist and architect of

[471] F.W. Went, "Postscript on Pervading Biological Themes," June 30, 1961, Box 147, BSCS Steering Committee, 1961, Bentley Glass Papers.

[472] A. J. Bernatowicz, "Teleology in Science Teaching," *Science*, New Series 128, no. 3336 (December 5, 1958), 1402-1405. While this writer indicates that there was general resistance to teleological expressions, some evolutionists have since argued for the utility of teleological language in explaining biological process. This use of teleological language (sometimes called "telonomic" to differentiate it) "has nothing to do with pre-Darwinian teleology," such as the concept of divine purpose central to natural theology. See Francisco J. Ayala, "Teleological Explanations in Evolutionary Biology," *Philosophy of Science*, Vol. 37, no. 1 (March, 1970), 1-15.

the modern synthesis, George Simpson.[473] From Colbert's viewpoint, "evolution should be an especially pervasive theme in modern biology … with documentation provided by the fossil record," but that "biological presentations are frequently weak on this last score." This is not a surprising comment from a paleontologist who saw the contributions of his discipline often treated sparsely in biology textbooks. While complementing the Green Version on its treatment of evolution in several chapters, he thought that evolution should have a greater presence from the beginning and then "wax and wane through the text…there should be an awareness of it on the part of the student."[474] This awareness was an important aspect of the presentation, because for too long evolution had been treated euphemistically in many texts. Student awareness of the theme of evolution in biology was precisely what previous high school biology textbooks, such as *Modern Biology*, had tried to suppress to avoid controversy. Colbert made similar comments with reference to the Yellow Version and the Blue Version.[475] In a separate memo on Chapter Three of the Blue Version, Colbert calls for an expanded explanation of Darwinism, including information on Lamarck and "a few pages devoted to some of the important facets of modern evolutionary theory, even though all of this will have full treatment

[473] G. G. Simpson, "One Hundred Years without Darwin are Enough," *Teachers College Record* 60 (1961): 617-626.

[474] Edwin Colbert, memorandum on Green Version, June 26, 1961, Box 169, Folder: Steering Committee May 13-14, Chicago, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[475] Edwin Colbert, memorandum on Yellow Version and memorandum on Blue Version, June 28, 1961, Box 169, Folder: Steering Committee May 13-14, Chicago, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

farther on in the book."[476] It was acceptable to Colbert that the full treatment of evolution was later in the book so long as the basics were addressed unambiguously in the beginning.

In a July 21, 1961 memorandum, Grobman provided a summary of the changes being made at the 1961 Summer Writing Conference. During this conference, each of the versions was thoroughly reexamined. The Blue Version had a new supervisor, Claude Welch, and it was largely rewritten to highlight evolution in the context of a physiological/biochemical approach. Evolution and natural selection were introduced in Chapter Three rather than waiting until after genetics was introduced in Chapters Fourteen to Eighteen. The conclusion to Chapter Three spells out the importance of evolution in the 1961 Blue Version:

> We have pointed out that we think evolution and natural selection are the great unifying principles in biology. As you will see, the entire book has these principles as its general theme and it is for this reason that this chapter occurs near the beginning of the book.[477]

Notice that in the 1961 Blue Version, at least, it was clear that evolution was *the* unifying theme.

The Yellow Version was also extensively rewritten, especially the early sections on cells, animals, and plants to be more comparative in nature. The last chapter of the 1960 Yellow Version had been a set of essays mostly on evolution. This information was

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[476] Edwin Colbert, "Memorandum on Blue Text, Chapter 3," n.d., Box 169, Folder: Steering committee, May 13-14, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[477] Biological Sciences Curriculum Study, *High School Biology: Blue Version Text*, (Boulder, CO: Johnson Publishing Company, 1961), 61.

redistributed throughout the 1961 Yellow Version so everything about evolution wasn't at the end of the book. In contrast, the 1961 Green Version had less extensive rewriting. The Green supervisor indicated that while there was early *indirect* introduction of the themes, explicit treatment of the themes was left for the teacher's manual.[478] The 1960 Green Version had been well received, largely because its ecological approach was closer to the familiar natural history approach and it was perceived as easier to read than the Blue and Yellow Versions.[479] As a result, the Green Version was under less pressure to be rewritten, and was ready for printing before Yellow and Blue.[480]

The piloting program was expanded in the fall of 1961 to include approximately 360 schools, organized into 36 testing centers, including 12 centers for each of the Yellow, Blue and Green Versions. Teachers were paid a stipend 10% of their normal salary and Center Leaders were paid 15% of their normal salary based on an estimate of the extra time the program had required of participants. The money and status involved in being part of the curriculum study seemed to more than make up for the increased workload. More than 95% of teachers from the first piloting program volunteered to pilot

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[478] Arnold Grobman to Directors of Summer Institutes with an interest in BSCS materials, July 21, 1961, Box 168, Folder: Writing Conferences 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA. This summary of changes being made at the 1961 Summer Conference was sent to the approximately 25 Summer Institutes which had arisen outside of the BSCS to prepare teachers for the second piloting of the BSCS curriculum in the Fall of 1961. Grobman to Glass, Klinge, Moore, Pearson, and Welch, April 20,1961, Box 148, unlabeled file, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[479] BSCS Memorandum No. 66, Minutes of the Fourth Meeting of the Steering Committee, February 2-3, 1961, Box 169, Folder: BSCS Steering Committee Feb 2-3,1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

[480] Archie Carr to Blue and Yellow Versions, "Conceptual Aspects of 'Diversity' Sections", July 12, 1961, Box 169, Folder: Steering Committee May 13-14, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

the 1961 version.[481] Over 850 applications were received for the 350 school testing positions.[482] Other schools found out about the program and wanted to have an opportunity to use the materials. In the end, about 500 schools actually used the 1961 Versions during the 1961-1962 school year. This amounted to 52,000 students using the new curriculum, which was five times the number from the previous year.[483] All along the way, opportunities for input of teachers and students provided a positive outlet for criticism and fostered ownership of the program.

Small teams utilized the extensive feedback from teachers for the next revision of the versions, which took place during the summer and fall of 1962.[484] The writers received much less public criticism concerning evolution and reproduction in the experimental versions of the texts than was anticipated.[485] The textbooks resulting from the 1962 revision became the first commercial editions of the three versions. Each commercial edition, including lab manuals and other materials was published by a different publishing house,[486] which meant that three publishing houses were marketing

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481 Grobman, *The Changing Classroom*, 113-115.

482 Notes on BSCS Conference: Park Ridge, Ill. May 13-14, 1961, Box 169, Folder: Steering Committee May 13-14, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

483 Grobman, *The Changing Classroom*, 113-115.

484 The members of the 1962 Yellow Version writing team included Donald Bucklin, Jay Davis, Bentley Glass, William Mayer, George Schwartz, Wilson Stewart and John Moore. "Report of the Yellow Version Supervisor," December 7, 1962, Box 168, BSCS Steering Committee 1962, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

485 "Yellow Version Center Leader Meeting," May 4-5, 1962, p.14, Box 158, Folder: Yellow Version Center Leader Meeting, Chicago, May 4-5, 1962, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

486 The 1963Yellow Version was published by Harcourt, Brace and World, Inc., the 1963 Blue Version by Houghton Mifflin Company, and the 1963 Green Version by Rand McNally.

the versions in competition to each other. In 1965, a resourceful Texas salesperson from Rand McNally decided to market the Green Version as the BSCS edition with the least amount of references to the word evolution in the index. All of the essentials for the modern theory of evolution were in the Green Version, but the word evolution was used less frequently than in Blue or Yellow, which apparently was attractive to some buyers.[487]

Summary and Evidence: The Negotiated Curriculum

The final treatment of evolution in the BSCS textbooks was constructed through the curriculum deliberation process, and reflected the commitments and concerns of the various agents involved. The envisioning of evolution as central to the curriculum can be traced to a study of biology education led by Oscar Riddle in the late 1930s and early 1940s which concluded that only around half of high school biology students in the United States had evolution taught to them as a fact or basic principle underlying all animal, plant, and human evolution. Riddle determined that religious objections were most important in perpetuating this scientifically unacceptable state of affairs. Bentley Glass was one of the authors of the study report, and his later writings show that his ideas about evolution education were influenced by this study. In addition, Hermann J. Muller

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[487] John A. Moore to Bentley Glass, Arnold Grobman, Haven Kolb and Scotty Welch, February 19, 1965, Box: H. Bentley Glass's BSCS Papers 1959-1970, Folder: 1965 Jan –May, BSCS Archives, BSCS, Colorado Springs, CO.

used Riddle's study to show the need for improvement in evolution education in his often-cited "One Hundred Years without Darwinism Are Enough."[488]

I have presented evidence that while evolution was proposed to members of the BSCS as *the* central theme of the BSCS curriculum as early as June 1959, there was a diversity of opinion among the biologists. Several of their concerns mirrored influences seen in Riddle's study such as questions regarding the relative importance of evolution among the other themes of biology and concerns over possible religious objections. In addition, teachers who were part of writing teams had their own agendas about what should be emphasized. In the early curriculum deliberation process, the consideration of themes became secondary to the practical difficulties of exactly what type of curriculum product would be designed. The decision to produce three complete textbooks with different emphases complicated the project, and a very short writing timeline in summer 1960 placed thematic considerations in the background in an effort to simply produce materials in time for piloting in the fall of 1960.

The 1960 preliminary textbooks had a greater treatment of evolution than then current texts, but it was mostly in the last chapters of the textbooks, after genetics had been introduced. The placement of most of the information at the end of the texts ignored Muller's call for evolution treatment throughout the text in his 1959 article "One Hundred Years of Darwinism Are Enough" and his communications with BSCS leaders. The release of the 1960 Versions of the textbooks in three separate sections throughout

[488] H. J. Muller, "One Hundred Years Without Darwinism Are Enough," *School Science and Mathematics* 59, no. 4 (April 1959): 308.

the school year delayed the sections that most concerned evolution from getting into the hands of teachers and students until the last part of the year. This release of the chapters on evolution late in the school year may have kept the topic “under the radar” of concerned groups, leading to less resistance than expected.

The lack of evolution information in the early part of the texts, as well as the general lack of thematic continuity in all three texts alarmed the Steering Committee, especially Hermann J. Muller. Muller had tried to influence the curriculum prior to the summer 1960 writing conference through correspondence with Arnold Grobman, John Moore, and the textbook writers and was hoping for a pervasive treatment of evolution throughout the texts. The Steering Committee resolved that all the themes and especially evolution needed to be introduced at the beginning of each of the texts and woven through the texts, and Bentley Glass created a theme corps to supervise that effort at the 1961 Summer Writing Conference. The results were two versions, Blue and Yellow, with increased emphasis on evolution, and the Green Version, which was less altered in that regard.

The changes can be most easily seen in the 1961 Blue Version Table of Contents. While the 1960 Blue Version contains an early chapter on the origin of life, the word evolution does not appear in any chapter heading or sub-heading until Section 9 (of 10 sections.) Most of the early chapters were concerned with organization and function, and energy utilization, as one would expect in a biology text with a “physiological” flavor. In contrast, in Section One of the 1961 Blue Version, “Evolution and Natural Selection” is the title of Chapter Three, followed by “The Origin of Life,” Chapter Four. Section Two is entitled “The Evolution of the Cell,” and contains five chapters which develop the evolution of the modern heterotrophic cell. Section Three covers “The Multicellular Organism: New Problems of Life” including Chapter Ten, “The Problems of Complexity,” and Chapter Eleven, “Cell Theory.” Section Four brings us to “The Multicellular Organism: Problems of Reproduction and Variation,” where genetics is introduced and integrated with modern evolutionary theory. Part of the reason that the 1961 Blue Version was such a dramatic change was that the supervisor changed from Ingrith Deyrup, who was more concerned with the physiological emphasis of the Blue Version, to Claude Welch, who embraced evolution as the central theme of the text while keeping the Blue Version’s physiological emphasis.

In the 1960 Yellow Version, “Evolution” was the title of Chapter Ten (of eleven chapters). In the 1961 Yellow Version, the word evolution still does not appear in the table of contents until Chapter Ten. But material that had appeared as a set of essays at the end of 1960 Yellow Version on the Origin of Living Things, Human Evolution and Cultural Evolution were integrated earlier in the 1961 Version. The 1960 Yellow Version was considered to be most in need of revision of the three versions, and while the 1961 version was an effort in that direction, it was not until the 1963 revision, (where Glass was heavily involved in addition to Moore) that Yellow was most cohesive in its treatment of evolution. In fact, the 1963 Yellow Version had the most references to evolution listed in the index (146) followed by the Blue Version (59) and the Green Version (9).[489]

The Green Version appears to have changed less in its treatment of evolution than the other two versions over the period from the 1960 Versions when Marston Bates was most involved until the 1963 Green Version where teacher Haven Kolb was the primary supervisor. Bates and Kolb worked together on the original 1960 Green Version, and over the subsequent versions, Kolb took over as Bates retreated to work on other projects. This is not to say that evolution was not important in the Green Version. The interaction of organisms with each other and the environment is central to both natural selection and ecology. It is just that its treatment in 1963 version does not differ so much from the 1960 version as the other two, and the word evolution is used far less frequently.

Significance

In this chapter, I have traced the influences which brought evolution to the position of central theme in the BSCS textbooks. While Ronald Ladouceur asserts that the centrality of evolution in the curriculum was part of an "after-the-fact history" created to help distinguish the BSCS texts from previous high school textbooks, I have shown that BSCS leaders Glass, Grobman, Moore, and Muller were all originally committed to evolution as the central theme of both biology and the curriculum even before the first BSCS writing conference in 1960. Initial attempts to have that priority reflected in the

[489] "Number of References to the Study of Evolution, with pages indicated, as found in the Texas State-Adopted Biology Textbooks," n.a., inclusion in John A. Moore to Bentley Glass, Arnold Grobman, Haven Kolb and Scotty Welch, February 19, 1965, Box: H. Bentley Glass's BSCS Papers 1959-1970, Folder: 1965 Jan –May, BSCS Archives, BSCS, Colorado Springs, CO. Note that this inclusion was authored by a Rand-McNally salesperson.

first preliminary versions of the textbooks failed for a variety of reasons, ranging from conflicting priorities among BSCS members, to a simple lack of time to accomplish the novel task of weaving the themes all the way through. Lack of significant objection to evolution on the part of parents for the 1960 preliminary version and the insistence of Muller encouraged a bolder attitude on the part of subsequent writers.

The early commitment on the part of the BSCS leaders to make evolution the central theme of the BSCS textbooks is an important one, because without that commitment, it is very unlikely that the BSCS texts would have differed substantially from the textbooks that were already available. Previous research indicates that Muller's influence during the Fourth Steering Committee Meeting was critical in cementing the course of action towards a more integrated treatment of evolution in the texts, but does not reveal the correspondence between Muller, Moore, and Grobman before the first writing conference when Muller was not yet a member of the Steering Committee. I suggest that Glass, Grobman, and Moore resonated with Muller's early ideas regarding the modern synthesis of evolution, and *recruited* Muller to advance this view within the BSCS Steering Committee. As shown in Chapter Three, Muller's commitment to evolution education was entwined with his commitment to reform eugenics. Far from being simply a marketing tool to differentiate the BSCS texts from previous high school biology textbooks, the modern synthesis of evolution was critical knowledge for the future citizen, a foundational fruit of the scientific worldview which the BSCS leaders wanted to instill in students. While not overtly challenging religious viewpoints towards origins, the naturalism inherent in the modern synthesis of evolution was promoted in the BSCS texts, relegating religious ways of knowing to uncertain status.

Chapter 6

The Eugenic Vision and the BSCS

> We [members of the BSCS] were in unanimous agreement that appropriate scientific treatment must be accorded such "controversial" subjects as organic evolution, the nature of individual and racial differences, sex and reproduction in the human species, and the problems of population growth and control.
>
> –Bentley Glass, "Perspectives: A New High School Biology Program"

In this chapter, I assert that reform eugenic concerns are evident in the BSCS texts. The influence of eugenics should not be surprising, given the involvement of geneticists Hermann J. Muller and Bentley Glass as well as the historic presence of eugenics in high school biology textbooks. However, I am unaware that anyone else has demonstrated how eugenics influenced the BSCS texts or how this influence was related to the modern synthesis of evolution. While the word "eugenics" was not used in the 1963 BSCS textbooks, I suggest that the controversial issues which the BSCS committed to address in the above quote reflect persistent eugenic concerns among leading biologists over the future of humankind and the quality of its gene pool. I will show that knowledge of organic evolution, the nature of racial differences, sex and reproduction in the human species, and the problems of population growth and control are all areas of knowledge that reflect the desire of BSCS biologists to advance a scientific worldview in addressing world problems, one consistent with the ideals of reform eugenics. By doing this, the BSCS prepared students to take their place as reproductive citizens in the nuclear age.

Eugenics in Biology Textbooks

Mainline eugenics had long been a staple of biology textbooks. Historian Steven Selden writes, "American eugenicists regularly recommended using the schools as a pulpit for their message of hereditarian reform."[490] According to Seldon, one of the first high school biology textbooks to include eugenics was George W. Hunter's *A Civic Biology,* in 1914.[491] Even before the rise of population genetics, biologists began to criticize the erroneous scientific assumptions of eugenic programs and their inherent classist and racist biases. For example, in 1917, geneticist R. C. Punnett "rebuked eugenicists for believing that recessives could be easily eliminated in just a few generations through breeding programs."[492] But the fascination with human betterment continued for some, including some of the chief critics of mainline eugenics such as Hermann J. Muller. These new reform eugenicists were often politically liberal. According to historian Daniel J. Kevles:

> The prominent biologists among [reform eugenicists] ranged from the moderate left to the Marxist left…they were united in recognition that advances in anthropology, psychology, and genetics had utterly destroyed the "scientific" underpinnings of mainline doctrine, and that any new eugenics had to be consistent with what was known about the laws of heredity.[493]

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[490] Steven Selden, *Inheriting Shame: The Story of Eugenics and Racism in America* (New York: Teachers College Press, 1999), 63.

[491] Ibid., 70.

[492] Ibid, 71.

[493] Daniel J. Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity* (Berkeley, CA: University of California Press, 1985), 170.

By the late 1930s, some high school textbook authors were also beginning to directly challenge eugenic assumptions. There was a downward tendency in the amount of coverage given to eugenics through the 1940s and 1950s, except for James Otto's *Modern Biology*, which continued to include the topic into the 1960s.[494] This reduction in the use of the word "eugenics" paralleled the reduction of the use of the word in prominent newspapers at the time.[495] While the 1963 published versions of the BSCS textbooks did not include the word eugenics, topics important to reform eugenicists nevertheless appeared. Reform eugenic priorities included improving human environmental conditions to maximize realization of genetic potential, the elimination of typological thinking about race, preserving the human gene pool, and promoting sex education and population control. These were all important to the future of humankind, regardless of race or social position.[496]

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[494] Ronald P. Ladouceur, "The Eugenic Zombie in a Graveyard of Textbooks," Textbook History, http://www.textbookhistory.com/?p=1948 (accessed July 2, 2012). For more on eugenics in the *Modern Biology* series, see Steven Selden, "Biological Determinism and the Narrative of Adjustment: The High School Biology Textbooks of Truman Jesse Moon, c. 1921-1963," *Curriculum Inquiry* 37, no. 2 (June 2007): 159-96.

[495] "Between 1950 and 1960, the term eugenic or any version of it appeared 774 times in the *New York Times*, the *Chicago Tribune*, the *Washington Post*, or the *Los Angeles Times*, compared to 1,744 times between 1930 and 1940." Mary Ziegler, "Reinventing Eugenics: Reproductive Choice and Law Reform After World War II," *Cardozo Journal of Law and Gender* 14, no. 2 (Spring, 2008): 324. http://www.cardozolawandgender.com/uploads/2/7/7/6/2776881/14-2_ziegler.pdf (accessed July 16, 2012).

[496] While it could be argued that the wealthiest nations and classes had the most to gain from addressing these concerns, most reform eugenicists emphasized that they were problems that affected all peoples.

Eugenics in the BSCS Textbooks

Even though many high school textbooks no longer included sections on eugenics, it was still included in the experimental 1960 Yellow Version, supervised by John Moore, in a section entitled "Eugenics." While some of the same information appeared in the other versions, neither the experimental 1960 Blue nor Green Versions had "Eugenics" as a section title. This could have been related to the early Yellow Version emphasis on genetics and evolution, but may indicate a difference of opinion between the writing teams on whether or not to address the controversial topic. Before the "Eugenics" section in the 1960 Yellow Version there were two related sections: one entitled "Improving Genetic Lines" and the second entitled "Eliminating Undesirable Genes." These were two classic eugenic concerns. The first section highlighted selective breeding with emphasis on the development of hybrid corn. But the section also provided more general information regarding selective breeding:

> When we talk about the general problem of improving genetic lines, we usually mean that the improvement should be in the direction of increased use or value to man. We must ask the purpose of the proposed improvement, in the specific organism, and know something about the environment in which the improved strain is to live. A trait considered an improvement in one environment might prove to be a severe handicap in another.[497]

Environment was more of a concern in reform eugenics than older mainline eugenics, which took a hardline hereditarian viewpoint.

[497] Biological Sciences Curriculum Study, *High School Biology: Yellow Version Text (Part Two) for Experimental Use During the School Year 1960-61* (Boulder, CO: Biological Sciences Curriculum Study, 1961), 8-90.

While the 1960 Yellow Version did not discuss Hermann J. Muller's eugenic program of germinal choice, it did introduce a key element of that program, artificial insemination. Remember from Chapter Three that in germinal choice, couples made the decision to use donor sperm from highly intelligent or gifted males for artificial insemination in order to have superior offspring. Glass had stated at a conference in 1960 that a discussion of sperm banks might be possible in the next BSCS textbook revision.[498] Discussions of artificial insemination and sperm banks were controversial at the time, because some people had religious or moral objections to the practice. I assert that the reason artificial insemination was included in the text was to prepare students for the possibility of that reproductive choice. The writer of the text emphasized that "with improved storage techniques, it has become possible to preserve excellent genetic material long after the death of the donor individual." While this might be useful for animals, it had important advantages specific to human artificial insemination. Herman J. Muller made the point in his writings that freezing of donor sperm was desirable because the fitness of the donor could be ascertained by the lifetime accomplishments of the individual. In addition, the use of deceased donor sperm would hopefully lessen the possible conflict and jealousy of the adoptive father.[499]

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[498]Bentley H. Glass, from unedited transcript for Conference A, as quoted in Demitri B. Shimkin to Ralph Burhoe, January 4, 1961, Series III, Box 4, Folder: 1960 American Academy of Arts and Sciences, Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

[499] Hermann J. Muller, "Should We Weaken Our Genetic Heritage?" *Daedalus* 90, no. 3 (Summer 1961): 441.

The second section entitled “Eliminating Undesirable Genes” discussed the relative ease of eliminating undesirable dominant genes from a population as opposed to the difficulty of eliminating undesirable recessive genes. Mainline eugenicists had long supported reproductive segregation or sterilization for those individuals with undesirable traits such as “feeblemindedness” or mental illness, erroneously assuming that this would quickly eliminate these traits from the population. In keeping with the reform understanding of heredity, this section of the text concluded, “The genes which are truly rare in the population are almost impossible to eliminate. And these are the very ones that frequently are most undesirable, at least for the individuals who have the misfortune to inherit them.”[500] The text makes the very important point that “even if all the homozygous recessive individuals in the population are prevented from mating, there are still many recessive genes hidden in heterozygous individuals.”[501] In human terms, this meant that reproductively isolating or sterilizing individuals who had diseases or disabilities caused by homozygous recessive genes would not address the hidden recessive genes in the rest of the population, making elimination of the undesirable gene extremely difficult. Reform eugenicists criticized coercive sterilization programs for this reason. Couples seeking to avoid the birth of a defective child could still choose voluntary sterilization.

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[500] Biological Sciences Curriculum Study, *High School Biology: Yellow Version Text (Part Two) for Experimental Use During the School Year 1960-61* (Boulder, CO: Johnson Publishing Company, 1961): 8-92.

[501] Ibid., 8-91.

The section entitled “Eugenics” in the experimental 1960 Yellow Version introduced eugenics with the following passage:

> When we come to the question of the “improvement” of the human population, we enter a Babel of controversy, misinformation, confusion, and doubt. It is generally agreed that there are many very undesirable human traits with a hereditary basis. Presumably the human population would be much better off if these traits were not a part of its heritage, since they frequently lead to tragic circumstances for the individuals afflicted, and to tremendous expense to society. And yet, the problems which emerge from a serious consideration of this question seem almost overwhelming.[502]

This section acknowledges the desirability of eliminating undesirable genetic traits, but also sounds a note of caution. The word “eugenics” could arouse mixed emotional reactions, including disdain from those remembering Nazi atrocities. The desirability of improving the human gene pool was still advanced by the text, however. Twin studies were examined, and a case constructed for that many physical traits are genetically controlled. BSCS writers discussed the hereditary aspects of intelligence and the genetic predisposition for disease. The section concluded that the most urgent priority was providing improved environments that allowed for the maximum realization of the genetic potential of every individual.

> The improvement of the social, educational and political environment in which a child develops is of urgent importance. Fair economic reward for service rendered, educational offerings and standards of high quality, adequate scholarship assistance for competent students, equality of opportunity for all persons –these goals all contribute towards making an environmental situation which will encourage the best performance in each individual.[503]

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[502] Ibid., 8-92.

[503] Ibid., 8-95.

Set in the context of school desegregation of the early 1960s, this was clearly a political statement. Bentley Glass had been very active in the desegregation of Baltimore schools, and a liberal outlook characterized many of the reform eugenicists.[504] Given the difficulties of reducing undesirable recessive hereditary characteristics, improving the environments of all people held the most promise in the short run so that it would not be the limiting factor in intellectual, moral, or physical performance. Once equal opportunity was established in society, a stable, controlled environment would exist, providing the optimal conditions for assessing the true genetic differences between various human groups, including races. Controlling the environment was the first step in taking control of the future of humankind.

In the next experimental Yellow Version, used in classrooms in 1961-1962, a section on "Human Heredity" replaced the eugenics section. At this point, it appears that the writers removed the word "eugenics" from the entire text. They retained the preceding section on "Improving Genetic Lines" but removed the section on "Eliminating Undesirable Genes." Only the barest mention of "negative selection" remained. The section on "Human Heredity" began:

> From time to time we hear of proposals to "improve the human race." Such schemes may depend on "eliminating undesirable genes" or "encouraging geniuses to have more children." There are two problems we must recognize when we try to judge such schemes. One of these is our relative lack of accurate knowledge about most of human heredity. Second, it is never quite clear in just what direction we want to guide the path of human improvement, if it were possible to do so. We are certain that the elimination of large gene pools from the

[504] Edwin Diamond, "Biologist in Society's Laboratory," *Saturday Review*, Nov 2, 1957, 47; Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity,* 170.

> face of the earth, as Hitler tried to do during the Second World War, is neither morally nor scientifically defensible.[505]

While the word eugenics was not used, it would have been clear to the knowledgeable reader that eugenics was the topic, although it may not have been apparent to students. Just as previous biology textbooks had covered evolutionary concepts such as natural selection without using the word evolution, the BSCS writers addressed eugenic issues without the controversial word appearing in the text. Again, the section began on a note of caution. Eugenic proposals were referred to as "schemes," a word with derogatory connotations. Eugenics had undeniably developed a bad reputation. The writers cited a lack of knowledge about human heredity as a key limitation of eugenic proposals, and this was one of the concerns that led to the decline in mainline eugenics in the 1930s. Another concern highlighted the political difficulties with state-sponsored programs of eugenic improvement. Most important of all, this introduction made it clear that the excesses of Nazi eugenics were totally reprehensible. However, the text does not stop there.

As in the 1960 Yellow Version, the 1961 Yellow Version included an overview of some human traits that have a genetic component, including blood types, intelligence, feeble-mindedness, eye color, height and weight, and diabetes. The writers pointed out that intelligence and feeble-mindedness depended on a combination of strong hereditary components and environmental influences. The section concluded with reasons why

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[505] Biological Sciences Curriculum Study, *High School Biology: Yellow Version Text (Part Three) for Experimental Use During the School Year 1961-1962* (Boulder, CO: Johnson Publishing Company, 1961): 726.

knowledge of human heredity was limited, but noted that recent years had shown rapid advances. Research was continuing into human heredity, regardless of the difficulties. Overall, the authors sounded a strong note of caution in this section, and yet let students know that work was still going on and that being informed in this area was important.

In the 1963 final Yellow Version, this section remained as "Human Heredity," but an introductory paragraph on artificial insemination being used in humans was included, making it clear that this technique was not limited to animals, and that students should be aware of this as a reproductive choice. This section stated: "Artificial insemination is applicable also to man. Under what circumstances do you think it should be used? Or does it raise so many questions that you think it should be prohibited?"[506] Rather than have to discuss the heavily controversial issue in the text, the authors simply posited questions for the reader. The rest of the section was very similar to the 1961 Yellow Version text except that more hereditary conditions were discussed, including hemophilia, color blindness, baldness, resistance to tuberculosis, and schizophrenia. Students were given enough examples to understand the complex interplay of "nature and nurture" in human disabilities, and to see the desirability of controlling both to improve the human condition.

A very small group of writers wrote the 1963 Yellow Version, with John Moore and Bentley Glass primarily responsible for the final copy of the text. If Glass, who was on the American Eugenics Society Board of Directors at the time, wanted to put in more

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[506] Biological Sciences Curriculum Study, *Biological Science: An Inquiry Into Life* (New York: Harcourt, Brace & World, Inc., 1963), 584.

information on eugenics or treat it in a different way, he would have had the opportunity.[507] But I think that they were reluctant to emphasize eugenics directly because the authors didn't want this topic to become a cause of rejection of the texts. While many geneticists still thought human genetic research important, some biologists and anthropologists had distanced themselves from this controversial area of research. I think that the primary goal in this section of the 1963 Yellow Version was to make students aware of the possibilities of human genetic improvement and the considerations involved so that, as citizens, they could understand future developments. Statements of caution were prudent because eugenics had a history of grievous misuse for political purposes. Students were informed that many human traits had genetic components, and that research was proceeding rapidly.

In the 1963 Blue Version and 1963 Green Version, there are no warnings regarding eugenic "schemes" and the word "eugenics" does not appear in the index. However, many of the same points are made about the role of heredity and environment in human intelligence, feeble-mindedness, and an array of physical traits and disabilities. The 1963 Blue Version again emphasizes the rapid advance of knowledge in human genetics.[508] This version also discusses artificial insemination, the storage of frozen

[507] Bentley Glass is listed as a member of the Board of Directors of the American Eugenics Society in each issue of the *Eugenics Quarterly* from 1958-1968. Other notable members of the board included Tracy Sonneborn (1958, 1959), who was president of AIBS in 1961, and Theodosius Dobzahnsky, (1964-1968). All three were notable scientists recruited by Frederick Osborn to improve the reputation of the society.
[508] Biological Sciences Curriculum Study, *Molecules to Man*: *BSCS Blue Version* (Boston: Houghton Mifflin Co., 1963), 418.

sperm after the death of the donor, and its use in humans. The 1963 Green Version does not address artificial insemination.

The 1963 Yellow and Blue Versions have diagrams of human sexual organs. This was unusual in high school biology textbooks at the time, but the BSCS biologists thought that information on human reproduction was important for teens. Sex education was an important part of the reform eugenics agenda as well. All three versions discuss methods of animal fertilization without being graphic about human intercourse. The fact that the Green Version did not have diagrams of human sexual organs and is noticeably different on other issues is an indication of the independence of its primary supervisor, ecologist Marston Bates. While I do not believe it was the intention of the BSCS leaders to have the Green Version be less “hard-hitting,” the fact that the word evolution was used less frequently in the Green Version and the fact that it omitted the diagrams of human reproductive organs made the Green Version the “least offensive” of the BSCS texts.

A central concern for Hermann J. Muller was the problem of genetic load. Eugenicists had been concerned for some time with the degradation of the human gene pool, but the problem took on a whole new dimension with the increased use of atomic radiation for both military and peaceful purposes. Even as scientists assuaged fears regarding the dangers of race-mixing during the 1940s and 1950s, the dangers of radiation became the new and more frightening concern. All of the experimental and final BSCS versions discussed the process of genetic mutation and the dangers of radiation in producing mutations. All versions discussed the contributions of Muller in the artificial creation of mutations through the use of X-rays, the lethal nature of most dominant mutations, and the production of recessive mutations. The dangers of nuclear radiation through weapons and medical uses were discussed, and concerns raised for the effects of increased radiation for human populations.[509] For example, the 1963 Green Version states:

> Mutation rates are strikingly increased by high-energy radiations, such as X-rays, beta and gamma rays, resulting from atomic changes (and from atomic explosions), and even ultraviolet light. In a world where such radiations are becoming a more frequent part of the environment, this source of mutation is of increasing concern to everyone.[510]

Remember that the dangers of atomic radiation were very important concerns of Muller and Bentley Glass, and Arnold Grobman wrote a book about the dangers of atomic radiation.[511] It is interesting to note that the topic of genetic load, per se, is not addressed in the texts, which would have revealed an even stronger influence of Muller on the texts. As it is, the dangers of radiation and the possibility of artificial insemination were noted without frank reference to genetic load or Muller's controversial program of germinal choice.

From the above we can see that even though the BSCS authors did not use the word eugenics in the final 1963 versions of the textbooks, they were interested in human

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[509] See Biological Sciences Curriculum Study, *High School Biology: BSCS Green Version* (Chicago: Rand McNally & Company, 1963), 558; Biological Sciences Curriculum Study, *Molecules to Man*: *BSCS Blue Version*, (1963),388-390; and Biological Sciences Curriculum Study, *Biological Science: An Inquiry Into Life*, (1963), 580, 686.

[510] Biological Sciences Curriculum Study, *High School Biology: BSCS Green Version* (1963), 558.

[511] Arnold Grobman, *Our Atomic Heritage* (Gainesville, FL: University of Florida Press, 1951).

heredity research and thought that students should be aware of the genetic nature of many human characteristics. They wanted students to have basic reproductive information without having the textbooks immediately rejected for being too graphic. They wanted students to realize that artificial insemination was a reproductive option. They were especially concerned that students understand the danger of X-rays and nuclear radiation for causing genetic mutations and human genetic diseases. Further research into human genetics would undoubtedly bring opportunities to make reproductive decisions which would have long term effects on the human gene pool, and the BSCS biologists wanted students to be prepared to understand these advances. All of these areas were important information for students who were about to enter their reproductive years in the nuclear age.

Population Control

All three 1963 BSCS versions also raised concerns about worldwide population growth. In the 1910s and 1920s, eugenicists were divided on contraception because it was most widely used by the well-educated and therefore decreased reproductive rates among the middle and upper classes. However, by the 1940s, eugenicists thought the effort to stop the spread of contraceptives was "fruitless at best and counterproductive at worst."[512] In the United States, reform eugenicists were delighted to see increasing reproductive rates among the upper and middle class during the postwar baby boom, but were still concerned with the high rate of reproduction among those in the lowest

[512] Diane B. Paul, *Controlling Human Heredity: 1865 to Present* (Atlantic Highlands, NJ: Humanities Press, 1995), 120-21.

socioeconomic classes. Eugenicists advocated greater availability of contraception for everyone. There was also growing concern about the population explosion in underdeveloped countries. While some accused population control efforts of being racist, Kevles points out, "it required no race prejudice to find a good deal that was dysgenic in the proliferation of people in environments that offered inadequate food, housing, education, and medical care."[513] A number of reform eugenicists became advocates for population control, most notably Frederick Osborn, a founder of the American Eugenics Society, who started the Population Council in 1952.[514]

The 1963 Blue Version warned students that by the time they were 50 years old, partially due to medical advances and lengthened lifespans, there would be twice as many people in the United States. "What are the long-range consequences for such geometric growth of the world population?" the text queried students rhetorically, and then answered:

> Adequate amounts of food, already in critically short supply in many areas of the earth, will become more difficult to obtain. Fresh water will be scarce in many places. . . Many scientists, educators, government leaders and citizens are becoming very concerned about this problem. One obvious way to slow the rate of population growth is to reduce the number of children born.[515]

Then the text posed problems to reducing the birthrate globally, including poor standards of living, lack of education, and religious objections. Rather than attempt to offer

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[513] Kevles, *In the Name of Eugenics*, 259.

[514] Ibid.

[515] Biological Sciences Curriculum Study, *Molecules to Man*: *BSCS Blue Version* (Boston, MA: Houghton Mifflin Company, 1963), 431.

solutions to these problems, the text again placed the responsibility with the students, asking them to consider the "biological consequences of overpopulation" and to suggest solutions. The writers wanted students, as future parents and world citizens, to become personally involved with the problem and its solution. Likewise, the 1963 Yellow Version made dire warnings regarding the world population: "'*Either the birthrate of the world must come down or the death rate must go back up.'* Population growth has become one of the most serious problems for our species. Every reader of this book belongs to a generation that must help to solve this problem."[516] The Yellow Version also related the population explosion to stress on animals and plants by saying, "Everywhere the number of species is shrinking, the food webs tearing."[517]

As disturbing were the warnings of the Blue and Yellow Versions, the most memorable warning regarding overpopulation was made by the 1963 Green Version.[518] As the version with an ecological emphasis, the Green version was the most thorough in situating humans within the web of life. After examining the geometric increase in world population growth, the Green Version stated:

> Clearly, modern man has escaped from the normal checks and balances that control populations within the biosphere. No one, certainly, would want to reestablish the checks—starvation, disease, and misery. But increasing numbers

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[516] Biological Sciences Curriculum Study, *Biological Science: An Inquiry Into Life* (1963), 712. The italicized portion of this quote is italicized in the text, and is a quote from *The Growth of World Population*. Report of the Committee on Science and Public policy, National Academy of Sciences. Washington, D. C.: National Academy of Sciences-National Research Council, 1963.

[517] Ibid., 718.

[518] Ronald P. Ladouceur makes a similar point in "Ella Thea Smith and the Lost History of American High School Biology Textbooks," *Journal of the History of Biology* 41 (2008): 465-66.

> of thoughtful people of all nationalities, religions, and races are worried about the possible results of these skyrocketing numbers.[519]

But, as if this was not enough, the version references Alan Gregg, of the Rockefeller Foundation, who compared human population growth to cancer:

> This tissue somehow escapes the ordinary growth controls and multiplies at the expense of all the other tissues, as man is multiplying at the expense of the rest of nature. If you could ask the cancer cells, they would surely think they were doing fine—but when at last the organism is killed, they die, too. There is a frightening possibility that man, with his apparently limitless increase in numbers and his increasing power to destroy the rest of nature, may multiply his way to destruction.[520]

Humans, by their out of control reproduction and disregard for other species, could potentially multiply themselves to extinction. This was the ultimate threat.

In summary, I have shown that population control was a concern of the BSCS writers that mirrored the concern of reform eugenicists. Through dire warnings, the textbooks confronted students with the consequences of continued population growth, and led them to the conclusion that the birthrate simply had to come down, on a worldwide basis. This was a critical message for students on the brink of their reproductive years. Another eugenic concern that was addressed by the texts was the issue of race.

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[519] Biological Sciences Curriculum Study, *High School Biology: BSCS Green Version* (1963), 692.

[520] Ibid., 692-93.

Race, Eugenics, and the BSCS Textbooks

Race has historically been an underlying discourse in eugenics, especially mainline eugenics. Historian Zoe Burkholder examines race in American classrooms in her book, *Color in the Classroom*.[521] Burkholder outlines how treatment of race changed during the period 1900 to 1954 under the influence of activist anthropologists Franz Boas, Ruth Benedict, and Margaret Mead. According to Burkholder, race was equated with nation in the schools from 1900-1938, as immigrants from Southern European, Asian, and African countries were each considered separate races. From about 1939-1945, race was equated with color, and from 1946-1954 race was equated with culture. In all cases, racial purity was considered paramount. But by the 1950s, change was in the wind. A major influence was cultural anthropologist Ashley Montague, whose 1942 book, *Man's Most Dangerous Myth: The Fallacy of Race* caused a generation of social scientists to re-evaluate the concept of race. Burkholder states,

> By the time this growing civil rights activism culminated in the 1954 Brown v. Board of Education ruling, American teachers were unable or unwilling to speak about race in the classroom, much less teach explicit lessons on racial equality and civil rights, imperiled by a political climate in which they could be accused of harboring communist sympathies. . . Teachers actively chose and were encouraged by professional educators to shift the focus of tolerance education away from racial minorities and to instead promote a colorblind pedagogy.[522]

[521] Zoe Burkholder, *Color in the Classroom: How American Schools Taught Race, 1900-1954* (New York: Oxford University Press, 2011).

[522] Ibid., 139.

In the late 1950s and early 1960s, this "colorblind" ideal encouraged the practice of racial integration but silenced the curricular discourse on race.[523] Race continued to be included as a topic in high school biology textbooks, however, according to sociologist Ann Morning. In her research, 92% of the high school biology textbooks published from 1952 to 1962 included passages that focused on race. Characteristically, the textbooks offered "accounts of which races exist, what their identifying traits are, and how races generally differ from each other. The most typical approach has been the verbal or visual taxonomy of races."[524] The 1963 Blue and Green Versions had brief discussions of racial differences and pictures of various races, while the Yellow Version did not contain pictures. However, the BSCS texts also presented race as a valid biological concept that had application to organisms besides humans.[525] According to biologist Benson E. Ginsburg and anthropologist William S. Laughlin,

> We should remind ourselves that the term race does not have a merely human connotation.…As Professor Dobzhansky has pointed out elsewhere in this symposium, if there were no such construct, we should have had to invent it in order to account for local genetic differences between population groups which are only partially isolated from each other and continue to exchange genes but also to maintain some obvious differences.[526]

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[523] Ibid., 173.

[524] Ann Morning, "Reconstructing Race in Science and Society: Biology Textbooks, 1952-2002," *American Journal of Sociology* 114, no. 51 (2008): S116.

[525] Non-human "races" or subspecies are discussed in the 1963 Yellow Version. Biological Sciences Curriculum Study, *Biological Science: An Inquiry Into Life* (1963), 627-28.

[526] Benson E. Ginsburg and William S. Laughlin, "The Distribution of Genetic Differences in Behavioral Potential in the Human Species," *Science and the Concept of Race*, ed. Margaret Mead, Theodosius Dobzhansky, Ethel Tobach, and Robert E. Light (New York: Columbia University Press, 1968), 26-27.

While many anthropologists had gradually distanced themselves from the concept of race during the 1940s and 1950s, biologists and physical anthropologists tended to retain the concept of race as a useful concept. Some biologists thought that humans were divided into races before separately evolving into Homo sapiens, but this was a minority viewpoint. As did most biologists at the time, the BSCS texts emphasized the common origin and membership of all races in the single species of Homo sapiens.[527]

As a result of the modern synthesis of evolution, race could no longer be thought of as a typological concept.[528] This means that each race could not be thought of as having an ideal type which every individual approximated. Typological thinking focused on the mean differences between the races for various traits such as skin color and eye shape. Under the modern synthesis, races had to be thought of as *populations* within a species which included a continuum of traits among its individuals. Each individual was seen as unique, and may have a combination of traits that reflect the influence of various races. The similarities between races and the fact that all human beings are one species was the focus, not differences between races. Although the BSCS texts did not try to discuss the difference between typological and population thinking per se with regards to

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[527] See John P. Jackson, Jr., "'In Ways Unacademical': The Reception of Carleton S. Coon's *The Origin of Races*," *Journal of the History of Biology* 34 (2001): 247-85. Also see Biological Science Curriculum Study, *High School Biology: BSCS Green Version* (1963), 660; Biological Sciences Curriculum Study, *Molecules to Man; BSCS Blue Version* (1963), 429; and Biological Sciences Curriculum Study, *Biological Science: An Inquiry into Life* (1963), 672. The Green Version makes more of differences in appearance than the other two versions.

[528] Ernst Mayr was the architect of the modern synthesis of evolution most noted for advancing population thinking as opposed to typological thinking. An easily accessible discussion of this concept and its application to race can be found in Ernst Mayr, "The Biology of Race and the Concept of Equality," *Daedalus* 131, no. 1 (Winter, 2002): 89-94.

race, the emphasis on all humans being one species in the texts is a result of this change in thinking.

The 1963 Yellow Version made four main points about race which were reflections of the modern synthesis. First, there is tremendous variation within any population or race, so much so that there is often as much variation within races as there is between races. Second, despite some differences in the distribution of inheritable traits, "the different members of the human species are still much more alike than they are different" because all men are of one species. Third, all races are completely interfertile with "no evidence of any biological lack of harmony among their traits," an attempt to allay fears about the supposed dangers of miscegenation. And lastly, "the distribution of intelligence . . . seems to be an individual, not a racial, matter," which attacked the mainline eugenic fears of racial inferiority based on intelligence.[529]

Historian Ronald Ladouceur argues that the Yellow Version compromised its attack on racism by using racist illustrations. John Moore, as Supervisor, was ultimately responsible for the choice of illustrations in the Yellow Version. Ladouceur presents two examples. In one, a picture of modern African Bushmen is used to illustrate text about humans of 10,000 to 25,000 years ago. This could be interpreted as disparaging to modern day Africans, an indication that they have not progressed much in 10,000 years. In the other example, Ladouceur criticizes the Yellow Version authors for referring to early *Homo sapiens* as children. The 1963 Yellow Version stated: "About a million years

[529]Biological Sciences Curriculum Study, *Biological Science: An Inquiry Into Life* (1963), 670-72.

ago, [man] reached the stage at which he could be called 'man' in the full sense of the term. Since then he has passed through a long childhood, as he slowly learned to use tools and fire, and to communicate with his fellow man."[530] Ladouceur states that this is "language reminiscent of that used by nineteenth century scientists and politicians who would speak freely of 'child,' 'adolescent,' and "adult' races."[531] While unfortunate, I do not believe these examples negate the overt message of anti-racism in the Yellow Version. However, they do illustrate the difficulty of talking about race in progressionist terms. While the biological concept of race had changed in the 1930s and 1940s, latent racism continued to plague writings that attempted to be race conscious, as it does today, and still can be read in-between the lines in some places of the 1963 BSCS texts.

The 1963 Blue Version noted the indeterminacy of the concept of race:

> The term 'race' has a rather uncertain meaning; it is difficult to define and it means different things to different people. Any precise description of a "race," or even of a population, in terms of gene frequencies, will have less value as time goes on…the gene pools of various populations are becoming less distinct.[532]

No matter if the term race or population is used, human races are merging due to increased migration. The Blue Version proclaimed: "All men belong to a single species, *Homo sapiens*. This means that all men are interfertile. They have no genetic differences great enough to prevent interbreeding."[533] This was a strong statement meant to be clearly anti-racist. But again we see what could be called unconscious racism: "Some

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[530] Ibid., xv.

[531] Ladouceur, "Ella Thea Smith," 463-64.

[532] Biological Sciences Curriculum Study, *Molecules to Man*: *BSCS Blue Version* (1963), 428-29.

[533] Ibid., 429.

populations prospered, such as the ancestors of today's Negroid and Mongoloid groups; in time they produced large numbers of individuals. Others, such as the Australian aborigines, remained small in numbers and culturally undeveloped."[534] This passage seems to be saying that some races are "more developed" than others, and that this might be interpreted as a form of superiority. When viewed from a present perspective, this would seem to compromise the Blue Version's anti-racist message, although the writers probably would not have seen this as problematic at the time. The differential development of races was being used as an example of the effects of genetic isolation, mutation, selection, and migration, which were all forces important in speciation. This example points to the difficulty of discussing variation between populations without seeming to confer value judgments. Further down the page, the Blue Version points out that "the separate populations of man are gradually merging into one . . . The gene pools of populations will lose still more of their distinctive natures as the rate of gene exchange increases because of marriages between members of different populations."[535] This statement of fact could be interpreted two ways, one which fuels fears of race-mixing, or the second which provides hope that racism will decrease as separate races merge into one. I think the surrounding text indicates that the second interpretation was the intended one.

Another statement in the 1963 Blue Version indicated that the average life-span of humans was increasing. This was interpreted positively in the text as giving humans more

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[534] Ibid.

[535] Ibid.

time to develop their interests. But increasing life span was one prominent reason for the need for population control. Two further statements were cast in a darker tone. First," the role of selection is diminishing."[536] This was reminiscent of Galton's concerns when he coined the word "eugenics" in the late 1800s. The 1963 Blue Version echoed this claim, pointing out that "the preservation of life has made it possible for many persons to pass genes for hereditary defects on to offspring," and "the long range effects of this lack of selection against some traits are unpredictable." [537] This was a concern that Herman Muller would have been especially glad to see voiced in the text. It was the basis for his concerns about genetic load, and the need for a eugenic program to address this problem. The second dark statement in the 1963 Blue Version was "the world population is increasing at a rapid rate."[538] Therefore, the problem of diminished selection was being amplified by the rapid rate of population increase.

The 1963 Green Version again emphasized the fact that all humans belong to one species. While this version acknowledged that there have been "numerous attempts" to work out a classification scheme for humans based on a few or many races, the whole project is problematic. In the last five hundred years, there have been mass migrations of populations and extensive mixing of gene pools. Also problematic is trying to argue about the inferiority or superiority of races. The Green Version stated emphatically,

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[536] Ibid., 431.

[537] Ibid.

[538] Ibid.

"There is no biological basis for such arguments."[539] This version did discuss cultural attempts to assign superiority, noting that "Caucasoids have become vain because the civilization of Europe has been the most powerful in the world for the last four or five hundred years—but this is no guarantee that it always will be."[540] This was a warning to those who would hold on to their feelings of racial superiority.

In summary, BSCS writers deliberately addressed race in the BSCS textbooks, even though a colorblind pedagogy prevailed in many other educational settings. Biologists and physical anthropologists tended to retain the concept of race while cultural anthropologists distanced themselves from the concept of race in the 1940s and 1950s. Biologists were simply not prepared to say that all races were physically, mentally, and emotionally identical. They did say that the differences between individuals within a race are as great or greater than the differences between races. The BSCS writers promoted racial harmony and allayed fears regarding miscegenation, but unconscious racism can be detected in a few locations. The central biological message, however, was that "all humans are one species," and therefore all are interfertile. It was invalid to consider any race as sub-human. This was important knowledge for future parents and world citizens. I shall consider next how the BSCS curriculum came to be used worldwide.

[539] Biological Sciences Curriculum Study, *High School Biology: BSCS Green Version* (1963), 661.

[540] Ibid.

Foreign Utilization

One aspect of the BSCS program which has been understudied is the foreign utilization of BSCS materials overseas. Plans for international cooperation between the BSCS and Latin American biologists began with a paper and a resolution presented at the UNESCO 7th National Conference on the Cultures of the Americas at Denver, Colorado, October 1, 1959, well before the first experimental versions were written in the summer of 1960. The Rockefeller Foundation funded two delegates, one from Chile and one from Columbia, to attend the February, 1960 BSCS Steering Committee Meeting in New Orleans, but "it was decided at that meeting to delay international cooperation in curriculum adaptation and translation until the material had been used experimentally one year in the high schools in the United States."[541] This makes it clear that the intention of the BSCS was to produce materials to be used internationally even before the first experimental versions were undertaken. The following quote provides the context in which this international cooperation occurred:

> International cooperation in biological sciences between BSCS of AIBS and biologists and educators of other countries has been of interest to government agencies and universities. The direct cooperation of scientist with scientist-teacher with teacher in the advancement of international understanding and development has been a recent reorientation of thought in administrative circles. The Kilian Report on Making Science a Vital Force in Foreign Policy stresses the great progress made by private, nonpolitical, nongovernment organization of scientists in contrast to that of a political body. The new Secretary of State, Dean Rusk . . . has endorsed this efficient method of promoting international progress through "the preparation of competent men and women for roles of leadership." To quote him further, "Science is a powerful unifying force among cultural diversities and

[541] James G. Dickson, "International Utilization of Curriculum/Biological Sciences Curriculum Study/American Institute of Biological Sciences," attachment to Arnold B. Grobman to BSCS Steering Committee, Memorandum No. 64, January 23, 1961, Box 169, File: BSCS Steering Committee, Feb 2-3, 1961, Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

> provides its own high returns in human understanding as scientific colleagues join to know, control, or adapt to the physical environments in which man finds himself." (The President's Review, The Rockefeller Foundation Annual Report, 1958.)[542]

The BSCS made its materials available for review to foreign biologists and supported a range of efforts to improve biological education in a number of countries before the 1963 versions of the text were commercially available. Rather than simply translate the texts, the BSCS attempted to facilitate the rewriting of texts to reflect local biological conditions, such as different flora and fauna. By June 17, 1963, the time of the BSCS International News Notes Number 2, at least sixteen countries and three international organizations were involved in some phase of review or adaptation of the BSCS materials.[543] By 1968, teams had or were producing 45 national and regional adaptations of BSCS materials.[544] BSCS writers were often sent to interested countries to assist in preparation of the local materials. These efforts were supported by a variety of organizations during the 1960s, including the Rockefeller Foundation, the ASIA Foundation, the Ford Foundation, and the US Agency for International Development (USAID) through the National Science Foundation.

When Hermann J. Muller and others tried to influence the BSCS curriculum, they were anticipating world-wide distribution of BSCS materials in one form or another. The

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542 Ibid.

543 BSCS International News Notes, Number 2, June 17, 1963, BSCS Archives, BSCS, Colorado Springs, CO. These countries included Afghanistan, Argentina, Brazil, China (Taiwan), Columbia, England, India, Israel, Japan, Netherlands, Philippines, Thailand, Turkey, Uruguay, and Venezuela. The organizations included the Consejo Superior Universitario Centroamericano (CSUCA), the Organization of American States (OAS), and the Organization for Economic Cooperation and Development (OECD) in Europe.

544 BSCS International News Notes, Number 7, October 1, 1968, BSCS Archives, BSCS, Colorado Springs, CO.

BSCS textbooks would not only influence other future textbooks in the United States, but around the world. Therefore, evolution education based on the modern synthesis could potentially reach much farther than it ever had before. Concerns about the effect of ionizing radiation on the human genome, race and diversity, and overpopulation could be shared globally with the next generation. Beyond providing the most up-to-date information from biological research, the BSCS textbooks were international vehicles for propagation of the rational, scientific worldview and the reform eugenic outlook espoused by the texts.

Conclusion

In this chapter, I examined the role of reform eugenics in the BSCS textbooks. While the word "eugenics" was not used in the 1963 BSCS textbooks, it was present in an early experimental version, and is reflected in the concern about controversial issues in the text. I suggested that the controversial issues which the BSCS committed to address were a reflection of persistent eugenic concerns among biologists, especially Hermann J. Muller and Bentley Glass, over the future of humankind and the quality of its gene pool. Reform eugenicists were concerned with evolution education, the nature of race, sex education, and population control, which were each addressed by the BSCS texts. A program of foreign utilization sought to create customized BSCS textbook versions in many countries, amplifying the influence of the BSCS texts worldwide and making them an attractive vehicle for disseminating a scientific world view that included reform eugenic concerns. In addition to distributing information critical to citizen participation in the future management of human evolution, the textbooks provided the opportunity to caution against wayward eugenic “schemes” and to correct mainline eugenic fallacies regarding typological thinking about race.

Conclusion

> "Evolution is the central unifying theme of biology. Yet today, more than a century and a half after Charles Darwin proposed the idea of evolution through natural selection, the topic is often relegated to a handful of chapters in textbooks and a few class sessions in introductory biology courses. In many introductory biology courses (both undergraduate and high school), and even in some upper-level courses, evolution is not covered at all."
>
> -- Steve Olson, *Thinking Evolutionarily*

The above quote is very similar to Hermann J. Muller's assessment of the status of evolution education in 1959, before the BSCS textbooks were published, but it was penned by science writer Steve Olson in 2012.[545] Has nothing changed? Science organizations still regularly contend with the fact that evolution is not wholly accepted by the public in the United States. The BSCS still publishes textbooks and operates at the vanguard of evolution education, but it has been joined by organizations such as the National Academy of Sciences (NAS) and the National Center for Science Education (NCSE), who work diligently to keep evolution at the center of biology education. Anti-evolution legislation is still regularly introduced at the state level, and is usually soundly defeated. But the public opinion polls cannot be ignored: About 46% of Americans reject evolution as an explanation of human origins.[546] This has not changed substantially in thirty years, despite state and national science standards to ensure adequate treatment of evolution in the textbooks used in the public schools.

[545] Steve Olson, Rapporteur and Jay B. Labov, ed., *Thinking Evolutionarily: Evolution Education Across the Life Sciences, Summary of a Convocation* (Washington, DC: National Academies Press, 2012), 1.

[546] National Center for Science Education, "The Latest Gallup Poll on Evolution," National Center for Science Education (June 1, 2012), http://ncse.com/news/2012/06/latest-gallup-poll-evolution-007431 (accessed September 19, 2012).

So what contribution has this dissertation made to understanding evolution education? Most important, this dissertation has added to the historiography of evolution education, providing insights into the thinking of the leaders of the BSCS and the process of curriculum development, and providing disciplinary and cultural context for the work of the BSCS. Central to my argument has been the importance of the modern synthesis of evolution to the BSCS curriculum. I have examined the modern synthesis and the ways in which it provided the modern theoretical grounding for the treatment of evolution in the BSCS textbooks. The primary contribution of the synthesis was substantive knowledge about evolution, but I suggest that an important theme for the architects of the modern synthesis and the BSCS leaders was their concern for the future of humankind, which was derived from their knowledge of the synthesis, and their commitment to a scientific, naturalistic worldview. This concern for the future of humankind, at this particular point in time, presented a subtext and a motivation for the full treatment of evolution in the BSCS textbooks, and for world-wide distribution of the curriculum. Everyone needed to know about evolution, the current status of humankind, and opportunities to improve the human condition.

The modern synthesis of evolution was the “new and improved” Darwinism of the twentieth century, where metaphysical elements were no longer needed for the explanation of how humans evolved.[547] Natural selection, as proposed by Darwin, had never been fully accepted by biologists or the public in the latter decades of the

[547] Vassiliki B. Smocovitis, *Unifying Biology: The Evolutionary Synthesis and Evolutionary B*iology (Princeton, NJ: Princeton University Press, 1996), 169.

nineteenth or the early decades of the twentieth century. Various mechanisms with metaphysical, or supernatural, elements were proposed during that time to cover aspects of evolution that Darwin could not fully explain. Some proposals relied on non-material forces that directed evolution, such as vitalism or orthogenesis.[548] Theistic evolution was also a significant player, as religious scientists tried to preserve room for the action of a deity in the process of evolution.[549] But the modern synthesis explained the workings of evolution without an appeal to metaphysical elements. This was important to biology in becoming a mature science, because under the logical positivism of the mid twentieth century, mature sciences had to be philosophically cohesive within the scientific, naturalistic worldview, without any appeal to supernatural agency.[550] As a result of the modern synthesis, scientists recognized that biology was a mature science with evolution at its core.

Historians Vassiliki Smocovitis and John Rudolph both emphasize this maturation of the discipline and the desire of biologists to be accepted on par with physicists and chemists, whose disciplines had lost their metaphysical ties much earlier. Rudolph also emphasizes the desire of biologists to spread a scientific, rationalistic worldview, which is related, but slightly different than the point I make. While Rudolph emphasizes the goal of scientists, I emphasize the change in science itself that made their goal possible.

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[548] Michael Ruse and Joseph Travis, *Evolution: The First Four Billion Years* (Cambridge, MA: Belknap Press of Harvard University Press, 2009) 25, 446-447.

[549] Edward J. Larson, *Evolution: The Remarkable History of a Scientific Theory* (New York: Modern Library, 2004), 122-28.

[550] Smocovitis, *Unifying Biology*, 169.

The science of evolution itself had changed in such a way through the modern synthesis that thorough explanations of evolutionary mechanisms *could* be made scientifically, and vitalistic or supernatural explanations were thereby nullified.

I emphasize two ramifications of the modern synthesis and its naturalistic worldview for the curriculum. One was that, as a result of the synthesis, the theory of evolution by natural selection "hardened" in the 1950s and evolution became codified knowledge. While there were still controversies regarding minor mechanisms, natural selection was reified as the only source of direction in evolution (see Chapter Two). Evolutionary biologists wanted the new strengthened status of evolution recognized, and encouraged teachers to teach evolution as "fact."[551] They consolidated evolution into a small number of natural processes including mutation, recombination, natural selection, gradualism, and isolation. This allowed for a more coherent presentation than trying to address the entire range of competing theories that existed before the modern synthesis or simply ignoring some mechanisms altogether. This new stabilized form of Darwinism has been the basis of high school evolution education for at least the last fifty years, although newer theories of mechanisms have been added, such as punctuated equilibrium.

Second, the modern synthesis, operating within the naturalistic worldview, conceives of humans as the only conscious organism aware of evolution and in a position to intervene in the evolutionary process, which itself is opportunistic and imperfect. Through cultural evolution, humans had been intervening in their own evolution and the

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[551] Sol Tax, "Tax Questions 'Watered-Down' High School Biology Textbooks," *Chicago Maroon* 69, no. 45 (October 21, 1960), Box 8, Folder 9, Darwin Centennial Celebration Records, Special Collections Research Center, University of Chicago, Chicago, IL.

evolution of other species for a very long time. But with the knowledge of hereditary mechanisms and population genetics in the modern synthesis, humans were in a better place to *consciously* direct their own evolution (both cultural and biological) than ever before. According to Julian Huxley,

> Man is that part of reality in which and through which the cosmic process has become conscious and has begun to comprehend itself. His supreme task is to increase that conscious comprehension and to apply it as fully as possible to guide the course of events. In other words, his role is to discover his destiny as agent of the evolutionary process, in order to fulfill it more adequately.[552]

Huxley reiterates this idea in a talk for biology teachers at the 1959 Darwin Centennial, adding,

> [Man] is the highest dominant type to be produced by more than two and a half-billion years of slow biological improvement effected by the blind opportunistic workings of natural selection. If he does not destroy himself, he has a least an equal stretch of evolutionary time before him to exercise his agency.[553]

Since humans were already agents of cultural and biological evolution, it behooved them to become *more conscious* agents, understanding of the processes involved, and be willing to take responsibility for the future direction of life on Earth.

While the architects of the modern synthesis and the leaders of the BSCS were trying to establish evolution as the central theme in the curriculum, there were counter-currents within the BSCS. I show that some biologists did not see evolution as being the central theme of biology, and others expressed concern about evolution causing rejection of the texts. BSCS teachers had their own priorities and were also concerned about the

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[552] Julian Huxley, *Religion Without Revelation* (London, C. A. Watts & Co. Ltd., 1967), 186.

[553] Julian Huxley, “Evolution in the High School Curriculum,” in booklet *Using Modern Knowledge to Teach Evolution in High School,* Series II, Box 3, Folder: 1959, Nov 24-28 Darwin Centennial Celebration (2), Hermann J. Muller Manuscripts, Lilly Library, University of Indiana, Bloomington, IN.

reception evolution and sex education would receive. As a result, evolution, which should have been woven throughout the first experimental textbooks with the other themes, was not adequately foregrounded in the texts. Other historians show that Muller's comments at the BSCS Steering Committee Meeting in February, 1961 solidified the BSCS commitment to making evolution the central theme in at least the Blue and Yellow Versions, but I show that Muller's involvement predates that meeting. I suggest that he was upset at that meeting because his earlier suggestions, made upon request of the BSCS leaders, had not been followed. I also suggest that Arnold Grobman and John Moore saw in Muller's 1960 correspondence what they were looking for in a plan for evolution education, and then later recruited him to become a BSCS Steering Committee Member because he would champion the cause. This is significant because without Muller's assertive participation, evolution would probably not be as prominent in the texts.

Indeed, the various forces within the BSCS working to advance or subdue evolution in the textbooks may have worked to the advantage of the project. For example, while scientists repeatedly made the point at the 1959 Darwin Centennial that evolution was a "fact" and should be taught that way, the BSCS textbooks never make that exact assertion. The BSCS writers treated evolution as a fact but presented it as a well-accepted scientific theory. While it is clear that the architects and the leaders of the BSCS considered evolution to be as factual as any scientific knowledge, the restraint shown allowed publishers not to have to fight that battle with the public at that time.[554]

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[554] The California State Board of Education ruled in 1963, the year the final BSCS texts were published, that evolution was to be taught as theory rather than as scientific fact. See John A. Moore, "Creationism in California," *Daedalus* 103, no.3 (Summer 1974), 176.

As the modern synthesis rose in acceptance among biologists, other cultural processes were taking place. Mainline eugenics decreased in acceptance in the United States as the new understanding of heredity in the modern synthesis did not support mainline assumptions about miscegenation and the efficacy of forced sterilization programs, and left bare the racist and classist nature of the program. I ascribe to the view presented by historian Daniel J. Kevles in which mainline eugenics was gradually replaced by reform eugenics, shorn of overt racist and classist motivations, and I make a case in Chapter Six that the concerns of reform eugenics can be seen in the BSCS texts. Let me be clear that I am not saying that the BSCS was a eugenics organization or that its members as a whole would identify themselves as eugenicists. I am saying that reform eugenic concerns appear in the BSCS texts. Reform eugenicists were concerned with evolution education, the nature of race, sex education, and population control, which were each addressed by the BSCS texts. In addition to distributing information critical to citizen participation in the future management of human evolution, the BSCS textbooks provided the opportunity to caution against wayward eugenic "schemes" and to correct mainline eugenic fallacies regarding typological thinking about race. This is a significant and heretofore unmentioned aspect of the BSCS program.

Lastly, the Cold War provides a critical context for understanding the priority of evolution in the BSCS textbooks. Concerns over radiation damage to the human gene pool from all types of sources, up to and including nuclear war, were a source of widespread anxiety. The Cuban Missile Crisis occurred while the final versions of the textbooks were being written in the fall of 1962. Humanity was facing the fact that it may have invented the source of its own demise. People needed to understand that their place in the world was tenuous in the face of exploding populations, racial unrest, shrinking resources, and the threat of extinction through nuclear war. Students needed to understand genetics and evolution to be able to make some of the tough choices they might be called on to make as the next reproductive generation in the nuclear age. This was science for survival.

Biology Education Today

While the anxiety over nuclear radiation has lessened somewhat since the end of the Cold War, concerns about the effect of radiation on the human gene pool are still a valid concern. New concerns such as air and water pollution, rainforest destruction, new infectious diseases such as HIV-AIDS, and global warming are just a few of the new threats to long-term survival that confront humankind today. But biology education is still hampered by the conflict over evolution, and rejection of evolutionary theory has spread to rejection of theories of climate change.[555]

My dissertation is relevant to this problem because current evolution education is still based on the modern synthesis of evolution. Therefore, the inherent naturalism of the synthesis is still the dominant worldview of evolutionary biologists, and infuses current biology standards and current textbooks. While other socio-cultural factors regarding the relationship of the public to science are also involved, the basic conflict of philosophical naturalism with many religious viewpoints remains the same as it was with the original

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[555] National Center for Science Education, "Climate Change Education," National Center for Science Education http://ncse.com/climate (accessed October 16, 2012).

BSCS textbooks, if not more so. Therefore today's rejection of evolution education can be traced back to the precedent set by the BSCS in its early textbooks.

While the National Academy of Sciences and the National Center for Science Education assert that religious views and evolutionary knowledge can be compatible, 87% of evolutionary biologists in a 2008 worldwide survey did not believe in God or an entity that is responsible for designing and maintaining life on earth.[556] This indicates that evolutionary biologists differ significantly from the general public in the United States on this issue. Most adhere to a philosophical naturalism which is an extension of the methodological naturalism inherent in the practice of science itself.[557] While it is certainly true that some evolutionary biologists have traditional religious beliefs, a significant majority discount religious ways of knowing, and are therefore in no position to help students who might wish to construct a coherent worldview that takes both religious and scientific perspectives into account.

According to Gary Graffin, primary investigator on the Cornell Evolution Study, evolutionary biologists associated with worldwide national academies of science usually maintain that religion and evolution are compatible. But this compatibilism is strongly conditional. As Graffin states,

> Evolutionary biologists see no conflict between evolution and religion on one condition; that religion remains mute on the most meaningful matters of human experience, such as belief in gods, life after death, spirits, or souls, all of which are deeply contradictory to a naturalistic world-view.[558]

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[556] Gregory W. Graffin, "Monism, Atheism, and the Naturalist World-View: Perspectives from Evolutionary Biology" (PhD diss., Cornell University, 2003), 49.

[557] Ibid., 61.

[558] Ibid., 123.

Therefore, to the extent that the modern synthesis of evolution is presented as the central theme within the biology curriculum, the naturalistic worldview will likely come into conflict with students' religious worldviews, causing resistance to the "fact" of evolution. However, the extent to which students are aware of this conflict depends on how evolution and the nature of science are taught: many students would be unaware of a conflict unless it is pointed out to them by teachers, parents, or religious leaders. Public school teachers are rarely prepared to assist and are generally discouraged from helping students negotiate this conflict.

Educational researchers Natalie Becker, Begoña Echeverria and Reba Page describe a student in their research who negotiated his position as an undergraduate science student and a religious person by not resisting the demands of science but not embracing them "wholeheartedly" either. He held on to both perspectives, moving between them to participate in both worlds and maintaining a degree of agency within both. Using the terminology of anthropologist Sherry B. Ortner to describe this process, they explain the student's approach:

> As he "slips" back and forth across the "gaps" that separate religion and science, Edward reproduces yet modulates science by playing in the "serious game" of science education while *simultaneously* pursuing his "local project." He works to become a biologist who can unlock "the secret[s] of life" without ignoring the "problems of living" and his "project" may yet reframe the "serious game."[559]

Edward does not abandon his religion, his "local project," but continues to participate in science, developing a unique identity as both a scientist and a religious person. I agree

[559] Natalie Becker, Begoña Echeverria, and Reba Page, "Science, Religion, and Education," in *Theoretical Perspectives on Comprehensive Education: The Way Forward*, ed. H. Varenne, E. Gordon, and L. Lin (Lewiston, NY: The Edwin Mellen Press, 2009).

with Becker, Echeverria and Page that more comprehensive research is needed that focuses on the complex interconnection between academic and social knowledge that exists within the science curriculum, especially within biology, and how students negotiate "the gaps" between science and religion in developing a scientific identity.

It appears that changes are on the horizon within evolutionary theory itself. Several areas of research within the last twenty years have provided new views that do not fit neatly within the framework of the modern synthesis. In 2010, there was a proposal for a new, larger framework entitled "the extended synthesis."[560] This extended synthesis would encompass the modern synthesis of evolution in much the same way that the modern synthesis encompassed traditional Darwinism. Natural selection is still important in the extended synthesis, but factors within the organism itself also seem to have a role in determining the direction of evolution. In my research, significant changes in evolutionary theory, particularly with regards to the understanding of the direction of evolution through natural selection, eventually changed the content and form of the high school biology curriculum. Depending on how the extended synthesis is received by the biological community, we may be on the verge of additional significant changes in biology education. Only time will tell how these changes will affect the acceptance of evolution in the United States and around the world.

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[560] Massimo Pigliucci, and Gerd B. Müller, eds., *Evolution – The Extended Synthesis* (Cambridge, MA: MIT Press, 2010).

Bibliography

Primary Sources

Manuscript Collections

Archie F. Carr, Jr. Papers, George A. Smathers Libraries, University of Florida, Gainesville, Florida.

Bentley Glass Papers, American Philosophical Society, Philadelphia, PA.

Biological Sciences Curriculum Study Archives, Biological Sciences Curriculum Study, Colorado Springs, Colorado.

Darwin Centennial Celebration Records 1959, University of Chicago Library, University of Chicago, Chicago, IL.

George Gaylord Simpson Papers, American Philosophical Society, Philadelphia, PA.

George Ledyard Stebbins Papers, University of California, Davis, Davis, CA.

Hermann J. Muller Manuscripts, Lilly Library, Indiana University, Bloomington, IN.

John A. Moore Papers, Rivera Library, University of California, Riverside, Riverside, CA.

Marston Bates Papers, Bentley Historical Library, University of Michigan, Ann Arbor, MI.

The Papers of Ernst Mayr, Harvard University Archives, Harvard University, Cambridge, MA.

Theodosius Dobzhansky Papers, American Philosophical Society, Philadelphia, PA.

Printed Materials

Bates, Marston. "Where Is Biology?" *AIBS Bulletin* 2, no. 3 (1952): 15-20.

Bestor, Arthur E. *Educational Wastelands*. Urbana, IL: University of Illinois Press, 1953.

Biological Sciences Curriculum Study. *Biological Science: An Inquiry into Life*. New York: Harcourt, Brace & World, Inc., 1963.

Biological Sciences Curriculum Study. *High School Biology: BSCS Green Version*. Chicago: Rand McNally & Co., 1963.

Biological Sciences Curriculum Study. *Molecules to Man: BSCS Blue Version*. Boston: Houghton Mifflin Co., 1963. Bloom, Alexander and Wini Breines, eds. *Takin' It to the Streets: A Sixties Reader*. New York: Oxford University Press, 2003.

Diamond, Edwin. "Biologist in Society's Laboratory." *Saturday Review*, November 2, 1957, 47.

Dobzahnsky, Theodosius. *The Biology of Ultimate Concern*. New York: The New American Library, 1967.

Dobzhansky, Theodosius. *Genetics and the Origin of Species*. New York: Columbia University Press, 1937.

Dobzhansky, Theodosius. *Mankind Evolving: The Evolution of the Human Species*. New Haven, CT: Yale University Press, 1962.

Dobzhansky, Theodosius. "Introduction." In *Science and Concept of Race*, edited by Margaret Mead, Theodosius Dobzhansky, Ethel Tobach and Robert E. Light, 78-79. New York: Columbia University Press, 1968.

Dobzhansky, Theodosius. "Nothing Makes Sense except in the Light of Evolution." *The American Biology Teacher* 35, (1973): 125-29.

Dobzhansky, Theodosius, Francisco J. Ayala, Ledyard G. Stebbins and James W. Valentine. *Evolution*. San Francisco, CA: W. H. Freeman and Company, 1977.

Dobzhansky, Theodosius and L.C. Dunn. *Heredity, Race and Society*. New York: The New American Library of World Literature, 1946.

Glass, Bentley. "Eugenics." *The Quarterly Review of Biology* 29, no. 4 (1954): 423.

Glass, Bentley. "The Genetic Hazards of Nuclear Radiations." *Science, New Series* 126, no. 3267 (Aug 1957): 241-46.

Glass, Bentley. *Science and Liberal Education*. Baton Rouge, LA: Louisiana State University Press, 1959.

Glass, Bentley. "The Academic Scientist, 1940-1960." *Science, New Series* 132, no. 3427 (Sept 1960): 598-603.

Glass, Bentley. "Perspectives: A New High School Biology Program." *American Scientist* 49, no. 4 (December 1961): 524-31.

Glass, Bentley. "The Biology of Nuclear War." *The American Biology Teacher* 24, no. 6 (Oct 1962): 407-25.

Glass, Bentley. "The Scientist and the Science Teacher." *AAUP Bulletin* 50, no. 3 (September 1964): 268.

Glass, Bentley. *Science and Ethical Values*. Chapel Hill, NC: The University of North Carolina Press, 1965.

Glass, Bentley. "The Ethical Basis of Science." *Science, New Series* 150, no. 3701 (Dec 1965): 1254-61.

Glass, Bentley. "Essays of an Evolutionist." *The Quarterly Review of Biology* 40, no. 2 (Jun 1965): 176-78.

Glass, Bentley. "Evolution in Human Hands." *The Phi Delta Kappan* 50, no. 9 (May 1969): 506-10.

Glass, Bentley. *The Timely and the Timeless: The Interrelationships of Science, Education and Society*. New York, NY: Basic Books, Inc., 1970.

Glass, Bentley. "The Scientist: Trustee for Humanity." *BioScience* 27, no. 4 (Apr 1977): 277-78.

Glass, Bentley. *Progress or Catastrophe: The Nature of Biological Science and Its Impact on Human Society*. New York, NY: Praeger, 1985.

Glass, H. Bentley. "The Responsibilities of Biologists." *AIBS Bulletin* 7, no. 5 (November 1957): 9-13.

Grobman, Arnold. "The Biological Sciences Curriculum Study." *AIBS Bulletin* 9, no. 2 (1959): 21-23.

Grobman, Arnold. "Recent Advances in Secondary-School Biological Education." In *Proceedings of the Conference on Progress in Nuclear Education*. Oak Ridge, TN, 1962.

Grobman, Arnold B. *Our Atomic Heritage*. Gainesville, FL: University of Florida Press, 1951.

Grobman, Arnold B. *The Changing Classroom: The Role of the Biological Sciences Curriculum Study*. Garden City, NY: Doubleday & Company, Inc., 1969.

Grobman, Arnold B., ed. *Social Implications of Biological Education*. Princeton, NJ: The Darwin Press, 1970.

Hoagland, Hudson and Ralph W. Burhoe. "Evolution and Man's Progress: Introduction." *Daedalus* 90, no. 3 (1961): 411-15.

Hurd, Paul DeHart. *Biological Education in American Secondary Schools 1890-1960*. Baltimore, MD: Waverly Press, Inc., 1961.

Huxley, Julian. *The Modern Synthesis*. New York: Harper Brothers Publishers, 1942.

Huxley, Julian S. *Religion without Revelation*. London: C.A. Watts, 1967.

Huxley, Sir Julian. "The Emergence of Darwinism." In *The Evolution of Life*. Chicago: University of Chicago Press, 1960.

Hylander, Clarence J. "The American Institute of Biological Sciences: A Historical Resume." *AIBS Bulletin* 1, no. 1 (1951): 6-7.

Hylander, Clarence J. "The American Institute of Biological Sciences: A Historical Resume." *AIBS Bulletin* 1, no. 2 (1951): 13-15.

Mayfield, John C., D. Bob Gowin and Richard Boyajian. "Using Modern Knowledge to Teach Evolution in High School." *The American Biology Teacher* 22, no. 7 (1960): 405-13.

Mayr, Ernst. "History." The Society for the Study of Evolution. http://www.evolutionsociety.org/history.asp (accessed March 9, 2012).

Mayr, Ernst. "Where Are We?" *Cold Spring Harbor Symposia on Quantitative Biology* 24, (1959): 1-14.

Mayr, Ernst. *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Cambridge, MA: Belknap Press of Harvard University Press, 1982.

Mayr, Ernst. "Typological Versus Population Thinking." In *Conceptual Issues in Evolutionary Thinking*, edited by Elliot Sober, 157-60. Cambridge, MA: MIT Press, 1993.

Mayr, Ernst. *What Evolution Is*. New York: Basic Books, 2001.

Mayr, Ernst. "The Biology of Race and the Concept of Equality." *Daedalus* 131, no. 1 (2002): 89-94.

Mayr, Ernst and William B. Provine, eds. *The Evolutionary Synthesis: Perspectives on the Unification of Biology*. Cambridge, MA: Harvard University Press, 1980.

Mead, Margaret, Theodosius Dobzhansky, Ethel Tobach and Robert E. Light. *Science and the Concept of Race*. New York, NY: Columbia University Press, 1968.

Medawar, Peter Brian. "The Future of Man." London: Methuen and Co Ltd, 1960.

Montagu, Ashley. *Most Dangerous Myth: The Fallacy of Race*. Walnut Creek, CA: Altamira Press, 1997.

Montagu, Ashley M.F., ed. *Culture and the Evolution of Man*. New York: Oxford University Press, 1962.

Moody, Paul Amos. *Genetics of Man*. New York: W. W. Norton & Company, Inc., 1967.

Moody, Paul Amos. *Genetics of Man*. 2nd ed. New York: W.W. Norton & Company, Inc., 1975.

Moon, Truman J., Paul B. Mann and James H. Otto. *Modern Biology*. New York: Henry Holt and Company, 1956.

Moon, Truman J., James H. Otto and Albert Towle. *Modern Biology*. New York: Holt, Rinehart and Winston, Inc., 1960.

Moore, John A. *Principles of Zoology*. New York: Oxford University Press, 1957.

Moore, John A. "The Development of Evolutionary Thought." *The University of Kansas Science Bulletin* 42, no. 2 (1962): Supplement.

Moore, John A. "Patterns of Cellular and Organismic Evolution." *The Science Teacher* 33, no. 7 (October 1966): 69-77.

Moore, John A. "Creationism in California." *Daedalus* 103, no. 3 (Summer 1974): 173-89.

Moore, John A. "Commentary: Evolution and Public Education." *Bioscience* 32, no. 7 (July-August 1982): 606-12.

Moore, John A. *Science as a Way of Knowing: The Foundations of Modern Biology*. Cambridge, MA: Harvard University Press, 1993.

Moore, John A. *From Genesis to Genetics: The Case of Evolution and Creationism*. Berkeley, CA: University of California Press, 2002.

Muller, H.J. *Out of the Night: A Biologist's View of the Future*. London, England: Victor Gollancz Ltd, 1936.

Muller, H.J. "The Call of Biology." *AIBS Bulletin* 3, no. 5 (1953): 4.

Muller, H.J. “One Hundred Years without Darwinism Are Enough.” School Science and Mathematics 59, no.4 (April 1959): 302-16.

Muller, H.J. "The Role of Biology in General Education." *AIBS Bulletin* 13, no. 4 (August 1963): 22-30.

Muller, H.J. "Survival." *AIBS Bulletin* 11, no. 5 (October 1961): 15-24.

Muller, Hermann J. "The Guidance of Human Evolution." In *The Evolution of Man: Man, Culture and Society*, edited by Sol Tax, 2, 423-62. Chicago: University of Chicago Press, 1960.

Muller, Hermann J. "Should We Weaken or Strengthen Our Genetic Heritage?" *Daedalus* 90, no. 3 (1961): 432-50.

Muller, Hermann J. "The Prospects of Genetic Progress: Science and the Future of Mankind." The Hague: Uitgeverij Dr. W. Junk, 1961.

Muller, Hermann J. "The Role of Science Education in Value Formation." In *Values in American Education*, edited by Theodore Brameld and Stanley Elam, 75-113. Bloomington, IN: Phi Delta Kappa, Inc., 1963.

Muller, Hermann J. "The Role of Biology in General Education." *AIBS Bulletin* 13, no. 4 (Aug 1963): 22-30.

Muller, Hermann J. "Human Values in Relation to Evolution." In *Man's Future Birthright: Essays on Science and Humanity*, edited by Elof Axel Carlson, 97-111. Albany, NY: University of New York Press, 1973.

National Academy of Sciences. *Science, Evolution and Creationism*. Washington, DC: National Academies Press, 2008.

Osborn, Frederick. *Preface to Eugenics*. New York: Harper & Brothers, 1940.

Paulson, Richard E. "The Committee on Educational Policies." *AIBS Bulletin* 5, no. 5 (1955): 17-18.

Raskin, Abraham. "Special Report on the Darwin Centennial Celebration, One Hundred Years Later." *The Science Teacher* 27, no. 2 (March 1960): 31-37.

Riddle, Oscar, ed. *The Teaching of Biology in Secondary Schools of the United States: A Report of Results from a Questionnaire.* Union of American Biological Societies, 1942.

Riddle, Oscar. *The Unleashing of Evolutionary Thought*. New York: Vantage Press, Inc., 1954.

Schwab, Joseph J., ed. *Biology Teachers' Handbook*. New York: John Wiley and Sons, Inc., 1963.

Simpson, G.G. "One Hundred Years without Darwin Are Enough." *Teachers College Record* 60 (1961): 617-26.

Simpson, George G., Colin S. Pittendrigh and Lewis H. Tiffany. *Life: An Introduction to Biology*. New York: Harcourt, Brace & World, 1957.

Simpson, George Gaylord. *The Meaning of Evolution: A Study of the History of Life and of Its Significance for Man*. New Haven, CT: Yale University Press, 1952.

Simpson, George Gaylord. *This View of Life: The World of an Evolutionist*. New York: Harcourt, Brace & World, 1964.

Smith, Ella Thea. *Exploring Biology*. New York: Harcourt, Brace and Company, 1939.

Smith, Ella Thea. *Exploring Biology*. 4th Edition ed. New York: Harcourt, Brace and Company, 1954.

Smith, Ella Thea. *Exploring Biology: The Science of Living Things*. 5th ed. New York: Harcourt, Brace & World, Inc., 1959.

Sonneborn, T. M. "Implications of the New Genetics for Biology and Man." *AIBS Bulletin* 13, no. 2 (1963): 22-26.

Sonneborn, T. M., ed. *The Control of Human Heredity and Evolution*. New York: The Macmillan Company, 1965.

Stebbins, G. Ledyard. *Processes of Organic Evolution*. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1966.

Stebbins, G. Ledyard. *The Basis of Progressive Evolution*. Chapel Hill, NC: The University of North Carolina Press, 1969.

Stebbins, G. Ledyard. "Evolution and Religion." In *Cry of the Environment: Rebuilding the Christian Creation Tradition*, 181-197. Santa Fe, NM: Bear & Company, 1984.

Steward, Julian H. and Demitri B. Shimkin. "Some Mechanisms of Sociocultural Evolution." *Daedalus* 90, no. 3 (1961): 477-97.

Stewart, Ileen E. "Biologists Meet at Stanford." *Science* 127, no. 3293 (Feb 1958): 293-95.

Subcommittee on Instructional Materials and Publications. Committee on Education Policies, Division of Biology and Agriculture, National Academy of Sciences-National Research Council. "Criteria for Preparation and Selection of Science Textbooks." *AIBS Bulletin* 7, no. 5 (1957): 27.

Tax, Sol. "The Celebration: A Personal View." In *Issues in Evolution: The University of Chicago Centennial Discussions*, edited by Sol Tax. Chicago: University of Chicago Press, 1960.

Tax, Sol, ed. *The Evolution of Life: Its Origin, History and Future*. Vol. 1, *Evolution after Darwin*. Chicago: University of Chicago Press, 1960.

Tax, Sol, ed. *The Evolution of Man: Man, Culture and Society*. Vol. 2, *Evolution after Darwin*. Chicago: University of Chicago Press, 1960.

Tax, Sol and Charles Callender, eds. *Issues in Evolution: The University of Chicago Centennial Discussions*. Vol. 3, *Evolution after Darwin*. Chicago: University of Chicago Press, 1960.

Secondary Sources

Agar, Nicholas. *Liberal Eugenics: In Defense of Human Enhancement*. Malden, MA: Blackwell Publishing, 2004.

American Institute of Biological Sciences. "The AIBS Story." American Institute of Biological Sciences. http://www.aibs.org/about-aibs/resources/AIBS_25th_An_History.pdf (accessed October 14, 2011).

Appel, Toby A. *Shaping Biology: The National Science Foundation and American Biological Research, 1945-1975*. Baltimore, MD: The Johns Hopkins University Press, 2000.

Apple, Michael W. *Teachers and Texts: A Political Economy of Class and Gender Relations in Education*. London: Routledge and Kegan Paul, 1986.

Apple, Michael W. *Ideology and Curriculum*. 3rd ed. New York: Routledge Falmer, 2004.

Apple, Michael W. and Linda K. Christian-Smith, eds. *The Politics of the Textbook*. New York: Routledge, 1991.

Barnes, Barry, David Bloor and John Henry. *Scientific Knowledge: A Sociological Analysis*. Chicago: University of Chicago Press, 1996.

Baum, Howell. "School Desegregation and the Limits of Liberalism: The Case of Baltimore" (paper presented at the annual meeting of the History of Education Society, Cambridge, MA, November, 2010).

Becker, Natalie, Begoña Echeverria and Reba Page. "Science, Religion, and Education." In *Perspectives on Comprehensive Education: The Way Forward*, edited by H. Varenne, E. Gordon and L. Lin. Lewiston, NY: The Edwin Mellen Press, 2009.

Benson, Keith R., Jane Maienchein and Ronald Rainger, eds. *The Expansion of American Biology*. New Brunswick, NJ: Rutgers University Press, 1991.

Bowler, Peter, J. *The Non-Darwinian Revolution: Reinterpreting a Historical Myth*. Baltimore, MD: Johns Hopkins University Press, 1992.

Bowler, Peter J. *Evolution: History of an Idea*. 3rd ed. Berkeley, CA: University of California Press, 2003.

Bowler, Peter J. and Iwan Rhys Morus. *The Making of Modern Science: A Historical Survey*. Chicago: University of Chicago Press, 2005.

Bruner, Jerome. *The Process of Education*. Cambridge, MA: Harvard University Press, 1960.

Brush, Stephen G. *Choosing Selection: The Revival of Natural Selection in Anglo-American Evolutionary Biology 1930-1970*. Philadelphia, PA: American Philosophical Society, 2009.

Burkholder, Zoe. *Color in the Classroom: How American Schools Taught Race, 1900-1954*. New York: Oxford University Press, 2011.

Bybee, Rodger W., ed. *Measuring Our Success: The First 50 Years of BSCS*. Dubuque, IA: Kendall/Hunt Publishing Company, 2008.

Cain, Joe. "The Columbia Biological Series, 1894-1974: A Bibliographical Note." *Archives of Natural History* 28, no. 3 (2001): 356.

Cain, Joe and Michael Ruse, eds. *Descended from Darwin: Insight into the History of Evolutionary Studies, 1900-1970*. Philadelphia, PA: American Philosophical Society, 2009.

Carlson, Elof A., ed. *Man's Future Birthright: Essays on Science and Humanity by H. J. Muller*. Albany, NY: State University of New York Press, 1973.

Carlson, Elof A. *Genes, Radiation, and Society: The Life and Work of H. J. Muller*. Ithaca, NY: Cornell University Press, 1981.

Carlson, Elof A. *Times of Triumph, Times of Doubt: Science and the Battle for Public Trust*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2006.

Carlson, Elof Axel. *The Unfit: A History of a Bad Idea*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2001.

Chomsky, Norm, Ira Katznelson, R.C. Lewontin, Laura Nader, Richard Ohmann, Ray Siever, Immanuel Wallerstein and Howard Zinn. *The Cold War and the University: Toward an Intellectual History of the Postwar Years*. New York: The New Press, 1997.

Cremin, Lawrence A. *The Transformation of the School: Progressivism in American Education, 1896-1957*. New York: Vintage Books, 1961.

Cueto, Marcos, ed. *Missionaries of Science: The Rockefeller Foundation and Latin America*. Bloomington, IN: Indiana University Press, 1994.

Cullinan, Frank P. "The American Institute of Biological Sciences, 1950-1951." *AIBS Bulletin* 1, no. 3 (1951): 8-10.

DeBoer, George E. *A History of Ideas in Science Education: Implications for Practice*. New York: Teachers College Press, 1991.

Depew, David J. "Darwinian Controversies: An Historical Recounting." *Science and Education* 19, (2009): 323-366.

Depew, David J. and Bruce H. Weber. *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection*. Cambridge, MA: MIT Press, 1995.

Dow, P. B. *Schoolhouse Politics: Lessons from the Sputnik Era*. London: Harvard University Press, 1991.

Etzioni, Amitai. *Genetic Fix*. New York: Macmillan Publishing Co., Inc., 1973.

Flinders, David J. and Stephen J. Thorton, eds. *The Curriculum Studies Reader*. New York: Routledge, 2009.

Fraser, James W. *Between Church and State: Religion and Public Education in a Multicultural America*. New York: St. Martin's Griffin, 1999.

Gieryn, Thomas. *Cultural Boundaries of Science: Credibility on the Line*. Chicago, IL: University of Chicago Press, 1999.

Gillette, Aaron. *Eugenics and the Nature-Nurture Debate in the Twentieth Century*. New York: Palgrave Macmillan, 2007.

Ginsburg, Benson E. and William S. Laughlin. "The Distribution of Genetic Differences in Behavioral Potential in the Human Species." In *Science and the Concept of Race*, edited by Margaret Mead, Theodosius Dobzhansky, Ethel Tobach and Robert E. Light, 26-36. New York: Columbia University Press, 1968.

Glass, Bentley and Curt Stern. "Geneticists Embattled: Their Stand against Rampant Eugenics and Racism in America During the 1920s and 1930s." *Proceedings of the American Philosophical Society* 130, no. 1 (Mar 1986): 130-54.

Goodlad, John. *The Changing School Curriculum*. New York: The Fund for the Advancement of Education, 1966.

Gould, Stephen J. "Hardening of the Modern Synthesis." In *Dimensions of Darwinism: Themes and Counterthemes in Twentieth-Century Evolutionary Theory*, edited by Marjorie Grene, 71-93. New York: Cambridge University Press, 1983.

Gould, Stephen Jay. *The Structure of Evolutionary Theory*. Cambridge, MA: Belknap Press of Harvard University Press, 2002.

Graffin, Gregory W. "Monism, Atheism, and the Naturalist World-View: Perspectives from Evolutionary Biology." PhD diss., Cornell University, 2003.

Greene, John C. *The Death of Adam: Evolution and Its Impact on Western Thoughts*. Ames, IA: The Iowa State University Press, 1959.

Greene, John C. *Darwin and the Modern World View*. Baton Rouge, LA: Louisiana State University Press, 1961.

Greene, John C. *Science, Ideology, and World View: Essays in the History of Evolutionary Ideas*. Berkeley, CA: University of California Press, 1981.

Greene, John C. *Debating Darwin: Adventures of a Scholar*. Claremont, CA: Regina Books, 1999.

Grene, Marjorie, ed. *Dimensions of Darwinism: Themes and Counterthemes in Twentieth-Century Evolutionary Theory*. Cambridge, MA: Cambridge University Press, 1983.

Gross, Paul R. and Norman Levitt. *Higher Superstition: The Academic Left and Its Quarrels with Science*. Baltimore, MD: The Johns Hopkins University Press, 1994.

Haller, Mark Hughlin. *Eugenics: Hereditarian Attitudes in American Thought*. New Brunswick, NJ: Rutgers University Press, 1963.

Hamblin, Jacob Darwin. "A Dispassionate and Objective Effort: Negotiating the First Study on the Biological Effects of Atomic Radiation." *Journal of the History of Biology* 40, no. 1 (2007): 147-77.

Hartman, Andrew. *Education and the Cold War: The Battle for the American School*. New York, NY: Palgrave Macmillan, 2008.

Hollowell, Victoria C., Vassiliki Betty Smocovitis and Eileen P. Duggan, eds. *G. Ledyard Stebbins: The Ladyslipper and I*. St. Louis, MO: Missouri Botanical Garden, 2007.

Jackson Jr., John P. "In Ways Unacademical: The Reception of Carleton S. Coon's the Origin of Races." *Journal of the History of Biology* 34, (2001): 247-85.

Kay, Lily E. *The Molecular Vision of Life: Caltech, the Rockefeller Foundation, and the Rise of the New Biology*. New York: Oxford University Press, 1993.

Kaye, Howard L. *The Social Meaning of Modern Biology: From Social Darwinism to Sociobiology*. New Haven, CT: Yale University Press, 1986.

Kliebard, Herbert M. *Forging the American Curriculum: Essays in Curriculum History and Theory*. New York: Routledge, 1992.

Kliebard, Herbert M. *The Struggle for the American Curriculum: 1893-1958*. 2nd ed. New York: Routledge, 1995.

Kline, Wendy. *Building a Better Race: Gender, Sexuality, and Eugenics from the Turn of the Century to the Baby Boom*. Berkeley, CA: University of California Press, 2001.

Knorr-Cetina, Karin D. *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of a Science*. Oxford, UK: Pergamon Press, 1981.

Kuhn, Thomas S. *The Structure of Scientific Revolutions*. 2nd ed. Chicago, IL: University of Chicago Press, 1970.

La Porte, Leo F. *George Gaylord Simpson: Paleontologist and Evolutionist*. New York, NY: Columbia University Press, 2000.

Ladouceur, Ronald P. "Ella Thea Smith and the Lost History of American High School Biology Textbooks." *Journal of the History of Biology* 41, (2008): 435-71.

Land, Barbara. *Evolution of a Scientist: The Two Worlds of Theodosius Dobzhansky*. New York: Thomas Y. Crowell Company, 1973.

Larson, Edward J. *Trial and Error: The American Controversy over Creation and Evolution*. Updated ed. New York: Oxford University Press, 1989.

Larson, Edward J. *Evolution: The Remarkable History of a Scientific Theory*. New York: The Modern Library Chronicles, 2004.

Latour, Bruno. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press, 1988.

Laudan, Larry. *Science and Values: The Aims of Science and Their Role in Scientific Debate*. Berkeley, CA: University of California Press, 1984.

Lehrman, Robert L. *Race, Evolution, and Mankind*. New York: Basic Books, Inc., 1966.

Levering, Ralph B. *The Cold War: A Post-Cold War History* The American History Series, Edited by John Hope Franklin and A.S. Eisenstadt. Wheeling, IL: Harlan Davidson, Inc., 2005.

Lewis, George. *The White South and the Red Menace: Segregationists, Anticommunism and Massive Resistance, 1945-1965*. Gainesville, FL: University Press of Florida, 2004.

Lewontin, Richard C. *Biology as Ideology: The Doctrine of DNA*. New York: Harper Perennial, 1993.

Ludmerer, Kenneth M. *Genetics and American Society: A Historical Appraisal*. Baltimore, MD: Johns Hopkins University Press, 1972.

Matzke, Nick. "Serbia Bans, Unbans, Evolution." National Center for Science Education. http://ncseweb.org/news/2004/09/serbia-bans-unbans-evolution-00537 (accessed October 10, 2009).

Morning, Ann. "Reconstructing Race in Science and Society: Biology Textbooks, 1952-2002." *American Journal of Sociology* 114, no. S1 (2008): S106-37.

National Center for Science Education. "Climate Change Education." National Center for Science Education. http://ncse.com/climate (accessed October 16, 2012).

National Center for Science Education. “The Latest Gallup Poll on Evolution.” National Center for Science Education. http://ncse.com/news/2012/06/latest-gallup-poll-evolution-007431 (accessed September 19, 2012).

Nelkin, Dorothy. *Science Textbook Controversies and the Politics of Equal Time*. Cambridge, MA: The Massachusetts Institute of Technology Press, 1977.

Nobel Foundation. "The Nobel Prize in Physiology or Medicine 1946: Hermann J. Muller." Elsevier Publishing Company. http://nobelprize.org/nobel_prizes/medicine/laureates/1946/muller-bio.html (accessed August 24, 2009).

Nola, Robert and Gurol Irzik. *Philosophy, Science, Education and Culture*. Dordecht, The Netherlands: Springer, 2005.

Numbers, Ronald L. *The Creationists: From Scientific Creationism to Intelligent Design*. Cambridge, MA: Harvard University Press, 2006.

Olson, Steve. *Thinking Evolutionarily: Evolution Education Across the Life Sciences, Summary of a Convocation.* Edited by Jay B. Labov. Washington, D.C.: National Academies Press, 2012.

Paul, Diane B. *Controlling Human Heredity: 1865 to the Present*. Atlantic Highlands, NJ: Humanities Press, 1995.

Pickering, Andrew. *Science as Practice and Culture*. Chicago: University of Chicago Press, 1992.

Pigliucci, Massimo and Gerd B. Muller, eds. *Evolution -- the Extended Synthesis*. Cambridge, MA: MIT Press, 2010.

Popkewitz, Thomas S. *The Formation of School Subjects: The Struggle for Creating an American Institution*. New York: Falmer Press, 1987.

Provine, William B. "Progress in Evolution and Meaning in Life." In *Evolutionary Progress*, edited by Matthew H. Nitecki, 49-74. Chicago: University of Chicago Press, 1988.

Provine, William B. and Elizabeth S. Russell. "Geneticists and Race." *American Zoologist* 26, no. 3 (1986): 857-87.

Ptacek, Margaret B. and Shala J. Hankison. "The Pattern and Process of Speciation." In *Evolution: The First Four Billion Years*, edited by Michael Ruse and Joseph Travis, 179-205. Cambridge, MA: Belknap Press of Harvard University Press, 2009.

Rainger, Ronald, Keith R. Benson and Jane Maienschein, eds. *The American Development of Biology*. New Brunswick, NJ: Rutgers University Press, 1988.

Reisch, George A. *How the Cold War Transformed Philosophy of Science: To the Icy Slopes of Logic*. Cambridge, MA: Cambridge University Press, 2005.

Ridley, Mark. *Evolution*. 3rd ed. Malden, MA: Blackwell Publishing, 2004.

Rudolph, John L. *Scientists in the Classroom: The Cold War Reconstruction of American Science Education*. New York: Palgrave, 2002.

Rudolph, John L. and Jim Stewart. "Evolution and the Nature of Science: On the Historical Discord and Its Implications for Education." *Journal of Research in Science Teaching* 35, no. 10 (1998): 1069-89.

Ruse, Michael. *Mystery of Mysteries: Is Evolution a Social Construction?* Cambridge, MA: Harvard University Press, 1999.

Ruse, Michael. *The Darwinian Revolution: Nature Red in Tooth and Claw*. Chicago: University of Chicago Press, 1999.

Ruse, Michael. *The Evolution Wars: A Guide to the Debates, Controversies in Science*. Santa Barbara, CA: ABC-CLIO, Inc., 2000.

Ruse, Michael. *The Evolution-Creation Struggle*. Cambridge, MA: Harvard University Press, 2005.

Ruse, Michael. *The Philosophy of Human Evolution*. Cambridge, UK: Cambridge University Press, 2012.

Ruse, Michael and Joseph Travis, eds. *Evolution: The First Four Billion Years*. Cambridge, MA: Harvard University Press, 2009.

Schaffarzick, Jon and Gary Sykes. *Values Conflicts and Curriculum Issues: Lessons from Research and Experience*. Berkeley, CA: McCutchan Publishing Corporation, 1979.

Selden, Steven. *Inheriting Shame: The Story of Eugenics and Racism in America*. New York: Teacher's College Press, 1999.

Selden, Steven. "Biological Determinism and the Narrative of Adjustment: The High School Biology Textbooks of Truman Jesse Moon, C. 1921-1963." *Curriculum Inquiry* 37, no. 2 (June 2007): 159-96.

Shapiro, Adam R. "Between Training and Popularization: Regulating Science Textbooks in Secondary Education." *Isis* 103, no. 1 (March 2012): 99-110.

Skoog, Gerald. "The Contributions of BSCS Biology Textbooks to Evolution Education." In *BSCS: Measuring Our Success*, edited by Roger Bybee, 45-72. Dubuque, NJ: Kendall/Hunt Publishing Company, 2008.

Smocovitis, Vassiliki B. "Organizing Evolution: Founding the Society for the Study of Evolution (1939-1950)." *Journal of the History of Biology* 27, no. 2 (1994): 241-309.

Smocovitis, Vassiliki B. *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology*. Princeton, NJ: Princeton University Press, 1996.

Smocovitis, Vassiliki B. "The 1959 Darwin Centennial Celebration in America." *Osiris* 14, (1999): 274-323.

Soylent Communications. "Hermann J. Muller." Soylent Communications. http://www.nndb.com/people/073/00128686/ (accessed November 4 2009).

Special Collections Research Center. "The Darwin Centennial Celebration." Special Collections Research Center of the University of Chicago Library. http://www.lib.uchicago.edu/e/webexhibits/DarwinCentennial/ (accessed September 3, 2012).

Tanner, Daniel and Laurel Tanner. *Curriculum Development: Theory into Practice*. 3rd ed. Upper Saddle River, NJ: Prentice Hall, 1995.

Tietge, David J. *Flash Effect: Science and the Rhetorical Origins of Cold War America*. Athens, OH: Ohio University Press, 2002.

Timson, John. "Portraits of the Pioneers: Sir Julian Huxley, FRS." Galton Institute. http://www.galtoninstitute.org.uk/Newsletters/GINL9912/julian_huxley.htm (accessed October 20, 2012).

Wolfe Audra. “Speaking for Nature and Nation: Biologists as Public Intellectuals in Cold War Culture.” PhD diss., University of Pennsylvania, 2002.

Wolfe, Audra. "Bentley Glass, Century's Son." *Mendel Newsletter* 12, (February 2003): 15-17.

Wolfe, Audra. "What Does It Mean to Go Public? the American Response to Lysenkoism, Reconsidered." *Historical Studies in the Natural Sciences* 40, no. 1 (Winter 2010): 48-78.

Ziegler, Mary. "Reinventing Eugenics: Reproductive Choice and Law Reform after World War II." *Cardozo Journal of Law and Gender* 14, no. 2 (Spring 2008): 319-48.

Zimmerman, Jonathan. *Culture Wars in the Public Schools*. Cambridge, MA: Harvard University Press, 2005.