Evolution and Creationism at Colby, William Elder

Jack Vanderhorst, Beck French, Michael Minard

Department of Science Technology and Society

ST 237: The History of Biology

Professor Lijing Jiang

May 14, 2021

Introduction

Throughout history, our understanding of the natural world, more specifically, how living organisms developed and diversified from earlier species, has changed tremendously. This change in our understanding of the natural world is primarily a result of the advancement of scientific technology and processes and the decline of using religion to explain the natural world. Prior to the 19th century, creationism was a widely accepted idea that stated that living organisms originated from supernatural acts of divinity such as God. This idea was accepted by many because religion played such a prominent role in the lives and beliefs of people. In addition, the lack of scientific knowledge and technology did not allow philosophers and scientists to understand the idea of evolution that is now taught in schools today. In the late 19th century, Charles Darwin published *On the Origin of Species*, a book with many controversial ideas surrounding the development of different species and evolution. At this time, some scientists accepted Darwin's idea of evolution that species develop due to natural selection; however, many denounced these evolutionary ideas and considered them materialistic atheism. Those who denounced these evolutionary ideas are considered anti-evolutionists who were very invested in their religious beliefs and stood firm in the idea of a "special creation."

As we entered the 20th and 21st centuries, the scientific technology and processes used in experimentation led to a more substantial acceptance of the idea of evolution and natural selection. During the 21st century, our understanding of evolution has advanced tremendously, and the idea of evolution is accepted by most scientists today. Due to the advanced scientific experimentation techniques that are used today, there is no evidence to reject the idea of evolution and those who do have profound religious beliefs that explain the natural world in an unscientific way. Today, evolution is taught in just about every biology textbook, and the amount

of scientific research being conducted on the topic is considerable. At Colby today, many courses teach ideas of evolution and genetics, and it is an integral part of the biology department.

While ideas of creationism and evolution have shifted dramatically from the 19th century to the 21st century, as seen through the analysis of many secondary sources, the main focus of our research is to understand how the change in ideas impacted what was taught at Colby College throughout this time. Looking at the 19th century, we conducted research on Colby professor William Elder taught at Colby from 1873 to 1903. For the 20th and 21st centuries, we researched by interviewing faculty within the biology department at Colby to understand how course offerings, curriculums, and research regarding evolution have changed over time.

Over the course of the semester, the questions that guided our research are: How did the ideas of creationism and evolution change from the 19th to 21st century? How did the study of science, particularly evolutionary sciences, change at Colby College over this time? In what ways have the larger contributions to evolution influence evolutionary sciences at Colby College? How did Colby College professors integrate evolution into the curriculum? Have there been any contributions to the greater evolution community by Colby professors?

Throughout this paper, by analyzing primary sources from special collections, secondary sources regarding evolution and creationism, as well as faculty interviews with professors within the biology department, we aim to answer these questions and give a thorough understanding of how the study and understanding of evolution have changed over time at Colby College.

19th Century

Creationism:

In the time leading up to the 19th century, creationist thought was predominantly the norm. This ultimately can be attributed to the prominence of religion at the time. However, throughout the 19th century, various key contributions toward evolution were made that sparked controversy amongst creationists and within the scientific community.

The most notable of these contributions was Darwin's *On the Origin of Species* in 1859, which marked a crucial turning point in the history of both evolution and creationism. While the majority of Bible-believing Christians remained faithful to the idea of creationism at this period in time, by 1880, only a quarter to nearly half of educated ministers in Evangelical denominations believed in the story of creation as told in Genesis (Numbers, 3), which goes to show the effect that Darwin's work had on the prominence of creationism- at least the form rooted in the Biblical account. It is important to note that the creationists were not just religious people who believed the account of creation as told in Genesis and ignored science; in fact, many creationists were scientists and formed other theories of creation to explain speciation. Take, for example, Asa Gray, an American botanist and religiously orthodox man. Gray pointed out a passage in Darwin's *Origin of Species* that gave Creationists some room for debate. Darwin writes, "I believe that animals have descended from at most only four or five progenitors, and plants from an equal or lesser number… that probably all organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed" (Darwin). Gray argued that if Darwin is to accept a supernatural beginning to life on earth, he should also accept a special, divine-like origination of humans on earth (Numbers, 4). However, as one would expect, Darwin disagreed with Gray. In the 15 years after its publishing, *Origin of*

Species and Darwin's defense of the work had successfully convinced the majority of naturalists that the origin of species was not supernaturally created, but rather his idea of organic evolution can explain the origin of species.

While the intellectual climate in the late 19th century was conducive to the acceptance of Darwin's theory, not all scientists accepted his theory. Harvard's Louis Agassiz, a well-known anti-evolutionist, was a firm proponent of special creation and formulated his own creation theories. Among them are the plural origin of the human race and multiple population/depopulation events, which he claimed were backed by geological evidence (Numbers, 7). Agassiz's impressive academic background granted him credibility within the scientific community. Agassiz's standing in the scientific community helped with the defense of his theories and contributed to the large following of creationists he acquired. Agassiz's ideas of creationism were not necessarily rooted in religion or science but rather philosophy. In response to *Origin of Species*, the Genesis account of creation largely died in the scientific community. Nevertheless, the idea of creationism adapted as it began to take on new forms due to the contributions of Gray, Agassiz, and other notable intellectuals in the 19th century.

Evolution:

Evolutionary studies changed considerably from the 18th century to the 19th century as naturalists began to observe nature and natural objects through direct observation rather than reading historical texts. In class this semester, we examined the work of Carl Linnaeus in *The Systema Naturae* (1735). Like other naturalists during this time, his book aimed to include all species he encountered throughout his travels without making any claims about the intrinsic or actual relationships amongst the species he studied. This led to Linnaeus and other naturalists

failing to recognize male, female, and juvenile forms of the same species instead of naming them as three different species. At times, Linnaeus' research seemed to lack professionalism and real-world applications, as he often named plants more like people's names, a single common name to all species in a genus. Buffon believed in natural classification very differently, reflecting species' actual relationships in nature, which he discovered through direct observation and experimentation. Buffon believed that in order for the study of natural history to be considered a science that naturalists needed to expand the observational study of natural history and be more selective of what they included in their writings.

Similarly, in the 1830 Cuvier-Geoffroy debate, naturalists argued that if a vertebrate was bent backward, then the internal organs would be arranged in a similar appearance to that of Mollusks. Unlike Cuvier, Geoffroy supported this conclusion by assuming that if the organs of mollusks were in harmony with each other, they must retain the same anatomical arrangement as vertebrates. Geoffroy came to these conclusions because he had developed his doctrine on the unity of composition and believed that if two organisms were composed in the same way, they were connected by the same anatomical structure. Cuvier went on to disprove this theory by displaying comprehensive research that he had conducted on mollusks, proving that although mollusks and vertebrates shared many similar organs, such as a brain, eyes, earns, stomach, it does not conclude that these two organisms are built on the same vertebra. Through diagrams, Cuvier showed organs that were composed differently in mollusks and vertebrates, organs in mollusks not found in vertebrates, and organs of vertebrates lacking in mollusks. He went on to show that if a vertebrate was bent backward, its brain would be facing the center, which was the opposite of Meyrank and Laurence's findings in their paper. This showed that these naturalists lacked true scientific knowledge of cephalopods. Although much of Geoffroy's research was not

scientifically supported, it led to a new scientific era in which naturalists would expand off each other's scientific knowledge by allowing naturalists to speak freely and learn from each other's ideas and scientific discoveries.

Nine years later, Charles Darwin published, *The Voyage of the Beagle*, forever changing how naturalists study and understand evolution and the natural world. After *The Voyage of the Beagle*, the world transformed into a sort of scientific revolution in which "evolution was in the air." Throughout this five-year expedition, Darwin proved that the study of natural science and evolutionary science was still very unknown. By using direct observation and personal experiences in nature, Darwin discovered many new species and created theories of evolution, natural selection, and survival of the fittest based on the changing beak shapes in finches that he had encountered while in the Galapagos. Along with this, Darwin proposed new theories of continental shift, observing that volcanic eruptions could create dramatic landscape changes similar to what he had encountered in the Andes. This voyage was so influential because it led to a desire of other naturalists to explore the world to collect samples of their own and attempt to hypothesize similar theories about evolutionary science as Darwin. This expedition forever changed how evolutionary science is studied, changing the focus from studying texts to instead encountering natural science through hands-on observation and experimentation.

William Elder:

When analyzing how broader developments in creationism and evolution affected Colby, there is no better person to look at than William Elder. William Elder was a professor at Colby College during the 19th century. Elder taught at Colby from 1873 to 1903. Elder taught chemistry at Colby, and he also taught biology for 12 years. Professor William Elder was born in 1840 in

Nova Scotia. When Elder grew up, he attended Acadia College and later attended Harvard for particular work in science. Before he began teaching at Colby, Elder was the chair of physical sciences at Acadia from 1869-1873.

In 1898, William Elder published the book, *Ideas From Nature*. In *Ideas From Nature*, Elder aims to explain the natural world and different phenomena in nature. When this book was published, Darwin was regarded by many as the creator of the new world, and his ideas began to become accepted by many. On the other hand, Elder went against Darwin's ideas and relied on God's existence to explain phenomena in nature: "Nature is the manifestation of God in things material; Christianity in things spiritual" (Elder, 191). Throughout his life, William Elder was both a man of science and a man of religion, and his commitment to Christianity is seen in the way that he explains the natural world in *Ideas From Nature*. Rather than accepting and understanding the new evolutionary ideas that began to come about after Darwin published Origins of Species, Elder instead relied on religion and God's existence to explain how the natural world worked. This was not uncommon for the time. Many people rejected Darwin's new ideas as they were so committed to their religious beliefs about the natural world.

After reading the Colby College Bulletin from 1906 and Elder's *Ideas From Nature*, it is clear that religion influenced his thinking about the natural world. As a science professor at Colby, religion sometimes played a role in his teaching as well. In the Colby College Bulletin from October 1906, a student of Elder notes, "To a rare degree, the personality of Prof. Elder was permeated by his religion, and its unspoken influence was felt throughout the college and the whole circle of his acquaintance." During the 19th century, new evolutionary ideas about the natural world began to surface. While many people adopted these ideas and understanding of the world, many such as Elder, were hesitant due to their religious beliefs and values. Over time,

however, as more scientific studies were conducted and the understanding of the natural world shifted more from creationism to evolution, religion began to lose its role in our scientific understanding of the natural world, and that is evident in the material that is taught at Colby College today.

20th Century

Creationism:

In the early 20th century, the belief in creationism was still widely prevalent and was rooted in biblical fundamentalism. Two significant forms of creationism existed: young-earth and old-earth creationism (Matzke). Young earth creationists believe the biblical account as told in the book of Genesis that the Earth, universe, and life were created in six days. Old-earth creationists believe in geological science on the age of the Earth but deny evolution and believe that God created numerous forms of life over millions of years. Throughout the 20th century, numerous creationist societies arose, such as the Creation Research Society, Institute for Creationism Research, and Answers in Genesis (Numbers, 243). These societies helped promote and spread the belief in creationism and published many anti-evolution works. One of the more influential works during the 20th century was *The Case Against Evolution* by clerical science professor and Benedictine priest George Barry O'Toole, published in 1925. This book received widespread praise from creationists and was published by Macmillan, a major publishing house, which was significant because no prior creationist works had been published by a publishing house with the degree of prestige that Macmillan had (Numbers, 55). O'Toole focused on issues such as the evolution of life, the human body, and the soul, which were of great concern to

Catholics at the time. He ultimately concluded that evolution was just a hypothesis and not a proven fact.

Harry Rimmer, Presbyterian minister and research scientist had one of the largest followings of any creationist during the first half of the twentieth century. Dr. Rimmer was a well-known anti-evolutionist during this time and was well established in both theology and science. This man of science and man of religion duality contributed to Dr. Rimmer's large following. He made significant discoveries in biology, chemistry, and physics and conducted heavy analyses of biblical scriptures. His most prominent argument against evolution was that acquired characteristics are not inherited. By the time of his death in 1952, his books and pamphlets had reached hundreds of thousands of people (Matzke).

Ultimately, creationism progressed throughout the early 20th century but had a declining and minimal prevalence in academia. In the later 20th century, creationists became more excluded and concentrated in creationist societies, especially after the Supreme Court ruling in 1987. In *Edwards v. Aguillard*, the court considered a Louisiana Law that essentially required that public schools teaching evolutionary sciences must also teach creation science. The ruling deemed this law unconstitutional under the first amendment because teaching creationism in schools is an effort to advance a particular religion. This ruling was detrimental to the creationist movement. Following the ruling, the prominence of creationism declined immensely throughout the remainder of the 20th century and into the 21st century. While it is certainly still present in small pockets, creationism has nowhere near the following and support that it once did.

Evolution:

The study of evolution progressed significantly throughout the 20th century, and many discoveries were made that contributed to the study of evolution and up new fields of study in biology. The rediscovery of Mendel's laws of inheritance in the early 20th century was monumental for evolutionary sciences. Although Mendel's experiments and writing were published in the late 19th century, they never received notable attention or recognition. It was not until 1900 that his work was rediscovered. As a result of the rediscovery, the field of genetics began to progress rapidly.

Another significant contribution of this time was that of Ronald Fisher, J. B. S. Haldane, and Sewall Wright. Fisher demonstrated that biometricians' continuous variation could be caused by the combined action of many discrete genes, and that natural selection could alter gene frequencies in a population, leading to evolution. J. B. S. Haldane, a British geneticist, applied statistical analysis to real-world examples of natural selection, such as the evolution of melanism in peppered moths, in a series of papers that began in 1924 and found that natural selection worked at a faster pace than Fisher thought. Sewall Wright, an American biologist, studied the interactions of genes and the impact of inbreeding on genetic drift in small, relatively isolated populations. Wright proposed the adaptive landscape concept in 1932, arguing that genetic drift and inbreeding could push a small, isolated sub-population away from an adaptive peak, allowing natural selection to drive it towards different adaptive peaks. Fisher, Haldane, and Wright are credited with establishing the field of population genetics. This integrated natural selection with Mendelian genetics was the critical first step in developing a unified theory of how evolution worked.

21st Century

In James R. Shapiro's, *Evolution: A View From the 21st Century*, Shapiro introduces new molecular evidence that tests the conventional scientific view of evolution based on the neo-Darwinian synthesis. The neo-Darwinian synthesis is the connection between Darwin's theory of evolution by natural selection and the assumption that the variations on which species evolve are produced solely by gene mutations. In Manfred D. Laubichler and Jane Maienschein's book, *From Embryology to Evo-Devo: A History of Developmental Evolution*, the authors present the history of evolutionary developmental biology and explore the idea that embryological development and evolution are linked. In the 21st century, evolutionary studies have bloomed, and many new sub-branches are being explored, as seen from the two sources above.

As mentioned earlier, in the 19th century, scientific study at Colby was still slightly influenced by creationist thought. William Elder was one of the most influential teachers in the science department at Colby during this time, and because of this, he often used religion and God to describe how the natural world worked. In a way, Elder went against many of the conventional ways of thinking about evolution and the natural world that Darwin and most people heavily supported during this time.

Starting in the 20th century, how teachers thought about the natural world and biology began to change. In 1904, the year after William Elder left Colby, there was still no reference to evolution in any of the science courses found in the course catalog during this time. However, by 1917, evolution began to be introduced in many of the course descriptions of science courses being offered this year. In 1917, Professor Little taught a course in physiography which explored, "A brief consideration of earth as a whole is followed by a more extended study of the land. The chief landforms are studied as to origin, evolution, and influence on human life". It

seems to be no coincidence that the study of the evolution of landforms occurred shortly after Darwin proposed his new theories of continental shift. Along with this, in the spring semester, Professor Little offered a course in general geology which was "largely occupied by the study of Historical Geology, with especial reference to the past history of the North American continent and the evolution of life." In the years following, evolution started to be introduced in biology courses taught by Webster Chester, and the school seemed to fall more in line with what other naturalists were focused on studying during this time. Specifically, the science courses at Colby began to encounter natural science through hands-on observation and experimentation and an understanding that the study of natural science and evolutionary science was still very unknown.

Today, the study of evolution is alive and thriving at Colby, as many professors continue to study evolution as it relates to plants, animals, and humans. Through faculty interviews, it became clear that many professors believed that Colby started studying evolution much later than other naturalists during the 19th and 20th centuries because the study of evolution can be very controversial at times and challenging to study in a school setting. Professors today believe that the study of evolution is much less controversial than in years past. At Colby, the study of evolution is currently offered in three different courses, which each approach evolution from a different perspective: Evolutionary Analysis, Evolution and Diversity, and Evo-Devo.

Faculty Interviews

Professor Stone:

When Professor Stone was hired as a Biology professor in 1999, the job advertisement described the preferred candidate as "someone who could teach about evolution, ecology, and plants" (Stone, Personal interview). Before arriving at Colby, Bruce Fowles taught about

evolution, and in a typical year, only two to three students were in these classes. Upon Stone's arrival at Colby, all students were required to take a class in either evolution or ecology, which led to over forty students taking this class per semester. Stone believes that the biggest challenge with teaching a course in evolution is that there is often a disconnect between what students think the course is going to be about and what the course actually is about. She argues that every species is an excellent example of evolution and that the course is so tricky because evolution is a very abstract concept. The evolutionary analysis course at Colby is focused on what evolutionary biologists do, specifically studying variations within species and population genetics.

Stone's main species of study since 1999 has been the *Witheringia Solanaceae*. In a long-term project of the *Witheringia Solanaceae*, a species of the tomato plant, Stone has been "investigating the role of colonization and gene flow on the mating system of populations of this tropical shrub in Costa Rica" (Stone, Research). Stone's research focuses on sex life in plants, particularly looking at the breakdown of self-incompatibility. With the *Witheringia Solanaceae* as her model, Stone has found that some of the plants can self-fertilize while others cannot. In her 2014 Evolution paper, Stone demonstrated that "the evolution of self-fertilization in small populations was promoted more by siring success than by enhanced capacity to set fruit when pollinators were scarce" (Stone, Research). Through this research, Stone has been able to target the evolutionary effects of self-fertilization in the *Witheringia Solanaceae*.

Today, Stone feels that evolutionary science is a thriving science worldwide and is less controversial than in past centuries. However, she still believes that schools are hesitant to teach courses in evolution because it can be controversial. Since arriving at Colby, evolution has been changed from a 200-level course to a 300-level course, and she feels that it rewards students for

making it to 300 level courses. Today, evolution at Colby is studied under the course name "evolutionary analysis." When asked about the relevance of creationism in science today, Stone said, "Creationists have gone dark; I do not hear about creationism much anymore." During this interview, she referenced a 2006 court case related to the relationship between creationism and science and resulted in "creationists getting clobbered." Stone believes that because of this, there is no precedent to help creationists anymore.

Professor Angelini:

Professor Angelini was hired in 2012. At this time, Colby desired a professor who could teach courses in genetics, evolutionary biology, and a course relating to the given professor's specialties. Currently, Angelini is an Associate Professor of Biology at Colby and focuses specifically on developmental genetics, evolutionary developmental biology, and gene expression. Angelini's research and courses explore how development and genetics intersect with morphological evolution. Angelini believes that evolutionary biologists in the past have often said things in the literature about developmental evolution out of ignorance due to their value on traditional evolution studies. Because of this, he has been very sensitive to these discrepancies in his field when conducting his research.

Angelini's research today is focused on studying the developmental process of the soapberry bug, a species native to tropical and subtropical regions of the world and first discovered in Asia. He has discovered that the wing length of the soapberry bug is dependent on how much food the bug is provided during its juvenile stages. If a soapberry bug is provided with more food, they grow longer wings, and if the bugs are given less food, they grow shorter wings and produce more offspring. The threshold relating to the amount of food it takes to cause the

bugs to have longer or shorter wings is genetically determined. In order to adjust this threshold, Angelini has been editing the amount of insulin that each bug is provided during their juvenile stages. Along with this, Angelini has utilized his free time during the pandemic to get more involved with research on bees, explicitly focusing on the shape of their wings and mouths and its relation to evolutionary developmental biology.

Professor Moore:

Chris Moore is an Assistant Professor of Biology at Colby College. He has a B.S. in Biology from California State Polytechnic University and received a Doctor of Philosophy from the University of Nevada, Reno, in 2014. Moore is primarily an ecologist, studying the population and community ecology of mutualism. Since arriving at Colby in 2017, Moore has taught Introduction to Ecology, Ecology and Evolution of Infectious Diseases, and Ecological Modeling. When it comes to research, Moore investigates the ecology of species interactions, focusing on positive species interactions and species interactions across space. His research can be broken down into three areas: mutualistic interactions, spatial ecology, and the R environment as a tool for ecological problems.

Looking at the first area of his research, mutualistic interactions, the focus here is on the problem of mutualistic feedback. Mutualism is arguably the most common ecological interaction and is essentially an interaction in which two species benefit each other. Mutualistic feedback is a positive feedback loop in a way and is the idea that one species benefits the second, that species then benefits the first, and so on. Moore has spent his time as a postdoc trying to accomplish two goals in his research: The first is to better understand the problem of mutualistic feedback, and second, to develop a framework that does not result in unrealistic/infinite

population sizes. Moore is working with Karen Abbott at Case Western Reserve, and they have several ongoing projects to accomplish the two goals above. One of these projects, which focused on the role of nonlinear intraspecific density dependence on stabilizing mutualistic positive feedback, was published in Ecological Modeling.

The second aspect of Moore's research is dispersal and spatial ecology. The goal in this aspect of his research is to understand how dispersal affects ecological and evolutionary dynamics. Specifically, Chris looked into a mechanism of seed dispersal for the Jeffrey Pine, and as a result, became interested in the relationship between disperser behavior and patterns of seed deposition. At Colby, Moore's lab is studying ant species distribution across elevations, and Moore's lab has the most extensive collection of ants from Maine in the world.

The last aspect of Moore's research is utilizing the R programming language to understand ecology better. Chris has do-developed his own package in R called QPot that analyzes two-dimensional differential equations. He is currently working on a spatial modeling project and trying to create R's first library for hexagonal lattices and spatial modeling. While Moore's primary focus as a professor and a researcher in ecology, it is essential to note that ecology and evolution are not that different. The contributions of Darwin, Linnaeus, and others certainly influence the development of both ecology and evolution.

Conclusion

After spending time researching the ideas of creationism and evolution over the past few decades, both at large and at Colby College, it is clear that there has been a significant shift in our understanding of how the natural world works, more specifically, how species develop over time. In the 19th century, religion played a significant role in our understanding of the natural

world, as the lack of scientific technology prevented scientists from conducting extensive experiments that are seen today in the 21st century. Due to the extensive reliance on religion to explain how species came about and developed, creationism was very prominent during this time. It is seen in William Elder's book, *Ideas From Nature*, and quotes from students in the Colby College Bulletin from 1906 that religion played a role in the teaching of biology at Colby as well.

After Darwin published *Origins of Species*, and our scientific technology advanced, scientists were able to conduct new experiments and ultimately adopted the ideas of evolution and natural selection that Darwin lays out in his book. This led to the depletion of creationist ideas in the 20th and 21st centuries, as scientific evidence and research revealed that natural selection is the reason why species develop as they do. Today, creationism is dead in academia, and evolutionary studies are thriving worldwide, including at Colby College. At Colby, several courses are dedicated to the study of evolution and genetics, and professors and students at Colby have contributed significant research to the field. Evolutionary studies are critical in our understanding of biology today, and Colby's dedication to the biology department reveals this. Ultimately, while creationist thought has been scientifically proven to be flawed, it thrived for a while, as religion played a central role in the lives of many and still does. As our technology progressed, so did our understanding of the natural world, and creationist thought began to shift to evolutionary thought after the 19th century.

Bibliography

Angelini, D. (2019, May 11). *Carpenter Bee*. Flickr. https://www.flickr.com/photos/142092478@N03/40943092703/.

Angelini, D. (2017, January 19). *2T3A1515*. Flickr. https://www.flickr.com/photos/142092478@N03/47624614491/.

Angelini, D (April 27, 2021). Personal interview.

Angelini, David. "Profile: College Directory." *Colby College*, www.colby.edu/directory/profile/dave.angelini/.

Colby College, "Colby College Catalogue 1904 – 1905" (1904). *Colby Catalogues*. 159. https://digitalcommons.colby.edu/catalogs/159

Colby College, "Colby College Catalogue 1917 – 1918" (1917). *Colby Catalogues*. 166. https://digitalcommons.colby.edu/catalogs/166

"Colby College Bulletin Series V, No. 4, In Memoriam: William Elder", October, 1906 Photograph of William Elder, 1888

Elder, William. *Ideas from Nature; Talks with Students,*. Philadelphia, American Baptist Publication Society, 1898.

From Embryology to Evo-Devo: A History of Developmental Evolution, MIT Press, 2007. *ProQuest Ebook Central*, https://ebookcentral.proquest.com/lib/colby/detail.action?docID=3338643.

Labov, J. (2012). *Thinking Evolutionarily Evolution Education Across the Life Sciences: Summary of a Convocation*. Washington, D.C. National Academies Press.

Matzke, N. J. (2010). The Evolution of Creationist Movements. *Evolution: Education and Outreach*, *3*(2), 145–162. https://doi.org/10.1007/s12052-010-0233-1

Moore, C (April 2021). Personal interview.

Moore, C (n.d.). *Research.* http://mutualismecology.com

Numbers, R. L. (1993). *The creationists: The evolution of scientific creationism*. Barkeley: University of California Press.

Shapiro, J. A. (2013). *Evolution: A view from the 21st century*. Upper Saddle River, NJ: FT Press Science.

Stone, J. (n.d.). *Research*. web.colby.edu. https://web.colby.edu/jstone/about/.

Stone, J (April 7, 2021). Personal interview.

Stone, J. (February 26, 2021). *Taxonomy ST237* [Powerpoint slides]. Evolutionary Analysis, Colby College.