NCSE

REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION

DEFENDING THE TEACHING OF EVOLUTION AND CLIMATE SCIENCE

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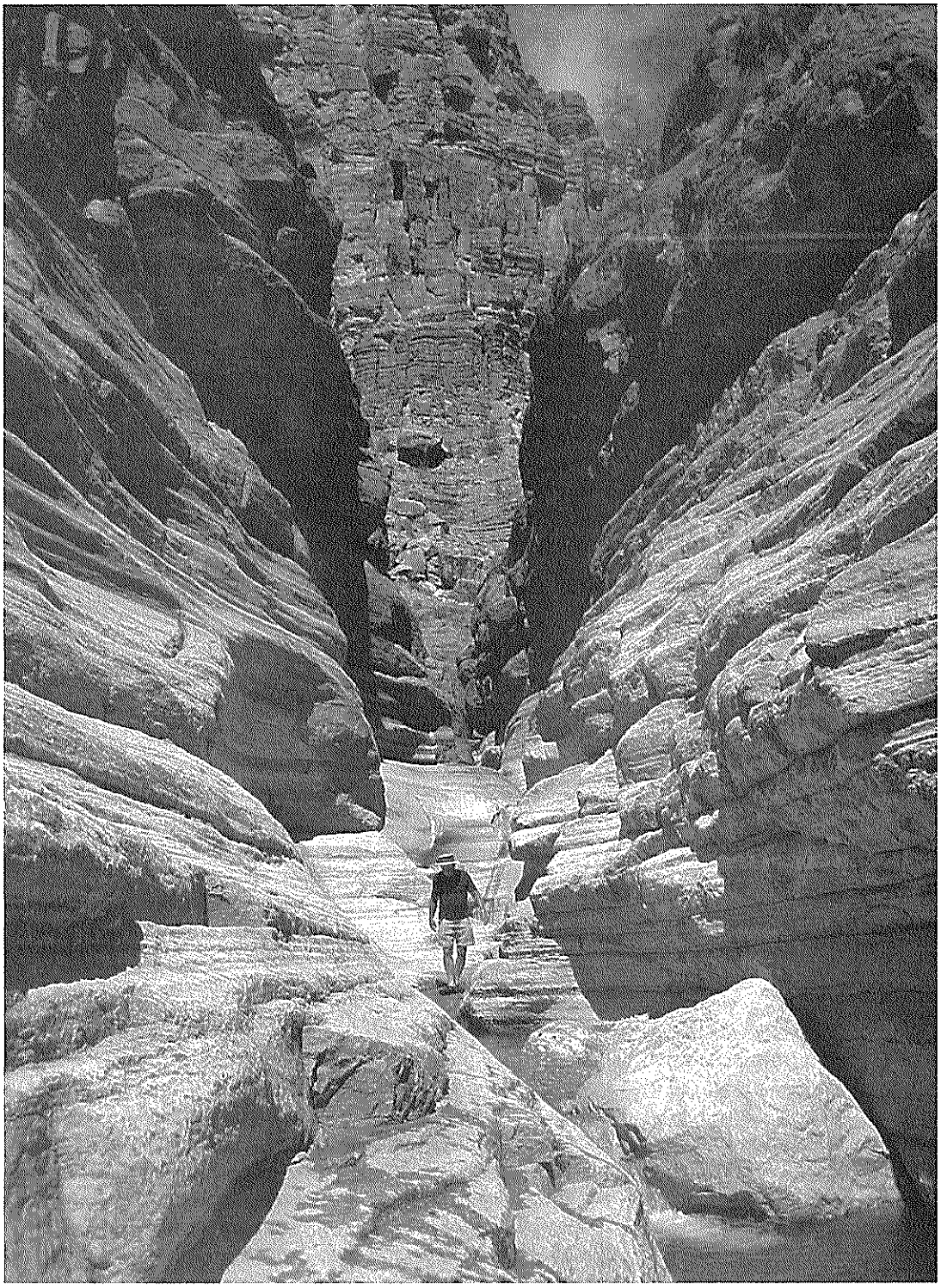


Photo: Eugenie C Scott

TABLE OF CONTENTS

UPDATES News from the Field

Controversies over evolution and climate science always seem to be happening somewhere. Here is a sampling of recent news.

Alabama: House Bill 592, introduced in the Alabama House of Representatives on April 30, 2015, and referred to the House Committee on Education Policy, would if enacted undermine the integrity of science education in the state by encouraging science teachers with idiosyncratic opinions to teach whatever they pleased while preventing responsible educational authorities from intervening. Topics identified in the bill as likely to "cause debate and disputation" are "biological evolution, the chemical origins of life, and human cloning."

The bill's lead sponsor is Mack Butler (R–District 30), who, discussing a different bill of his with al.com (2015 Jan 21), commented, "It takes a lot more faith to believe in evolution." Except for a failed bill to establish a credit-for-creationism scheme in 2012, HB 592 is the first antiscience bill in the Alabama legislature since 2009, when HB 300, the last in a long string of "academic freedom" bills in Alabama, failed to win passage.

Explaining his motivation, Butler revealingly told the *Anniston Star* (2015 May 7), "There is animosity to anything Christian. ... I'm just trying to bring back a little balance." Raw Story (2015 May 7) noted that Butler explained on his Facebook page that his bill would "encourage debate if a student has a problem learning he came from a monkey rather than an intelligent design!"

Susan Watson, the executive director of the ACLU of Alabama, told al.com (2015 May 7), "This is a thinly-veiled attempt to open the door to religious fanatics who don't believe in evolution, climate change or other scientifically-based teaching in our schools." She added, "It also opens Alabama to costly litigation that it just cannot afford."

NCSE's Josh Rosenau told the *Anniston Star*, "Evolution is recognized as the foundation of modern biology. To single it out as if it's scientifically controversial is misleading and encourages teachers to skip out on this concept that students need if they want to be doctors or even patients in the 21st century."

Rosenau also observed that, with no credible evidence that Alabama teachers are prevented from teaching science effectively, the bill seemed to be "a solution in search of a problem." Similarly, he told al.com that the bill would make it harder for teachers and administrators "to stand up for the standards and what they know the best science to be."

Subsequently, al.com (2015 May 8) editorialized, "The point is, what is the point of this bill? ... Can we just give Butler an "I love God" badge and let that be it? ... Let's focus on the real problems facing our state, rather than meddling in the classroom, where I'm sure there's been no groundswell from teachers complaining that they aren't free to discredit evolution."

Similarly, a columnist for the *Montgomery Advertiser* (2015 May 8) argued, "The goal of Butler's bill ... was to make it OK for some two-bit religious zealot posing as a biology teacher to fill kids' heads with debunked and ridiculous ideas. That's bad enough, but what's worse is that this bill, should it pass, will open the door to giving religious ideas the same standing in a classroom as scientific theory."

California, San Luis Obispo: "After receiving complaints from parents in Arroyo Grande and both local and national atheist organizations, the Lucia Mar Unified School District has launched an investigation into reports of an Arroyo Grande High School science teacher teaching creationism in class," reported the weekly *New Times San Luis Obispo* (2015 Apr 29). Brandon Pettenger was accused of injecting his personal religious beliefs into his classroom by screening the Bill Nye/Ken Ham debate and by asking students to summarize blogs on creationist websites. The mother of a student in the class told the *New Times*, "When your child brings home paperwork he's done for science class and one of the questions is 'Did God really make the universe?' it leaves you a bit dumbfounded." The district would not comment except to confirm that it was investigating the complaints, but after the complaints were received, Pettenger reportedly desisted from discussing creationism in class; he is no longer listed as teaching life science on the school's website and the material relating to his class is no longer present there. The organizations to complain to the district were Atheists United SLO and (together) the Freedom From Religion Foundation and the Richard Dawkins Foundation for Reason and Science. The San Luis Obispo *Tribune* (2015 May 1) editorialized, "to spend three days showing a filmed debate on creationism vs. evolution—as Arroyo Grande High School science teacher Brandon Pettenger reportedly did—and to assign students to read and summarize a pro-creationist blog is not OK. It violates state teaching standards and the Lucia Mar Unified School District's board policy. ... Teaching religious dogma in science class is prohibited—period."

Massachusetts, Holyoke: Controversy erupted in Holyoke, a suburb of Springfield, Massachusetts, over a proposed project at Dean Technical High School in which "[s]tudents will play the role of School Committee Members, community members, and journalists in a Mock School Committee Hearing for the district on whether or not the concept of 'intelligent design' should be included along with the teaching of The Scientific Theory of Evolution in the science classroom." The school's

principal Barry Bacom, who approved the project, told *The Republican* (2015 Apr 21) that creationism was not going to be taught: "That couldn't be further from the truth. The point of the whole project is to have students understand the scientific theories of evolution." But the president of the Holyoke Teachers Association, Agustin Morales, told the newspaper (2015 Apr 28) that "teachers have told him they feel it is inappropriate that [the project] is including discussions about the faith-based belief of creationism in the instruction of evolution"; he claimed that they are reluctant to air their concerns public for fear of reprisal. The controversy seems to be accentuated by

the fact that Dean Technical High School is under state control and run by a private manager, owing to "years of students' poor academic performances." The project launched on April 27, 2015.

Missouri: Missouri's House Bill 486 died in committee in the Missouri House of Representatives on May 15, 2015, when the legislature adjourned.

HB 486 purported to confer "academic freedom to teach scientific evidence regarding evolution" to teachers. If enacted, the bill would in effect have encouraged science teachers with idiosyncratic opinions to teach anything they pleased, while preventing responsible educational authorities from intervening. The bill specifically cited "the theory of biological and hypotheses of chemical evolution" as controversial.

HB 486 was referred to the House Committee on Elementary and Secondary Education, where it died without a hearing.

South Dakota: The South Dakota state board of education adopted a new set of science standards for the state on May 18, 2015. The new standards were developed in South Dakota, but include elements of the Next Generation Science Standards, which have so far been adopted in thirteen states—California, Delaware, Kansas, Kentucky, Illinois, Maryland, Nevada, New Jersey, Oregon, Rhode Island, Vermont, Washington, and West Virginia—plus the District of Columbia.

During a series of public hearings on the proposed standards, "[t]he debate over choosing standards for science education in South Dakota's public schools [became] a divisive battleground with a clear split between science professionals who strongly support the new standards and opposing parents who disbelieve climate change and evolution," reported the *Rapid City Journal* (2015 Mar 17).

A recognition of the controversy appears in the introduction to the standards: "Through the public hearing process related to adoption of the South Dakota Science Standards, it is evident that there is particular sensitivity to two issues: climate change and evolution." Nevertheless, the South Dakota standards on climate change and evolution are not significantly different from the corresponding standards in the NGSS.

The board "recognizes that parents are their children's first teachers, and that parents play a critical role in their children's formal education" and "that not all viewpoints can be covered in the science classroom," adding, "the board recommends that parents engage their children in discussions regarding these important issues, in order that South Dakota students are able to analyze all forms of evidence and argument and draw their own conclusions."

West Virginia: "A parent of a Jefferson County student has filed a federal lawsuit against local, state and federal education officials claiming the teaching of evolution, which he says is a religion, violates his child's Constitutional rights," reported the Charleston, West Virginia, *Daily Mail* (2015 May 21).

In a complaint filed with the United States District Court for the Northern District of West Virginia on May 12, 2015, Kenneth Smith contends that teaching evolution in West Virginia's public school constitutes "the propagation of religious faith" and that it hinders his daughter's ability to enter college and to become a veterinarian.

Listed as defendants are the Jefferson County School Board; Michael Martirano, the West Virginia state superintendent of schools; Francis Collins, the director of the National Institutes of Health; Arne Duncan, the Secretary of Education; and the Department of Education itself. Smith is representing himself.

In his complaint, Smith contends that the defendants "wrongfully violated established clauses"—presumably a reference to the Establishment Clause—in continuing to allow evolution to be taught "[w]hile denying the Plaintiff's accurate scientific mathematical system of genetic variations that proves evolution is a religion."

Smith is apparently the author of *The True Origin of Man* (Bloomington [IN]: iUniverse, 2013), which "represents the truth of mans [*sic*] origins confirmed by DNA mathematical and scientific facts." The about-the-

author line explains, "Kenneth Smith after gaining his science degree has spent many years thereafter studying theology and made the ultimate discovery."

The complaint concludes by asking the court to "declare the policy of evolution, as to be violating of United States Constitutional Amendments" (presumably the First, prohibiting any government establishment of religion, and the Fourteenth, requiring state governments to abide by the restrictions of the Bill of Rights).

Absent from the complaint is any mention of the relevant case law. In *McLean v Arkansas* (1982), for example, the court commented, "it is clearly established in the case law, and perhaps also in common sense, that evolution is not a religion and that teaching evolution does not violate the Establishment Clause."

Similarly, in *Peloza v Capistrano School District* (1994), the court characterized the Supreme Court's decision in *Edwards v Aguillard* (1987) as holding "unequivocally that while the belief in a divine creator of the universe is a religious belief, the scientific theory that higher forms of life evolved from lower forms is not."

Australia: "An Australian documentary about Charles Darwin produced by a creationist ministry has caused controversy after it emerged that it received over AUD $90000 (£46745) [$72750] of taxpayers' money," reported the *Guardian* (2015 Apr 29). The film in question, *Darwin: The Voyage that Shook the World* (2009), was released by Creation Ministries International. (CMI is the rebranded union of the creationist groups formerly operating under the Answers in Genesis name in Australia, New Zealand, Canada, and South Africa; as Jim Lippard described in *RNCSE* 2006;26(6):4–7, Answers in Genesis underwent a schism in 2005, with the United States and the United Kingdom groups retaining the Answers in Genesis name.) CMI's film was not directly funded by the Australian government; rather, it received a tax rebate. According to the *Guardian*, Screen Australia "is legally obliged to offer rebates to producers of all Australian feature films, regardless of content or artistic merit." Reviewing *Darwin: The Voyage that Shook the World* in *RNCSE* 2010;30(6):22–24, Jim Lippard and John M Lynch concluded, "the film is somewhat better than we expected it would be, and the film can be described as trying to downplay or even hide its own creationism, probably in hopes of functioning as a Trojan horse. As such, it omits key evidence for evolution, and suggests that the viewer infer the reasonability of creationism from the selective evidence that is presented." According to *The Australian* (2015 Apr 29), the film cost AUD $452518—the AUD $90504 rebate was 20% of that amount—but grossed only AUD $116436 at the Australian box office.

Scotland: "Campaigners who called for an official ban on teaching creationism in schools have welcomed a 'clear statement' from a Scottish Government minister it should not be taught in science classes," reported the *Glasgow Herald* (2015 May 24). The proposed ban would have barred "the presentation in Scottish publicly funded schools of separate creation and of Young Earth doctrines as viable alternatives to the established science of evolution, common descent, and deep time."

As NCSE previously reported, the Scottish Secular Society, prompted by recent creationist incursions, lodged the petition with the Public Petitions Committee of the Scottish parliament in 2014. The committee agreed to write to the government about the petition, but the government rejected the proposed ban as unnecessary. Subsequently, the committee decided to forward the petition to the Education and Culture Committee, which also agreed to write to the government about the petition.

The government again declined to act on the petition, but a letter sent to the committee by the minister of learning and science explained, "Guidance provided by Education Scotland ... does not identify Creationism as a scientific principle. It should therefore not be taught as part of science lessons." Paul Braterman, the scientific advisor to the SSS, welcomed the statement, telling the *Herald*, "Now we have, at least, a clear statement from the responsible minister that creationism should not be taught as science."

In the meantime, the dueling motions introduced in the Scottish Parliament in January 2015—S4M-12148, calling for a "Crackdown on Creationism" and supporting the SSS's position on teaching creationism in the Scottish public schools, and S4M-12149, entitled "Creationism and Evolution" and describing a variety of positions, including young-earth creationism, as "valid beliefs for people to hold"—are both listed on the parliament's website as having "fallen" on May 12, 2015.

United Kingdom: "Creationism is still taught in dozens of faith schools [in the United Kingdom] despite Government threats to withdraw their funding," reports the *Telegraph* (2015 May 2), describing the results of a recent investigation by the British Humanist Association.

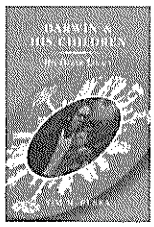
In September 2014, the Department of Education instituted a ban on the state funding of nurseries (for children 2–4) that promote extremist views. Although the main target of the ban were "nurseries linked to radical mosques or run by Islamic hardliners," the *Telegraph* (2014 Aug 7) noted, "Nurseries that teach creationism as scientific fact will be ineligible for taxpayer funding, under the new rules."

Before the ban was instituted, the British Humanist Association identified ninety-one schools of concern. Subsequently, in January 2015, the BHA sent freedom of information requests to local authorities to ascertain whether those schools were still receiving state funds. Only fourteen of the ninety-one schools in fact lost their funding. Fifty-one schools still receiving funding were regarded as likely to be teaching creationism.

The BHA's Pavan Dhaliwal told the *Telegraph*, "It is hugely disappointing ... to discover that creationist schools have continued to receive state funds since the ban on their doing so came into force" and called on the Department of Education to address the situation. ■

NCSENEWS News from the Membership

We regularly like to report on what our members are doing. As the following list shows, they—and we—have a lot to be proud about!



William D Anderson Jr reviewed **Tim M Berra**'s *Darwin and His Children: His Other Legacy* (New York: Oxford University Press, 2013) for the journal *Copeia* 2015;103(1):225–227, praising it as "a well-researched effort that integrates details of Darwin's family life with comments on his scientific achievements and includes numerous photographs of members of the extended Darwin family." Anderson is Professor Emeritus in the Graduate Marine Biology program at the College of Charleston.

David A Baum received the Chancellor's Distinguished Teaching Award from the University of Wisconsin, Madison, where he is a professor of botany. According to a press release dated April 14, 2015,

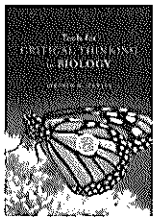
> Baum is respected for his popular lectures and innovative introductions to overall evolutionary biology and phylogenetics—what Baum calls "tree thinking." Baum is a fellow of the American Association for the Advancement of Science, has served as chair of the Department of Botany and is the founding director of the UW's Crow Institute for the Study of Evolution. A generous colleague who promotes active learning, Baum recently coauthored two new textbooks that introduce evolutionary thinking to a broad audience. Baum, a champion of the UW's Darwin Day programming, regularly delivers a lecture on evolution dressed as Charles Darwin.

Tim M Berra contributed "Darwin's harbingers" to *The Linnean* 2015;31(1):11–19. He explained,

> A lecture I gave on the life of Charles Darwin in the AC Moore Lectures in Evolutionary Biology and Society series at the University of South Carolina (USC) was followed by a tour of the Irvin Department of Rare Books & Special Collections of the Ernest F Hollings Library. The Director asked if I could provide a list of Darwin's predecessors so that their works could be added to the impressive collection of Darwiniana at the USC. Such requests are rarely as simple as they sound. What follows is my attempt to be helpful.

Berra is Professor Emeritus of Evolution, Ecology, and Organismal Biology at The Ohio State University, Mansfield.

Nina Jablonski, the Evan Pugh Professor of Anthropology at the Pennsylvania State University, was elected to the American Academy of Arts and Sciences in April 2015. Founded in 1780, the American Academy of Arts and Sciences is an independent policy research center that conducts multidisciplinary studies of complex and emerging problems. The Academy's elected members are leaders in the academic disciplines, the arts, business, and public affairs. Jablonski is also the star and narrator of a new HHMI short film about her research, *The Biology of Skin Color*, available free online.



Stephen H Jenkins's *Tools for Critical Thinking in Biology* (Oxford: Oxford University Press, 2015) was published. According to the publisher,

> Biology courses and curricula must engage students in how scientific inquiry is conducted, including evaluating and interpreting scientific explanations of the natural world. The book uses diverse examples to illustrate how experiments work, how hypotheses can be tested by systematic and comparative observations when experiments aren't possible, how models are useful in science, and how sound decisions can be based on the weight of evidence even when uncertainty remains. These are fundamental issues in the process of science that are important for everyone to understand, whether they pursue careers in science or not. Where other introductory biology textbooks are organized by scientific concepts, *Tools for Critical Thinking in Biology* will instead show how methods can be used to test hypotheses in fields as different as ecology and medicine, using contemporary case studies. The book will provide students with a deeper understanding of the strengths and weaknesses of such methods for answering new questions, and will thereby change the way they think about the fundamentals of biology.

Jenkins is Emeritus Professor of Biology at the University of Nevada, Reno.

Adrian Melott wrote to the *Lawrence Journal-World* (2015 Apr 18) to rebut a claim in George Will's syndicated column. Discussing Stanford University's divestiture from coal, but not oil or gas, stocks, Will wrote, "Evidently carbon from coal is more morally disquieting than carbon from petroleum." Melott replied, "Coal emits a lot more carbon per unit of energy gained—about half again as much as oil and nearly twice as much as natural gas. Also, coal recovery and burning emits a lot more toxic waste. ... the Stanford choice is based on facts, not moral disquiet." Melott is Professor in the Department of Physics and Astronomy at the University of Kansas.

Jeffrey M Selman's *God Sent Me: A Textbook Case on Evolution vs Creation* (Blossom Press, 2015), recounting the *Selman v Cobb County School District et al* case over textbook disclaimers in a Georgia school district, was published. The publisher writes,

God Sent Me is the account of one citizen making himself heard and taking action to preserve constitutional protections in the context of the conflict between evolution science and religion-based creationism. When the public school board in Cobb County, Georgia, glued a disclaimer against evolution into the county's new science textbooks, the implications were clear—separation of church and state and accurate education were at risk. Author Jeffrey Selman, along with several other like-minded citizens and the ACLU, marched into battle with a lawsuit against the forces undermining science education. This narrative shines a light on just what it takes to protect freedom and reminds the average citizen to "Wake up and get to work!"

The Brown University biologist **Kenneth R Miller** (a member of NCSE's Advisory Council and co-author of the textbook targeted by the Cobb County school board) describes *God Sent Me* as "[a] guidebook to citizens everywhere on how to fight back—and win."

NCSE is pleased to congratulate **Jeremy Thorner**, Professor of Biochemistry, Biophysics, and Structural Biology at the University of California, Berkeley, on his election to the National Academy of Sciences. Members of the academy are elected in recognition of their distinguished and continuing achievements in original research.

Learning that few students in the college of education at his alma mater were planning on pursuing a career in science education at the secondary level, **James Walker** established a scholarship program to fund a local graduating high school student interested in studying science education. Its first recipient, Isabella Petit of Massillon, Ohio, received the first award, and will be entering the Ohio State University in Columbus, Ohio, in the fall of 2015. She will receive $5000 in four installments, the final installment when she secures a position teaching middle school or high school science in Ohio. In 1989, while teaching seventh-grade science in Massillon, Ohio, Walker was forced to file suit in both federal and state courts against his local school district, which, he alleged, punished him after local parents complained of his teaching evolution. Both suits were settled in his favor, and Walker continued to teach in the district until 2004, after which he taught physics and mathematics at Stark State College from 2005 to 2010.

After a colleague at Doane College in Crete, Nebraska, published a letter in the student newspaper, the *Doane Owl*, alleging that there is no scientific consensus about anthropogenic global warming, **Chris Wentworth** and Ramesh Laungani published a rebuttal (2015 Apr 22), explaining, "The interdisciplinary field of climate science progresses at a dizzying pace, but is mature enough to offer robust hypotheses and conclusions about historical, current, and future climate," and concluding, "rather than cherry-pick authors that support a particular position on AGW, one should look broadly at the peer-reviewed literature, searching for themes, paying particular attention to the credibility of sources and reproducibility of results." The newspaper later reported (2015 Apr 24) that the letter to which Wentworth and Laungani were responding appeared to have been plagiarized from the climate change section of a website called procon.org, which presents the "pros & cons of controversial issues." Wentworth is Professor of Physics at Doane College.

DAVID M RAUP DIES

The paleontologist David M Raup died on July 9, 2015, at the age of 82, according to a press release from the University of Chicago (2015 Jul 14). The press release explains, "Raup was widely known for the new approaches he brought repeatedly to paleontology, such as extensive computation, modern evolutionary biology, theoretical ecology, and mathematical modeling." Raup was also a pedagogical innovator: *Principles of Paleontology* (1971, 1978), his textbook coauthored with Steven M Stanley, focused on paleontological methods rather than adopting a systematic or historical approach. To the public, he was famous for his popular books explaining his views on periodicities in mass extinctions: *The Nemesis Affair* (1985) and *Extinction: Bad Genes or Bad Luck?* (1991).

A vivid and candid writer, Raup was often misleadingly quoted by creationists. For example, a supposedly antievolutionary phrase from a 1979 essay of his—"we have even fewer examples of evolutionary transitions than we had in Darwin's time"—is still in circulation, although in context it is clear that Raup was talking about such evolutionary transitions as driven by natural selection alone; in the same article, he writes, "This record of change pretty clearly demonstrates that evolution has occurred if we define evolution simply as change; but it does not tell us how this change took place, and that is really the question." Raup contributed a chapter on "The Geological and Paleontological Arguments of Creationism" to Laurie R Godfrey's *Scientists Confront Creationism* (1984), in which he commented, "[Duane] Gish ... has popularized the notion that the rocks and the fossils say NO to evolution. As I will show here, the rocks and the fossils say YES to evolution!" Later in his life, Raup was apparently intrigued by the "intelligent design" movement, reportedly having a better opinion of Phillip Johnson's scholarship than did his colleague Stephen Jay Gould.

Raup was born in Boston on April 24, 1933. He received his BS from the University of Chicago in 1953 and his MA and PhD in geology from Harvard University in 1955 and 1957. He taught at Caltech and the John Hopkins University before becoming a professor of geology at the University of Rochester from 1966 to 1978. Returning to Chicago, he was curator of geology from 1978 to 1980 and dean of science from 1980 to 1982 at the Field Museum of Natural History. He also joined the Department of the Geophysical Sciences at the University of Chicago in 1980, becoming emeritus in 1995. His honors included the Paleontological Society's Charles Schuchert Award in 1973, election to the National Academy of Sciences in 1979, and the Paleontological Society Medal in 1995.

Fresh From Florida: An Intern's Experience at NCSE

Kate Heffernan

In May 2015, I graduated from the University of Florida, and did what a lot of newly minted graduates do these days: I became an intern. I expected the typical "internship" experience when I arrived at NCSE. I figured that I would be creating some Facebook posts, helping Minda Berbeco with her programs, and maybe blogging a bit—nothing too exciting or demanding. I was thrilled to be wrong. I have been presented with responsibility and creative liberty within the organization and have quickly realized that my experience here at NCSE would span far beyond coffee runs and note taking.

So far, I have helped to develop a new initiative, Scientists in the Classroom, which will be piloted this fall. The goal of the program is to connect early career scientists with teachers to help bolster climate change and evolution education. We hope to create a platform for educators and scientists to work together in clearing away denialism, doubt, and confusion in the classroom, helping students (and teachers) better understand evolution and climate change. I have also worked on building NCSEteach, the organization's new network designed especially for educators (see page 8). On the NCSEteach twitter (@NCSEteach) and Facebook accounts are a myriad of resources for teachers and science lovers alike, and we are busy working on our webpage (http://ncseteach.com), which will have even more materials for educators. I am excited to be working on these two initiatives, as they put NCSE's powers to work to support the most important group fighting science denialism: teachers on the front lines in the classroom.

While at NCSE, I have learned firsthand just how prevalent science denialism still is today, and most importantly, how to best go about addressing it. Combating climate change and evolution denialism is a crucial step in increasing science literacy and advocacy in the United States. In fact, I was first attracted to the internship with NCSE because I'm absolutely convinced that we need people to be climate literate in order to work to effectively address climate change. I grew up a science lover and nature enthusiast in South Florida. I lived just fifteen minutes from the beach in an area highly susceptible to sea level rise and hurricanes, so climate change became a very personal issue for me at a young age. At the University of Florida, I studied political acience and natural resource conservation and learned strategies to address climate change through education and policy initiatives. It became clear that overcoming climate change denial, especially in schools, is a crucial step in getting more people to care about and take action to combat climate change.

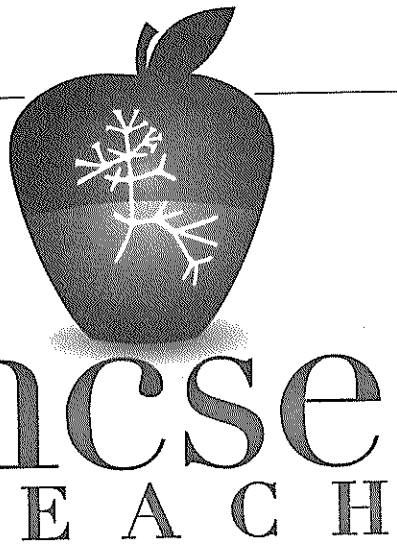
While I was expecting there to be a lot of work to be done with climate change education before coming to intern at NCSE, I naively thought that creationism was a thing of the past. Sure, I had heard about the Scopes trial and creationism creeping into the classroom decades ago, but I was convinced that today, evolution was being taught in science classrooms with little issue. I was proven wrong within a week of arriving at NCSE, as I was charged with researching creationist museums and the schools that visit them. It astounds me that people around the country, and the world for that matter, are still denying the science of evolution. Perhaps even more alarming, there is evidence suggesting that a majority of educators are either avoiding the topic altogether or presenting "both sides" of the non-existent evolution debate.

This is why the teacher network is so crucial. It's going to give NCSE an avenue to communicate and work directly with the teachers that may be ambivalent to teaching climate change and evolution. Through professional development, online resources, the Scientists in the Classroom program, and support from NCSE's teacher network, we will be able to reach these educators and give them the tools and confidence to become strong advocates for climate change and evolution in their classrooms.

I feel so lucky to be a part of this exciting new chapter in spreading the good science and fighting science denialism directly in the classroom, an opportunity made possible by generous donations from NCSE members Stephen Jenkins and Warren Friedman, to whom I am very grateful.

What Can 50,000 Teachers + NCSE Accomplish?

Minda Berbeco



We're going to find out...

Big changes are afoot at NCSE. If you follow our blog, you already know that NCSE is expanding its efforts from a focus on evolution and climate change denialism to a larger project of supporting the development of a "science-savvy" citizenry. (If you don't follow our blog, you will be hearing much more about these efforts in the months to come.) NCSE was founded in the midst of calculated efforts by evolution-deniers to alter how science was taught in public schools. Educators, parents, community members and others needed help getting organized to counter attempts to teach creationism. NCSE became—and remains—the #1 go-to place for advice, support, and action when science denial comes knocking on the doors of our schools. The metaphor we use around the office is that where there is a fire, NCSE will show up to hand out fire extinguishers.

The problem is, however, that we keep running around with fire extinguishers putting out brushfires rather than going after the fuel that science denial feeds on: a profound misunderstanding of the nature of science and a distrust of the scientific enterprise. We see this affecting many areas of science, not just climate change and evolution. Everything from an understanding of the Big Bang to vaccine acceptance is under threat.

Of course NCSE can't solve this problem alone—we are a tiny organization—but we can do *something*, and we can start by building on our roots. NCSE has over thirty years of experience defending the teaching of science in public schools, whether it is taking on legislators when they introduce bills that would allow the teaching of creationism, ensuring that textbooks present science accurately, or helping communities organize to support good quality science standards. But we believe we can do more—notably, doing more to support science teachers.

Teachers are on the frontline of science education but they get little thanks for it. When science grades are low, we blame science teachers—even as administrators and local governments steadily reduce the resources teachers need. When a goofy school board member tries to bring anti-science materials into a district, it's teachers who have to deal with the fallout. When polls suggest that the public has a poor grasp of scientific issues, whose fault is it? That's right: it's those darn science teachers.

That's not fair, and we want it to stop.

Science educators are an integral part of the scientific enterprise. Without them we would have no doctors, no researchers, and no citizens who understand and respect the role of science in their daily lives. We need science educators, and they need our support.

So what does that mean for NCSE? We know that more effective science teaching isn't just about getting kids to memorize facts. When teachers are asked to cover topics like evolution and climate change, they have to contend with the confusion and doubts that students bring into the classroom. We can help science educators teaching these socially contentious topics. We have the background, the experience and the knowhow to combat science denial at its roots. Our goal is to give science teachers the support and respect that they need to teach science forthrightly even when there is societal pressure not to.

As a result, we are launching our first-ever teacher network, called NCSEteach, which will bring science teachers together, allow educators to connect with one another (and NCSE staff), guide them to high-quality and well-vetted resources, share stories of how they have dealt with challenges to science education and also connect them to early career scientists as a resource and partner in advancing the scientific enterprise.

Science teachers are the first and last hope for science in America. We need them to be strong and confident advocates for the good science. If you are interested in joining NCSEteach, you can sign up at http://www.NCSEteach.com and follow us on Facebook and Twitter (@NCSEteach). If you are not an educator, but want to support us as we reach out to teachers across the country, you can donate to our cause by clicking on the "Join/Donate" button from our homepage www.ncse.com (write in the comments of the donation page "Go Teachers!").

Teachers, we are depending on you to help develop a science-savvy citizenry! But you are not alone. NCSE is here to help.

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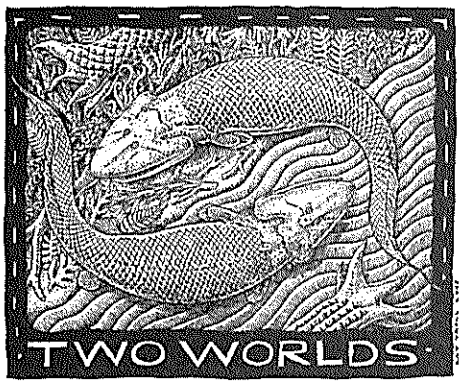

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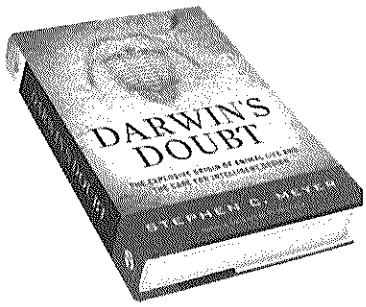

Where Are My Genes? Genomic Considerations on *Darwin's Doubt*

Michael Buratovich

In his book *Darwin's Doubt*, Stephen C Meyer makes some very unorthodox claims about animal origins. He argues that the diversification of animal body plans during the Cambrian explosion, in a time period "lasting only 5 to 6 million years" (Meyer 2013:72), must have required the creation of new genes. His reasoning stems from the increased number of cell types in Cambrian animals relative to their earlier counterparts. Increased numbers of cell types, he says, means an increased number of genes to encode the proteins that characterize those cell types.

Meyer further claims that these new genes, which drove animal diversification, must have encoded novel protein structures known as protein folds. However, according to Meyer, the generation of new protein folds runs into a probabilistic Rock of Gibraltar, since the "probability of any given mutational trial generating (or 'finding') a specific functional protein among all the possible 150 amino-acid sequences is 1 change in 10^{77}" (Meyer 2013:200). Meyer contends that these odds make it far too unlikely that random mutation and natural selection could generate a new protein fold, and therefore, we need a new model, specifically "intelligent design," to explain the origin of animal life.

I will address Meyer's mistaken probability argument elsewhere, but most of the remaining assertions presented in the above paragraphs are simply mistaken.

Burrowing into the Precambrian

Meyer is correct when he says that more complex animals require greater numbers of cell types. But Meyer wants to restrict the entirety of this explosive increase in structural complexity to the duration of the Cambrian explosion (circa 521–514 million years ago), during which large numbers of structurally diverse animals first appeared in the fossil record. In reality, extensive trace fossils are found in Precambrian rocks as far back as approximately 560 million years. The nature of a particular set of these traces, from about 20 million years *before* the Cambrian explosion, leaves little doubt that animals with a central digestive system and sophisticated neural system formed them. Thus, the ancestors of major animal groups with all their interesting cell types diverged during the late Precambrian and not during the Cambrian. These events in animal evolution set the stage for the later Cambrian explosion, and their omission by Meyer is a serious oversight.

Something Old, Something New

Did animal diversification require new genes? Genomic studies of simple invertebrates and a survey of the developmental genetics of different types of animals suggests not. Bilaterally symmetric animals (those whose adult bodies can be divided only in one plane, such as worms, mollusks, and vertebrates) share eight major conserved signaling pathways that are used during development. The varied deployment of these pathways establishes the peculiar forms of the animal groups.

Thus, animals achieve their final disparate forms not by using new genes that encode novel proteins with brand-new protein folds, but through the differential expression of a common set of evolutionarily conserved genes that encode components of signal transduction pathways. This strongly suggests that the evolution of animal diversity was driven not by the creation of new genes, but by the increasingly creative use of already existing genes.

But while all animals use versions of the same signaling pathways, it might be argued that they arose all at once during the Cambrian explosion, thus maintaining Meyer's argument. However, when we examine the genomes of extant (living) organisms closely related to animals as well as structurally simple animals whose ancestors originated in the Precambrian and earlier, it is clear that the majority of the body plan signaling pathways were in place long before the Cambrian period, and the creation of new genes was not a driving force behind the Cambrian explosion.

Conclusion

Meyer's entire thesis largely collapses because the genes that he asserts had to be created in such a short period of time to drive Cambrian explosion were in fact in place millions of years prior to this famous burst of diversity. This is the one of the main reasons the central hypothesis of his book *Darwin's Doubt* has been rejected by mainstream evolutionary biologists.

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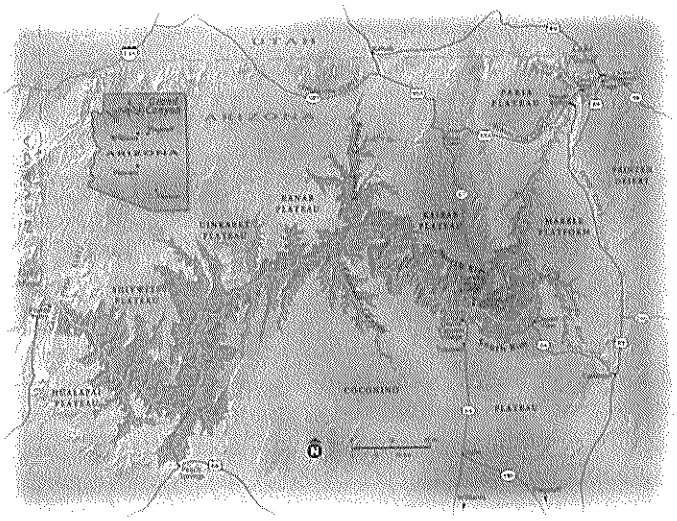
Summary of *RNCSE* 2015;35(4):1.1–1.9; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/331/719

ARTICLE SUMMARY

When Was Grand Canyon Carved—Millions of Years Ago or Thousands of Years Ago? How Do We Know?

Lorence G Collins



Map of Arizona–Utah area showing Grand Canyon, nearby plateaus, the Colorado River, and its tributaries. Reprinted with permission from Bronze Black.

Grand Canyon is one of the most impressive erosional features on Earth. While geoscientists know that the most ancient rocks of Grand Canyon are nearly two billion years old, the young-earth creationist (YEC) view is that most of the rocks of Grand Canyon were deposited in just one year in the wake of Noah's Flood, about 4363 years ago (Wright 2012). So who's right—and how do we know? Fortunately, there are at least two scientific tools that can be used to test the YEC hypothesis.

1. Apatite crystals

Apatite is a common mineral in igneous and metamorphic rocks. As rocks break down, crystals of apatite are released to become grains within sedimentary rock. Apatite usually contains traces of uranium, which, as it breaks down, emits helium and creates noticeable "fission tracks" in the apatite. By analyzing Grand Canyon apatite crystals for the presence of helium and fission tracks, we can recognize two important time periods in which these rocks were exposed: 50–70 million years ago, and 5–6 million years ago (Karlstrom and others 2014). Both time ranges show that the YEC view of Grand Canyon as a few thousand years old is way off.

2. River terraces

When a river initially cuts into Earth's crust, it generally forms a steep **V**-shaped canyon. But if the river jumps out of its channel, it deposits sediment on a large lateral flood plain. As a river evolves, this cycle repeats over and over again. As the river cuts lower, it picks up and drops off new sediment layers forming river terraces. There are two ways to date river terrace sediments: cosmogenic radionuclide dating (CRN) and optically stimulated luminescence (OSL).

Terraces along the Colorado River near Lee's Ferry in Utah south of Lake Powell (upper right corner of Figure 1) show that the CRN ages are 124000 years (124 ka) at the oldest and highest terrace and 38000 years (38 ka) at the lowest and youngest terrace (Pederson and others 2013). The oldest OSL age is 142 ka in a high level terrace near Lee's Ferry and the youngest is 23 ka in a terrace near the bottom of the canyon (Pederson and others 2013). The OSL and CRN ages are not exactly the same because both the samples and exact sample locations differed in each set of measurements, but both methods produce ages that are complementary and consistent with the relative positions of the terraces. And they are both inconsistent with the notion that Noah's Flood deposited these formations 4363 years ago.

Conclusions

In science, all data must be considered, not just those cherry-picked data to fit a preferred model. In their claims, YECs either ignore the data summarized here in this article or fail to perform due diligence in research. Several different scientific methods establish, neither fortuitously nor arbitrarily, the same 5 to 6 million-year age of the youngest erosion by the Colorado River and its upstream tributaries. Creationists make outlandish claims about a very young Grand Canyon, but when one examines the rocks, these claims simply do not hold up.

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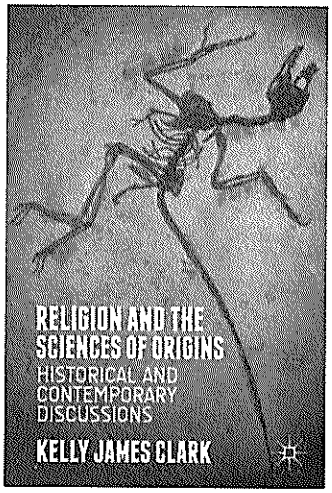
The Relentless Retreat: Kelly James Clark's *Religion and the Sciences of Origins*

Maarten Boudry



Is there anything more to be said about the conflict between science and religion? In *Religion and the Sciences of Origins*, philosopher and Christian apologist Kelly James Clark focuses on questions about origins (of life, the universe, and everything), one notable area where the "religious rubber meets the science road" (Clark 2014:7). Borrowing the medieval metaphor of the Doctrine of the Two Books, Clark maintains that there is no genuine conflict between science (the Book of Nature) and monotheistic religion (the Book of Scripture). Religious believers need not fear the discoveries of science, he asserts, as these do not jeopardize their faith. The study of either Book can enrich one's understanding of the other.

According to the Doctrine of the Two Books metaphor, Truth can never contradict Truth, so if the Book of Nature seemed to be at odds with Scripture, we should blame our limited understanding of Scripture. With the benefit of hindsight, one can see that this notion forbode trouble from the very start, because it could only accommodate changes in one direction: from Nature to Scripture, never the other way around. Whenever scientific knowledge advances, religion is forced to retreat. The current position occupied by many theologians who reject creationism (including "intelligent design") is called *theistic evolutionism*: evolution by natural selection has occurred, but God was somehow keeping evolution on track, for example by fiddling with "random" mutations, conveniently ensuring that such interventions escape his creatures' scientific efforts to detect them. Clark, although it is hard to pin him down, seems to adhere to this view.

What remains, then, of the Book of Scripture after Clark's reconciliation with the Book of Nature? Well, the phrase "Let there be light" in Genesis can still be interpreted, with considerable mental gymnastics, as God stooping down to humanity to inform us about Big Bang cosmology. Clark argues that there are some other gaps in the fabric of the cosmos for God to fill up, too. The fundamental physical constants in our universe seem to be finely tuned, for example, laying within a very narrow range, outside of which the cosmos would not be conducive to the formation of matter and solar systems, let alone be hospitable to intelligent life. Surely this is a sign of God's providence?

On the contrary, there are plenty of natural explanations on offer for this appearance of fine-tuning (Carroll 2012). In the multiverse model arising from string theory, for example, the constants of nature vary from one place to the other, and the existence of certain life-conducive regions is a matter of sheer happenstance.

Clark is aware of this possibility, and is hedging his bets. Either God, in his loving providence, has created one universe carefully tailored for life, or in his infinite profligacy, has created a whole plethora of worlds, the finely tuned and the messed-up ones alike.

In science, this kind of "heads I win, tails you lose" reasoning would be met with ridicule, but for theology, being "another way of knowing," different rules seem to apply. Towards the end of his book, Clark argues against one type of multiverse because the second law of thermodynamics (the inexorable rise of entropy in a closed system) would prevent life from arising within it. But what about the resurrection of the dead, a prospect which he apparently takes seriously (Clark 2014:177–178)? Wouldn't that be the most massive violation of the law of increasing entropy imaginable? Ah, but of course God can do whatever he likes, and he is hardly accountable to such trifles as the laws of thermodynamics. Presumably he has an inexhaustible supply of usable energy, or infinite time and patience. As a mere mortal, my patience with this kind of apologetic nonsense is limited.

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Summary of *RNCSE* 2015;35(4):3.1–3.6; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/345/715

WGN Radio

Randy Moore

Courtesy of Bryan College

John Scopes at his famous trial in 1925 in the Rhea County Court House. William Jennings Bryan is over Scopes's left shoulder. WGN's microphone is in the left foreground.

On June 1, 1924, radio station WGN (formerly WDAP) began broadcasting in Chicago, Illinois. The call letters of WGN, a subsidiary of the *Chicago Tribune*, stood for "World's Greatest Newspaper." Within a few weeks of its launch, WGN had reported live from the Republican National Convention in Cleveland, from the Democratic National Convention in New York, and from the sentencing of thrill-killers Leopold and Loeb, who had been defended by Chicago attorney Clarence Darrow. In the spring of the following year, WGN broadcast a live "Prohibition Debate" that also featured Darrow.

In July 1925, at a cost of more than $1000 per day, WGN aired a live broadcast of the Scopes "Monkey Trial" from Dayton, Tennessee (Cornelius 1991:68). This was the first trial in American history to be broadcast live on radio. To produce the broadcast, WGN rented AT&T's telephone cables stretching from Chicago to Dayton and was allowed to rearrange the courtroom as it saw fit. Quinn Ryan, a *Tribune* editor famous for creating realistic broadcasts, and engineer Paul Neal covered the trial in Dayton with four microphones in the courtroom. WGN's coverage gave listeners a front-row seat to the trial's proceedings.

In 1925, radio was still relatively new, especially in tiny Dayton, and Ryan and Neal were treated as celebrities. The mayor of Dayton asked Ryan and Neal to stay at his house. For most of the trial, Ryan sat in a windowsill and let the trial's dialogue speak for itself, only occasionally adding commentary (for example, clarifying points or identifying speakers). In 2000, WGN returned to Dayton and broadcast live from a festival celebrating the seventy-fifth anniversary of the Scopes Trial.

A WGN microphone used at the Scopes Trial is displayed at the Smithsonian Institution's National Museum of American History. However, in 1925, there was no technology available to record broadcasts; as a result, there are no recordings of Ryan's famous coverage of the trial.

Today, Chicago's WGN AM-720 is a 50000-Watt station having a news-talk format. On certain nights, WGN's signal can be heard over much of the United States.

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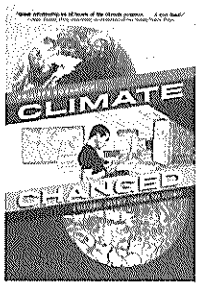
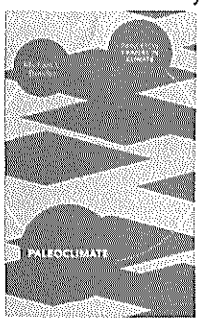
Summary of *RNCSE* 2015;35(4):4.1–4.2; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/352/714



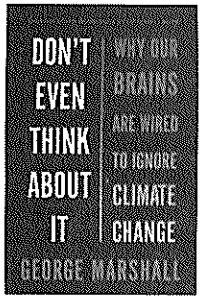
Climate Changed: A Personal Journey through the Science by Philippe Squarzoni (New York: Abrams ComicArts, 2014; 480 pages). Squarzoni's book, writes reviewer **Peter Buckland**, "is a deeply personal and at times painful voyage through the scientific understanding of human-caused climate change and its moral morass. By expertly using a graphic novel form, Squarzoni makes the reader more scientifically literate and concerned for our present and future situation ... Squarzoni has weaved a rich story that both enlightens and challenges, pleases and unsettles. By the end of this book, you will be changed. But how? Your story is not over."

Summary of *RNCSE* 2015;35(4):5.1–5.3; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/333/705



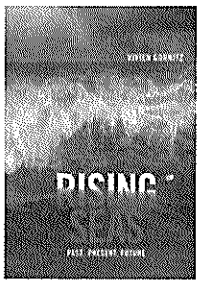
Paleoclimate by Michael L Bender (Princeton [NJ]: Princeton Univer-sity Press, 2013; 320 pages). According to reviewer **Jeffrey T Kiehl**, *Paleoclimate* "provides the scientifically interested reader with insight into how Earth's climate has changed through time," primarily from the perspective of geochemistry (and so with little mention of paleontology). The book proceeds chronologically: "the reader gains a fairly comprehensive understanding of what the observational data say about the climate of the period and how models may provide a global perspective to the climate picture." Kiehl concludes. "I heartily recommend the book for those interested in understanding Earth's rich climate complexity."

Summary of *RNCSE* 2015;35(4):6.1–6.3; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/327/693



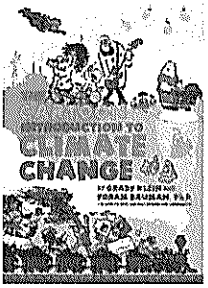
Don't Even Think About It: Why Our Brains Are Wired to Ignore Climate Change by George Marshall (New York: Bloomsbury USA, 2014; 272 pages). "The book's central quest is to understand why humankind has thus far failed to address the greatest physical and existential threat it has ever faced," explains reviewer **Stephan Lewandowsky**, referring to global warming due to greenhouse gas emissions. While finding Marshall's book accurate, entertaining, and stimulating, Lewandowsky still commented, "I found the grand narrative of the book difficult to discern along the way, and it took some effort to unpack the key points from the cornucopia of anecdotes."

Summary of *RNCSE* 2015;35(4):7.1–7.4; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/361/716



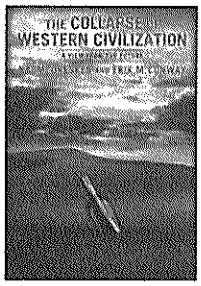
Rising Seas: Past, Present, Future by Vivian Gornitz (New York: Columbia University Press, 2013; 360 pages). According to reviewer **Kenneth G Miller**, "The specter of sea-level rise is one of the most prominent indicators of a warming planet, and Vivian Gornitz has produced an excellent book, *Rising Seas*, that documents past, present, and future sea-level changes." Miller concludes by asking, "Who should read this book?" and answering, " Technically minded students and readers of popular science would surely enjoy it, though ... it could have been streamlined. ... Finally, I can give the book the highest praise: I wish that I had written it."

Summary of *RNCSE* 2015;35(4):8.1–8.3; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/314/717



The Cartoon Introduction to Climate Change by Yoram Bauman and Grady Klein (Washington DC: Island Press, 2014; 216 pages). "*The Cartoon Introduction to Climate Change* is suitable for teachers to use as a well-written and comprehensive introduction to an understanding of the climate system and climate change," writes reviwer **Tegan Morton**. Although she thinks that middle school students would especially benefit, she concludes "most readers will find that the text is enjoyable and well-written, making it a good read for anyone interested in the basics of climate change science but not wanting to tackle a more traditional textbook."

Summary of *RNCSE* 2015;35(4):9.1–9.2; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/340/708



The Collapse of Western Civilization: A View from the Future by Naomi Oreskes and Erik M Conway (New York: Columbia University Press, 2013; 104 pages). Reviewer **Gordon Sayre** writes, "Orestes and Conway have followed up their influential *Merchants of Doubt* with a slim volume that seems a half-hearted effort. The concept is promising: a satirical future history of our current century, by a Chinese historian who makes an ex post facto critique of the failure of the United Nations and Western governments to reduce carbon emissions and thereby save civilization from climate change. But the execution of the concept itself collapses."

Summary of *RNCSE* 2015;35(4):10.1–10.3; the full text is available from: http://reports.ncse.com/index.php/rncse/article/view/335/700

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