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In the Beginning: American Physics, the Kansas Science Education Standards, and the Attack on Scientific Cosmology

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IN THE BEGINNING: AMERICAN PHYSICS, THE KANSAS SCIENCE EDUCATION STANDARDS, AND THE ATTACK ON SCIENTIFIC COSMOLOGY

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While the battle over teaching evolution in American public schools significantly pre-dates the infamous 1925 Scopes, or “Monkey,” Trial, the battle over teaching physics has just begun. In August, 1999, the Kansas Board of Education voted to drop not only the theory of evolution from state science standards, but to remove the Big Bang theory of cosmic origins as well. It is important to view the Board’s actions in the context of contemporary American culture, and its changing attitude toward physics. For much of the twentieth century, theoretical and experimental physics was viewed as good for American progress and essential to American defense. Now, however, the field is seen by an increasing number of Americans to be both irrelevant and a drain on the country’s financial resources. Recognizing this shift is essential to understanding the new vulnerability of physics to proponents of creationism. Understanding why the shift is occurring is essential to any defense.

My life has been so short that I really know nothing whatever. I was only made the day before yesterday. Whatever happened in the world before that time is all unknown to me.

—the Scarecrow (who doesn’t have a brain), speaking to Dorothy (a child from Kansas)

—*The Wizard of Oz*, by Frank Baum

When the Kansas Board of Education voted to drop the theory of evolution from state science standards in August 1999, the move made headlines around the world. While dramatic, it was just the latest yank in a tug of war between creationists and evolutionists for control of American public school policy, a war that has continued for more than three quarters of a century.

Largely overlooked in the most recent controversy, but potentially of greater significance, was another deletion the board made. By a slim majority, the Board voted to remove passages from the original standards that dealt with the Big Bang theory of

cosmic origins taught in physics classes. Instead of demonstrating competency in understanding the formation of the universe, the new standards merely asked that students achieve an understanding of the structure of the universe (for example, an understanding that “galaxies are found in clusters”).¹ The standards do not prohibit teachers from teaching scientific cosmology; but since it will no longer be included on statewide student assessments, the apparent hope of the conservative majority is that teachers will not have time in the school year to address it.

The original draft of the science revisions submitted to the Board was written by a 27-member committee that included several members of the Kansas Academy of Science, an organization of scientists and science educators. However, a loosely-knit group of Kansas creationists pulled together by Celtie Johnson presented its own set of standards to the board. (Johnson is founder of the National Committee for Excellence

in Science Education, an organization to help citizens challenge the teaching of evolution.) They were assisted in this task by Glenn Kailer, a researcher with the Creation Science Association for Mid-America.² Their document was met with a sympathetic response by the the conservative majority on the board, who then proceeded to incorporate the creationist work into the advisory committee's draft.³

While the battle over teaching evolution in American public schools significantly pre-dates the infamous Scopes, or "Monkey," trial held in Tennessee in 1925, the battle over teaching physics has just begun. Although a few preliminary shots have been fired over the bow in the last decade, the Kansas School Board's action is the first significant attack in eighteen years to be mounted at a statewide level.⁴ And while the Board was subsequently forced to make a partial retreat, they have by no means surrendered. On 7 December 1999, Board members voted to replace the August revised guidelines with yet another revision and to have that version vetted by an outside reviewer. The changes became necessary when three national science organizations, citing the Board's anti-evolutionary stance, objected to the state's incorporation of copyrighted materials into the standards. Saying that the Kansas standards did not "embrace the vision and content" of their groups' national documents, the National Research Council, the American Association for the Advancement of Science, and the National Science Teachers Association revoked their permission to use the copyrighted materials.⁵

But the Board, if bloodied, is unbowed. According the latest revision,

Some scientific concepts and themes (eg. blood transfusion, human sexuality, nervous system role in human consciousness, cosmological and biological evolution, etc.) may conflict with a student's religious or cultural beliefs. The goal is to enhance understanding, and a science teacher has a responsibility to enhance students' understanding of

scientific concepts and themes. Compelling student belief is inconsistent with the goal of education. Nothing in science or any other field of knowledge should be taught dogmatically.⁶

It is important to put the Kansas School Board's actions in the context of contemporary American culture and the changing way it is regarding the practice of physics. While for much of this century both theoretical and experimental physics have been viewed as somehow sacrosanct, there are indications that that perception is shifting significantly. Once seen as good for American progress and essential to American defense, physics is increasingly seen as an irrelevant drain on the country's financial resources.

Recognizing this perceptual shift is essential to understanding physics' new vulnerability to creationism. Understanding why the shift is occurring is essential to any proposed defense.

Physics: before the Fall

At the same time William Jennings Bryan and Clarence Darrow were squaring off in a Tennessee courtroom, American physics was entering a golden period that would last for the next half century. "We are evidently in an era of still more remarkable discoveries concerning the nature and laws of the physical world," claimed Princeton University President John Grier Hibben in his 1925 "Report of the President," and few would have disagreed with him.⁷ Most of the action was taking place in Europe, where physicists divided themselves roughly into two camps: those who took the radical approach to quantum mechanics pioneered by Neils Bohr and Max Born, and those who followed the more conservative path cut by Albert Einstein. But American physicists, determined to get into the game, made the acquisition of theorists an important part of their expansion programs. "No field of physics at the present time is of greater importance," wrote Karl T. Compton, chairman of the Princeton

physics department, in that same year. "In this country we have carried [our] experimental sides to a high degree of achievement, but...theoretical developments...are coming largely from Germany."⁸ The public had already been primed to identify with and support the work of science, particularly physics. In 1920, publishing magnate Edward W. Scripps launched the popular Science Service, a news service with a board of trustees representing both journalists and science organizations.⁹ Publishers brought out numerous science books for the general public; and magazines lauded the efforts of scientists not only to make technological advancements, but to solve the mysteries of the universe. Improbable by today's journalistic practices, in 1923, *The New York Times* won a Pulitzer Prize for its coverage of the Annual Meeting of the American Association for the Advancement of Science.

The public was already aware of the value of science to national security. During World War I, the National Academy of Science, at President Wilson's request, formed the National Research Council. The NRC's mission was to encourage both pure and applied research with the ultimate goal of furthering "the national security and welfare." "True Preparedness," the Academy stressed, meant pure as well as applied research.¹⁰ Pure physics became applied physics in the pursuit of German U-boats.

Physics, as did everything else, suffered from economic constraints during the Depression, but the rebound was swift. By 1936, *Newsweek* would proclaim, "The United States leads the world in physics."¹¹ Prominent graduate schools were offering first-rate training and facilities, and America had more cyclotrons than the rest of the

world combined. The United States became a magnet for physicists seeking refuge from political instability in Europe; their contributions to American physics should not be minimized. However, their impact would not have been so significant if there had not, as J. Robert Oppenheimer observed, already been "a rather sturdy indigenous effort in physics" and the infrastructure to support it.¹²

In 1938, almost 1300 American scholars and scientists, conscious of the growing threat to academic freedom in Germany, issued a manifesto condemning the fascist suppression of science and the Nazi racial policies.¹³ Affirming the legitimacy of modern theoretical physics, they concluded, "Any attack upon freedom of thought in one sphere, even as non-political a sphere as theoretical physics, is an attack on democracy itself."¹⁴

The relationship of American physicists to the war effort was a complex one. By and large, the physics community moved away from isolationism at a quicker pace than did the general public. The development of Albert Einstein's position is in no way atypical. Before 1933, Einstein, a so-

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cialist and pacifist, repeatedly called for resistance to military service and for scientists to refuse to lend their science to the military. By 1933, he had publicly declared he saw no alternative to the rearmament of western democracies.¹⁵ Six years later he had, together with Leo Szilard, written his famous letter to President Roosevelt advis-

ing that “extremely powerful bombs of a new type” could be made of fissionable materials, and urging that the president “speed up the experimental work” being done.¹⁶ (Einstein’s own work on the war effort was hampered by the fact that the German physicist was regarded as a security risk. He rode out the war years working—officially, at least —on an unified theory of relativity.)¹⁷

But while the atomic bomb was the most visible (and to the public mind, at least, most important) contribution of physics to the war effort, the development of three other projects—solid-fuel rockets, the proximity fuse (which could explode an artillery shell at a set distance from its target), and, most critically, microwave radar—were essential to the success of the Allied effort.¹⁸

Post-war physicists lobbied aggressively and somewhat successfully to have control of the nation’s science returned to civilian hands. In 1946, Congress created the civilian Atomic Energy Commission, which had broad powers over the production, use, and ownership of fissionable material, as well as the authority to dispense information and funding for pure and applied science. However, in that same year, Congress made the Office of Naval Research a permanent agency; and the funding and direction of American science came increasingly under the direction of the military.

The launch of the Soviet satellite Sputnik I on 4 October 1957 galvanized America. On 7 November, four days after the launch of Sputnik II, (this one with a rider on a one-way ticket: a dog, Laika) President Eisenhower announced the creation of the post of Special Assistant to the President for Science and Technology. Between 1957 and 1961, federal expenditures for research and development more than doubled, and in-

creased funding for student support and facilities was provided under the National Defense Education Act. And in May 1959, Eisenhower announced he would ask Congress to fund Stanford’s giant linear accelerator—a proposal that had been received tepidly in pre-Sputnik 1957.¹⁹ Between 1957 and 1967, the number of institutions

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offering doctorates in physics nearly doubled, with physics Ph.D.s going disproportionately into academia.²⁰ In his book, *The Physicists: The History of a Scientific Community in Modern America*, Daniel J. Kevles recalls,

It was a time when Americans ranked nuclear physicists third in occupational status—they had been fifteenth in 1947—ahead of everyone except Supreme Court Justices and physicians; where physicists, among other scientists, were identified not only as the makers of bombs and rockets but as the progenitors of jet planes, computers and direct dial telephoning, of transistor radios, stereophonic phonographs, and color television; when research and development in...this ‘age of the knowledge industry’ were believed to generate endless economic expansion....²¹

It was not to last. The growing American disenchantment with the Vietnam War meant that by the late sixties, many people no longer made the distinction between pure science and science that informed and supported the military-industrial complex. Protests escalated, despite the very vocal participation of many of the nation’s leading physicists in the anti-war movement.

In 1971, a thirty-three-year-old post-doctoral student was killed at the University of Wisconsin when an anti-war protestor's bomb blew up in a building shared by the Army Mathematical Research Center and the physics department. A year later, two more bombs ripped through a section of the Stanford Linear Accelerator. Mirroring the economic recession—which, for those physicists with long careers and memories, was reminiscent of that of the 1930s—science in the 1970s underwent a period of retrenchment. The number of physics Ph.D.s awarded declined steadily through the early and mid 1970s.²² But the Fermi National Accelerator Laboratory (Fermilab), at Batavia, Illinois, was completed on time and within budget. And in November 1974, two teams of physicists working independently at Brookhaven and at Stanford detected a new particle, the “charmed” quark, bound to an anti-quark. Despite the fact that in 1976 *The New York Times* declared that physics was no longer the “glamor king” of the sciences,²³ it held enough allure that presidential candidate Jimmy Carter would conflate his service aboard a nuclear submarine and lay claim to being a “nuclear physicist.”²⁴

Throughout this entire period, there was one overarching figure, one enduring cultural icon. The name Einstein became American shorthand for genius, imposing intellect, unfathomable brilliance. Einstein was the point of entry through which the general public connected with pure science. They might not be able to talk about, much less understand, theoretical physics, but they could talk about Einstein. Einstein was time travel, splitting atoms, the secrets of the universe. Twenty years after his death, his cultural persona was as strong—if not stronger—than it had been during his lifetime.²⁵ Forty years after his death, physicists could still invoke his name to excite the popular imagination. But it was becoming harder to transfer that enthusiasm to their contemporary projects.

Cracks in the firmament: the death of the Supercollider

The 1970s had seen the development of the “standard model,” which seeks to account for three of the four forces known in nature: the electromagnetic force, the weak force, and the strong force. (The fourth force, gravity, is not incorporated in the model.) Using the standard model, theoretical physicists hypothesize about the cosmological processes in effect as the universe is born. High energy accelerators can approximate some of the energies present in those early moments, giving experimental evidence of theoretical speculation.

At a meeting of high energy physicists in 1992, Nobel laureate and Fermilab director Leon Lederman urged that America reassert its dominance in HEP by building a supercollider. However, he would not prove quite quick enough. In 1983, physicists at the European Center for Nuclear Research (CERN) discovered the W- and Z-particles, two of the last firm predictions by the standard model. The next year, two European physicists, Simone van der Meer and Carlo Rubbia, were awarded the Nobel prize for the discovery, effectively bringing to an end to thirty years of domination by American high-energy physics.

In response to the Europeans' discovery, a blue-ribbon panel of American physicists recommended building a superconducting supercollider (SSC), which they claimed would become the “forefront high-energy facility of the world,” essential for “a strong and creative United States high-energy physics program into the next century.”²⁶ The High Energy Physics Advisory Panel to the Department of Energy issued its formal recommendation for the SSC in July 1983, and Congress began funding the project in 1985. The planned collider was to encircle an area 160 times greater than Fermilab and was to have an acceleration energy 60 times greater than the European CERN collider and 20 times greater than that of Fermilab. Its capacity was such

that, theoretically at least, it could reveal the presence of the Higgs boson.

In 1987, the Department of Energy sent out a request for site proposals. Twenty-five states responded. Physicists recommended Texas and Illinois, with preference going to Illinois and Fermilab. On 10 November 1988—the day after one-time Texas congressman George Bush was elected president—Waxahachie, Texas, was announced as the site of the new SSC.

Although few foresaw it, the selection of Waxahachie was the beginning of the end for the SSC. To begin with, while project

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supporters had succeeded in generating great enthusiasm for the potential benefits the SSC would bring to the selected community (jobs, jobs, and more jobs), they had done little to sell the entire country on the potential scientific benefits the SSC could bring. The instant the site was selected, the potential Senate constituency shrank from 100 to two. Congressional support waxed and waned, depending upon which pork-barrel projects were appended to SSC appropriations. And the Texas political muscle, which had brought the project South in the first place, unexpectedly dwindled. By 1992, with a permanent funding commitment to the SSC still not in place, George Bush was gone, replaced by Bill Clinton, whose support for the project consistently wavered.

“Obviously, the Texas political clout which looked so formidable and gave us such reason for optimism disappeared,” reflected Steven Weinberg, a Nobel laureate in physics and professor at the University of Texas.

Jim Wright, [D-Texas] a very powerful speaker of the house, resigned. Lloyd Benson [*sic*: Lloyd Bentsen, D-Texas, and former vice-presidential nominee] left the chairmanship of the Senate Finance Committee and went to be Secretary of the Treasury, which doesn't put him in the position of influencing senators.²⁷

Still, it appears the physicists could have done significantly more to capture the atten-

tion of the American public and the commitment of the Congress. In the land where Lucas and Spielberg are kings, it does seem that a search for the beginnings of the universe, properly marketed, could have found a constituency.²⁸ And certainly, with very little effort at all—“The Einstein collider,” perhaps—the ultimate stamp of approval could have been placed on the project.

Even those non-physicists closest to the project had trouble conveying what was important about the collider. A little more than a month after the project was shut down, Waxahachie City Manager Bob Sokall mused,

With the Space program at least you had something you could see, like men going to and from the moon. But with the supercollider what have you got to show? Things you can't even see going around and around in circles.²⁹

But the inability of the theoretical physics establishment to convince the general public of the project's importance was not the only way physics demonstrated its new vulnerability. Deep divisions within the physics establishment itself were suddenly exposed to outsiders. Condensed-matter physi-

cists, tired of having their work considered second-class, were only too happy to challenge their brethren's claim on billions of federal dollars to fund the SSC. "Dollar for dollar," Philip Anderson, a Nobel-prize winner for his work in condensed matter physics, told a congressional subcommittee hearing on the SSC, "we in condensed-matter physics have spun off a lot more billions than the particle physicists...and we can honestly promise to continue to do so."³⁰

Projects have lost public favor, and been beset by internecine squabbling, while still managing to receive ample federal funding. The most dramatic thing about the defeat of the supercollider was the precipitous erosion of congressional support, not merely for the collider, but also for the practice of physics. No longer was physics research automatically assumed to be of potential benefit to the national defense. The Cold War was over, and very few representatives could get excited about racing European scientists to the top quark. In the minds of Congressmen and -women, physics had been irrevocably divorced from national security.

Each time the SSC project came up for new appropriations, it was challenged both by moderate to liberal Democrats and moderate Republicans. Liberal Democrats argued that the money—projected costs had risen exponentially, from 4 billion to 8 to over 11 billion dollars—could better be spent on social welfare programs such as Headstart, HUD housing and support programs for Gulf War veterans.³¹ Republicans raised questions about managerial competence, design problems, and the failure of the administration to secure promised foreign investment. In 1992, the House voted to kill the project, but an eleventh-hour rally by the Senate saved it.

By 1993, the Supercollider had gone through three administrations without a commitment to permanent funding. And in October of that year, the House pulled the plug on the project. Defying the advice of the President as well as the House leadership of both parties, 81 of the 113 freshman representatives casting votes moved to cut off all future funding for the SSC, even though more than 2 billion dollars had al-

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ready been spent on the project. "It is obviously very energetic budget cutting," explained George E. Brown, Jr. (D-Calif.), Chair of the House Space, Science and Technology Committee.

You have a majority who weren't even around when this project was started. It is a high priority target for them. A project that takes this long may no longer be viable in a Congress that has no collective memory.³²

Or in the mind of an American public which no longer remembers the primacy of American physics.

The evolution of creationism: expanding to include physics

At the Fourth International Conference on Creationism, held in Pittsburgh in 1998, creationist astronomer Danny R. Faulkner, of the University of South Carolina at Lancaster, told the audience,

While many Christians have entered the fields of biology and geology to combat evolution, the takeover of astronomy by

evolutionary thinking has scarcely been noticed, and there are few qualified creationist astronomers. Unlike those other disciplines, there is no overall theory or, if you will, paradigm, of astronomy from a creationist perspective.

Part of the problem, he maintained, was a lack of researchers in the field.

Most people see the obvious effect that evolution and long time scales have had on geology and biology, and this has attracted Christian young people to pursue these sciences. The result has been that while evolutionary thinking has come to dominate much of astronomy, this has escaped the notice of most creationists.³³

Within the last decade, creation physicists have begun to publish books on creation cosmology in attempt to create familiarity with the subject; some, such as *Starlight and Time: Solving the Puzzle of Distant Starlight in a Young Universe*, written by D. Russell Humphreys—a leading creation scholar and a physicist with Sandia National Laboratories—have gone into multiple printings.³⁴ But until quite recently, most creationists have considered scientific cosmology incidental to the larger question of evolution. Creationists have usually followed three basic responses to scientific cosmology: criticism of the Big Bang, advancing the argument for design, and supporting evidence for a recent creation. But many creation scholars now are urging that the issue be considered independently of evolution, and that a more sophisticated challenge be mounted accordingly.

There is no single creationist position on the age of the earth and the age of the universe, although most creationists fall into one of three categories. First, there are those who believe that both the earth and the universe were created during a literal six-day creation week just a few thousand years ago. That position is held by the Institute for Creation Research (ICR)³⁵ and most members of the Creation Research Society (CRS). However, a second position—which holds

that while the earth is only a few thousand years old, most of the universe was created in the distant past of Genesis' "In the beginning"—is also compatible with CRS theology.³⁶ Finally, there is the "liberal" wing of creationism, which attempts to reconcile modern science and biblical literalism by claiming the six days of Genesis refer to epochs of undetermined terrestrial length. "Often young-universe and old-universe creationists focus more energy on defending their respective positions than on reaching out to nonbelievers," writes Hugh Ross, an evangelical Christian and former radio astronomer, in his book, *Creation and Time: A Biblical and Scientific Perspective on the Creation-Date Controversy*.³⁷ Ross, who is the president of Reasons to Believe, a non-profit organization dedicated to disseminating information about how science can be reconciled with the Bible, is a proponent of the "six long periods" approach to Genesis.

It is essential, Ross believes, that a creationist apologetics be developed. In *The Creator and the Cosmos*, he writes,

Cosmological chauvinism is not simply a manifestation of academic pride. It reflects decades of increasing specialization in education. Universities long ago dropped theology from their science curriculum. Few, if any, seminaries draw students with a background in science...[While] theology and philosophy students may study the history of their organization, science students rarely do.³⁸

It is useful at this point to consider the origins of the creationist movement. The term "scientific creationism" first entered the popular lexicon in the mid-sixties, following the 1961 publication of a book called *The Genesis Flood*, by John C. Whitcomb and Henry M Morris. In the following decade, several organizations were founded to promote the idea that the teachings of Genesis were supported by science. They include the aforementioned Institute for Creation Research, first established in California in 1970 as an arm of the fledgling Chris-

tian Heritage College, and dedicated to “research, publication, and teaching in those fields of science particularly relevant to the study of origins.”³⁹ The ICR split from Christian Heritage College in 1981, establishing its own graduate-degree-granting program. The ICR is also arguably the world’s largest disseminator of creationist pamphlets and tracts.

The ICR’s primary competitor, the CRS, was formed in 1963 following a split from the American Scientific Affiliation. In turn, the Creation Science Research Center of San Diego (CSRC), which has a special outreach to children, was formed after a 1970 split from the CRS.⁴⁰

A comparative newcomer to American creationism, but one who wields considerable influence, is Ken Ham, a Australian-born science teacher who first came to this country to work with the ICR. In late 1993 (with encouragement from the ICR, Ham maintains) he founded Answers in Genesis in a Kentucky storefront. Six years later, Answers in Genesis has its own offices, em-

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ploys 50 people and claims an annual budget of 4.5 million dollars. About two-thirds of that comes from donations, Ham says, and the rest from the sale of books and videotapes.⁴¹

Kentucky has proved to be fertile ground for creationist cosmologists. In 1996, Marshall County School Superintendent Kenneth Shadowen ordered two pages in a fifth- and sixth-grade science textbook glued together. The pages discussed the

Big Bang with no mention of the biblical account of creation. Shadowen defended his actions, saying, “We’re not going to teach one theory and not teach another theory.... It has nothing to do with censorship or anything like that.”⁴² An apparently unconcerned state official told reporters, “It’s unusual. But we are not going to send curriculum police down there to unglue the pages.”⁴³

Outreach efforts by organizations such as AiG are meeting with enviable success. Last spring, 600 people turned out to hear Ham speak at a Lexington, Kentucky, church. One, a 51-year-old postal inspector, said the seminar helped to reinforce his views about the creation of the earth. “One thing they do is they help your critical-thinking skills, in understanding what you believe and why you believe it, having a basis for that belief.”⁴⁴

Kansas creationism: a search for the origins

On the face of it, Kansas would seem an unlikely battleground for creationism. The state has a historical reputation for moderation, as evidenced by the politicians it has placed on the national stage: respected middle of the roaders such as former GOP Senators Bob Dole and Nancy Landon Kassebaum. But much lies below the surface.

The roots of the School Board controversy can be found in the 1988 presidential campaign of evangelist Pat Robertson, according to Burdett A. Loomis, a political scientist at the University of Kansas. According to Loomis, Robertson energized a long-latent populist streak in Kansas.⁴⁵ The conservative social agenda gained increased attention, as Wichita-based Operation Rescue became the country’s most visible anti-abortion group. National television crews followed the Rev. Fred Phelps around as he picketed the fu-

nerals of gay men. A Baptist minister from Topeka, Phelps is an extremist with an anti-homosexual agenda.

Religious conservatives began organizing at the grassroots level, and by 1996 they controlled the Kansas House of Representatives and much of the apparatus of the state GOP. (For a time, the state party was directed by a former head of the Kansas Christian Coalition.) That same year, national political observers turned their sights away from the presidential race to spotlight a battle for the 4th District seat on the Kansas Board of Education. It was paradigmatic, some

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analysts thought, of what was happening just below the surface of the Republican party across America.⁴⁶

The ostensible issue was "phonics." GOP insurgent candidate Rene Armbuster was making the teaching of phonics to young children the centerpiece of her campaign. But somehow other words kept getting thrown in there, words like "condom" and "permissiveness" and "Bible." And Armbuster just happened to be one of five school board candidates endorsed by the Kansas Education Watch Network (KEW-NET), an organization that attacked sex and AIDS education, as well as the accreditation standards. "Having a majority of people on the Board who think like this," retiring Republican State Representative James E. Lowther warned prophetically, "would be a detriment to the children of Kansas."⁴⁷

After the Bang: the implications for scientific cosmology

In 1981, the Arkansas legislature passed the "Balanced Treatment for Creation-Science and Evolution-Science Act" (Act 590), mandating the teaching of "creation-science" on a par with "evolution-science." The act held creation-science to be an "alternative scientific model of origins" that could be "presented from a strictly scientific standpoint."⁴⁸ The act was intended primarily to address issues related to human evolution; however, it did define creation-science as including "the scientific evidences and related inferences that indicate...[s]udden creation of the universe, energy, and life from nothing...."⁴⁹

Suit was immediately brought in federal district court under the auspices of the American Civil Liberties Union, which contended that the act constituted an establishment of religion prohibited by the First Amendment, as well as an abridgment of academic freedom as guaranteed by the Free Speech clause, and a violation of the Due Process clause of the 14th Amendment. On 5 January 1982, the judge concurred and permanently enjoined the defendants from enacting Act 590.⁵⁰ The judge found that the act was "self-contradictory" and that a Genesis-based explanation for creation could not be taught without resorting to making religious claims. Interestingly, the judge also challenged the creationists' methodology, writing:

A scientific theory must be tentative and always subject to revision or abandonment in light of facts that are inconsistent with, or falsify, the theory. A theory that is by its own terms dogmatic, absolutist and never subject to revision is not a scientific theory.⁵¹

It seems highly likely that the Kansas creationists had this ruling in mind when they offered their draft version of the science standards to the Board of Education. By omit-

ting the teaching of certain subjects (e.g., the Big Bang, evolution) rather than requiring that certain subjects be taught (e.g., creation-science) the standards could be effectively insulated from legal challenge. The net effect would be almost the same—however: evolution and scientific cosmology, instead of being placed on equal footing with creationism, would be diminished by omission.

It seems probable that more and more of these battles will be fought, not in the legal courts, but in court of public opinion. As physicists struggle with their profession's diminished stature, they are particularly vulnerable to creationist advances. Some physicists have already recognized that vulnerability and taken action. In New Mexico, physicist Marshall Berman started an organization to combat creationist influence; in 1998 he defeated a 20-year state School Board incumbent who supported creationists' attempts to influence science content in the state's public schools. On 8 October 1999, the New Mexico Board of Education voted 10-1 to adopt new educational guidelines affirming, among other things, the theory of evolution and scientific cosmology.⁵² After the vote, Berman released a statement reflecting on the victory.

But this is not a time to relax. Creationists have scored heavily around the country. Perhaps it is only natural for attacks on science to wax and wane over the decades. But we cannot afford to lose any more battles. The struggle between ignorance and knowledge is eternal.⁵³

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Endnotes:

1. Kansas, 7 Dec. 1999 revision.
2. Beem, "Woman's Creationism Shakes Up Public Education."
3. Learning.
4. The Arkansas creation-science act of 1981 will be discussed in greater detail below. While the act, which later fell to a court challenge, mandated the teaching of creationist cosmology on a par with scientific cosmology, cosmology was treated only as a starting point for creation or evolutionary theory.
5. Beem, "Science Standards Rewritten."
6. Kansas, op. cit.
7. Kevles, p. 157.
8. Compton to Henry Allen Moe, cited in Kevles, footnote 1, p.169.
9. Ibid., p. 171.
10. Ibid., pp. 112-113.
11. Ibid., p. 282.

12. *Ibid.*, p. 283.
13. It is worth noting, in any discussion of creationism and physics, that in 1920 an anti-Einstein club was founded in Germany. The "Study Group of German National Philosophers," as they called themselves, offered money to anyone who would speak out against relativity and "Jewish physics." Regis, p. 21.
14. Kevles, p. 287.
15. *Ibid.*, p. 288.
16. Regis, p. 127.
17. *Ibid.*, p.128.
18. Kevles, p. 307.
19. *Ibid.*, pp. 385-6.
20. *Ibid.*, pp. 387-8.
21. *Ibid.*, p. 391.
22. *Ibid.*, p.421.
23. Cited in Kevles, p. 423.
24. Schram, pp. 49-52.
25. Indeed, at least as late as 1986, the Institute for Advanced Study in Princeton was still receiving the occasional piece of mail addressed to Einstein. Regis, p.10.
26. Taubes.
27. *Ibid.*
28. It's not clear, even now, the extent to which physicists realize this is necessary. At a meeting of the Division of Particles and Fields of the American Physical Society held almost a year after the SSC's demise, speakers discussed what could have been done differently. "We speak a different language from that of people outside our field—a language that must be articulated by mathematics," said Dr. Julia Thompson, an organizer of "outreach groups" of physicists who seek to reduce public alienation. Perhaps her remarks were unfairly truncated by the reporter; however, it seems that not much progress can be made if those who seek to reduce alienation also insist they must speak another language. See "Physicists Ponder Life After the Demise of the Super-collider," by Malcolm W. Browne, in *The New York Times*, 9 Aug. 1994, p. C-5.
29. Schodolski.
30. Kevles, p. xxv.
31. Barone and Ujifusa. pp. 58, 917.
32. Hotz and Hart.
33. Faulkner.
34. See Humphreys.
35. Institute for Creation Research, "Tenets of Creationism."
36. Faulkner.
37. See Ross, *Creation and Time*.
38. See Ross, *The Creator and the Cosmos*, p. 11.
39. Institute for Creation Research. "Short History of ICR."
40. Gilkey, pp. 272-73.
41. Van Campen.
42. Malone and Schaver.
43. *Ibid.*
44. Van Campen.
45. Jacobson.
46. Shribman.
47. *Ibid.*
48. Arkansas.
49. *Ibid.*
50. Overton.
51. *Ibid.*
52. "Evolution-Only Policy in Schools."
53. Coalition for Excellence in Science and Math Education.

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