Science & Math CESE Education

The

BEACON

News from

The Coalition for Excellence in Science and Math Education

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DATA, DATA, DATA!

My eighth-grade physical science students learn very quickly that I'm obsessed with data. In a typical week, at least three days are spent in laboratory activities that require the careful collection of data. Numbers without units lose points. Broad conclusions without citing actual data lose points. I've often thought I could save a lot of writing if I simply bought a stamp that said, "Cite Data!"

When my students write up and turn in the results of their investigations, I allot 60 percent of the grade for simply having the original data recorded in a readable format. I'm convinced that knowing how to record data is a critical task.

We as a group are also obsessed with data. This recent legislative session saw the publication of a CESE White Paper on educational reform using data as the criterion for making sound decisions. When explained well and presented to the right people, data can make all the difference in the world.

Whether it's the saturation point of potassium bromide or the governance system for the public schools, it's clearly data that should be cited.

—Steve Brügge, President

BEAT THE RUSH–Pay Dues Now

We are a totally volunteer organization. Dues go entirely for printing, postage, web page, Science Fair awards, etc. If your mailing label reads "no record," or a date prior to 2001, or is blank, we'd appreciate your contribution. You will be credited to July 2002.

CESE comprises interested citizens throughout New Mexico and the nation, including scientists, engineers, educators, university faculty, members of the clergy, and parents. CESE is nonpartisan and nonsectarian, and welcomes members of all religions and political philosophies. This coalition works to improve science and math education and literacy for all citizens. CESE also provides support to teachers, students, and public officials who deal with education issues. We want to ensure that the Beacon of Enlightenment is not extinguished in 21st century America.

ALABAMA IMPROVES CURRICULUM

The Alabama State Board of Education has adopted a science curriculum much improved over that which had been corrupted by creationist efforts in 1995. The Board did *not* rule on the infamous "Evolution Textbook Disclaimer"; that will be considered next winter at the end of the Textbook Approval period.

In March 2000 the Alabama Course of Study: Science (ACOSS) came up for its regular 6-year review. During the public comment period, relatively few letters were written in support of evolution because no organization in Alabama was really focused on this issue.

About this time, several individuals in diverse parts of the state began to identify key people interested in improving the treatment of evolution in the ACOSS and eliminating the disclaimer. Within a few months we connected and coordinated our efforts.

Fairly early in the process, we contacted the National Center for Science Education, Kansas Citizens for Science (KCFS), and the New Mexico Coalition for Excellence in Science and Math Education (CESE). Their advice was invaluable, saved lots of time and effort, and averted several major blunders. We spent the spring and summer finding interested people and building support.

The proposed ACOSS, released in November, was the most strongly pro-evolution in almost 20 years. All we had to do was to keep opponents from messing it up. This we did by sending lots of letters to the Governor (an ex-officio member of the Board of Education), the Superintendent, the Department of Education, and elected Board members. We also wrote lots of letters to the editors of newspapers. Helping this effort was our email tree, by then several hundred people. We started emailing them once a week with information about the key issues, critiques of the proposed

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www.CESAME-NM.org

Membership Information:
CESE annual dues are $25 for an individual, $35 for a family membership, and $10 for students.
Please make checks payable to CESE and mail to:
11617 Snowheights Blvd. NE
Albuquerque, NM 87112.-3157

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standards, addresses to write to, etc. The few infiltrators did no real damage, because we were careful not to broadcast any real secrets.

Changes to ACOSS during this period were very minor, except for a four-paragraph Preface addition intended to cast doubt on science in general and evolution in particular. We learned later that this addition was a sop to the creationists, and that if the ACOSS committee made this addition, then the two strong creationists on the Board would tell their friends to lay low.

We had 14 speakers at the February Board meeting; these included 7 PhDs, 2 high school teachers, 2 ministers and 3 concerned citizens. No creationists spoke. As we expected, the Board voted unanimously to approve the new ACOSS.

Due to another issue before the Board, four TV crews were there, as well as several major newspaper reporters. Media coverage was extremely positive. Several newspapers ran articles with very nice quotes from our speeches, and the Montgomery Advertiser ran an excellent editorial supporting our views.

Counterattacks were sporadic, and I think the opponents actually marginalized themselves. We ignored a lot of activity on radio call-in shows because of our policy not to debate creationists.

Our strategy of taking the moral and intellectual high ground, building a blue-ribbon team of recognized leaders, and respectfully participating in the process, was viewed positively.

Many key decision makers had been repulsed by the strong-arm tactics opposing groups had used in 1995. They had publicly demeaned the Board and its staff, used lies, intimidation, manipulation, raw political force, and had probably violated several sunshine laws.

Here is what we have learned:

1. Very early in the process identify a small number of committed people willing to work as hard as it takes to see this through to a successful completion. This will involve hundreds of hours over a year or more. Expect *lots* of emotional highs and lows.

2. Take the moral and intellectual high ground. Evolution ***is the*** mainstream, supported by an overwhelming majority of the scientific, religious and academic communities.

3. Convince yourself that huge numbers of people are secretly frustrated by creationists' influence on schools, and want to do something about it, but don't know how. Your job is to find and inform them.

4. Develop a strategy appropriate to your situation. It should be simple and well focused. (Read *The Art of War* by Sun Tzu and *Baden-Powell, the Two Lives of a Hero,* by William Hillcourt.) Tell people only what they need to know, and what you want them to do, without divulging your strategy in a way that might leak to the opposition. Don't worry if some folks deviate somewhat from your plan; if you have done a good job of #5 below, this will work out ok.

5. Enlist people who have good judgment. Coalition building works. Recruit educators, scientists and community leaders. Religious

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leaders are excellent because they counteract the far-right's most powerful argument—the fallacy that all Christians are creationists.

6. Keep everyone informed and enthusiastic. Get together for lunch, etc.—email your entire list only when you have a specific objective and can make it interesting.

7. Email is key. We could not have done in 1995 what we did in 2001 because most of us did not have email. Encourage folks to forward your email to their friends. This means you will get some infiltrators, so be careful what you say in your letters.

8. Create a PC database and use it to record who wrote letters, spoke, etc. Then thank every individual profusely and personally when they do something good for The Cause.

9. Get advice from everyone you can find who has successful experience in this conflict.

10. ***Don't give up.***

Our real target, the Biology Textbook Disclaimer, was never an issue. We knew that this was going to be considered during the Textbook Approval period following the new standards approval. Our objective so far has been to position ourselves to attack the Disclaimer at the proper time. This will be a much tougher fight, but we hope to have another good report in a year or so.

—Bob Collins

ARKANSAS

This spring, Rep. Jim Holt of the Arkansas House of Representatives introduced a bill in that state's legislative session, HB2548, ostensibly to prohibit schools from presenting fraudulent information without informing the students of the nature of the fraud. However, the bill was an obvious promotion of creationism. All of the examples of "fraud" cited in the bill were the usual attacks on evolution— from radiocarbon dating of mammoths to Heidelberg Man to peppered moths. Holt even brought in "expert" Kent Hovind, a young-earth creationist, to testify for the bill in committee (see www.drdino.com).

Many of the citations in the bill were taken directly from Jack Chick's evangelical comic-book tract entitled "Big Daddy." The bill almost passed in the Arkansas house on March 24th — it needed 51 votes to pass, and garnered 45, only six shy of the goal. A subsequent motion to overturn the defeat of the bill failed to reach the required two-thirds majority of the Arkansas house. According to Rob Moritz of the Little Rock News Bureau, Rep. Jay Bradford, D-White Hall, said that "every example included in HB 2548 as a falsehood or theory taught as fact somehow was related to the age of the earth or creation." Bradford also said that "It cost the state $357,000 in 1981 to fight a lawsuit filed over the creation-science law. That's over $600,000 today."

Wesley Elsberry has produced an excellent web page detailing the creationist sources of HB 2548, including the "Big Daddy" comics. Check it out! http://inia.cls.org/~welsberr/ae/ar_hb2548.html

—Dave Thomas

SCIENCE FAIR AWARDS

The awards are given this year in the name of Tom Manaster for his persistent dedication to life-long learning.

Senior Division:

$125 award
"Interaction between Sound and Liquid Crystals"

Naveen Sinha

Los Alamos High School

Junior Division:

$125 award,
"What Blade Shape Works Most Efficiently on a Wind Turbine"

Camille Metzinger

Our Lady of Annunciation
7th Grade, Albuquerque

BOOK REPORT

Evolution and the Myth of Creationism

by Tim M. Berra
Stanford University Press
198 pp., paperback, $11.95

Do you ever feel that discussing the natural sciences with a biblical fundamentalist is like trying to thread a sewing needle with a frayed, high-voltage wire? I'm most exasperated by stale, worn claims that: *"Evolution violates the 2nd law of thermodynamics," "Dinosaur and human footprints are found together in Cretaceous rocks in Texas," "There are no transitional fossils,"* or *"All fossils and geologic strata were deposited during Noah's Flood."*

Unfortunately, unscientific claims such as these, along with the bogus methodologies of "scientific creationism," are all-too-often a starting point for public discourse about science education in schools. We have seen this happen in New Mexico, Kansas, and other states.

It is from this context that I highly recommend *Evolution and the Myth of Creationism*, an engaging, eloquent, and lucid summary of evidence for biologic evolution. Compared with the pitched emotions swirling about the evolution-creationism "debate," Mr. Berra's directness and clarity is refreshing, and his scientific observations and arguments are readily understandable by teachers, parents, policy makers, or even high school students.

While Mr. Berra's overall goal is an unyielding, unambiguous refutation of "scientific creationism," only the final part of the book (~15%) addresses the tactics of biblical fundamentalists in their bogus battle to legitimize so-called "creation science." Mr. Berra wrote his book in the 1980's shortly after the US Supreme Court struck down the Arkansas Balanced Treatment Act (1985) and the Louisiana Creationism Act (1987). Impressively, the book's substance is germane today as groups such as CESE work to implement better science standards and better science curricula.

Mr. Berra's book is much more than merely a great read in biology for two reasons. First, he offers a rich historical perspective, from Darwin to Leakeys to Gould, for understanding the advances that have shepherded us to science in the 21st century. Darwin finches and peppered moths retain their time-honored places at the table, but this is only a small part of the story. Second, Mr. Berra integrates masterfully numerous academic fields, showing intimate interrelations among zoology, botany, embryology, the medical sciences, paleontology and geology, chemisty, physics, astronomy, history, law, religion, anthropology, and yes, science education. For cre ationists hung-up on whether or not subspecies can evolve to species, or whether the genetic code is "irreducibly complex," one can only wonder after reading Mr. Berra's work whether they are missing the bigger, wonderful, and more tantalizing picture.

Mr. Bera never denies the complexity of genetic code, the intricacy of organs or organisms, or the all-encompassing geologic processes shaping the Earth and life, yet he excites us and challenges us to try to

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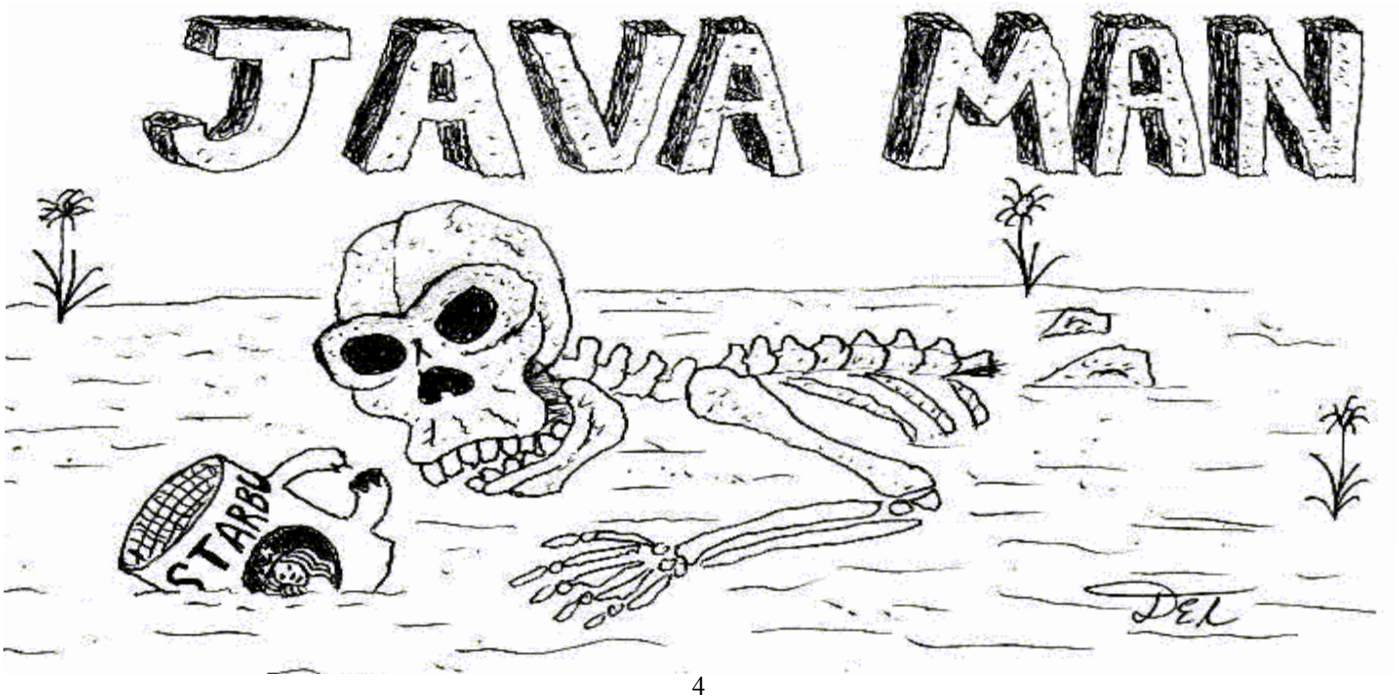

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understand these processes better. He's not one for biblical cop-outs, so he guides us through the basics. A perennial favorite of mine in the book is the wonderful summary of horse evolution. Or, why do I still get a shiver up my spine when I re-read the section on the coelacanth, thought to be extinct since the Cretaceous (70 Ma) and re-discovered in 1938 off the coast of Madagascar? To reinforce his points, I really like his striking example of descent with modification via the Chevy Corvette from 1953 to the present. Readers will also find a highly useful reference in a summary of key legal cases, including the Scopes Trial (Tennessee, 1925), a refutation of the 16 claims by creationists about science, an Appendix describing chromosomes, genes, and genetic variation, and a glossary of biologic and geologic terms key to the debate.

This book is a rare, comprehensive and comprehensible summary of biology, geology, and the history of science. Put this book on your summer reading list, and you will not be disappointed.

—Steve Getty, Dept. of Geology, Colorado College, Colorado Springs, CO 80903

WHAT THEY WERE AFRAID TO TELL YOU IN STATISTICS 101

Here are some facts that you probably didn't hear in your elementary or even advanced statistics classes. They would not let you know these things for fear that you might say, "Statistics is bunk." It isn't; it is very useful, but you can't always take it to the bank.

1. *Statistics can't prove anything.* Statistics can point out probable effects. Remember, though, they are only probable. That's true of everything in science; it's the same in statistics, only much more so. Sometimes the probability is very high, but never a sure bet. Your statistics prof probably covered this unpleasant fact lightly, if at all.

2. *Significance doesn't mean much.* "Significant ($p \leq 0.05$)" pops up often. All it means is that there is no more than one chance in 20 that you reject the null hypothesis when it is actually true. In plain language, only one chance in 20 of saying that there is an effect when there really is none. It often means that the published experiment is one of 20; the other 19 were thrown away. (Don't do that yourself; it is very unethical.) Many of the tests for significance are based on things like normality and homogeneity of variance; these are rare items in the real world. There are tests for these requirements, but they only give you the probability that your data are appropriate for the analysis you used. A lot of squeaky data might slip through.

3. *Significant doesn't mean large or important.* Suppose you are testing the viscosity of over-cooked versus under-cooked oatmeal, and you only have three bowls of each to test. The difference in viscosity might be very large, but with such a small sample, it would be hard to show significance. Significance doesn't even mean interesting. In the oatmeal experiment, even if we could show significance, who would care? In addition, if you use a very large sample, even trivial effects can be significant.

4. *Sometimes significance is not what you ought to look for.* Often the consequences of incorrectly accepting the null hypothesis are worse than the consequences of falsely rejecting it. Suppose your experiment is to find the lethal side effects of a drug. It would be dangerous to say that there were no side effects when there really were some. You aren't looking for the probability of falsely rejecting the null hypothesis; the real danger is that you might falsely accept the null hypothesis. There are tests for this, and in many cases they should be carried out but aren't. Some people involved in data analysis don't even know about this.

5. *Don't assume causality.* A correlation does not tell you which way the causal arrow points, or even if there is one. A might be causing B, or B might be causing A, or a hidden C might be causing both A and B to covary, or none of the above. All a correlation means is that A appears, in this sample, and perhaps only in this sample, to vary with B (positive correlation) or opposite to B (negative correlation).

6. *Sometimes statistics doesn't tell you much.* You try a chi-squared test of the scores of boys and of girls in several subjects. Chi-squared tells you they don't differ significantly, but your eyeball tells you they are decidedly different. Believe your eyeball. And no test will tell you what you really want to know: why they are different.

7. *Don't ever let politicians know these things.* I'm sure I don't need to belabor this point.

—Walt Murfin

SCIENCE, RELIGION, AND THE GALILEO AFFAIR

Part One

Over the past few decades, historians of science have been re-examining the 'Galileo Affair'– Galileo's trial by the Roman Catholic Church in 1633. While scholars have (naturally) been unable to come to a consensus on why Galileo was tried by the Inquisition, almost all historians agree that it was not primarily because Galileo believed in Copernican heliocentrism.

The facts of the case are not in dispute. In 1616, Galileo went to Rome to defend his recent writings and public statements promoting heliocentrism after some of his critics had charged that Galileo was promoting a poorly-substantiated belief that was contrary to Scripture. By this point, many, and perhaps most Church officials had already concluded that Copernicus's system was the most accurate and useful way of predicting astronomical positions (which was particularly important to the Church because of its use in calendar reform), but the question of whether the system was an accurate depiction of reality remained open. First of all, no one had yet come up with a convincing proof that the Earth really flew around the sun at great speed, as Copernicus's proposal required. And second, there were some Biblical passages that seemed to suggest that the Earth was stationary at the center of the universe. This was an unusually touchy subject at the time, since the Church was in the midst of crisis stemming from the Protestant Reformation and was particularly concerned about arguments over who had authority to interpret Scripture.

During his 1616 visit, Galileo received the support of some powerful liberal theologians, particularly Cardinals Roberto Bellarmine and Maffeo Barberini, who argued that, if Copernicus's system was someday proved true, then the Church would have to re-interpret those Biblical passages that seemed to contradict it. However, they also supported the compromise that Galileo eventually agreed to: Until such definitive proof was forthcoming, Galileo should discuss heliocentrism only hypothetically, and not promote it as a true description of the heavens.

Flash forward to 1624. By this point, Galileo had become convinced that he had precisely the proof he was looking for. Even better, his old ally, Maffeo Barberini, had by then become Pope Urban VIII. In 1624, Galileo went back to Rome and had six separate audiences with the new Pope during which he assured the pontiff that he had worked out a definitive proof of the Earth's motion. Urban, intrigued by the prospect of such a demonstration, yet concerned about how the Church would handle the theological consequences, gave Galileo the green light to write about heliocentrism, but still with the understanding that he would not describe it as truth (rather than simply a useful hypothesis) unless he could really prove it.

Convinced that he had the required proof in hand, and feeling that he had the Pope's personal blessing to make his case, Galileo published his Dialogue on the Two Chief World Systems in 1632. It is a wittily written treatise, crafted as a dialogue between three characters: Simplicio (the geocentric Aristotelian), Salviati (the heliocentric Copernican), and Sagredo (an intelligent and well-informed neutral observer to the debate). In the Dialogue, Salviati systematically destroys all of Simplicio's arguments, and concludes with Galileo's new, killer proof that the Earth orbits the Sun. Sagredo ultimately concludes that the brilliant Salviati (a transparent stand-in for Galileo himself) is correct, Aristotle is wrong, and everyone retires for wine and snacks.

One problem: Galileo's new proof made no sense; it was a cockamamie argument about how the motion of the tides proves that the Earth orbits the sun, and it just doesn't work. When push came to shove (and it did), Galileo simply did not know how to prove that the Earth truly moved. Galileo had therefore crossed the line set out sixteen years earlier—he had promoted an idea contrary to Scripture without providing convincing proof of its truthfulness. (In order to protect himself, Galileo had added a preface that claimed that his treatment of heliocentrism was purely hypothetical, but even a casual reading of the Dialogue makes clear that this was hogwash; the book was a manifesto for heliocentrism, plain and simple.) Galileo's critics back in Rome instantly seized on the weaknesses of his arguments by charging that Galileo had committed serious offenses: disobeying a papal injunction and promoting teachings contrary to Scripture. [Important: Galileo was never charged with nor tried for heresy, as is commonly believed. Heresy was a far more serious offense and carried a much stiffer penalty, if you know what I mean.]

In 1633, Galileo was called back to Rome to answer these charges. His trial was a see-saw battle that turned on all manner of technical points in church law, theology, and

In the ensuing plea bargain, Galileo admitted that he had gone a bit too far in promoting heliocentrism as truth without sufficient proof and promised not to do it again; all sides then prepared to conclude the face-saving compromise. Then, almost at the last moment (and for reasons that are still quite mysterious), the Inquisition over-ruled the plea bargain and handed down a verdict and sentence that was unexpectedly harsh: Galileo was found guilty of a "vehement suspicion of heresy" (which was not nearly as bad as heresy itself but still worse than disobedience and teachings contrary to Scripture) and forced to abjure and recant his belief in heliocentrism. Galileo signed a recantation in June of 1633. (I should also point out that Galileo was never imprisoned in a dungeon or tortured during the inquest, as is also sometimes believed. By all accounts, his physical surroundings were quite enviable.)

After the trial, Galileo returned to his villa outside Florence, where he technically spent the last decade of his life under a very comfortable house arrest and under injunction not to write anything further on physics. Just to show how strictly his sentence was carried out, during his remaining years Galileo often stayed at the palaces of nobles and patrons in Tuscany, and openly disobeyed the gag rule by writing his Discourse on Two New Sciences, in which he essentially invented kinematics and materials science (though it's true that Galileo's criminal record meant that the book could not be published in Italy; it was published in the Netherlands in 1638). On a purely technical level, the Discourse was actually Galileo's greatest contribution to modern science. He died in 1642, the year of Isaac Newton's birth.

So much for the facts. But why did the Church come down so hard on Galileo? Some scholars argue that Galileo simply had terrible luck, since he happened to be pushing his arguments at the worst possible political moment. In the early 17th century, the Catholic Church was desperately trying to fight off an insurrection within Christendom (the Protestant Reformation). Many within the Church hierarchy were not particularly fond of liberalizing Catholic doctrine while it was under assault, and Galileo may have ended up as a collateral casualty of a much larger war.

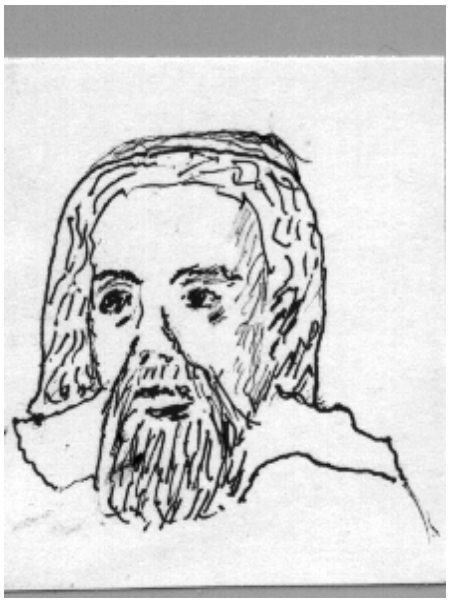
Other historians argue that an enormous amount of the fault was Galileo's. He was, without a doubt, a voracious social and political climber, and his political maneuverings in the Italian Renaissance court system over his career had garnered him many powerful enemies. With his (erroneous) proof of Copernicanism, Galileo apparently hoped to climb the pyramid to the most prestigious court of all: the Vatican itself (he wanted to become official mathematician/astronomer for the Pope). He took a gamble on his proof, lost, and suffered the consequences.

Still other scholars suggest that Galileo's downfall resulted from a personal falling-out he had with the Pope. There is some documentation to support the conclusion that Urban VIII felt personally betrayed by Galileo's false proof, and was irritated to boot that Galileo had put the Pope's words from one of their private conversations into the mouth of Simplicio (the simpleton) at the end of the Dialogue.

Personally, I imagine that Galileo got into so much trouble for a variety of reasons. First, he thought heliocentrism was true and became an evangelist for the idea; sadly, there is good reason to believe that Copernican helio centrism was already succeeding within Church hierarchy and would have become an accepted element of doctrine on its own if Galileo had not forced the issue. Second, he felt that the Church needed to reform its entire intellectual structure in order to modernize and protect itself against Protestantism; in particular, Galileo believed that science had to replace theology as the Church's principal mode of understanding, and that accepting Copernicus was a good first step. Third, he felt that he could have the greatest impact in shaping new doctrine at precisely the moment when the Church was feeling weak and on the defensive. And finally, he felt that he, Galileo Galilei, had the authority and brilliance to transform Catholicism in this way. When you read his writings, you get the distinct impression that Galileo believed that expertise in astronomy and mathematics gave him (and all scientists) a special authority to make theological pronouncements and inform Rome how to run the Church. Frankly, I find it no surprise that the Inquisition dropped the hammer on him.

To Be Continued

—Timothy MoyCESE
Vice President



Coalition for Excellence in Science and Math Education
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Albuquerque, NM 87112-3157

Return Service Requested

Annual Meeting - Bring a Friend

Saturday, June 16, 2:30 - 5:00 p.m.

First Unitarian Church

3701 Carlisle Blvd. NE
(southwest corner of Carlisle & Comanche)

Free Lunch - Really!!!

Please call 296-1467,

and leave your <u>name</u> and the

<u>number attending</u> so we'll have enuff.

Working Overtime

Dave Thomas spoke to the Civitans on The Evolution of Creationism

Dr. Timothy Moy spoke at the Albuquerque Archeological Society

Marilyn Savitt-Kring
and
Dr. Marshall Berman
made presentations in Kansas on science education in the schools. Attendees came from KS, NM, CA, MI, LA, NE, and IA>

Speaker

Rick Miera

Chair, NM house Education Committee
Chair, Legislative Education Study Committee