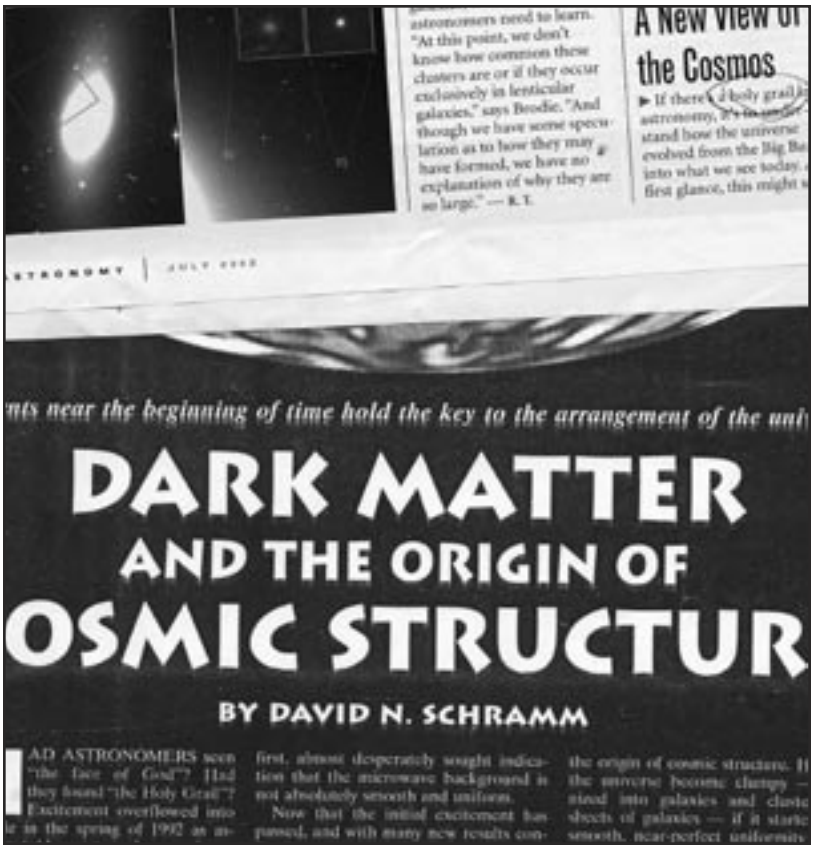

astronomers need to learn. "At this point, we don't know how common these clusters are or if they occur exclusively in lenticular galaxies," says Brodie. "And though we have some speculation as to how they may have formed, we have no explanation of why they are so large." — R. T.

A New View of the Cosmos

ASTRONOMY | JULY 1992

nts near the beginning of time hold the key to the arrangement of the uni

DARK MATTER AND THE ORIGIN OF OSMIC STRUCTUR

BY DAVID N. SCHRAMM

AD ASTRONOMERS seen "the face of God"? Had they found "the Holy Grail"? Excitement overflowed into

first, almost desperately sought indication that the microwave background is not absolutely smooth and uniform.

Now that the initial excitement has passed, and with many new results con-

the origin of cosmic structure. If the universe booms chumpy — mixed into galaxies and cluste sheets of galaxies — if it starte smooth, near-perfect universe

Deconstructing Astronomy's Holy Grail

by Steve Nadis
Cambridge, Massachusetts, U.S.A

I have discussed the "holy grail problem" extensively in previous studies.[1] Rather than retread yet again on that same hallowed ground, I've elected, in this paper, to give the research a new focus -- that of specialization. The field of astronomy, in particular, is ripe for a treatment of this sort. As for why astronomy stands out in this regard, it's not for me to say. My job (according to my grants manager) is to collect the data and present it in an even-handed way, without tipping my hand in a manner that might be perceived as uneven-handed or worse. However, I am allowed to speculate, albeit briefly, since my editor told me I could do so provided I limit my remarks to a few introductory sentences (the edited remnants of which you are reading here).

Allowable Digression

Astronomy, it strikes this observer, attracts an inordinate number of grail references because the field naturally lends itself to exaggeration: the biggest supercluster, the oldest galaxy, the most distant supernova, the brightest gamma-ray burster, the most massive supermassive black hole, and so forth. Given the penchant of bench scientists, as well as the reporters heralding their exploits, to resort to hyperbole, it is no surprise that the holy grail is an active (and some might say "hyperactive") player in the celestial literature, cropping up, on average, once every two to three peer-reviewed articles and even more frequently in the non-refereed literature, where editorial "gatekeepers" are few and far between.[2]

The Twin Pillars

Having dispensed with my two allotted sentences -- digressive, as well as complex, and borderline run-ons -- I shall now proceed with the task at hand, an attempt to divine the meaning of the holy grail from the "twin pillars" of grail analysis upon which everything else (including all forms of punctuation, even the lowly apostrophe) rests: **history** and **context**. When the examples are lined up on the printed page, and laid out, logarithmically, in chronological fashion, does a pattern emerge? If so, is that pattern real or imagined? Likewise, one might ask whether we can ever define the "holy grail" in precise, unambiguous terms, or will its definition be limited to a set of transient qualities that shift endlessly like the proverbial sands of time?

The task, as always, is formidable, yet I am comforted in my journey by the almost myopic single-mindedness of science. Indeed, my mantra can be summed up in a simple dictum -- one that's been drummed into the head of every aspiring reductionist: when legitimate theories are at odds, or even nonexistent, it's time to consider the harsh cruel facts. In other words, let the data speak.

The Impassioned Fight Over Grail Bragging Rights

Although fleeting mention of the holy grail cropped up in the astronomical literature before this date,[3] the true starting point was 1992, when the first results from NASA's Cosmic Background Explorer (COBE) satellite mission were announced. Oxford cosmologist Joseph Silk (then stationed at the University of California, Berkeley) called the observed ripples in

the cosmic microwave background (CMB) "the missing link,"[4] paving the way for untold grail references to follow. At the time, a leading astronomer on that mission, George Smoot (also of Berkeley), placed a sign on his office door that read, "Home of the Holy Grail" and added this caption to a now-famous COBE map, "Behold the Face of God,"[5] suggesting a link between the holy grail and the divinity that is none too surprising, given that a common definition of "holy" means "given or belonging to God." (The "grail," itself, was originally supposed to be a cup or dish used in a key religious ritual, but has since taken on metaphorical meaning, as we shall see.)

A year later, everything shifted, as University of Washington astronomer Craig Hogan spoke of the "halo grail," while referring to objects -- such as brown dwarfs, "degenerate dwarfs," and other compact remnants -- that make up the "dark halo" of our galaxy.[6] In one fell swoop, the holy grail had come home, so to speak, moving from a redshift ("z") of 1089 to z=0. In the process, galactic astronomers had usurped the "higher ground" from the cosmologists, contesting their long-held claim to the grail.

Then the free-for-all began. A solar neutrino experiment in Japan, ostensibly the domain of astrophysics, led one observer to speak of (yet-to-be-seen) evidence of proton decay, manifested by a distinctive pattern of Cerenkov radiation, as "'the Holy Grail' of particle physics."[7]

Two months later, cosmologists recaptured the grail as rightfully theirs in a discussion of the Hubble parameter (better known as the Hubble constant) which, at the time, had been **narrowed down** (emphasis added) to "somewhere between 40 and 100 on the odd-sounding scale of 'kilometers per second per megaparsec.'"[8]

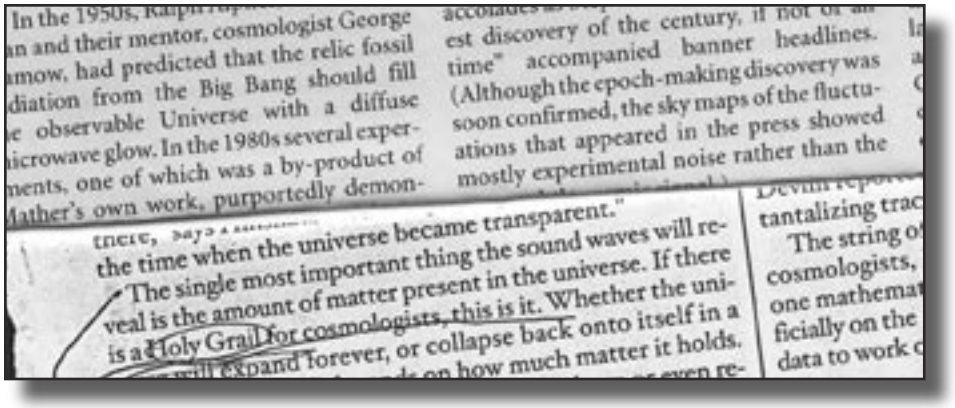
Planet watchers did not take this sitting down. Another two months later (might this be a special "grail transition interval"?), they claimed to have found the holy grail in the form of a "planet orbiting a sun-like star."[9] Geoff Marcy, also of Berkeley (might this venue, like "Area 51," be another connection as well?), clarified this several years later in a 2000 interview for the *Berkeleyan*, presumably a campus newspaper: the discovery of two planets about the size of Saturn, he claimed, "is like finding the Holy Grail of astronomy."[10] The definition narrowed two years later, once again demonstrating the ineluctable power of two (two months, two years, etc.): the holy grail was then called "a true analog of our Solar System, complete with Earth-like planets."[11]

The Transitory Grail Period

So it might appear the matter was settled at the dawn of the 21st century. But nothing could be further from the truth. The European Southern Observatory, speaking in 2001 through its official mouthpiece, made a bold, though controversial statement: "Most astronomers would agree that the age of the Universe -- the time elapsed since the 'Big Bang' -- is one of the 'holy grails of cosmology.'"[12]

But did they agree? Far from it. A strong riposte was offered a year later: "If there's a holy grail in astronomy, it's to understand how the universe evolved from the Big Bang into what we see today."[13]

Another two months passed before Dale Doeleman of Haystack Observatory averred that locating the point at which jets (of high-speed particles emitted by active galactic nucleii) turned on was itself the long-sought "Holy Grail."[14]


In the 1950s, Ralph ... an and their mentor, cosmologist George ... amow, had predicted that the relic fossil ... diation from the Big Bang should fill ... e observable Universe with a diffuse ... icrowave glow. In the 1980s several exper- ... ments, one of which was a by-product of ... father's own work, purportedly demon- ... accolades ... est discovery of the century, if not of all ... time" accompanied banner headlines. ... (Although the epoch-making discovery was ... soon confirmed, the sky maps of the fluctu- ... ations that appeared in the press showed ... mostly experimental noise rather than the ... tnere, says ... the time when the universe became transparent." ... The single most important thing the sound waves will re- ... veal is the amount of matter present in the universe. If there ... is a Holy Grail for cosmologists, this is it. Whether the uni- ... will expand forever, or collapse back onto itself in a ... on how much matter it holds. ... even re- ... tantalizing trac ... The string o ... cosmologists, ... one mathema ... ficially on the ... data to work

Two months (an interval that is almost becoming tedious in its ubiquity) later, the "astronomical grail" was identified as the "discovery of any still-living Population III stars" -- in other words, the universe's first stars.[15]

The "holy grail of astronomy," as stated a shade less than two months later, was recast as "a pulsar in orbit around a black hole."[16] A concomittant claim suggested the grail would not be found in the vicinity of a black hole but rather in a specific polarization pattern in the CMB data betraying hints of primordial gravity waves.[17] Michael Turner (then at the University of Chicago and now at the National Science Foundation) concurred with this assessment: "Gravity waves are the real holy grail in all this," he said, calling their existence the next big test for the theory of inflation.[18]

The beat goes on, as two Californians once said, and that's certainly the case with the grail as well. Edward Bowell of the Lowell Observatory called the "re-sighting of Hermes" -- 66 years after it was last observed -- "the Holy Grail of near-Earth asteroid astronomy."[19] The trend here, as stated at the onset, is one of "specialization," with each of astronomy's

sub-fields claiming its own piece of the grail pie. Yet another new category to emerge, for example, is the "Holy Grail of extrasolar planet research."[20]

Neutrino astronomy, similarly, has its own grail, hidden in the postulated (though never seen) "cosmic neutrino background."[21] And that, I believe is a fitting note upon which to conclude this discussion, for that's exactly where the grail lies today: "postulated though never seen."

Concluding Remarks, Afterthoughts, and Second Thoughts

The balkanization of the holy grail -- like the spread of kudzu or the mass production of pocket universes in eternal inflation scenarios -- is not likely to stop. The search for "the Holy Grail of astronomy," to this observer, is almost guaranteed to fail. There may not be any grails to be had whatsoever, and if there is one, there are surely many.

The debate about the grail will persist for as long as people remain sentient creatures, as opposed to inert pieces of calcified rock. Various threads, a few of which were first uncovered in this analysis, will undoubtedly be explored in future studies: is "two" a statistically-significant number in grail evolution, like "lucky seven" in craps and "number nine" in Beatles lore? Is Berkeley a hotbed of grail activity, in addition to being a hotbed of leftist agitation and general rowdiness? The questions are many and the answers still scant, which perhaps is as it should be in this Holmesian mystery saga otherwise known as "The Strange Case of the Holy Grail."[22,23]

Notes

1. See, for example, "The Holy Grail Redux," Steve Nadis, *Annals of Improbable Research*, November/December 2001, vol. 7, no. 6, pp. 6-10, and "In Search of the Holy Grail." Steve Nadis, *Annals of Improbable Research*, March/April 1996, pp. 4-6.

2. I can't cite any official "source" for this statement, but trust me, it's true.

3. Hinted at (though not explicitly detailed) in the aforementioned "In Search of the Holy Grail," *Annals of Improbable Research*, March/April 1996, pp. 4-6.

4. "COBE Causes Big Bang in Cosmology," M. Stroh, *Science News*, vol. 141, May 2, 1992.

5. "Basking in the Cosmic Glow," William Plummer, *People Weekly*, vol. 37, no. 20, May 25 1992, pp. 105.

6. "In Search of the Halo Grail," Craig J. Hogan, *Nature*, vol. 365, October 14, 1993, pp. 602-3.

7. "'Super' Japanese Site Gears Up to Solve Neutrino Puzzle," author unknown, *Science*, vol. 270, November 3, 1995, p. 729.

8. "Cosmology: All Sewn Up or Coming Apart at the Seams?" Joshua Roth and Joel R. Primack, *Sky and Telescope*, vol. 91, no. 1, January 1996, pp. 20.

9. "Is This Planet for Real?" Robert Naeye, *Astronomy*, March 1996.

10. "Finding Worlds Like Our Own," Diane Ainsworth, *Berkeleyan*, October 18, 2000.

11. "All Our Suns," *Nature*, vol. 419, September 26, 2002, p. xi.

12. "How Old Is the Universe?" European Southern Observatory press release, February 7, 2001.

13. "A New View of the Cosmos," R.T., *Astronomy*, July 2002, p. 28.

14. "New Virtual Telescope Provides Sharpest Views of the Cosmos," Deborah Halber, MIT News Office, September 30, 2002.

15. "In Search of the First Star," David Tytell, SkyandTelescope.com, November 5, 2002.

16. "Arecibo Observatory Undergoing Major Changes," David Brand, Cornell News Office, December 20, 2002.

17. "Polarized Microwaves Bolster New Cosmology," Joshua Roth, *Sky and Telescope*, December 2002, pp. 20-1.

18. "The Results Are In," Michael Brooks, *New Scientist*, vol. 178, April 5, 2003, pp. 22-3.

19. "Near-Earth Asteroid Hermes Respotted," Edward Bowell, Lowell Observatory press statement, October 21, 2003.

20. "Seeking Other Earths," Robert Zimmerman, *Astronomy*, vol. 32, August 2004, p. 42.

21. Reference unknown; lost by the editor of this journal (though he is certain to deny it and cast blame elsewhere—on a surrogate, perhaps).

22. Sir Arthur Conan Doyle never wrote this mystery but surely would have had there been an additional installment in the Sherlock Holmes saga.

23. You can be sure I have much more to say on this subject, but my editor is kind of stingy when it comes to "word count." Fortunately, he tends to get tired by the end of a wearying article like this and, as a result, inattentive. If you are reading this note, you can be sure he never got this far. His loss is our gain.

AIR Teachers' Guide

Three out of five teachers agree: curiosity is a dangerous thing, especially in students. If you are one of the other two teachers, *AIR* and *mini-AIR* can be powerful tools. Choose your favorite h*AIR*-raising article and give copies to your students. The approach is simple. The scientist thinks that he (or she, or whatever), of all people, has discovered something about how the universe behaves. So:

- Is this scientist right -- and what does "right" mean, anyway?
- Can you think of even one different explanation that works as well or better?
- Did the test really, really, truly, unquestionably, completely test what the author thought he was testing?
- Is the scientist ruthlessly honest with himself about how well his idea explains everything, or could he be suffering from wishful thinking?
- Some people might say this is foolish. Should you take their word for it?
- Other people might say this is absolutely correct and important. Should you take their word for it?

Kids are naturally good scientists. Help them stay that way.