The Big Bang Theory--A Scientific Critique [Part I] [Whole]

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[EDITOR'S NOTE: This is the first in a three-part series of articles examining the concept of the origin of the Universe known as the Big Bang Theory. With the assistance of a number of credentialed physicists and astronomers, we have been working behind the scenes on this subject for the past several months. We deem it to be of such critical importance that we are devoting three entire issues of *Reason & Revelation* to it. In addition, as our regular readers no doubt already have noticed, this is a special double issue of **16 pages** (not counting the usual 4-page *Resources* section). The June issue also will be a double issue like this one.

On a separate but related note, regular readers of *Reason & Revelation* also will notice the addition of a new name—Branyon May—as one of the authors of this series of articles. Branyon, who is one of our extremely talented interns, is a physics major at Angelo State University in San Angelo, Texas. As a result of his background in physics, we gave him the assignment of researching and beginning the initial writing phases of this scientific critique of the Big Bang. He did a masterful job, and even after returning to school, continued his work with us to produce a series that we believe will be of immense value in helping people (especially high school and college-age students) understand what the Big Bang Theory advocates, the unbelievably tenuous assumptions upon which it is based, and how and why it is scientifically flawed. Branyon has prepared a "Galactic Glossary" to go with this issue, in order to assist readers with terminology with which they might not be familiar. I hope you enjoy, and profit from, this important series.]

INTRODUCTION

Where are you right now? Are you sitting down with a cup of hot tea, ready to enjoy the few brief moments you can devote just to yourself? **Where** are you? Are you somewhere other than in your armchair at home? Or are you even at home? And if you are, in what city? In what state? In what country? And on what continent?

Astronomically speaking, you are on the third planet from the Sun, in a solar system of nine other planets, only one of which—the one where you reside—sustains life. How? Why? These are intriguing questions worth pondering. And, most likely, this is not the first time you have considered them.

Throughout the whole of human history, people have contemplated not only their origin, but also their physical place in the Universe. The question of our ultimate origin weighs heavily on the human psyche. Science, to be sure, has brought its theories to bear on the subject. It is some of those theories that we would like to examine here. We invite you to join us, because such an investigation makes for a fascinating study.

Cosmology is the study of the Cosmos in all its aspects. The Cosmos, in simplest terms, is the space/mass/time Universe and all its arrays of complex systems. The cosmologist, whether under this title or not, has been around conceptually for centuries. Specifically, in the realm of science—as long as this term has been defined—we read about those of long ago such as Epicurus, Aristotle, and Copernicus, who sought answers to what they saw in the heavens. More recently in scientific history, we have people like Isaac Newton (1642-1727), Johannes Kepler (1571-1630), Willem de Sitter (1872-1934), Albert Einstein (1879-1955), Edwin Hubble (1889-1953), Georges Lemaître (1894-1966), Aleksandr Friedman (1889-1925), and George Gamow (1904-1968), each of whom made major contributions to understanding various theories and physical laws.

Nowadays, the scientific community includes numerous contributors of varying degrees. **Many viewpoints**, however, by no means implies **correct beliefs**. So, let us travel together down this road of cosmological descent—from the long-defunct Cartesian Hypothesis to modern versions of the Big Bang—and examine several of these theories in light of the scientific knowledge now available to us. As we proceed, let us heed the warning of the late, eminent cosmologist, Sir Fred Hoyle (1915-2001), and his colleague, Chandra Wickramasinghe, in their book *Evolution from Space*: "**Be suspicious of a theory if more and more hypotheses are needed to support it as new facts become available, or as new considerations are brought to bear**" (1981, p. 135, emp. added).

EVOLUTION OF A THEORY

The science of cosmology, as we know it today, began, not surprisingly, with a look into the nearest and most readily observable astronomical environment—our solar system. Due to the sizable number of theories regarding the origin of our solar system, we will review only those that were of primary importance in the grand historical panorama.

The Cartesian Hypothesis, set down by the seventeenth-century French physician, mathematician, and philosopher René Descartes (1596-1650) in his *Principles of Philosophy,* postulated that our solar system had formed from a vast system of vortices running spontaneously. Out of these vortices emerged stars, comets, and planets, each decaying into the next subsequent formation of matter, respectively. This particular conjecture did not sit well with some of Descartes' contemporaries, including Sir Isaac Newton, who made his disdain for Descartes' theory poignantly clear in a letter (penned on December 10, 1692) to evangelist Richard Bentley when he wrote: "The Cartesian hypothesis...can have no place in my system, and is plainly erroneous" (as quoted in Munitz, 1957, p. 212).

The next few hypotheses that flickered in history evolved their conceptual results from an initial rotating cloud of gas and/or dust known as a nebula. [Originally, the term "nebula" was applied to any distant object that appeared "fuzzy and extended" when viewed through a telescope; eventually, nebulae were identified as galaxies and star clusters.] Pierre S. Laplace (1749-1827), the distinguished French mathematician, presented his Nebular Hypothesis—a variation on the previously held hypotheses by Emanuel Swedenborg (1688-1772) and Immanuel Kant (1724-1804)—to the world in 1796. Laplace believed that, as the nebula rotated, it cooled and contracted, causing a discernible increase in rotational velocity, which eventually forced the matter that was located on the rim of the disc to overcome the gravitational attraction and be ejected from the cloud. The ejected matter then coalesced, forming a planet outside of the contracting nebula. This specific sequence of events continued until it formed a central portion of dense, rotating gases—what we know today as our Sun—and the outlying, orbiting planets (see Mulfinger, 1967, 4[2]:58). However, after failing a battery of mathematical and physical tests, these fanciful views ultimately were abandoned for the Planetesimal Hypothesis.

Heralded by T.C. Chamberlain (1843-1928) and F.R. Moulton (1872-1952), the Planetesimal Hypothesis started out with two initial stars, one of which was our Sun. The secondary star swept a near-collision path by the Sun, close enough to tear off two "arms" of matter on opposite sides. Over time, these arms coalesced to form planetesimals—tiny planets. This hypothesis followed in the footsteps of those that had preceded it (as well as a number of those yet to come) by failing to be scientifically accurate. Lyman Spitzer of Yale University demonstrated these failings: (1) the hot matter ripped from the Sun would not coalesce, but instead would continue to expand; and (2) one could not reconcile the angular momentum distribution of the solar system resulting from the interaction of the two passing stars (see Mulfinger, 4[2]:59-60).

The story of **modern** cosmology begins in the early parts of the twentieth century—a time when astronomers viewed the Universe as static, eternal, and limited in space to our own Milky Way Galaxy. Those views began to change in the early 1900s with the work of two American astronomers—Edwin Hubble and Vesto M. Slipher (1875-1969). Using one of the largest and most powerful telescopes available at the time, Hubble concluded that the Universe actually was much larger than just our galaxy. He determined that what were then known as "spiral nebulae," occurring millions of light-years away, were not part of the Milky Way at all, but rather were galaxies in their own right. [A light-year is the distance that light travels in a vacuum in one year—approximately 5.88 trillion miles. Distances expressed in light-years represent the time that light would take to cross that distance. For example, if an object were two million light-years away, it would require two million years, traveling at the speed of light, to traverse that distance.] Then, in 1929, Hubble reported a relationship between his distance information and some special analyses of light that had been carried out by Slipher (see Hubble, 1929).

Redshifts, Blueshifts, and Doppler Effects

In the decade spanning 1910-1920, Slipher (using a 24-inch, long-focus refractor telescope) had discovered the characteristic signature of atomic spectra in various far-flung galaxies. That discovery then led to another somewhat "unusual" finding. Examining a small sample of galaxies (which, at the time, were referred to as nebulae), he observed that the light frequencies those galaxies emitted were "shifted" toward the red portion of the spectrum (the concept of redshift is explained in detail below), which meant that they were receding from Earth. In 1913, Slipher reported the radial (or "line of sight") velocity of the Andromeda galaxy, and discovered that it was moving toward the Sun at a rate of 300 kilometers per second (see Slipher, 1913). This was taken as evidence in favor of the hypothesis that Andromeda was outside the Milky Way. [The Andromeda Galaxy is now considered a part of the "Local

Group," which is an assortment of around thirty nearby galaxies (including the Milky Way) that is bound together gravitationally.] In 1914, Slipher reported radial velocities of 13 galaxies, and all but two were visualized as redshifts. By 1925, Slipher had compiled a list of 41 galaxies, and other astronomers had added four additional ones. Of the total of 45, 43 showed a redshift, which meant that only two were moving toward the Earth (see Gribbin, 1998, p. 76), while all the others were moving away from us.

These were, by all accounts, extraordinary observations. Using a far more sophisticated instrument (specifically, a larger, short-focus telescope that was better suited for this type of work), Edwin Hubble made the same types of discoveries in the late 1920s after Slipher had turned his attention to other projects. This "galactic redshift," Hubble believed, was an exceptionally stunning cosmic clue—a shard of evidence from far away and long ago. Why, Hubble wondered, should galactic light be shifted to the red, rather than the blue, portion of the spectrum? Why, in fact, should it be shifted at all?

From the very beginning, many astronomers have attributed these shifts to what is known as the Doppler effect. Named after Austrian physicist Christian Johann Doppler (1803-1853) who discovered the phenomenon in 1842, the Doppler effect refers to a specific change in the observed frequency of any wave that occurs when the source and the observer are in motion relative to each other; the frequency **increases** when the source and observer **approach** each other, and **decreases** when they **move apart**. By way of summary, the Doppler effect says simply that wavelengths grow longer (redshift) as an object recedes from the viewer; wavelengths grow shorter (blueshift) as an object approaches the viewer (see Figure 1 below). [Color actually is immaterial in these terms, since the terms themselves apply to any electromagnetic radiation, whether visible or not. "Blue" light simply has a shorter wavelength than "red" light, so the use of the color-terms is deemed convenient.]

Click image for larger picture.

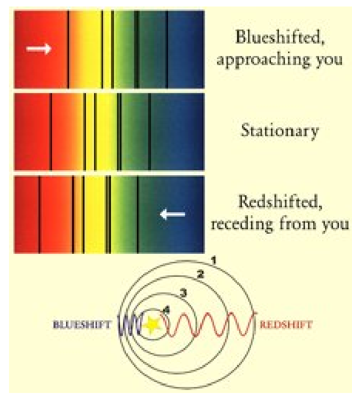

Figure 1 — Blueshift/Redshift Depiction

The light that we observe coming from stars is subject to the Doppler effect as well, which means that as we move toward a star, or as it moves toward us, the star's light will be shifted toward shorter (blue) wavelengths (viz., light that is emitted at a particular frequency is received by us at a higher frequency). As we move away from a star, or as it moves away from us, its light will be shifted toward longer (red) wavelengths (viz., light that is emitted at one frequency is received by us at a lower frequency). In theory then, a star's Doppler motion is a combination of both our motion through space (as the observer), and the star's motion (as we observe it). As it turns out, "the light from most galaxies exhibits a redshift roughly proportional to the galaxies' distance from us. Most cosmologists consider this pattern of redshifts to be evidence of cosmic expansion" (Repp, 2003, 39:270).

A word of caution is in order here. The Doppler effect, combined with the concepts of blueshift and redshift, can be somewhat confusing. It would be easy to assume that the expansion of the Universe is due solely to matter "flying through space" of its own accord. If that were true, then, of course, the Doppler effect would explain what is happening. But there is somewhat more to it than this. Cosmologists, astronomers, and astrophysicists suggest that the matter in the Universe is actually "at rest" with respect to the space around it. In other words, it is not the matter that is necessarily moving; rather, it is space itself that is doing the expanding. This means that, as space expands, whatever matter is present in that space simply gets "carried along for the ride." Thus, the particles of matter are not **really** moving apart on their own; instead, more space is appearing between the particles as the Universe expands, making the matter **appear** to move. Perhaps an illustration is appropriate here. [Bear with us; as you will see, the distinction that we are about to make has serious implications.]

More often than not, cosmologists use the example of a balloon to illustrate what they are trying to distinguish as "the true nature of the expanding Universe." Imagine, if you will, that someone has glued tiny shirt buttons to the surface of the balloon, and then commences to inflate it. As the balloon increases in size, the buttons will **appear to move** as they are carried along by the expansion of the balloon. But the buttons themselves are not actually moving. They are "at rest" on the balloon, yet are being "pushed outward" by the expansion of the medium around them (the latex of the balloon). Now, cosmologists suggest, compare this example to galaxies in space. The galaxies themselves can be "at rest" with respect to space, yet appear to be flying apart due to the expansion of the medium around them—space.

Almost all popular (and even most technical) publications advocate the view that the redshifts viewed in the expansion of the Universe are, in fact, attributable solely to the Doppler effect. But if it is true that the galaxies are actually at rest (although, admittedly, being "carried along" in an outward direction by the expansion of space itself, with its "embedded" galaxies), then the redshifts witnessed as a result of the expansion are not true Doppler shifts. To be technically correct, perhaps the galactic redshift should be called the “cosmological redshift.” On occasion, when the “perceived motion” of the galaxies (as opposed to “real motion”) is acknowledged at all, it sometimes is referred to as “Hubble flow.” One of the few technical works with which we are familiar that acknowledges this fact (and even provides different formulae for the Doppler expansion versus the Hubble flow expansion) is *Gravitation*, by Misner, Thorne, and Wheeler (1973; see chapter 29).

Interestingly, as we were in the process of researching and writing this material, physicist Andrew Repp of Hawaii authored a fascinating, up-to-date article on the nature of redshifts. In his discussion, Dr. Repp correctly noted that there are several known causes of redshifts (see Repp, 2003). One of the causes that he listed was the concept of “Hubble flow” expansion that we introduced above—which (again, interestingly) he labeled as “cosmological redshift” (39:271). As Repp remarked, this “expansion redshift” (a synonym for Hubble flow or cosmological redshift) “is caused by the expansion of space through which the wave is traveling, resulting in an ‘expansion’ (redshifting) of the wave itself.... [T]he expansion redshift would be the result of the motion of space itself.” Yes, it would—which is exactly the point we were making in the above paragraphs. And, as Repp went on to acknowledge concerning expansion redshift: “It is the commonly accepted explanation for the redshifts of the distant galaxies” (39:271). Yes, it is.

But that is not quite the end of the story. There is evidence to support the idea that the galaxies themselves may, in fact, **actually be moving**, rather than simply being “at rest” while being carried along by the expansion of space. The Andromeda Galaxy (known as M31), which is among our nearest neighboring galaxies, presents a light spectrum that is blueshifted. If the Universe is expanding, how could that be? Apparently, the **Doppler motion** is large enough blueward to negate the **cosmological redshift expansion**, thereby allowing us to view a galaxy that has a blueshift. The implication of this is that the galaxy itself must be moving.

What could be responsible for that? Some astronomers have suggested that such movement may be attributable to the localized forces of gravity. Galaxies are known to clump together into clusters that can contain anywhere from a few dozen to a few thousand galaxies. [Clusters of clusters are known as “superclusters.”] What holds these structures together? Presumably, it is gravity. That would imply that the objects composing the structures have orbits—which produce motion that are indeed Doppler in nature.

Andrew Repp expounded upon the concept we are discussing here under the title of “gravitational redshift” in his article reviewing the various causes of redshifts, and specifically mentioned that “the expansion redshift differs from the gravitational redshift” (39:272). Yes, it does. As Dr. Repp commented, whereas the expansion redshift is the result of the motion of space itself, “gravitational redshift is the result of...the effects of gravity on spacetime” (39:271).

That being true, the light spectrum of any given galaxy will exhibit shifts that are the result of **both** the Doppler effect (due to actual motion) and the “cosmological redshift” (expansion redshift/Hubble flow—due to perceived motion). And how would astronomers differentiate between the two? They wouldn’t; observationally, there is no way to do so—which means that no one can say with accuracy how much of each exists. In fact, as Repp once again correctly noted, the Big Bang Model does not allow for “large-scale pattern of gravitational attraction, the mass distribution being assumed homogeneous; hence it predicts expansion redshifts but not (large-scale) gravitational redshifts” (39:272, parenthetical item in orig.). In point of fact, however, the commingling of cosmological redshift and gravitational redshift may well be one of the reasons that the calculation of the Hubble constant (discussed below) has been so problematic over the years. And this is why we stated earlier that the important distinction being discussed in this section has serious implications (different values for the Hubble constant result in varying ages for the Universe).

According to the standard Doppler-effect interpretation then, a redshifted galaxy is one that is traveling farther away from its neighbors. Hubble, and his colleague Milton Humason (1891-1972), plotted the distance of a given galaxy against the velocity with which it receded. By 1935, they had added another 150 points to the expansion data (see Gribbin, 1998, p. 81). They believed that the rate at which a galaxy is observed to recede is directly proportional to its distance from us; that is, the farther away a galaxy is from us, the faster it travels away from us. This became known as “Hubble’s Law.” Today, the idea that redshift is proportional to distance is a crucial part of distance measurement in modern astronomy. But that is not all. The concepts of (a) **an expanding Universe**, and (b) **the accuracy of redshift measurements**, form a critically important part of the foundation of modern Big Bang cosmology. As David Berlinski put it: “Hubble’s law embodies a general hypothesis of Big Bang cosmology—namely, that the universe is expanding...” (1998, p. 34). One without the other is not possible. If one falls, both do. We will have more to say on this important point later.

Hubble and Humason’s work gave cosmologists clues to the size of the Universe and the movement of objects within it. But while **astronomers** were peering through their telescopes at the Universe,

theoretical physicists were describing that Universe in new ways. The first two models came from Albert Einstein and Willem de Sitter in 1917. Although they arrived at their models independently, both ideas were based on Einstein's General Theory of Relativity, and both scientists made adjustments to prevent expansion, even though expansion seemed a natural outcome of General Relativity. However, as knowledge about redshifts became more widespread, expansion was introduced as a matter of fact. [**Redshift** and **expansion** inevitably became the "twin pillars" upon which much of modern Big Bang cosmology was built. Interestingly, expansion itself also was built upon two pillars—**homogeneity** (matter is spread out uniformly) and **isotropy** (matter is spread out evenly in all directions). We will have more to say about all of this later, as well.] This was the case in 1922 with a set of solutions produced by Russian mathematician and physical scientist Aleksandr Friedman. Five years later, in 1927, the Belgian scholar Georges Lemaître produced a model incorporating a redshift-distance relation very close to that suggested by Hubble. If the Universe is expanding now, Lemaître calculated, then there must have been a time in the past when the Universe was in a state of contraction. It was in this state that the "primeval atom," as he called it, expanded to form atoms, stars, and galaxies. Lemaître had described, in its essential form, what is now known as the Big Bang, and scientists even today speak frequently of FL (Friedman-Lemaître) cosmology, which assumes the expansion of the Universe and its homogeneity (see Illingworth and Clark, 2000, p. 94).

THE STEADY STATE THEORY

But, we are getting ahead of ourselves. The most problematic liability of each of the aforementioned hypotheses was their inability to ultimately explain the **literal origin** of the Universe. Each sequence of events started out *in medias res* (in the middle of things). Admittedly, the most comfortable position for the evolutionist is the idea that the Universe is eternal, because it avoids the problem of a beginning. In fact, it was to avoid just such a problem that evolutionists Sir Fred Hoyle, Thomas Gold, and Hermann Bondi developed the Steady State Theory. In an attempt to avoid the conundrum of beginning *in medias res*, these three scientists decided to create their own loophole by simply removing the need for either a beginning or an end, and therefore assumed an eternal Universe. (This still did not change the fact that they were beginning in the middle of the sequence.) This also was a nice sidestepping tactic for philosophical questions such as "What came before the beginning?" and "What will come after the ending?" The Steady State Theory picks up in mid-cycle with the eternal Universe's expansion. In explaining the expansion, Hoyle invented fictitious points of spontaneous generation called "irtrons"—where hydrogen was manufactured **out of nothing** and spewed out into the Universe. Since two objects cannot occupy the same space at the same time, and since the newly created matter had to "go" somewhere, it simply pushed the already-existing matter farther into distant space. This replenishing "virgin" matter, which allegedly maintained the density at a steady state (thus the name of the model), had the amazing ability to condense into galaxies and everything contained within them—stars, planets, comets, and, ultimately, organic life.

When asked the question as to the origin of this matter, Hoyle replied that it was a "meaningless and unprofitable" pursuit (1955, p. 342). Astronomer Robert Jastrow, in his book, *Until the Sun Dies*, noted: "The proposal for the creation of matter out of nothing possesses a strong appeal to the scientist, since it permits him to contemplate a Universe without beginning and without end" (1977, p. 32). Yet, Dr. Jastrow had concluded just two pages earlier that "modern science denies an eternal existence to the Universe, either in the past or in the future" (p. 30). So, despite the "strong appeal" of the Steady State concept set forth by Hoyle, Gold, and Bondi, scientists nevertheless have acknowledged that "the specific theory they proposed fell into conflict with observation long ago" (Barrow, 1991, p. 46). First, empirical observations no longer fit the model—that is, we now know the Universe had a beginning (see Gribbin, 1986). Second, new theoretical concepts (to be discussed later) were at odds with the model. Third, it violated the first law of thermodynamics, which states that neither matter nor energy can be created or destroyed, but only conserved. Jastrow commented on this last point when he wrote:

> But the creation of matter out of nothing would violate a cherished concept in science—the principle of the conservation of matter and energy—which states that matter and energy can be neither created nor destroyed. Matter can be converted into energy, and vice versa, but the total amount of all matter and energy in the Universe must remain unchanged forever. It is difficult to accept a theory that violates such a firmly established scientific fact (1977, p. 32).

Unable to overcome these flaws, scientists "steadily" abandoned the Steady State Theory, and sought another theory to fill the void. They ended up turning back to the theory that had been proposed earlier by Georges Lemaître and the Russian-American physicist George Gamow—a theory that had been shoved aside hastily by the Steady State model only a few years prior.

THE BIG BANG THEORY

Now, re-enter the Big Bang hypothesis. While it was credited to Lemaître in his obituary, the eventual widespread acceptance of this hypothesis was due mainly to its leading constituent, Gamow. Even though it probably is not known widely today, the Big Bang—in its original "standard" form—actually came **before** the advent of the Steady State Theory and, ironically, was given its name (intended to be derogatory) by Hoyle as a result of a snide comment he made on a radio show for which he served as host (Fox, 2002, p. 65). In this section, we will discuss only the "standard" form of the Big Bang, leaving the discussion of the Big Bang's most recent variations for later.

In the beginning was the ylem...or so the theorists say. The "ylem"—an entirely hypothetical construct—was a primordial substance 10^{14} times the density of water, yet smaller in volume than a single proton. As one writer expressed it:

> Astonishingly, scientists now calculate that everything in this vast universe grew out of a region many billions of times smaller than a single proton, one of the atom's basic particles (Gore, 1983, 163:705).

The ylem (a.k.a. the "cosmic egg") was a "mind-bogglingly dense atom containing the entire Universe" (Fox, p. 69). [Where, exactly, the cosmic egg is supposed to have come from, no one quite knows; so far, no cosmic chicken has yet been sighted.] At some point in time, according to Big Bang theorists, the ylem reached its minimum contraction (at a temperature of 10^{32} Celsius—a 1 followed by 32 zeros!), and suddenly and violently expanded. Within an hour of this event, nucleosynthesis began to occur. That is to say, the light atoms we know today (e.g., hydrogen, helium, and lithium) had been manufactured in the intense heat. As the Universe expanded and cooled, the atoms started "clumping" together, and within a few hundred million years, the coalescing "clumps" began to form stars and galaxies (see Figure 2 below). The heavier elements are assumed to have formed later via nuclear fusion within the cores of stars.

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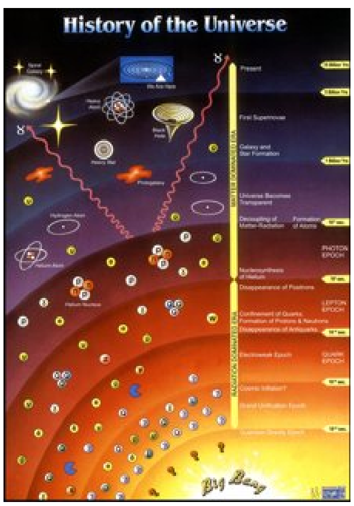


Figure 2 — Graphic representation of the alleged evolutionary origin of the Universe, from the Big Bang to the present, including the initial expansion phase, the production of matter, and galaxy formation. Courtesy of Center for European Nuclear Research (CERN), Geneva, Switzerland.

While the Steady State Theory had been widely accepted for more than a decade after its introduction, 1948 also was a good year for the competing Big Bang Theory. The first boost came from George Gamow and Ralph Alpher (currently, distinguished professor of physics, Union College, Schenectady, New York). They applied quantum physics to see how the Big Bang could make hydrogen and helium (plus minute amounts of lithium)—the elements thought to form 99% of the visible Universe—in a process called nucleosynthesis (see Gribbin, 1998, pp. 129-134). However, their theory was unable to account for elements heavier than helium; these would have to be made elsewhere. Geoffrey and Margaret Burbidge, Willy Fowler, and Fred Hoyle obliged—by suggesting that these other elements were manufactured in stars. To cap it all off, Fowler, Hoyle, and Robert Wagoner showed that the proportions of certain lighter-weight elements produced during the Big Bang matched almost exactly the proportions thought to exist in the solar system. This result, published in 1967, convinced many astronomers that the Big Bang was the correct description of the Universe's origin.

A decade later, the Big Bang was in full bloom. Robert Jastrow of NASA parroted the standard Big Bang refrain when he commented that, in the beginning, "all matter in the Universe was compressed into an infinitely dense and hot mass" that exploded. Then, over the many eons that followed, "the primordial cloud of the Universe expands and cools, stars are born and die, the sun and earth are formed, and life arises on the earth" (1977, pp. 2-3). With these statements, he was describing, of course, the essence of the Big Bang Theory, a concept that reigns supreme—in one form or another—as the current evolutionary explanation of the origin of the Universe. Berlinski assessed the theory's popularity as follows:

> As far as most physicists are concerned, the Big Bang is now a part of the structure of serene indubitability created by modern physics, an event undeniable as the volcanic explosion at Krakatoa. From time to time, it is true, the astrophysical journals report the failure of observation to confirm the grand design. It hardly matters. The physicists have not only persuaded themselves of the merits of Big Bang cosmology, they have persuaded everyone else as well (1998, p. 29).

Well, not quite everybody. It is true, of course, that cosmologists cling tightly to what they view as such a seemingly cohesive theory as the Big Bang. Princeton physicist Paul Steinhardt admitted:

> An expanding universe, the microwave background radiation [discussed later—BT/BH/BM] and nucleosynthesis—these are the three key elements of the Big Bang model that seem to be very

> well verified observationally. They set a standard for any competing model (as quoted in Peterson, 1991, 139:232).

Truth be told, however, none of these concepts is without its own set of problems, and as a result, many scientists have acknowledged a number of critical flaws in the scenario you have just read. Hoyle stated the matter quite succinctly when he wrote:

> As a result of all this, the main efforts of investigators have been in papering over holes in the big bang theory, to build up an idea that has become ever more complex and cumbersome. ...**I have little hesitation in saying that a sickly pall now hangs over the big bang theory**. When a pattern of facts becomes set against a theory, experience shows that the theory rarely recovers (1984, 92:[5]:84, emp. added).

It is the view of many that the standard Big Bang not only **has not yet recovered**, but, in fact, **never will recover**. While that form of the Big Bang Theory has been in vogue throughout almost the whole of the scientific community, it nevertheless has fallen on hard times of late. [Revisions and variations of the Big Bang that still remain popular today will be discussed later.] As long ago as 1981, prominent astrophysicist Jayant Narlikar remarked:

> These arguments should indicate to the uncommitted that the big-bang picture is not as soundly established, either theoretically or observationally, as it is usually claimed to be—astrophysicists of today who hold the view that "the ultimate cosmological problem" has been more or less solved may well be in for a few surprises before this century runs out (91:21).

Only two years later, evolutionist Don Page wrote: "There is no mechanism known as yet that would allow the Universe to begin in an arbitrary state and then evolve to its present highly ordered state" (1983, 304:40). Three years after that, renowned cosmologist John Gribbin reiterated the point when he wrote of the Big Bang Theory that "many cosmologists now feel that the shortcomings of the standard theory outweigh its usefulness..." (1986, 110[1511]:30). A decade-and-a-half later, one scientist, writing under the title of "The Bursting of the Big Bang," admitted that "while few people have seen the obituary...**the reality is that the immensely popular Big Bang Theory is dead**.... The Big Bang cannot explain the nature of the universe as we know it" (Lindsay, 2001, emp. in orig.). Berlinski, in "Was There a Big Bang?," wrote: "If the evidence in favor of Big Bang cosmology is more suspect than generally imagined, its defects are far stronger than generally credited" (1998, p. 37). Oh, how true. As it turns out, Narlikar, Page, Gribbin, and Lindsay were all correct. Scientists who advocated the Big Bang **were** in for "a few surprises." The standard Big Bang Theory **has** "outweighed its usefulness." And, yes, "the immensely popular Big Bang Theory **is** dead." Keep reading to find out why.

SCIENTIFIC REASONS WHY THE BIG BANG THEORY CANNOT BE CORRECT

When one steps away from all the Big Bang propaganda, and carefully examines the foundation on which the concept itself rests, there is legitimate reason for concern. The theory, it appears, is haphazardly nestled on, and teeters on the brink of, some incredible assumptions—"incredible" in that each unstable assumption is built on top of another equally volatile supposition. It seems that, as this stack mounts, each subsequent assumption casts a shadow that hides from public view the visible uncertainties of the preceding one. Like an onion, as each layer is stripped back, it leaves only another lachrymose layer to be viewed. The time has come to peel back several of those layers, and expose what lies beneath. The Big Bang, as it turns out, is scientifically flawed.

An article ("The Self-Reproducing Inflationary Universe") by famed cosmologist Andrei Linde in the November 1994 issue of *Scientific American* revealed that the standard Big Bang Theory has been "scientifically brain dead" for quite some time. Linde (who, by the way, is the developer of two closely related variations of the Big Bang, known as the chaotic and the eternal inflationary models) is a professor of physics at Stanford University. He listed half a dozen extremely serious problems with the theory—problems that have been acknowledged for years (yet sadly, not always in a widely publicized fashion). Linde began his obituary for the Big Bang by asking the following question:

What Was There Before the Bang?

Scientists have been extremely successful, thus far, at diverting attention away from the obvious question: Where did the original material for the Big Bang come from? That is to say, what came before the Big Bang? John Gribbin voiced the opinion of many when he wrote: "The biggest problem with the Big Bang theory of the origin of the Universe is philosophical—perhaps even theological—**what was there before the bang**?" (1976, 259:15-16, emp. added). David Berlinski, writing in *Commentary* magazine, concluded:

> Such is the standard version of hot Big Bang cosmology—"hot" in contrast to scenarios in which the universe is cold, and "Big Bang" in contrast to various steady-state cosmologies in which nothing ever begins and nothing ever quite ends. **It may seem that this archeological scenario leaves unanswered the question of how the show started and merely describes the consequences of some Great Cause that it cannot specify and does not comprehend** (1998, p. 30, emp. added).

It's not just that "it may **seem**" that the Big Bang Theory "leaves unanswered the question of how the show started." It's that it **does** leave such questions unanswered! Linde admitted that there is a chicken-and-egg problem involved here. In his *Scientific American* article, he noted:

> The first, and main, problem is the very existence of the big bang. **One may wonder, What came before?** If space-time did not exist then, how could everything appear from nothing? What arose first: the universe or the laws governing it? Explaining this initial singularity—where and when it all began—still remains the most intractable problem of modern cosmology (1994, 271[5]:48, emp. added).

Yes, "one may wonder." But that is not all about which one may wonder, as Linde pointed out later when he asked, "If there was no law, how did the Universe appear?" (as quoted in Overbye, 2001). British physicist Stephen Hawking asked:

> **What is it that breathes fire into the equations and makes a universe for them to describe?** The usual approach of science of constructing a mathematical model cannot answer the question of why there should be a universe for the model to describe.... Even if there is only one possible unified theory, it is just a set of rules and equations (1988, p. 174, emp. added).

In a chapter titled "Science and the Unknowable" in one of his books, humanist Martin Gardner followed Hawking's and Linde's lead:

> Imagine that physicists finally discover all the basic waves and their particles, and all the basic laws, and unite everything in one equation. We can then ask, "Why that equation?" It is fashionable now to conjecture that the big bang was caused by a random quantum fluctuation in a vacuum devoid of space and time. But of course such a vacuum is a far cry from nothing. **There had to be quantum laws to fluctuate. And why are there quantum laws?**...**There is no escape from the superultimate questions: Why is there something rather than nothing, and why is the something structured the way it is?** (2000, p. 303, emp. added).

British cosmologist John Barrow addressed the issue in a similar fashion when he wrote:

> At first, the absence of a beginning appears to be an advantage to the scientific approach. There are no awkward starting conditions to deduce or explain. **But this is an illusion. We still have to explain why the Universe took on particular properties**—its rate expansion, density, and so forth—at an infinite time in the past (2000, p. 296, emp. added).

Gardner and Barrow are correct. And science, as impressive as it is, cannot provide the solutions to such problems.

Entire Universes from Black Holes?

The eminent cosmologist Hannes Alfven has voiced his opinion that the ylem never could have attained the incredible density postulated by the Big Bang Theory (see Mulfinger, 1967, 4[2]:63). But what if it had? Astronomer Paul Steidl offered yet another puzzle.

> If the universe is such and such a size now, they argue, then it must have been smaller in the past, since it is observed to be expanding. If we follow this far enough backward in time, the universe must have been very small, as small as we wish to make it by going back far enough. This leads to all sorts of problems which would not even come up if scientists were to realize that time can be pushed back only so far; they do not have an infinite amount of time to play with.... To bring all the matter in the universe back to the same point requires 10 to 20 billion years. Astronomers postulate that at that time all the matter in the universe was at that one spot, and some explosion of unimaginable force blew it apart at near light-speeds. What was that matter like, and how did it get there in the first place? And how did it come to be distributed as it is now? These are the basic questions that cosmological models try to answer, but the solutions continue to be elusive. With the entire universe the size of a pinpoint,* normal physical laws as we know them must have been drastically different. There is no way scientists can determine what conditions would have been like under these circumstances. One could not even tell matter from energy. Yet astronomers continue to make confident assertions about just what went on during the first billionth of a second! (1979, p. 195).

Interestingly, at the place in Steidl's quote where you see the asterisk ("...with the universe the size of a pinpoint*..."), there was a corresponding asterisk at the bottom of the page, indicating a footnote that included this statement: "Question: **Why did the universe not become a black hole?**" (emp. added). Why not indeed? Or, as Gerardus Bouw wrote in an article titled "Cosmic Space and Time": "In order to save the Big Bang cosmology, are we to believe that the...physics of black holes does not work for the universe?" (1982, 19[1]:31). If all the matter and energy in the Universe were packed into a point "many billions of times smaller than a single proton," why would that not constitute a black hole? [NOTE: The reader who is interested in investigating further the concept of black holes (including whether or not they actually exist) may wish to read: (a) Hazel Muir's article, "Death Star," in the January 19, 2002 issue of *New Scientist;* and (b) "New Theories Dispute the Existence of Black Holes," (2002).]

Interestingly, some scientists actually have now begun to suggest that the Universe **did** evolve from a black hole. Lee Smolin, a professor of physics at Pennsylvania State University, suggested exactly that in his book, *The Life of the Cosmos: A New View of Cosmology, Particle Physics, and the Meaning of Quantum Physics* (1995). In a chapter titled "The Theory of the Whole Universe" that he authored for John Brockman's book, *The Third Culture*, Dr. Smolin discussed his view of what he refers to as "cosmological natural selection."

> It seemed to me that the only principle powerful enough to explain the high degree of organization of our universe—compared to a universe with the particles and forces chosen randomly—was natural selection itself. The question then became: Could there be any mechanism by which natural selection could work on the scale of the whole universe?
> Once I asked the question, the answer appeared very quickly: the properties of the particles and the forces are selected to maximize the number of black holes the universe produces. ...[A] new region of the universe begins to expand **as if from a big bang, there inside the black hole**.... I had a mechanism by which natural selection would act to produce universes with whatever choice of parameters would lead to the most production of black holes, since a black hole is the means by which a universe reproduces—that is, spawns another (1995, p. 293, emp. added).

Immediately following Smolin's chapter in *The Third Culture*, cosmologist Sir Martin Rees (Britain's Astronomer Royal) offered the following invited response:

> Smolin speculates—as others, like Alan Guth, have also done—that inside a black hole it's possible for a small region to, as it were, sprout into a new universe. We don't see it, but it inflates into some new dimension.... What that would mean is that universes which can therefore produce lots of black holes, would have more progeny, because each black hole can then lead a new universe; whereas a universe that didn't allow stars and black holes to form would have no progeny. Therefore Smolin claims that the ensemble of universes may evolve not randomly but by some Darwinian selection, in favor of the potentially complex universes.
> My first response is that we have no idea about the physics at these extreme densities, so we have no idea whether the physics of the daughter universe would resemble that of the parent universe. But one nice thing about Smolin's idea, which I don't think he realized himself in his first paper, is that it's in principle testable....
> The bad news is that I don't see any reason to believe that our universe has the property that it forms more black holes than any other slightly different universe. There are ways of changing the laws of physics to get **more** black holes, so in my view there are arguments **against** Smolin's hypothesis. It's just everyday physics, or **fairly** everyday physics, that determines how stars evolve and whether black holes form and I can tell Smolin that our universe doesn't have the properties that maximize the chance of black holes. I could imagine a slightly different universe that would be even better at forming black holes. If Smolin is right, then why shouldn't our universe be like that? (as quoted in Smolin, 1995, pp. 298,299, emp. in orig.).

The essence of Sir Martin's question—"If Smolin is right, why shouldn't our universe be like that?"—applies to more than just Dr. Smolin's particular theory. It applies across the board to any number of theories: "If ____ is right, why shouldn't our universe be like ____?" Which is exactly one of the points we are trying to get across. The simple fact is, in many of these "off the wall" theories, the Universe **is not** "like that." In commenting on Smolin's ideas, Berlinski wrote:

> **There is, needless to say, no evidence whatsoever in favor of this preposterous theory**. The universes that are bubbling up are unobservable. So, too, are the universes that have been bubbled up and those that will bubble up in the future. Smolin's theories cannot be confirmed by experience. Or by anything else. What law of nature could reveal that the laws of nature are contingent?
> **Contemporary cosmologists feel free to say anything that pops into their heads**. Unhappy examples are everywhere: absurd schemes to model time on the basis of the complex numbers, as in Stephen Hawking's *A Brief History of Time*; bizarre and ugly contraptions for cosmic

> inflation; universes multiplying beyond the reach of observation; white holes, black holes, worm holes, and naked singularities; theories of every stripe and variety, all of them uncorrected by any criticism beyond the trivial. The physicists carry on endlessly because they can (1998, p. 38, emp. added).

"Carrying on endlessly," unfortunately, has not helped matters. Once again, keep reading.

Redshift and Expansion Problems

As we mentioned earlier, the twin ideas of (a) **the accuracy of redshift measurements** and (b) **an expanding Universe** form a critically important part of the foundation of modern Big Bang cosmology. As late as 1979, scientists were shocked to learn that two of the methods that had been used to derive many of their measurements regarding ages and distances within the Universe—the Hubble constant (see next paragraph) and redshift measurements (to be discussed shortly)—were in error.

The value of the Hubble constant (H_0 —the constant of proportion between relative velocity and distance that is used to calculate the expansion rate of the Universe) is expressed in kilometers per second per megaparsec [one parsec equals just a little over 3 light-years (3.2616 to be exact); a megaparsec (Mpc) is one million parsecs]. Initially, the Hubble constant was set by Hubble himself at around 500 km/sec/Mpc (Hubble, 1929). Since then, it has been revised repeatedly. In fact, of late, astronomical theory has run headlong into a series of nasty problems regarding the continued recalibration of the so-called Hubble **constant**. Observe the following in table form (adapted from DeYoung, 1995).

In an article he wrote on "The Hubble Law," physicist Don DeYoung noted:

> **The Hubble constant cannot be measured exactly, like the speed of light or the mass of an electron. Aside from questions about its possible variation in the past, there is simply no consensus on its value today**....
> Today there are two popular competing values for the Hubble constant. A smaller value of about *H* = 50 is promoted by Allan Sandage, Gustav Tammann and colleagues. This constant results in a universe age of about 19.3 billion years. A larger value, *H* = 100, is preferred by many other astronomers: Gerard de Vaucouleurs, Richard Fisher, Roberta Humphreys, Wendy Freedman, Barry Madore, Brent Tully and others. The *H* = 100 value gives a universe age half that of Sandage, "just" 9 billion years or less, depending on the gravity factor used (1995, 9[1]:9, emp. added).

DeYoung was correct when he suggested in regard to the Hubble constant that "there is simply no consensus on its value today." Gribbin, in his book, *In Search of the Big Bang*, remarked concerning the disagreement between the two camps specifically mentioned by DeYoung (Sandage, et al., and Vaucouleurs, et al.): "Neither seems willing to budge" (1998, p. 188). Little wonder. As Gribbin also observed: **"Hubble's constant is the key number in all of cosmology**. Armed with an accurate value of *H* and redshift measurements, it would be possible to calculate the distance to any galaxy" (pp. 187-188, emp. added).

But "an accurate value of *H*" has thus far eluded astronomers, cosmologists, and physicists. Based on measurements of 20 Cepheid variable stars from the Virgo Cluster of galaxies, the Hubble constant has been measured at 80 km/sec/Mpc (see Freedman, et al., 1994; Jacoby, 1994). [Assuming that the Big Bang theory for the origin of the Universe is correct, that would correspond to an age of the Universe of about 8 billion years.] Yet, as DeYoung pointed out, another group of astronomers, led by Allan Sandage, has claimed that the Hubble constant should be set at about 50 km/sec/Mpc (see Cowen, 1994), which (depending on the application of various correction factors) would make the Universe somewhere in the range of 13-20 billion years old (Travis, 1994).

Still another group of astronomers has argued that astronomical theories would require a Hubble constant of 30 km/sec/Mpc (Bartlett, et al., 1995). As of this writing, according to data from NASA's Wilkinson Microwave Anisotropy Probe [WMAP] (as reported in an article, "Turning a Corner on the New Cosmology," in the May 2003 issue of *Sky and Telescope*), the latest value for the Hubble constant has been set at 71 +/- 4 km/sec/Mpc, yielding an age for the Universe of 13.7 billion years (see MacRobert, 105[5]:16-17). Well-known astronomer Halton Arp (discussed below) has referred to what he calls the continuing "soap opera of conflicting claims about the value of the Hubble constant" (1999, p. 234), and commented that numerous "corrections" frequently are required to make the available data "fit" (p. 153).

Christopher DePree and Alan Axelrod admitted: "Actually the precise value of H_0 is the subject of dispute" (2001, p. 328). That is a mild understatement, since the current value of the Hubble constant varies between 50 and 75 km/sec/Mpc (see Cowen, 1994; Illingworth and Clark, 2000, p. 198). [It is important to understand that the value of the Hubble "constant" is not a trivial matter. As DePree and

Axelrod went on to note: "A different Hubble constant gives the universe a different age" (p. 328). This, of course, is clearly evident from the data in Table 1 below.]

AUTHOR	PUBLICATION YEAR	HUBBLE CONSTANT	UNIVERSE AGE (billions of years)
Hubble	1929	500*	2
Harwit	1973 (p. 61)	75	9
Pasachoff	1992 (p. 366)	36	18
Gribbin	1993	26	25
Freedman	1994	65-99	8-12
Hawking	1994 (p. 46)	43	15
Kuhn	1994 (p. 556)	54	12
Matthews	1994	80	8
Ross	1994 (p. 95)	38	17
Schmidt	1994	64-82	10-12
Wolff	1994 (p. 164)	50	13
MacRobert	2003 (pp. 16-17)	71	13.7

Table 1 — Hubble constant values, 1929-2003. *The original value of the Hubble constant was not well defined because of scatter in the data (see Gribbin, 1998, p. 79, figure 4.1A). Estimates range from 320 to 600 km/sec/Mpc, but perhaps the most popular viewsets Hubble's initial estimate at around 500 km/sec/Mpc.

In the minds of some, one of the most significant problems facing Big Bang cosmology today has to do with the concept of **redshift**. Perhaps the easiest way to understand redshift is to imagine the sound coming from a siren on a fire engine. Once that fire engine passes, the pitch drops. The siren does not actually change pitch; rather, the sound waves of an **approaching** fire engine are made **shorter** by the approach of the sound source, where the waves of the **departing** fire engine are made **longer** by the receding of the sound source (see Figure 1). Light (or electromagnetic radiation) from stars or galaxies behaves in exactly the same manner. As we mentioned earlier, an approaching source of light or radiation emits shorter waves (relative to an observer). A receding source emits longer waves (again, relative to the observer). Thus, the radiation or light of a source moving **toward** an observer will be "shifted" toward the **blue** end of the wavelength scale. The radiation or light of a source moving **away** from the observer "shifts" toward the **red** end of the light spectrum. The amount of shift is a function of the relative speed. A body approaching or receding at a high speed will show a greater shift than one approaching or receding at a low speed.

Illingworth and Clark observed in regard to the Hubble constant: "The velocity can be measured accurately from the redshift in the galaxy's spectrum" (2000, p. 198). But what if the redshift measurements themselves are incorrect? That, by definition, would affect the Hubble constant, which in turn would alter the size and age estimates of the Universe, which in turn would impact cosmic evolution, etc.

Edwin Powell Hubble (image courtesy of California Institute of Technology)

The redshift controversy has been elucidated most effectively by American astrophysicist Halton Arp, currently at the Max Planck Institute for Astrophysics in Munich, Germany. Arp—who has been called "the world's most controversial astronomer" (Kaufmann, 1982)—has suggested that redshifts are not necessarily attributable to the Doppler effect (see Amato, 1986; Bird, 1987, pp. 5,8). Dr. Arp is difficult to dismiss; he worked with Edwin Hubble himself, and formerly was at the Mt. Palomar Observatory. He has studied the relationship between quasars (see definition below) and what he refers to as "irregular" galaxies, and, on the basis of his observations, has opposed the standard belief in the correlating relationship between an object's redshift and its velocity. In fact, Arp has found what he calls "enigmatic and disturbing cases," where two apparently connected objects that seem to be the same distance away, actually have significantly different redshift values (see Sagan, 1980, p. 255; Arp, 1987; Cowen, 1990; Arp, 1999).


SEEING RED

ARP'S ANOMALIES

For example, by taking photographs through the big telescopes, Arp discovered that many pairs of quasars that have extremely high redshift values (and therefore are thought to be receding from us very rapidly—which means that they must be located at a great distance from us) are associated physically with galaxies that have low redshifts, and thus are thought to be relatively close. Dr. Arp has produced extremely impressive photographs of many pairs of high-redshift quasars that are located symmetrically on either side of what he proposes are their parent, low-redshift galaxies [See "Arp's Anomalies."]. These pairings, he suggests, occur much more frequently than the probabilities of random placement should allow. Mainstream astrophysicists have tried to explain away Arp's observations of connected galaxies and quasars as being "illusions" or "coincidences of apparent location." But, the large number of physically associated quasars and low-redshift galaxies that he has photographed and cataloged defies such an explanation. It simply happens too often. As Dr. Arp himself lamented: "One point at which our magicians attempt their sleight-of-hand is when they slide quickly from the Hubble, **redshift-distance** relation to **redshift velocity** of expansion" (as quoted in Martin, 1999, p. 217, emp. added). In his volume, *Seeing Red: Redshifts, Cosmology and Academic Science*, Arp wrote:

> But if the cause of these redshifts is misunderstood, then distances can be wrong by factors of 10 to 100, and luminosities and masses will be wrong by factors up to 10,000. **We would have a totally erroneous picture of extragalactic space, and be faced with one of the most embarrassing boondoggles in our intellectual history** (1999, p. 1, emp. added).

All of this means, of course, that the redshift may be virtually useless for calculating the recession speed of distant galaxies, and would completely destroy one of the main pillars of the expanding-Universe idea. Meteorologist Michael Oard noted:

> What if the redshift of starlight is unrelated to the Doppler effect, i.e., the principle that relative motion changes the observed frequency of the light emitted from a light source? Many of the deductions of mainstream cosmology would fold catastrophically (2000, 14[3]:39).

Astronomer William Kaufmann concluded in an article he wrote about Arp titled "The Most Feared Astronomer on Earth":

> If Arp is correct [about redshifts not being distance indicators—BT/BH/BM], if his observations are confirmed, he will have single-handedly shaken all modern astronomy to its very foundations. **If he is right, one of the pillars of modern astronomy and cosmology will come crashing down in a turmoil unparalleled since Copernicus dared to suggest that the sun, not the earth, was at the center of the solar system** (1981, 89[6]:78, emp. added).

Or, as Fox lamented:

> Redshifts are not, in and of themselves, a sign of a star's age or distance, and yet redshifts have become intrinsically entwined with how we determine not just the speed of any given object, but also how old and how far away it is. **If the interpretation of redshift is wrong, then all the proof that the universe is expanding will disappear. It would undermine everything that's been mapped out about the heavens**. Not only would the big bang theory come crashing down, but scientists wouldn't be able to determine how the nearest galaxy is moving, much less how the whole universe behaves (2002, p. 129, emp. added).

What is going on here? The history of this fascinating story actually harks back to the 1940s. But Arp's work has updated it considerably. Berlinski has told the tale well.

> At the end of World War II, astronomers discovered places in the sky where charged particles moving in a magnetic field sent out strong signals in the radio portion of the spectrum. Twenty years later, Alan Sandage and Thomas Mathews identified the source of such signals with optically discernible points in space. These are the quasars—**quasi stellar radio sources**. Quasars have played a singular role in astrophysics. In the mid-1960's, Maarten Schmidt discovered that their spectral lines were shifted massively to the red. If Hubble's law were correct, quasars should be impossibly far away, hurtling themselves into oblivion at the far edge of space and time. But for more than a decade, the American astronomer Halton Arp has drawn the attention of the astronomical community to places in the sky where the expected relationship between redshift and distance simply fails. Embarrassingly enough, many quasars seem bound to nearby galaxies. The results are in plain sight: there on the photographic plate is the smudged record of a galaxy, and there next to it is a quasar, the points of light lined up and looking for all the world as if they were equally luminous.
> These observations do not comport with standard Big Bang cosmology. If quasars have very

> large redshifts, they must (according to Hubble's law) be very far away; if they **seem** nearby, then either they must be fantastically luminous or their redshift has not been derived from their velocity.... But whatever the excuses, a great many cosmologists recognize that quasars mark a point where the otherwise silky surface of cosmological evidence encounters a snag (1998, pp. 32-33, emp. and parenthetical item in orig.).

That "snag" is what Halton Arp's work is all about. Compounding the problem related to the quasars is the concept of what might be termed "premature aging." Cosmologists now place the Big Bang event at 13.7 billion years ago (see Brumfiel, 2003, 422:109; Lemonick, 2003, 161:45), **and the beginnings of galaxy formation somewhere between 800,000 to 1,000,000 years after that** (Cowen, 2003, 163:139). Hence, radiation coming from an object 13 billion light-years away supposedly began its journey approximately a billion years after the Big Bang, when the object was somewhat less than a billion years old. Such distant objects should show relatively few signs of development, but observations within the last decade have threatened such concepts. For example, the Röentgen Satellite found giant clusters of quasars more than 12 billion light-years away (Cowen, 1991a), and astronomers have detected individual quasars at 12-13 billion light-years away (Cowen, 1991b; 2003).

The problem is that quasars—those very bright, super-energetic star-like objects—are thought to have formed **after** their hypothetical energy sources and resident galaxies had emerged. Hence, very distant quasars and quasar clusters represent **too much organization too early in the history of the Universe**. This is indeed problematic. As one scientist put it, the Big Bang theorist suddenly "finds himself in the position of a cement supplier who arrives after the house is already built" (Major, 1991, 11:23).

In the January 31, 1997 issue of *Science*, Hans-Dieter Radecke wrote that modern cosmology's dependence on "interpretations of interpretations of observations" makes it essential that "we should not fall victim to cosmological hubris, but stay open for any surprise" (275:603). Good advice, to be sure. And six years after he made that comment, those "surprises" began. The March 1, 2003 issue of *Science News* reported several "surprises" that "do not comport with standard Big Bang cosmology" (to use Berlinski's words). First, astronomical research indicates that

> a surprising number of galaxies grew up in a hurry, appearing old and massive even when the universe was still very young. If this portrait of precocious galaxies is confirmed by larger studies, astronomers may have to revise the accepted view of galaxy formation.... In mid-December [2002], scientists announced in a press release that they had found a group of distant **galaxies that were already senior citizens**, chockablock with elderly, red stars a mere 2 billion years after the Big Bang. The same team found another surprise. **Some of those galaxies were nearly as large as the largest galaxies in the universe toda**y (Cowen, 2003, 163:139, emp. added).

Talk about "premature aging"!

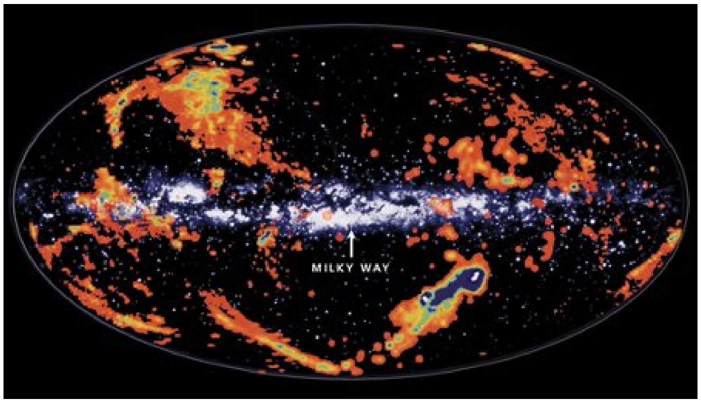
Second, on January 7, 2003, another team of scientists reported that it had found "the oldest, and therefore most distant, galaxy known. If confirmed, the study indicates that some galaxies were in place and forming stars at a prolific rate when the universe, now 13.7 billions years old, was just an 800-million-year-old whippersnapper" (Cowen, 163:139).

Third,

> at a galaxy-formation meeting in mid-January [2003] in Aspen, Colorado, [Richard] Ellis [of the California Institute of Technology in Pasadena] reported other evidence that the 2-billion-year-old universe was populated with as many galaxies marked by red, senior stars as by blue, more youthful stars.... **If accurate, this new view of galactic demography might force astronomers to rethink the fundamentals of galaxy formation** (Cowen, 163:140, emp. added).

Talk about "cosmological evidence encountering a snag"! What an understatement. A number of astronomers, of course, have preferred to simply ignore work like Arp's, which "does not comport" with standard Big Bang cosmology. "Others," wrote Berlinski, "have scrupled at Arp's statistics. Still others have claimed that his samples are too small, although they have claimed this for every sample presented and will no doubt continue to claim this when the samples number in the billions" (p. 33). Sadly, because Arp's views do not come anywhere close to supporting the status quo, he even has been denied telescope time for pursuing this line of research (see Gribbin, 1987, Marshall, 1990). [As William Corliss commented (somewhat sarcastically) in discussing this issue: "Some astronomers, according to news items in scientific publications, have heard enough about discordant redshifts and would rather see scarce telescope time used for other types of work" (1983).] If Dr. Arp is correct, however (and there is compelling evidence to indicate that he is—see next paragraph), then the Universe is not acting in a way that is consistent with the Big Bang Theory.

Support for Arp's conclusions arrived in the form of research performed by another American—I.E. Segal—a distinguished mathematician who also happens to be one of the creators of modern function theory, and who is a member of the National Academy of Sciences. He and his coworkers studied the evidence for the recessional velocities of galaxies over the course of a twenty-year period. The experimental results of their research, as it turns out, were quite disturbing to Big Bang theorists, because those results are sharply at odds with predictions made by Big Bang cosmology.



Our place in the Universe. This composite radio light image (as seen in visible light) illustrates the enigmatic "high-velocity clouds" of gas (depicted by the various colors) above and belowthe plane of the MilkyWay Galaxy (seen in white). Photo courtesy of NASA.

Galaxies, as everyone involved in cosmology readily acknowledges, are critical when it comes to verification (or non-verification, as the case may be) of Hubble's law, because it is by observing galaxies that the crucial observational evidence for the Big Bang must be uncovered. When Segal examined redshift values within various galaxies during his two-decade-long study,

> [t]he linear relationship that Hubble saw, Segal and his collaborators cannot see and have not found. Rather, the relationship between redshift and flux or apparent brightness that they have studied in a large number of complete samples satisfies a quadratic law, the redshift varying as the square of apparent brightness (Berlinski, 1998, pp. 33-34).

Segal concluded: "By normal standards of scientific due process, the results of [Big Bang] cosmology are illusory." He then went on to claim that Big Bang cosmology

> owes its acceptance as a physical principle primarily to the uncritical and premature representation [of the redshift-distance relationship—BT/BH/BM] as an empirical fact.... Observed discrepancies...have been resolved by a pyramid of exculpatory assumptions, which are inherently incapable of noncircular substantiation (as quoted in Berlinski, p. 33).

More than one cosmologist has dismissed Segal's claims (which, remember, are based on twenty-years' worth of scientific research) with what Berlinski called "a great snort of indignation." But, observed Berlinski, "the discrepancy from Big Bang cosmology that they reveal is hardly trivial" (p. 34).

Indeed, the discrepancy is "hardly trivial." As we noted earlier, the idea that the Universe is expanding is listed as one of the three main support pillars for Big Bang cosmology (see Fox, pp. 56,120). Both the **fact** of expansion, and the **rate** of expansion, have as part of their foundation the redshift values of stellar objects (specifically, galaxies)—redshift values that now are being called into question in a most rigorous manner by distinguished astronomers and mathematicians. Surely, it is evident that a serious re-evaluation of these matters is in order. Fox stated the relationship well when she wrote:

> Many...people strike at the very heart of the big bang theory: expansion. While, as mentioned earlier, an expanding universe doesn't require that the universe began with a bang, the big bang theory certainly requires an expanding universe. **If it turns out that galaxies and stars aren't receding from each other, then the entire theory would fall apart** (p. 126, emp. added).

Yes, it certainly would. But it gets worse. In his critique of the standard Big Bang Theory in *Scientific American*, Andrei Linde listed as number four in his list of six "highly suspicious underlying assumptions" (as he called them)—"the expansion problem."

> The fourth problem deals with the timing of the expansion. In its standard form, the big bang theory assumes that all parts of the universe began expanding simultaneously. **But how could**

> **the different parts of the universe synchronize the beginning of their expansion? Who gave the command?** (1994, 271[5]:49, emp. added).

Who indeed? George Lemaître, who originally postulated the idea of the Big Bang, suggested that the Universe started out in a highly contracted state and initially expanded at a rapid rate. The expansion slowed down and ultimately came to a halt, during which time, galaxies formed and gave rise to a new expansion phase that then continued indefinitely. One of the difficulties here is that the Universe is supposed to be all there is. That is to say, it is self-contained. [The late astronomer of Cornell University, Carl Sagan, opened his television extravaganza *Cosmos* (and his book by the same name) with these words: "The Cosmos is all that is or ever was or ever will be" (1980, p. 4). That is about as good a definition of a "self-contained" Universe as you will ever be able to find.]

But, "somehow," the expansion conveniently started moving again, after the galaxies had time to form in a non-moving, static Universe. According to Newton's first law of motion, however, an object will continue in whatever state of motion it is in, unless acted upon by an unbalanced external force. In other words, if it were sitting still, it would have to remain like that (meaning—no further expansion!). But in the Big Bang, the Universe just "picks up" and continues to expand after the galaxies finally get formed. Sir Fred Hoyle, addressing this very point, put it succinctly when he referred to the Big Bang model as a

> dull-as-ditchwater expansion which degrades itself adiabatically [without loss or gain of heat —BT/BH/BM] until it is incapable of doing anything at all. The notion that galaxies form, to be followed by an active astronomical history, is an illusion. Nothing forms; the thing is dead as a doornail (1981, 92:523).

Ouch!

The idea of a "brief hiatus" of sorts for galaxy formation is one of those *ad hoc*, quickly improvised hypotheses that had to be added to keep the Big Bang Theory alive. There certainly is no physical basis for it—which was what Dr. Hoyle's "dull as ditchwater" comment was intended to reflect. A "bang" does not allow for starts and stops. Once a bomb goes off, an observer hardly expects gravitation to cause the shrapnel to come back together and form clumps, no matter how near (or far) the pieces travel from the location of the initial explosion.

[to be continued]

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No one outside of our offices knows just **how much** "assistance" these individuals actually provided. But my staff and I know. And we would like to not only acknowledge the invaluable input of these men, but also offer our sincere thanks in a public fashion within the pages of *Reason & Revelation*.

In the space available here, it would be impossible to list by name everyone who has assisted us in the production of these special issues on the Big Bang. However, even though we run the risk of omitting some who should be mentioned, Dr. Harrub, Branyon, and I nevertheless want to express our gratitude to the following men.

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