# The making of a paradigm

A Review of
*Big Bang, the Origin of the Universe*
*by Simon Singh*
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Singh writes about the history and development of a religious paradigm—knowing the details helps us to understand the mind of those mortals who aspire (even unknowingly) to replace God and His history with their own 'designer truth'. It also teaches us the lesson of presupposing we can know truth without the One Who has revealed it all. This in turn helps us, as creationists, to answer those who ask of the hope we have in this 'so-called' age of science.

Singh writes in a clear, informative style describing the development of the big bang cosmological theory, which is believed by most of the present secular scientific community. He starts with the ancient Greeks, and chronologically works his way through most of the players who have been involved in developing our understanding of the cosmos. He also looks at the understanding developing from the size scale of the earth, through the solar system and the galaxy, to the universe as a whole. He provides many personal details of the people involved and their personalities. The book is well researched and details a very interesting and fascinating history, provided the reader keeps in mind the author's strong bias. Singh presents science as the eventual victor over Scripture, which he asserts cannot be trusted for scientific truth. Instead, for him, man is the ultimate determinant of the truth of the origin of the universe and all things in it, living and non-living.

## Paradigms, science and the Bible

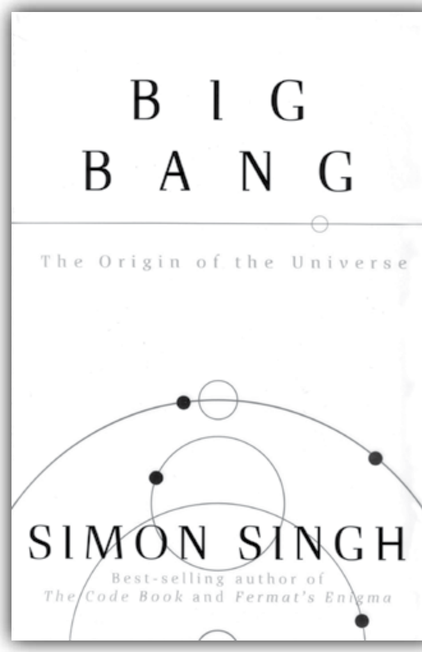
When discussing the problem of the anomalous precession of the perihelion of the planet Mercury, supposedly due to the presence of unseen 'dark' matter, but solved by the development of Einstein's general theory of relativity, Singh says when 'a new theory overturns an old one, the old theory has to be abandoned and what remains of the scientific framework has to be reconciled with the new theory' (p. 126). In the case in question, Newtonian mechanics could not explain the discrepancy, but general relativity could. However, the old scientists were reluctant to accept the new theory, which is symptomatic of the power of a paradigm. Singh however falls into the same trap himself—where the big bang theory has been shown to falter he makes no mention. He is without a doubt a strong disciple, perhaps even of 'priestly status'. He speaks of the battle between Einstein and Newton (actually their physics), praising Einstein. However, he makes it personal and is very critical of Newton, but does admit, 'Newton made an unparalleled contribution to seventeenth-century science.'

Singh is very critical of those who take the Bible 'literally', his misinformed term for those who take the text according to its original grammatical and historical context.[1] He says early scientists were reluctant to question how the universe was created, even admitting,

> 'Modern notions of a godless big bang would have seemed heretical to eighteenth-century theologians, much as the sun-centred universe had offended the Inquisition back in the seventeenth-century' (p. 76).

He says the only question that was open for discussion was 'when'.

He condescendingly speaks of Kepler's 3992 BC and Ussher's Saturday 22 October 4004 BC date for




the beginning, again confusing biblical *interpretation* with biblical *authority*:

> 'While this may seem an absurdly literal interpretation of the Bible, it made perfect sense in a society that judged Scripture to be the definitive authority on the great question of creation … . However, the *scientific pressure* to question 4004 BC as the year of creation emerged strongly when Charles Darwin published his theory of evolution by natural selection' (p. 77) [emphasis added].

In Singh's revisionist historiography, since 'natural selection was a painfully slow mechanism', a concerted effort was made to 'date the age of the earth by scientific means, with the hope of establishing an age of millions or even billions of years' (p. 78). There it is: the presuppositional approach. Victorian geologists then estimated the age of the earth from the rate of sedimentation to be at least millions of years. Later developments included Lord Kelvin on cooling of the molten Earth and John Joly on sea salt accumulation, eventually increasing the age to a billion years. Finally, uniformitarians convinced the scientific community that Earth was more than one billion years old and the universe much more. He quotes Charles Lyell, stating the beginning of time was 'beyond the reach of mortal ken', and James Hutton, 'The result therefore of our present enquiry is, that we find no vestige of a beginning, no prospect of an end' (p. 79). In reality, the historical and logical order was the reverse of his claims. It was presupposition of denial of biblical authority, in particular the creation and Flood accounts, which led to long-age beliefs. Then this geological evolution led to biological evolution.[2]

### General relativity

In discussing Einstein and his role in developing his version of a cosmological model, Singh says, 'Einstein was not prepared to acknowledge a role for God in holding the universe apart'. Einstein believed in an eternal and static universe, therefore he added the famous 'cosmological constant'. He later dropped the cosmological constant when he heard of Hubble's discovery that the universe was expanding.

In 1922 Alexander Friedmann, a Russian mathematician, and independently in 1927 Georges Lemaître, developed the model that has become the current big bang cosmological model. Lemaître, a Belgian Catholic, maintained parallel careers as a physicist and a priest. Einstein was very quick to severely condemn both of these men, even accusing Friedmann of being mathematically wrong, and of Lemaître saying his mathematics were correct but his 'physics is abominable'. Einstein had to apologize to both, especially after Hubble's observations were made known.

The Friedmann–Lemaître model hinges on the 'cosmological principle', which states that the universe is homogeneous in composition, that is, regardless of where you observe from, on the large scale you see the same thing. That principle is believed today more by blind faith than by observation. Singh does not explore the problems of finding that, on the largest observed scales, the universe is not homogenous, but instead isotropic, i.e. we find ourselves at the centre of a spherical distribution of matter.

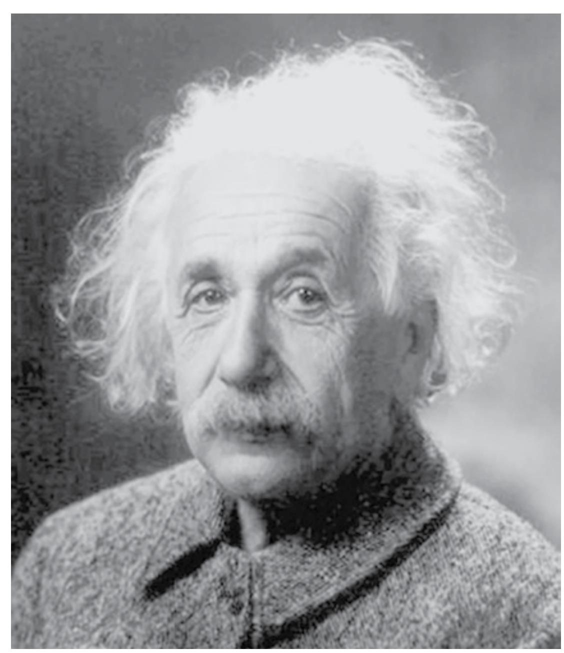
### Distance to galaxies

It was Immanuel Kant who suggested that what were then known as 'nebulae' were, in fact, independent galaxies. William Herschel believed that the Milky Way Galaxy was the whole universe. Many took the view that our galaxy was all there was, and it became a great debate. How to resolve this question became enormously important? Were the objects called nebulae really galaxies outside of our own, which meant the universe must be a whole lot larger.

In 1784, the deaf astronomer, John Goodricke, discovered that the eponymous Delta Cephei was variable. Its period is 5.36634 days. Prior to that, he first noticed, with the naked eye, that Algol was varying in brightness with a minimum every 68 hours 50 minutes. While Geminiano Montanari had previously noted Algol's variability in 1670, Goodricke proposed that the variability was due to one star circling another—what we now call an eclipsing binary. This won him the prestigious Copley medal from the Royal Society. He was just 18 years old. This medal was won three years earlier by William Herschel and later by Dmitri Mendeleev, Albert Einstein, James Watson and Francis Crick, to name a few. At the age of 21, Goodricke was made a Fellow of the Royal Society. But only 14 days later, he died of pneunomia, before learning of this award.

Then in 1874, Pigott observed Eta Aquilae varying in brightness and on 10 October Goodricke observed Delta Cephei, and the pattern was distinctly different from Algol. These single stars that varied in size—pulsated—and their period was related to their *intrinsic* brightness. These observations would ultimately help solve the great debate, determining the distances to our neighbouring galaxies.

Henrietta Leavitt, also deaf and a Christian volunteer at Harvard College Observatory, discovered[3] the distance scale that could solve the dilemma. She analyzed a type of variable stars, the yellow giant Cepheids, which oscillated in brightness with a regular period. In 1912, she discovered that the period depended on intrinsic luminosity (true brightness)—e.g. Cepheid with a three-day period is 800 brighter than the sun, while with a 30-day period Cepheid is 10,000 times brighter than the sun. These could provide the 'standard candles' needed to measure the distance to the nebulae. A team of astronomers including Harlow Shapley and Ejnar Hertzsprung used a combination of techniques including parallax to measure the distance to one Cepheid variable star—making Cepheids a 'yardstick' for the universe. Leavitt used the 25 she found in the Small Magellanic Cloud to measure their distance. Hubble then discovered



From Wikipedia.org

Einstein added his famous 'cosmological constant' to his early model to produce an eternal and static universe in order to remove a beginning and any role for God. He later dropped this constant when Hubble discovered that the universe was expanding.

the first Cepheid in M31, now known as the Andromeda galaxy, which proved its distance was greater than a million light-years.

In 1912 Vesto Slipher was the first to observe the redshift of spectral lines from a nebula, which he attributed to the Doppler Effect. Hubble measured the distance to nearby nebulae in the 1920s and proved they were independent galaxies. His findings propelled him into celebrity status as he resolved the great debate. Hubble heard of Slipher's discovery and the help of Humason, who measured the redshifts of the galaxies. Hubble determined conclusively that the galaxies (mostly) were speeding away from Earth. Furthermore, the greater the distance, the greater the redshift. This became known as the Hubble Law. The repercussions were immense—the big bang was seen as the origin, but neither Humason nor Hubble would speculate, promote or encourage any implications of a big bang. They wrote 'The writers are constrained to describe the "apparent velocity-displacements" without venturing on the interpretation and its cosmological significance.'

#### Nuclear physics of the big bang

The parallel development that was to aid the cosmologists was the progressive development of atomic and nuclear theory. Ernest Rutherford in the early 1900s developed his model of the atom. This replaced J.J. Thomson's 'plum pudding' model of protons and electrons embedded like a pudding. Friedrich Houtermans believed that a neutral particle with about the same mass as the proton existed, and proposed fusion of hydrogen nuclei to form helium nuclei in stars in a 1929 paper with Robert Atkinson. However, because of a lack of knowledge of the neutral particle's properties, he was not able to complete his theory. In 1932 James Chadwick discovered this neutral particle, the *neutron*, which led to physicists being able to understand atomic and nuclear structure and hence the cause of radioactivity. Hans Bethe finished off Houtermans' fusion theory, proposing an alternative route via an intermediary—carbon. These ideas were confirmed in the 1940s with the atomic bomb project, which gave a great boost to this area of theoretical physics development.

Lemaître believed the universe started in a single enormously dense, super-massive, primeval atom, which broke apart, forming the various nucleons—a top-down approach. George Gamow was a Ukrainian theoretical physicist who studied with Friedmann and escaped the Soviet Union in 1933. He adopted a bottom-up approach, suggesting the universe started as a compact soup of simple hydrogen atoms. Note the necessary starting assumption, well beyond the highly dense state of material nearer to the initial big bang, which started from the putative singularity. Gamow studied the processes proposed by Houtermans and Bethe but found the processes were far too slow for the stellar nucleosynthesis of helium from initially 100% hydrogen. He concluded though that most of the helium in stars must have been there at their formation, therefore it was created in the big bang. There was another problem; physicists could not explain the formation of elements in stars much heavier than helium. Gamow set about showing that the big bang was responsible for the nucleosynthesis of all the heavier elements.

Gamow was trying to calculate the reactions in the first few moments of the big bang, with rapidly evolving temperature and pressure conditions. This was a difficult task that was aided by his Ph.D. student Ralph Alpher, who used valuable data that was declassified after the end of the Manhattan Project (the first atomic bomb). Alpher was convinced they could accurately model the formation of helium in the first five minutes, a calculation that was consistent with measured abundances. Because Gamow was a close friend of Bethe, he couldn't resist the temptation to publish a paper with the authors Alpher, Bethe, and Gamow, a pun on the Greek letters α, β and γ, even though Bethe had contributed nothing to the paper. Alpher was not happy and feared being sidelined with these two famous names on a paper that would become one of the most important papers in the history of cosmology—now known as the Alpha-Beta-Gamma paper. However, they could not explain the creation of the heavier elements. The theory could not build nuclei heavier than 4 nucleons (a nucleon is a proton or neutron). The 5-nucleon nuclei were unstable and it seemed an insurmountable problem to the theorists.

#### Cosmic microwave background

Alpher was joined by Robert Herman to develop further their ideas on the early universe. They proposed the cooling universe would eventually reach a critical temperature where the nuclei (in a plasma sea) would capture electrons and form stable neutral atoms. This would happen at 3,000°C and about 300,000 years after the big bang—called the era of recombination. Light would then be free to travel unhindered through a transparent universe. This light would be released like an echo of the end of that plasma era, and should currently exist as a 'fossil'. This is the *cosmic microwave background* (CMB) radiation that Gamow had predicted with various temperatures ranging between 5 K and 50 K.

Critics had said that when Gamow and Alpher had performed their calculation that produced the abundance of helium in the universe, they knew the answer from measurements before they started. They were accused of fiddling the result—certainly it was not a prediction. However, the remnant fossil 'afterglow' of the big bang could not be classified as an *ad hoc* postdiction. Singh emphasizes that it was a prediction based solely on the big bang, and detecting it 'would provide powerful evidence that the universe really did start with a big bang' (p. 332). However, is that really true? It only follows if it is proven that there is no other possible cause, otherwise it commits the logical fallacy of *affirming the consequent*. Singh says:

'Anyone who could detect this so-called *cosmic microwave background* (CMB radiation) would prove that the big bang really happened. Immortality was waiting for whoever could make the measurement' (p. 333).

You see the type of religious fervour this attracts—here is man saying you can be as gods! Where have I heard that before?

### The rival: Steady State theory

Sir Fred Hoyle was a rebel cosmologist and Singh admits that he was a 'creative genius' and that he 'would make a huge contribution towards our understanding of the universe' (p. 337). Hoyle, with Thomas Gold and Hermann Bondi, developed the Steady State cosmological theory, a rival which challenged the big bang in the 1950s and '60s. It proposed an expanding universe, but because of the creation of new matter in the voids of space, the universe would always be observed to be the same regardless of the epoch of the observer—the perfect eternal universe.

Singh is very critical of Hoyle's obsessive questioning of orthodoxy. Singh says that many times:

'… he showed himself as a scientist out of his depth. Most notoriously, Hoyle denounced an archaeopteryx [sic] fossil as a forgery, and he also expressed serious doubts about Darwin's theory of evolution by natural selection. He wrote in the journal *Nature*: "The likelihood of the formation of life from inanimate matter is one to a number with 40,000 noughts after it … It is big enough to bury Darwin and the whole theory of Evolution"' (p. 350).

Singh claimed that comments from Hoyle like this damaged his standing, and that of the Steady State model. Word slinging/squabbling then ensued between the proponents of the Steady State and big bang models. However, Singh has the events out of sequence again. The Penzias and Wilson discovery of 1965 (see p. 7) was seen by many to kill the steady state theory, two decades before Hoyle started to attack chemical and biological evolution.[4] Bondi defended Hoyle's steady state theory, saying that an astronomical fact is only a 'smudge on a photographic plate!' It is well known, with some irony since he was its biggest critic, that Hoyle christened the big bang on a BBC radio show in 1950 using 'big bang' in a derisory comment.

### The Catholic Church capitulates

It was a sad day in the development of independent religious thought when Pope Pius XII, on 22 November 1951, endorsed the big bang as the scientific interpretation of the Genesis account. He claimed it as a proof for the existence of God. Since he had previously proclaimed evolutionary biology was not in conflict with the teachings of the church, the door was fully opened for the largest church organization in the world to embrace the billions of years of naturalistic molecules-to-man evolution. God was relegated to the starting 'first cause' and thereafter had nothing to do. This only infuriated Fred Hoyle, saying the big bang was a model built on Judeo-Christian foundations. Thomas Gold was also very critical, 'Well, the Pope also endorsed the stationary Earth' (p. 361). Interestingly, the Soviets who were about controlling truth, which is why Friedmann fled, could accept neither big bang nor Steady state models because both involved 'creation'.

However, Singh was right, as cited earlier (p. 1), to point out that most big bang theorists regard the theory as 'godless'. So the Pope and Christian apologists who accept the big bang should take note!

### The timescale difficulty

In the early 1950s there was a problem; the ages of the stars were considered larger than the age of the universe calculated from the Hubble distance scale. Walter Baade was able to rescue the theory by showing that there were two separate populations of stars—Population I and Population II. The Population I Cepheids, used to determine the distance to the nearby galaxies, were in fact intrinsically brighter than the Population II Cepheids having the same period of variation. Astronomers tended to only see the brighter Population I stars in the Andromeda galaxy, but had built their distance scales based on the dimmer Population II stars in our Galaxy. Hubble had therefore erroneously estimated the distance to the Andromeda galaxy to be smaller than it really is. Baade recalibrated the distance scale, which doubled the distance to the Andromeda galaxy (to about 2 million light-years). This in turn doubled the distance to all galaxies because it was used to estimate the distance to them. This increased the estimated age of the universe to about 3.6 billion years. Hubble's hopes of a Nobel Prize were consequently dashed because Baade had shown that he had made an error in his work. However, Singh says that that wasn't the reason Hubble wasn't given the prize, as the Nobel committee considered him the greatest astronomer of all time, but it was because they never considered astronomy to be part of physics. The Nobel committee then decided to change the rules and were about to announce Hubble's nomination, when he died on 28 September 1953.

Allan Rex Sandage studied under Baade, and he revised yet again Baade's own measurements, increasing the age of the universe yet again. Cepheids could not be used in the distant galaxies because they could not be seen. It was therefore a reasonable assumption that the brightest star in a galaxy was intrinsically as bright as the brightest star in the farthest galaxy, and the distances could be estimated from the inverse square law of luminosity, especially if one averaged over more than one star. Using the newly developed photographic plates, Sandage was able to push back the distance scale of Baade and hence the age of the universe to 5.5 billion years.

During the 1950s and beyond,

Sandage would continue to work on measurements to the distant galaxies, even comparing the brightness of the first ranked galaxies of individual clusters, which would again revise the distance scales and hence the age of the universe to 10 to 20 billion years.

### Nucleosynthesis of heavier elements

Fred Hoyle provided the desperately needed solution to the formation of elements heavier than 5 nucleons. He realized that his own model, although involving a series of mini-creation events, also needed a mechanism, and Singh says that the big bang model owes a lot to him for his discoveries in this regard. Hoyle suggested that there was a stage in stars of certain masses that underwent a massively rapid collapse and this resulted in an incredible explosion (a supernova), which caused rapid fusion to produce the heavy and super-heavy elements. Hoyle analyzed the various types of stars and calculated the temperatures and pressures that occurred in stars near the ends of their lives.

However, Hoyle ran into the same brick wall that Gamow and Alpher had run into earlier—the problem of building the elements through the 5-nucleon stage. All of Hoyle's reaction routes depended on the existence of a way past this impasse. The problem involved the formation of the carbon-12 nucleus, but it seemed that it would have too much energy and quickly break up. Hoyle reasoned that since carbon-12 is abundant in our environment and particularly in Fred Hoyle himself, then there must be an excited state of carbon-12 that mitigates this reaction route. He worked out what must be the energy of the excited state. In 1953 Hoyle visited the Kellogg Radiation on the Caltech campus, where Willy Fowler had earned a world class reputation as an experimental nuclear physicist. Hoyle told Fowler of this excited state of carbon and convinced him to look for it. It is important to realize this was not a prediction based on physical theory but purely on logic. Fowler's team found it exactly at 7.65 MeV, where Hoyle had predicted it would be. Singh called this an instance of pure genius. Thus Hoyle had inadvertently helped the theory that he so thoroughly despised. The reaction route is very slow, but with an age of the universe of 20 billion years, there is enough time for the supernovae to build all the heavier elements in stars.

Hoyle and Fowler collaborated with Margaret and Geoffrey Burbidge and wrote a definitive 104-page paper which set out the role of each stellar phase and each nuclear reaction to build all of the known elements. The paper became very famous and became known as $B^2FH$ and '… was widely recognized as one of the greatest triumphs of the twentieth-century' (p. 400).

It subsequently earned the Nobel Prize for Fowler, but not Hoyle. Singh was clear in his denouncing this as one of the greatest injustices in Nobel history. Fowler himself said, 'Fred Hoyle was the second great influence in my life. The grand concept of nucleosynthesis in stars was first definitely established by Hoyle in 1946.'[5] However, Hoyle had made many enemies because he was very outspoken about some of the decisions of the Nobel committee. One notable example was not awarding the 1974 Nobel Prize to the Quaker astronomer Jocelyn Bell Burnell for her discovery of pulsars but to her supervisor, Antony Hewish (with Martin Ryle), who was not involved in the crucial observations.

### Radio-astronomy

In 1942 Stanley Hey discovered that a problem with the Allied radar was not from the Nazis but from strong radio emissions from the sun, which were linked to the 11-year cycle of sunspot activity. Bernard Lovell started a program of radio astronomy observations after the War. In 1948 Martin Ryle embarked on a survey of the sky and discovered large amounts of objects that emitted radio waves but very little light. Baade was able to show that one of Ryle's radio sources (Cygnus A) coincided with a hitherto unseen galaxy, which led astronomers to link other radio sources with galaxies.

The Steady State model predicted that galaxies of all ages should be evenly distributed throughout the universe. The big bang model would have younger galaxies with stronger radio-emissions farther away. Ryle set about measuring the age of galaxies as a function of distance. With a survey of five thousand galaxies, in 1961, Ryle concluded on statistical grounds that the distribution favoured the big bang. However, he was looking for this because he was keen to prove Hoyle wrong.

In 1963, when Maarten Schmidt was studying light from the radio source from Ryle's 3C survey catalog, which was considered to be a new type of peculiar star within our own galaxy, he realized that the wavelengths of the hydrogen lines were shifted by an enormous amount—more than had ever been seen before. It had a redshift of 0.16, or in other words, was receding at 16% of the speed of light. The Hubble Law would put it at over a billion light-years distant. He also concluded that this apparent point-like object was very luminous since he believed it was so very distant. This became known as a quasi-stellar radio object, or *quasar*.

Because most quasars, assuming the Hubble Law distances apply, were seen only in the far reaches of the cosmos, big bang astronomers assumed that conditions in the early universe favoured their formation. The Steady State model should not have such a particular distribution, but they should be evenly distributed. But this problem only exists if the assumption that their large redshifts represent cosmic expansion and the quasars are truly distant. In recent years there has been a lot of contrary evidence.[6]

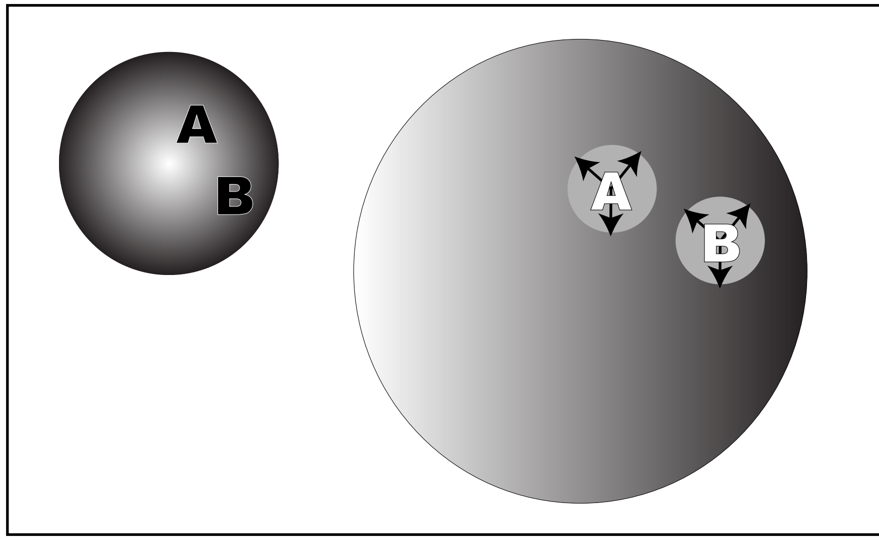
### Discovery of the CMB

Arno Penzias studied at Columbia University under Charles Townes, who would later win the Nobel Prize for his development of the maser.[7] Penzias's thesis required him to build an ultra-sensitive radio-receiver that incorporated the Townes maser. In 1963, after working for two years as a radio-astronomer at Bell Labs, Penzias was joined by Robert Wilson. Using the 6-metre horn antenna to scan the skies for radio sources, they tried to determine what the source of an incessant and annoying background noise was—a constant hiss. This turned out to be the *cosmic microwave background* (CMB) radiation, for which they were awarded the Nobel Prize. Remember, Gamow, Alpher and Herman had predicted the CMB radiation in 1948, but by this time that was forgotten. However, Robert Dicke and James Peebles of Princeton had also realized this radiation should exist and were planning its detection. Penzias and Wilson never made the connection to the big bang model themselves, although this was claimed as the biggest success of the big bang model ever. However, as Hoyle has said, that would only be true if there were no other explanation for the effect. Regardless, this discovery rang as the death-knell of the Steady State model.

### Formation of galaxies

Singh says:

> 'Leaving aside the issue of creation, which remained a difficulty for both models, cosmologists focused their attention on the only other issue that was problematic for the big bang model. It was not clear how a universe created from a big bang could evolve to form galaxies … . Hoyle was complaining that the big bang was absurd because it would have blown apart all existing matter to create a universe containing a thin and even smattering of substance, as opposed to a universe with its matter concentrated in galaxies.'




The big bang's horizon problem. Early in the alleged big bang, points A and B (left) start out with different temperatures. Today, points A and B (right) have the same temperature, yet there has not been enough time for them to exchange light (heat radiation, depicted by arrows) to equalize temperature.

This admission by Singh is very damning of the big bang, as the same problem of explaining the formation of galaxies still exists today. However, I would not agree that it is the only other remaining problem—yet even if we give the big bangers that point—a universe without galaxies is no universe. Notice that Singh also agrees that the issue of creation is problematic for both models. Only a Creator can create matter, because it is not part of Natural Law for matter to form from nothing. No purely naturalistic model can ever explain creation.

Therefore, the big bangers needed to find evidence of variations in the CMB radiation, which they believe are echoes of the density variations in the early universe that allowed galaxies to form. Singh uses the expression 'To prove …' (p. 446) there were massive density variations in the past, but it just doesn't follow. You can't prove anything about the past, and Singh is writing with a knowledge of what was eventually discovered.

George Smoot became obsessed with looking for these variations in the CMB. Eventually he built a differential microwave radiation detector that was housed aboard the COBE satellite, designed to precisely measure the CMB radiation. It completed its first year survey in April 1990. After two years, no variations were detected at the level of 1 part in 10,000. Finally by December 1991 a variation appeared at the level of 1 part in 100,000, that is, peak CMB radiation varied across the sky by 0.001%. This was hailed as what the big bang needed, yet the theorists at the time had required that the variations be 10 times larger than this level. Smoot told an assembly of journalists, that 'if you're religious, it's like seeing the face of God' (but which god?). Despite Smoot's claim in 1992 that these are the primordial-seeds of modern day galaxies, Hawking continues to maintain that galaxy formation cannot be explained.[8]

Singh says that after this, the challenge to prove the big bang was over and the paradigm shift was complete. However, what about the remaining issues? What about the universe being filled with dark matter and dark energy, and observational falsification. If the big bang is truly testable, then it should be rejected when it fails to meet observation. Instead, it is a paradigm that is modified as needed.

One example that has been added is inflation as proposed by Alan Guth. It was added *ad hoc* to prevent the universe collapsing back in on itself, and to solve the Horizon Problem. But there is no actual mechanism for starting or stopping the alleged superluminal expansion of space.[9]

How are the helium/hydrogen relative abundances a prediction of the big bang model when Gamow and Alpher knew the result before they started their calculations? Dark matter is invoked on all scales in the universe to explain the dynamics—particularly to get the Friedmann–Lemaître-Robertson-Walker equations to fit the observations of the measurements of the type Ia supernovae (which are used as 'standard candles'). Now they have accepted dark matter, they are finding that it is needed for galaxy formation, even though it is thus far undetectable.

Supporters of the big bang seem to naïvely claim they have found the true model when so much is still unknown. It seems to me to fall short. Singh quotes Fred Hoyle saying, 'To claim, however, as many supporters of big bang cosmology do, to have arrived at the correct theory verges … on arrogance' (p. 483). I could not agree more, and many other cosmologists agree.[10] Cosmology at best is very difficult to test, so it should invite the challenges that new models offer, but this is not the usual case.

## Science and the church

Singh says: 'Even the [Catholic] church has grown to love the big bang model … . It has effectively abandoned any pretence that Scripture gives a literal explanation of the universe' (p. 484). In 1988, Pope John Paul II declared that Christianity need not to look to science for its apologetics. Its justification is found with itself. Singh says science and religion can now live independently, side by side. His meaning is that religion is not about facts, just philosophy, although the Christian faith is all about real history. It was a sad day when the Catholic church laid aside the truth of the Scripture to substitute science instead.

Singh says that the Pope in 1992 admitted this church was wrong to persecute Galileo. However, he misses the point that it was the religious system, largely politics, not the true church that persecuted Galileo. Dr Thomas Schirrmacher showed:

> 'Contrary to legend, Galileo and the Copernican system were well regarded by church officials. Galileo was the victim of his own arrogance, the envy of his colleagues, and the politics of Pope Urban VIII. He was not accused of criticising the Bible, but disobeying a papal decree.'[11]

As if to leave a little remaining for God to do, Singh then discusses the anthropic principle. This is the idea that the universe seems to be designed for life—physical constants are just right for life.

Singh relegates the church, which he equates with religion, to hold the job of speculating on philosophical questions, not science. He confuses the concept of proof with some belief. Finally though, he says the big bang model cannot be complete without knowing what happened before the big bang. The last outstanding question according to Singh is what caused the big bang. What came before the big bang? He misquotes St. Augustine:

> 'What was God doing before He created the universe? Before He created Heaven and Earth, God created hell to be used for people such as you who ask this kind of question' (p. 493).

In reality, Augustine pointed out that God created time itself, so the concept of 'before' the beginning of creation has no meaning. Those who reject the concept of the Creator God need to explain how the big bang created time.

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