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# Hidden Light

Science Secrets of the Bible

Maggid Books

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## Chapter 1

# Cosmology and the Bible

**T**his Chapter begins with an overview of the six days of creation in the Book of Genesis and develops comparisons and analogies between science and the Biblical account. In some respects, the approach is similar to the familiar Day-Age model used by other authors, but with significant differences in the details. In general, this Day-Age method posits that each day corresponds to a specific epoch in the evolution of the Universe. Contradictions and discrepancies are duly noted with their resolution deferred to later sections of the chapter. The conflict between the Big Bang and Steady-State models of the Universe is described in detail as part of our discussion on Day One. Each succeeding day is then covered in separate sections, up to Days Five and Six, which describe the appearance of life on Earth. The Second Day provides the greatest difficulty, as it has for many generations of scholars and commentators. The “raqiya,” variously translated as firmament, dome, expanse, etc., is identified in Section *c* as the barrier between matter and anti-matter – a speculation based on analysis of Biblical language and commentaries. An apparent contradiction between the Third and Fourth Days is resolved in Section *d* by discussion of light scattering in the primordial atmosphere.

*This chapter concludes with a comparison of scientific and Biblical sources on the age and fate of the Universe, in Sections E and F.*

## **A. INTRODUCTION – CREATION ACCORDING TO THE BIBLE, MODERN SCIENCE AND PAGAN ACCOUNTS**

### **1) Genesis – The Six Days of Creation**

The Bible starts with a simple seven-word sentence:

“בְּרֵאשִׁית בָּרָא אֱלֹהִים אֶת הַשָּׁמַיִם וְאֶת הָאָרֶץ”.

“In the beginning God created the heaven and the earth”

In this very first sentence, the Torah raises several questions, such as:

1. Why is the first letter written extra large (the big *Bet*)?
2. How could it say that heaven and earth were created at the “beginning” when the earth doesn’t make its appearance until Day 3?

In response to question 1), note that the Big *Bet* opens on the left and is closed on the right. Hebrew is written from right to left. This oversized first letter of the Bible acts as a time barrier, with time’s arrow flowing from right to left following the written language.

We cannot penetrate to the right of “Time Zero” (as in the latest theoretical models of the Big Bang – “The Beginning”). The Bible is anticipating the difficulties encountered by our contemporary cosmologists, who are struggling with the singularities at Time Zero. It is interesting that this scientific term (‘singularity’), in reference to the point of Time Zero, could be interpreted as descriptive of the Oneness and Unity of God.

Professor Leon Kass has succinctly addressed this point in a recent issue of *Commentary Magazine* (Ref. I.1). He writes:

“In Cosmology, we have seen wonderful progress in characterizing the temporal beginnings as a big bang and elaborate calculations to characterize what happened next. But

from science we get complete silence regarding the status quo ant and the ultimate cause. Unlike a normally curious child, a cosmologist does not ask – what was before the big bang? – because the answer must be an exasperated ‘God only knows.’”

One response to question 2) was provided by Rashi<sup>1</sup>, who suggested that this first sentence should run together with the succeeding sentences such:

“At the beginning of the Creation of heaven and earth when the earth was without form and void and there was darkness on the face of the murmuring deep...” Some contemporary authorities are of the opinion that this first sentence encompasses the first ten billion years of creation which includes the formation of the stars, the solar system and the earth (private communication from Prof. Joseph Bodenheimer, President of the Jerusalem College of Technology).

This author prefers the following alternative interpretations of the first sentence:

1. In the beginning God created the spiritual world (*Shomayim*) and the physical world (*Eretz*). These are two orthogonal, non-intersecting domains which only meet under very special conditions.
2. In the beginning God created space-time (*Shomayim*) and compacted matter (*Eretz*).

Continuing with the Biblical narrative (verse 3): “And God said let there be light and there was light...and it was evening and it was morning, one day (יום אחד).” Once again we are confronted with an apparent chronological contradiction as in Question (2) on the opening sentence. The Bible speaks of evening and morning and yet the rotating Earth hasn’t even been formed. There is also the related question, what is meant by one day?

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1. *Rashi* (Rabbi Shlomo Itzhaki), b. 1040, France



The description of the second day is even more mystifying (verse 6):

“And God said, let there be a *raqiya* (רַקִּיעַ) *in the midst* of the waters and let it cause a division between waters and the waters. The “raqiya” has been variously translated as a dome, firmament or expanse. Nachmanides (Ramban) has noted that these verses touch upon the innermost mysteries of Creation and states: “Do not expect me to write anything about it” (Ref. 1.2). With the hindsight of modern science, a speculative solution to the mystery of the Second Day is proposed in Section c of this chapter.

The Biblical narrative continues to describe the formation of our Earth on the Third Day and the placement or appearance of sun, moon and stars on the Fourth Day. Modern cosmology holds that the stars and our sun were formed well before the solar system and Earth. This apparent contradiction will be addressed in detail in Section d of this Chapter.

The description of The Fifth and Sixth Days starts with life in the seas and the formation of higher order species, culminating in the creation of Adam (first man) on the evening of the Sixth Day. There is a remarkable similarity between the chronology of the Biblical account and the current theories of cosmology, cosmogony<sup>2</sup> and evolution. As shown in Table 1 (page 5), there are two cases where the chronologies do not seem to track. In the first case, the transition from the end of Day 1 to the formation of the mysterious Raqiya on Day 11 seems to have a time slip of 370,000 years (column 4 of the Table). A possible solution is discussed in detail in Section c. The apparent discrepancy between the Third and Fourth Days is resolved in Section d of this chapter.

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2. Cosmogony is the study of the solar system and its origins, whereas cosmology refers to the study of the universe.

**Table 1: Comparison of Six Days of Creation with Modern Science\***

verse	Biblical Account	Modern Science	Estimated elapsed time after the Big Bang
1a	Creation of matter, energy, space, time	The Big Bang – Dark Ages of the Universe	The first three minutes
1b	First Light	CMBR (Cosmic Microwave Background Radiation)	According to the Standard Model 370,000 years
2a	<i>Rakia</i>	Separation of matter from anti-matter	Right after the Big Bang
2b	Cycles of dark and light (erev v'boker) Commentaries of the sages	Speculative model that the First Light were high-energy gamma rays down-shifted to today's soft x-ray background (section c) Stars and sun	(about 5 seconds) End of the recombination epoch at 5 seconds 200 million years to 8 billion years
3	Earth, plants, oceans, seas	Earth and moon, our solar system	9 billion years
4	Sun, moon and stars	Transformation of Earth's atmosphere	10 to 11 billion years
5	Life begins in seas, fish, reptiles, birds	Life begins in seas, fish, reptiles, birds	13 billion years prox.
6	Land mammals Adam on the evening of the sixth day	Mammals, hominids Man	13.6 billion years (100 million years ago) Open Question – biblical dating says 5768 years ago

\* based on the age of the Universe at 13.7 billion years, as determined by data from the WMAP satellite – see Section E.

As noted in Table 1, the biblical chronology of the Fifth and Sixth Days dealing with the appearance of life and the creation of higher-order species gives astonishingly similar results to the Theory of Evolution, except for one fundamental difference. The Bible implies that each species was independently created (with evolution possibly occurring within a given species), whereas Darwinian theory talks about an evolutionary ladder between each species, culminating in Man. Evolutionists point out the amazing similarities in the DNA chains between Man and chimpanzees which are cited as proof of a common ancestor. There is a difference of only two percent in the genetic sequences. However, one searches in vain for some explanation on how such a small difference can account for the miniscule intelligence of a species more than one million years old, compared to their human “cousins.” Also, until such time as there is clear evidence from the fossil record showing the transition phases from one species to the next, each model should be given equal consideration and taught in our schools and universities in the spirit of free enquiry.

**Appendix 1.1 Biographical Note on Moshe Dove Medved**

One of my earliest memories as a young child growing up in South Philadelphia was the emblem painted on the sides of my brother's truck. My brother, Moshe Leib Dove was a struggling electrical contractor during the dark days of the Great Depression. Written in both Hebrew and English were the words יהי אור (Let there be Light) together with three lightning bolts originating from a common point. This message from Genesis resonated so well with the good citizens of Greater Philadelphia that Dove Electric became a household word. Although he was not religiously observant, his self-taught knowledge of the Bible and his love of Zion were transmitted to me and subsequently to my sons when he came to live with us in the Santa Monica mountains in the last ten years of his life. His influence on our family as Uncle Moish has been eloquently described in my son Michael Medved's recent book "Right Turns."

## **2) Other Creation Stories**

Generations of secular scholars have tried to draw parallels between Genesis and ancient Middle Eastern accounts of the origins of the world. These parallels exist only in their imaginations, since in none of these graphic, even obscene pagan accounts, is there any anticipation or prediction of the development of the Universe as described by modern cosmology. Rob Yule, previously at St. Albans Presbyterian Church (in New Zealand), has written: “Genesis 1... is strikingly different from the other creation accounts...yet it anticipates many of the most remarkable findings of modern science” (Ref. 1.3).

The Egyptian papyrus of Apophis describes how their sun god (Ra) created the world and mankind by using his salivating mouth to spit out progeny. A less sanitized version deals with masturbation and autofellatio. Apophis is a seven-headed monstrous serpent who is in constant warfare with the sun god. In the Babylonian epic of Enuma Elish, we read about a drunken Marduk, who after killing and dismembering Tiamat, performs acts of magic in front of the gods and then proceeds to create the world while killing off his competitors. Their gods are fickle, bribable, malicious, irrational and capricious. These and other distasteful depictions of their deities are cultural ancestors of today’s R- or X-rated movies. One could write a great Ph.D. thesis tracing the connection between these 4000-year-old pagan stories and the current Hollywood ethos. Both Marduk and Apophis (mistakenly called Aphosis) are names prominently featured in the popular media, from video games to television. In the TV series *Stargate SG1*, Marduk was a Goa’uld who ruled over a planet with great brutality. His own priests revolted and sealed him in a sarcophagus. In the same series, the Goa’uld Death Glider was designed and built by Aphosis. This fascination by the lords of the entertainment industry with the names of these ancient deities is a clear indication of the connection.

At least the Gilgamesh Epic, which has often been cited as an “inspiration” for the story of Noah and the Flood, does have some redeeming PG features. The Epic is an ancient Babylonian poem

about a mythological hero-king thought to have ruled during the Third Millennium BCE (around 2600 BCE) – corresponding to the year 1167 on the Hebrew calendar. According to tradition, the Great Flood which covered the whole earth occurred in 1656 when Noah was 600 years old. By contrast, the Babylonian flood myth describes a large deluge on a local river.

On the continent of Australia, halfway around the globe from the Middle East, the nomadic Aborigines developed stories of creation which have more in common with the Biblical account than those of Israel's neighboring cultures. Consider these characteristics:

1. Although their depictions vary from tribe to tribe, all have the concept of the "Dreamtime" – the time which existed before the creation of the world (cf. our discussion of the Big *Bet* in Section A.1).
2. It was dark and there was no space between earth and sky, the magpies had no space to fly.
3. With a great concerted effort, they began to lift the dome of the sky with their beaks.
4. As the magpies watched, the sky split open and the sun appeared.
5. The magpies (and other birds) have never forgotten that first glimpse of the sunlight and consequently greet the sunrise every day with a joyous chorus of song.

Contrast this lyrical vision of creation from a primitive culture with the degeneracy of those advanced civilizations so much admired by the elitist literati of the Western world.

At the start of every day, observant Jews praise the handiwork of the Creator with prayer and joyous song, including the Hallelujahs of Psalms 145 to 150, culminating in the words of Psalm 150 – "Every soul will praise Thee Hallelujah." Many Christians, including President Bush, also begin their day with inspirational readings from the Bible.

**B. DAY 1 – HOW IT ALL BEGAN (THE ORIGINS OF THE UNIVERSE ACCORDING TO SCIENCE)**

**1) Red Shift and the Expanding Universe**

The competing models of the Big Bang (BB) and the Steady State Universe (SSU) were both attempts to explain the expansion of the Universe as observed in the several decades before 1948. As early as 1912, Vesto Slipher, working with Percival Lowell in Arizona, was able to obtain spectra of spiral nebulae with a red shift, corresponding to velocities of recession<sup>3</sup> up to 300 km/sec (one thousandth the velocity of light). This speed was considered to be so large that astronomers questioned the data.

In 1922–24, Alexander Friedmann, a Russian-born meteorologist and mathematician, published his three solutions of the Einstein Equations of General Relativity. As a firm believer in a static universe, Einstein himself had introduced the Cosmological Constant, which became known as one of the greatest fudge factors of science.

In fact, Einstein introduced this concept into his Equations of General Relativity, as some mysterious, repulsive energy which exactly balanced the gravitational contraction of matter in the Universe. The idea of a static universe goes back to the Greek philosophers and the Hindus. When confronted by the evidence of an expanding universe, he declared that his introduction of the cosmological constant was “...the biggest blunder of my life.” About 70 years later (in the late 1990s), it was found that this may not have been Einstein’s “biggest blunder”, but perhaps his greatest legacy (see section F).

The Friedmann solutions predicted an expanding universe, and they also predicted the beginning and the end of Time. In Sections E and F (on the Age and Fate of the Universe), these three solutions will be discussed in detail.

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3. Actually, out of 25 nebulae analyzed, 3 (including Andromeda) seemed to be approaching Earth. This anomaly was later explained as a large random velocity superimposed on the smaller expansion velocity.

In 1927, Georges Lemaître, a Belgian Catholic priest working in Astrophysics, published his model of an expanding universe, which was completely overlooked until 1931 when Einstein and de Sitter (a Dutch cosmologist who also believed in a static universe) publicly praised his work.

Beginning in 1928, Edwin Hubble and his assistant, Milton Humason, at the Mt. Wilson Observatory in California, began a systematic study of red-shifted spectra from faint distant nebulae and discovered a linear relationship between their distance ( $r$ ) and their velocity ( $v$ ) as given in

$$\text{Eq. 1: } v = H_0 r.$$

$H_0$  is known today as the Hubble constant. An updated extension of the original results is shown in Fig. 1.1. The region surveyed by Hubble and Humason as shown near the origin is roughly 10% of the current data. Hubble's constant has dimensions of reciprocal time.

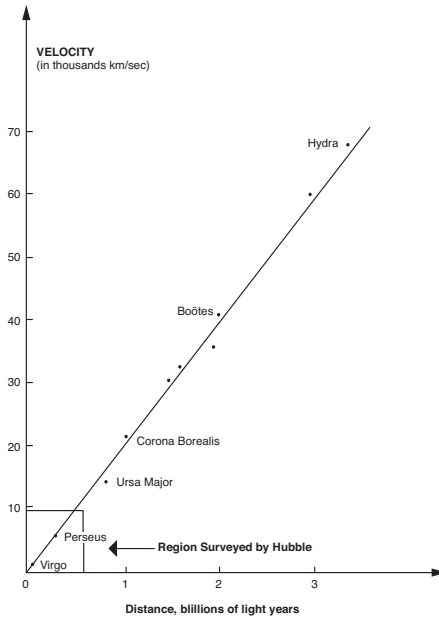


Fig 1.1 The Hubble Diagram Galaxy Recession Velocity as a Function of Distance



One Light Year (LY) is the distance traveled by light in one year and is readily computed as

$300,000 \frac{\text{km}}{\text{sec}}$  (speed of light)  $\times$  31,557,600 (no. of seconds in one year) =  $9.467 \times 10^{12}$  km or approximately  $10^{13}$  km. One billion light years is  $10^{22}$  km., so the Hubble constant is  $2 \times 10^{-18} \text{ sec}^{-1}$ . The convergence of Relativity, Quantum Mechanics and the model of the Expanding Universe just before World War II became the basis for the New Astrophysics of our post-war world.

## **2) Steady State vs. The Big Bang**

The theory of the Steady State Universe (ssu) was developed around 1950 by Fred Hoyle, Hermann Bondi and Tom Gold as an alternative to the early Theory of the Big Bang (bb), first propounded by George Gamow in 1948. In fact, Hoyle invented the term, intending it as a pejorative (there never had been a “big bang” according to Hoyle). By 1948, most scientists had accepted the model of the expanding universe based on the observations of the red shift by Edwin Hubble. Hoyle, et al., proposed that as the galaxies moved apart, new galaxies were formed out of spontaneously created “new matter” (about one hydrogen atom every four cubic kilometers). These new galaxies filled up the voids produced by the expansion of the Universe. As a result, the Universe would look the same in the future as in the past. The density of matter and energy would stay approximately constant.

Many scientists (especially in England) favored the ssu model over the bb theory since the latter idea of a beginning to the Universe implied Divine Intervention. A much smaller number of religious scientists preferred the bb model for that very reason. Many philosophers and scientists have compared the ssu to the Aristotelian view of the world and also to concepts in the Hindu and other Far Eastern theologies. The controversy raged on for nearly two decades, punctuated by alternating moments of bitter invective and hilarious humor. Hoyle on the BBC was quoted as saying: “This instantaneous creation of the Universe is like a party girl jumping out of a cake.” George Gamow and his wife, Barbara,

composed verses during the early 1950s, poking fun at Hoyle and his supporters (see Appendix 1.2 on George Gamow).

*The Universe...*

Gamow imagined Hoyle in a cosmic opera, suddenly materialized from nothing in the space between the brightly shining galaxies, bursting majestically into song:

The universe, by Heaven's decree  
Was never formed in time gone by,  
But is, has been, shall ever be –  
For so say Bondi, Gold and I.  
Stay, O Cosmos, O Cosmos, stay the same!  
We the Steady State proclaim!

The aging galaxies disperse,  
Burn out, and exit from the scene.  
But all the while, the universe  
Is, was, shall ever be, has been.  
Stay, O Cosmos, O Cosmos, stay the same!  
We the Steady State proclaim!

And still new galaxies condense  
From nothing, as they did before.  
(Lemaître and Gamow, no offence!)  
All was, will be for evermore.  
Stay, O Cosmos, O Cosmos, stay the same!  
We the Steady State proclaim!

From 1948 to about 1960, the ssu had a major advantage over the bb. When the rate of expansion was extrapolated backward it would result in an age of the Universe much less than the age of the older stars. Later it was shown by Walter Baade that the size of the Universe had been underestimated by a factor of two and this resulted in an age of the Universe significantly greater than that of the solar system and the stars.

By 1955, Martin Ryle at Cambridge had surveyed almost 2,000 radio stars and determined that most of them were outside our galaxy. It took another nine years of hard work, using better radio telescopes, for his results to be accepted. Hoyle complained with some bitterness that Ryle was motivated by some deep desire to destroy the SSU, whereas Ryle commented that "... (theoretical) cosmologists... have always lived in a happy state of being able to postulate theories which had no chance of being disproved." There was no love lost between observational astronomers and theoretical cosmologists. Lev Landau, a great physicist of the Golden Era in Physics (1930–1950), once commented that "cosmologists are seldom correct, but have no doubt that they are always right."

Barbara Gamow wrote a long ditty following the Hoyle-Ryle row (only two stanzas are given here. See Appendix 1.3 for the full poem):

*Ryle vs. Hoyle*

**Commentary on Ryle versus Hoyle** by Barbara Gamow, George Gamow's wife

"Your years of toil,"  
Said Ryle to Hoyle,  
"Are wasted years, believe me.  
The steady state  
Is out of date.  
Unless my eyes deceive me,

My telescope  
Has dashed your hope;  
Your tenets are refuted.  
Let me be terse:

Our universe  
Grows daily more diluted!"

Ryle's radio stars and the publication of the discovery by Penzias

and Wilson of the Cosmic Background Radiation in 1965 heralded the demise of the ssu, except for a few die-hards who invented the quasi-ssu. This feeble innovation proposed that the new matter came into being by a series of mini big bangs. There may still be some scientists who support this model and its variations.

## **Appendix 1.2**

### ***Biographical Note on George Gamow***

George Gamow was an Ukranian-born physicist who joined the faculty at George Washington University after coming to the U.S. in 1934. He had two brilliant collaborators – Ralph Alpher, his graduate student at GWU, and Robert Herman, who worked in the Applied Physics Lab. Alpher and Herman had predicted that a background remnant of the primordial fireball from the Big Bang should still be detectable.

A famous paper by Alpher and Gamow on cosmogenesis and the abundance of elements in the early Universe became known (perhaps notoriously) as the Alphabet Paper.

Not one to pass up the opportunity for a good joke, Gamow had sent the manuscript to Hans Bethe and asked the Nobel Laureate's permission to insert his name as a co-author on the work (even though Bethe had nothing whatsoever to do with this work). The paper was accepted and duly published in the *Physical Review*, the premium journal of the physics community, with authors Alpher, Bethe and Gamow. Rumor has it that Herman refused to change his name to Delter and missed out on his chance for fame and glory.

In 1956, before joining the University of Colorado, George Gamow came to San Diego, California at the invitation of John Jay Hopkins, a visionary entrepreneur and president of General Dynamics. Prof. Gamow gave a series of lectures to a large mixed audience of old-line airplane designers, aerospace engineers and physicists like this author (who had joined the Convair division of General Dynamics just after receiving his Ph.D. a year earlier). We became good friends and he was a frequent visitor at our home, where my dear wife of blessed memory would be constantly amazed at the prodigious amounts of vodka he was able to consume without any visible effect.

On one memorable evening he decided to teach me and my good friend, Dr. Wade Fite, "how to hear music." He demonstrated by taking a short broomstick, placing the palm of his hand on the top and bending over so that his head rested on the back of his hand. We were then instructed to pivot quickly around the

broomstick five times and then stand up straight, at which point we would “hear music.” The effect was quite dramatic. Wade and I both went sprawling across the floor.

It was only a few years later, while engaged in qualifying for the NASA Scientist-Astronaut Program<sup>4</sup>, that I learned about nystygmus and gyroscopic fluids in the head. I also had the privilege of learning from George Gamow, in private conversations, about his views on the new satellite age just dawning, and I reciprocated by attempting to teach him about the physics of transistors. We discussed the possibility that there may be other planetary systems around the stars and how one might overcome the scintillating effects of the Earth’s atmosphere to observe such bodies. The concept of a space telescope in orbit above the atmosphere was conceived around that time (some forty years before the launch of the Hubble space telescope).

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4. The Scientist-Astronaut program was initiated by NASA in the early 1960s to select Ph.D. scientists and MDs as active participants for future missions to the moon and beyond.

**Appendix 1.3**

***Ryle vs. Hoyle***

by Barbara Gamow, George Gamow's wife:

“Your years of toil,”  
Said Ryle to Hoyle,  
“Are wasted years, believe me.  
The steady state  
Is out of date.  
Unless my eyes deceive me,

My telescope  
Has dashed your hope;  
Your tenets are refuted.  
Let me be terse:  
Our universe  
Grows daily more diluted!”

Said Hoyle, “You quote  
Lemaître, I note,  
And Gamow. Well, forget them!  
That errant gang  
And their Big Bang –  
Why aid them and abet them?”

You see, my friend,  
It has no end  
And there was no beginning,  
As Bondi, Gold,  
And I will hold  
Until our hair is thinning!”

“Not so!” cried Ryle  
With rising bile  
And straining at the tether;  
“Far galaxies

Are, as one sees,  
More tightly packed together!”

“You make me boil!”  
Exploded Hoyle,  
His statement rearranging;  
“New matter’s born  
Each night and morn.  
The picture is unchanging!”

“Come off it, Hoyle!  
I aim to foil  
You yet” (The fun commences)  
“And in a while”  
Continued Ryle,  
“I’ll bring you to your senses!”

### 3) **The Cosmic Microwave Background Radiation (CMBR)**

In 1964, Arno Penzias and Robert Wilson, two radio astronomers at the Holmdel Facilities of Bell Telephone Laboratories, were engaged in the difficult work of measuring the absolute source strengths of radio stars. They were troubled by an unexpected noise or hiss which added to the noise of their electronic circuits. They even went to the trouble of chasing out the pigeons who had made a comfortable home in their horn antenna (15 meters in length and 4×4 meters at the aperture) and cleaning out the accumulated guano (which Penzias euphemistically described as a “white dielectric substance”), but to no avail. No matter which way they pointed their highly directional antenna, the noise persisted with essentially equal amplitude from all directions, i.e., it was coming from an isotropic source at the receiver frequency of their radio telescope (approx. at 4 Gigahertz).

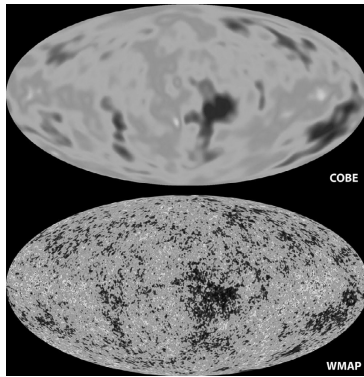
It turns out that Holmdel is not far from Princeton University, where R.H. Dicke and his colleagues were cognizant of Gamow’s pioneering work on the Big Bang. Alpher and Herman had published a paper which predicted that a remnant of the radiation



from the “primordial fireball” should still be detectable and they also gave an estimate of its temperature (Ref. 1.4). In a telephone call from Penzias, Dicke recognized the annoying hiss as a message from “the edge of the universe.” He and his group were in fact preparing their own equipment to search for this radiation. As he hung up the telephone, he turned to his colleagues and uttered those words which are the nightmare of every scientist – “Boys, we’ve been scooped!”

In 1965 both groups published consecutive papers in the *Astrophysics Journal* on the theoretical interpretation and the experimental results (Ref.s 1.5 and 1.6), but only Penzias and Wilson received the Nobel Prize. As one reviewer put it, “The Big Bang has delivered a knock-out punch to its Steady-State competitor.”

Subsequent measurements using satellites have confirmed that the CMBR is indeed a red-shifted remnant (by a factor of 1,000) of the Big Bang. Today’s Standard Model of the Big Bang requires that the CMBR be isotropic (uniform in all directions) and have a thermal radiation spectrum. Fig. 1.2a shows the microwave images recorded and transmitted by these satellites.



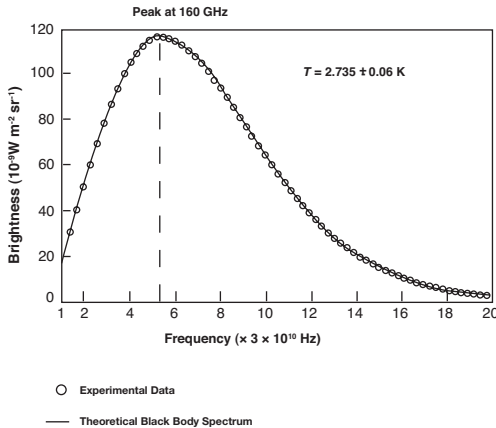
**Fig 1.2a – the CMBR as seen by COBE and WMAP satellites. Note the improved resolution obtained by WMAP.**

When the results from COBE (*Cosmic Background Explorer*) were first presented, they received a standing ovation from the audience of scientists and engineers. The remarkable agreement of the data

points with the theory of black-body radiation is shown in Fig. 1.2b.

After the initial moments of the Big Bang, light was trapped inside the stew of ions and free electrons and was only able “to escape” when the temperature dropped below  $3000^\circ \text{K}$ , allowing atoms to be formed.

Free electrons will absorb photons, as will atoms, by a process known as Compton scattering (if the photons are energetic enough to ionize such atoms). At temperatures above  $3000^\circ \text{K}$ , corresponding to 0.25 electron-volts, there are enough energetic photons in the tail of the Maxwell-Boltzman distribution to keep free electron production in equilibrium with hydrogen atom formation. The equivalence between the temperature of a gas or plasma and the kinetic energy of its constituent particles will be discussed in more detail in Section 1C in connection with the temporal evolution of the Universe.



**Fig 1.2b – Radiation Spectrum of the CMBR as measured by COBE instrumentation**

About 370,000 years after the Big Bang, as the Universe inflated and expanded, the temperature had dropped from values like  $10^{12}$  degrees  $\text{K}$  to  $3000^\circ$ , at which point the trapped light could be emitted.

The CMBR is 1,000 times cooler today, corresponding to a Black Body Radiation temperature of approx. three degrees Kelvin (see Fig. 1.2b).

Two satellites have provided significant confirmations of this model. In 1989, NASA launched the COBE mission. It found that:

1. The temperature of the Universe is  $2.735^{\circ}$  K, which agrees with the predictions of the Big Bang.
2. The anisotropy (variation from uniformity in different directions) in the CMBR was found to be quite small, less than one part in 10,000. However, even such a small variation caused great excitement in the cosmological community, as it provided a view on what happened as matter coalesced in non-uniform clumps to form galaxies and clusters (as shown in Fig. 1.2a). The conditions under which the galaxies were allowed to form are known as the “Goldilocks Conditions,” where the fluctuations in the ratio of temperature to matter must be “just right.” If the fluctuations in this ratio were too large, the Universe would only consist of lots of massive black holes – if too small, there would be no stellar formation.

If the early Universe had been perfectly uniform, Days Three, Four, Five and Six would not have happened (no galaxies, no sun, and no earth).

In 2001, the WMAP (Wilkinson Microwave Anisotropy Probe) was launched with the capability of measuring temperature differences in the CMBR to a millionth of a degree. Wilkinson was a co-author with Dicke on the theoretical interpretation of the CMBR first detected by Penzias and Wilson. Sadly, he died before the data from the WMAP became available. The WMAP results are still undergoing analysis, but have already given us an “updated” value of the Age of the Universe at 13.7 billion years. These initial results also indicate that the first stars were formed 200 million years after the Big Bang, much earlier than previously thought.

More exciting results on “The Oldest Light in the Universe” will be discussed in greater detail in Chapter 11. The composite of

Fig. 1.2a was prepared from NASA data by Senior Minister Rob Yule of Greyfriars Presbyterian Church (formerly of St. Albans Presbyterian Church) in Auckland, New Zealand (see his recent booklet entitled “The Discovery of the Beginning” (2006), available from Affirm Publications, Tauranga, New Zealand).

#### 4) The Light of Genesis 1, Chagiga 12a and the CMBR

The Torah Sages (first and second centuries) held conflicting opinions on the nature of the Light that was created on the First Day. Rabbi Elazar said, “The Light the Lord created on the First Day enabled Man to see from one end of the World to the other.” Rabbi Elazar ben Shamua lived a long and productive life during the era of the Mishnah (second century CE). He was one of the Ten Martyrs, tortured and executed by the Romans for teaching Torah. An allegorical poem on these events is read during *Musaf* on Yom Kippur and in modified form on Tisha B’Av.

Some skeptics might say that the good rabbi, despite his great learning and intelligence, was a member of The Flat Earth Society. Not so! He based his opinion on the Hebrew word for world, *olam*, which can also be translated as Universe or infinity of space and time.

This relativistic concept was expounded by the Maharal of Prague at the end of the sixteenth century. About 25 years ago, my teacher, Rabbi Daniel Lapin, pointed out that in his opinion the Maharal had anticipated Einstein by some 400 years. With the passage of time I had forgotten the reference and was unable to respond to my editor’s challenge to elaborate on this assertion. The Rabbi’s son, Aryeh Lapin, was attending Yeshiva in Israel (June, 2007) and had become an honorary member of the Medved family often joining us for Sabbath meals. I asked if he could elaborate on his father’s comments; five minutes later he came up with a detailed answer – see Ref. 1.7.

It is tempting to identify the relative uniformity of the CMBR as the remnant of that Light. Rabbi Elazar goes on to state that this light was subsequently hidden and “saved for the righteous.” My grandson Itamar recalls reading that one reason this Light was

hidden was its high energy/intensity, but we have been unable to locate the specific reference. In Section I.C we discuss the problem of identifying the 25th word of Genesis (light) as the CMBR, which would lead to serious chronological contradictions. In today's Universe, the CMBR spectrum is that of a black body at a temperature of 2.7 degrees Kelvin. As shown in Fig. 1.2b, it has a radiation peak at 120 GHz., corresponding to 2.5 mm. Note that the observations of Penzias and Wilson were at 4 GHz., where the brightness of the radiation was about  $\frac{1}{3}$  that of the peak frequency detected by a satellite high above the earth's atmosphere. Since this spectrum was downshifted by a factor of 1000 from the original emission, the first light would peak at 2.5 microns in the near-infrared with a significant visible light component.

Rabbi Elazar continues with the statement, "This issue is debated by the Tannaim (the Torah Sages)...They say that this light originated from the 'meorot' (luminaries) that were created on the First Day but which were only placed in the heavens on the Fourth Day."

The original light of the Big Bang was trapped in the primordial plasma stew until the Universe expanded and the temperature dropped. Genesis 1:4 states "...and God separated between the Light and the Darkness." Darkness is characterized as a specific creation – not just the absence of light. In Isaiah XLV:7 we read, "He who forms the light and creates the darkness." In that sense, until Light and Darkness were separated, they were mixed together in that hot soup of quarks and gluons, matter and anti-matter, and finally photons and electrons. The CMBR is therefore the earliest direct evidence available to us of the evolution of our bouncing baby Universe. For earlier times (known as the Dark Ages of the Universe), we must rely on data obtained using high energy particle accelerators at facilities like Brookhaven, CERN and Stanford, and on recent studies of the BAO (Baryon Acoustic Oscillations), to be discussed in Chapter IIA.

### 5) Edgar Allan Poe on Olbers' Paradox and the Big Bang, 100 Years Before Gamow

In 1826, German astronomer Heinrich Wilhelm Olbers described the “dark night sky paradox,” following earlier comments by Kepler, Halley and Cheseaux that in a static universe the night sky should be as bright as the sun. The prevalent opinion of the time held that the universe was static, of infinite age and containing an infinite number of uniformly distributed luminous stars. Under such circumstances, every line of sight from the surface of planet earth would terminate in a star, resulting in a night sky of blinding bright light. An early attempt to solve this paradox used the argument that the universe is not transparent, i.e. the light from distant stars may be blocked or absorbed by interstellar dust, gas or opaque objects. This mechanism was discounted when it was pointed out that any matter blocking the star's light would undergo a rise in its temperature and reradiate the absorbed energy, possibly at longer wavelengths.

In 1848, Edgar Allan Poe proposed in a 55 page prose poem that the Universe is not infinitely old and that it is expanding (Ref. 1.8). Either idea resolves Olbers' Paradox. Even more remarkable is his model of the Big Bang in the same paper. He describes a primordial particle of Divine Origin, which radiated an immense number of minute atoms into empty space, whose tendency to coalesce and reunite (under their mutual gravitational attraction) is opposed by the original “diffusive energy” imparted at the Beginning. Poe also hypothesizes that our galaxy is part of a cluster and a belt of clusters and then proceeds to introduce the concept of multi-universes. He also employs the term “universe” on two levels – the universe of stars, and all things material and spiritual (see the discussion on Genesis 1.1 in Section 1.A.1).

These seminal ideas put forth by Poe one year before his untimely death and 100 years before the work of Gamow, Alpher and Herman, were ignored and forgotten by the scientific community. With incredible prescience, he writes in the poem's preface, “What I here propound is true – therefore it cannot die – or if by

any means it be now trodden down so that it die, it will rise again to the Life Everlasting.”

Poe’s views of most scientists are summarized in a futuristic allegorical passage (below), which could certainly be applied to today’s practitioners of scientism and Darwinian evolution. Scientism is defined as “...an exaggerated trust in the efficacy of the methods of natural science applied in all areas of investigation” (Merriam-Webster Collegiate Dictionary – 1997).

*“From a letter found in a bottle floating on Mare Tenebrarum (Sea of Shadows) in the year 2848 [1000 years in Poe’s future] – the persons thus suddenly elevated by the Hog-ian philosophy [I guess he means Baconian] into a status for which they are unfitted – thus transferred from the sculleries into the parlors of Science – from its pantries into its pulpits – than these individuals a more intolerant set of bigots and tyrants never existed on the face of the earth.”*