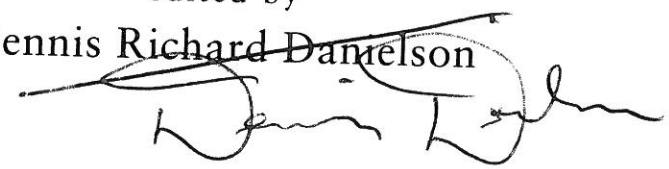
the Book of the Cosmos

Imagining the Universe from Heraclitus to Hawking

A Helix Anthology

edited by

Dennis Richard Danielson



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Acknowledgments

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Introduction: Telescopes for the Mind

Canadian cosmologist Werner Israel tells of the time he was interviewed for a television show by someone who had carefully prepared a list of questions to ask him about lipstick, blusher, and mascara. Although the kinship between cosmology and cosmetology probably did little to advance the career of that interviewer, it actually helps me here to introduce an idea central to the purpose of this book. In lecturing about cosmology, I sometimes try to break the ice by asking how many members of the audience wear cosmetics—and then I take advantage of their candor by pointing out that our word *cosmetics* derives from the Greek verb meaning "to bring order out of chaos." My point, simply, is that cosmology, like its etymological cousin cosmetology, is indeed about order, and about beauty.

Are we not drawn to the heavens in the first place because they are beautiful and because they are awesome? Their grandeur humbles us, thrills us, calls forth our contemplation, and inspires a craving (as Alan Guth has put it) "that has been part of human consciousness from the writing of Genesis to the scientific era of relativity and quantum mechanics."[1] What *is* the cosmos? How did it come into being? How are we related to it, and what is our place in it? Furthermore, when we contemplate the universe, isn't what we see and experience molded by what others of our species have seen and thought elsewhere and before us? What *I* see is in large measure an amalgam of what *we* see and have seen—and it is a very long and complex *we*. From the beginning of human history, others have looked at and spoken and written about this cosmos that is the object of our awe and our contemplation. And, to echo Wordsworth, the world is rich and dear to us both for itself and for the sake of those others who have preceded us and shaped our vision.

To make available and audible the voices of some of "those others"—of exceptional minds across time who have spoken and written about the cosmos—is this book's principal aim. Although we most naturally talk about *looking* at the heavens, the essence of *The Book of the Cosmos* is more pre-

cisely the process of *thinking* that is mediated by writing and reading about the cosmos. Important as pictures are to our understanding of the universe, they can often virtually bypass our critical faculties and make us feel as if we have understood something, when actually the "vision" that moves and inspires us goes far beyond the pictorial. What I offer here, therefore, are cosmologists' voices as embodied in their writings, accompanied by only a small handful of pictures. Employing a capacious and nontechnical definition of cosmology—discourse concerned with the cosmos and with cosmic questions—I have selected these writings using a number of criteria both objective and subjective. But above all, I have chosen readings I think succeed in evoking that very mixture of the beautiful and the awesome that draws us to contemplate this great universe in the first place.

By *contemplate* I don't, however, imply passive observation. Part of the beauty of literature, including cosmological literature, is its capacity to join author and reader in *active* contemplation—in acts of imagination and acts of interpretation. It will be clear from Chapter 1 onward how persistent is the idea that we can hear the heavens speak, and that the cosmos is a book that we can read. The same profound analogy of verbal communication undergirds much cosmological writing and, as my title intimates, informs the overall conception of *The Book of the Cosmos* itself. Finally, this whole splendid dimension of the verbal—with its evocation of beauty, order, meaningfulness, and often ambiguity, as well as its engagement of human imagination—justifies the book's aesthetic agenda. Philosopher Charles Hartshorne has written that science is "a form of love or sympathy, sympathy for the ideas of others and love of reality as open to observational inquiry. It is the imaginative, socially critical, and observational feeling for nature."[2] I hope that readers will find much of such love, sympathy for ideas, observation, imagination, and criticism in *The Book of the Cosmos*, the more so for its attempt to display cosmology as an art as well as a science.

To indulge in one more brief fit of etymology, I'd like to add that *anthology* means, roughly, a gathering of flowers. In *The Book of the Cosmos* I have tried to gather a single big bunch of cosmological blossoms picked from a range of species. You will find here excerpts from poetry, philosophy, theology; from diaries, dinner speeches, and dialogues; from epics, essays, and epistles—as well as from the more standard garden variety of colorful scientific prose. This book also collects a wider chronological range of cosmological specimens, from the beginnings of the western tradition to the present, than has previously been pressed between two covers. For all its range, it does not pretend to be an encyclopedia or a comprehensive history of cosmology. Nor is it a science or astronomy textbook, even though it presents

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As I have already hinted, *The Book of the Cosmos* is also an anthology that deliberately transgresses the boundaries that often separate academic "cultures" or disciplines. C. P. Snow's somewhat shopworn account of "two cultures"—scientists on one side and literary intellectuals on the other, each group speaking their own language and, in splendid isolation, fancying themselves the true bearers of wisdom—still unfortunately has some validity as a description of the academic scene today. This picture has been updated by John Brockman, according to whom there is now a "third culture" consisting of eloquent scientists who have usurped the role of "rendering visible the deeper meanings of our lives"; meanwhile, those in the humanities, particularly the literary types, whose culture "dismisses science," busy themselves with "comment on comments, the swelling spiral of commentary eventually reaching the point where the real world gets lost."[3] According to this account, it is not that the scientists have staked out a territory separate from that of the humanities but, rather, that they have extended their domain to take in the entire continent of true learning, while the "arts" people inhabit floating islands that drift ever farther from the scientific mainland. According to Murray Gell-Mann, one of Brockman's third-culture colleagues, "there are people in the arts and humanities . . . who are proud of knowing very little about science and technology, or about mathematics. The opposite phenomenon is very rare. You may occasionally find a scientist who is ignorant of Shakespeare, but you will never find a scientist who is *proud* of being ignorant of Shakespeare."[4]

Although I would reply by admitting a *measure* of justice in the third-culture scientists' complaint, I doubt that scorn or smugness directed at whatever culture helps to solve our problems. My main fields are English literature and intellectual history, and my knowledge of Shakespeare may well exceed my knowledge of mathematics. I'm not proud of my arrested mathematical adolescence. Yet I do believe that people whose education is primarily in the humanities can both learn much from and contribute significantly to the sciences. In fact, I'd like to see an end to the war among the cultures, with no victors nor losers declared, and to work instead for a grand coalition in which a small degree of humility regarding one's own particular discipline and a large degree of respect regarding others' disciplines is the rule.

Study of the cosmos provides an excellent realm in which to exercise such principles of academic disarmament and diplomacy. Accordingly, working

from my home territory in literature and intellectual history, I have assembled here a firsthand (if necessarily abridged) *textual* history of cosmology, a history that begins long before cosmology's establishment as a specific scientific discipline. Nevertheless, while aiming in this way to enhance interest in the sciences by employing tools primarily from the humanities, I have also tried to avoid making *The Book of the Cosmos* an unduly academic volume. My preferred model is more that of Renaissance humanism than of postmodern academia with its generally laudable if not conspicuously successful promotion of "interdisciplinarity." Renaissance humanists were interested in all things principally because of their intuition that all things *are* interesting and their conviction that all things are connected. The philosopher Giovanni Pico's delight was precisely in declaring and exploring those connections, and part of his effort was directed toward encouraging the investigation of physical reality through the practice of a kind of "magic" stripped of its occult or demonic connotations—something we have come to call experimental science. And the poet Philip Sidney, while he certainly recognized the differences among the genres of history, philosophy, and poetry (which today we would simply call "fiction"), saw the various "kinds" of writing as engaging in the same moral and educational undertaking. All had their roles to play in the *scientiae* (literally, the "knowledges"), even if Sidney thought poetry did a somewhat superior job of teaching, moving, and delighting. A century later, Isaac Newton the physicist and mathematician was publishing his own theories in a journal called not physical or mathematical but *philosophical* transactions (that is, *Philosophical Transactions of the Royal Society*).

In keeping with this old-fashioned model of interconnectedness, I have, as indicated, chosen excerpts of writings on the nature of the universe from across a wide spectrum of "philosophical" writings—from poetry to history of science to physical theory—writings that in varying ways, I hope, may indeed teach, move, and delight. Most of these selections have in common the creative exercise of imagination, something not less vital to good science than to good literature. Moreover, on a practical level, a humanities approach to the human history of the cosmos (along with the constraint imposed by the curtailed extent of my own and many readers' mathematical education) offers the advantage that writings selected for *The Book of the Cosmos* may be accessible to both scientists and nonscientists. I don't pretend that every facet of the cosmic story can be understood by the nonspecialist, but I do try here to provide a lively, historically responsible textual foundation for further study and deeper appreciation of the narrative's connectedness and attractiveness. Again, one of the distinctive features of this book is that, in all but a few chapters, what you hear is the voices of the cosmologists themselves. The

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tour that it offers across the chronological sweep of written history affords a firsthand experience of the human passion, awe, and not-infrequent bewilderment, as well as the intellectual flair, displayed in literature about cosmic origins, about the structure of space and time, and about the purpose of the universe and of humankind within it.

An effort partially to bridge or transcend the academic disciplines harmonizes, I hope, with the aim I have already mentioned of presenting cosmology as an art as well as a science. Poets, dreamers, religious thinkers, philosophers, physicists—all may look at the cosmos and contemplate its mysteries, and each may write in a way that reflects its beauties. There really are more things in heaven and earth than can be contained in a single discipline. More and more scientists seem to share this recognition, although there are plenty of examples of books about the universe whose authors arbitrarily rule out views they deem to be influenced by religious or philosophical presuppositions—as if science (or any other discipline) were devoid of such things. This observation is not intended to kindle or promote any sort of polemic against science. On the contrary, *The Book of the Cosmos* is constructed upon a foundation of deep respect for science no less than for poetry, religion, and philosophy. And to repeat my point, serious attention to cosmological writing may contribute to closer and more fruitful relations among these areas of human endeavor. It may conduct us in the sharing of beautiful things.

The other "bringing together" that this book seeks to accomplish, as by now may be apparent, is that of past and present. Its organization is primarily chronological, its approach historical. A considerable number of books on theories of the universe begin with ten or fifteen pages of potted history, rounding up and identifying the usual suspects—Democritus, Aristotle, Ptolemy, Copernicus, Galileo, and possibly Cusanus, Bruno, Kepler, or Herschel. But these introductions often only perpetuate outworn clichés and, not infrequently, ignorance. (One study published by Oxford University Press in 1995 places Ptolemy in the second century B.C.!) Something else that such introductions often perpetuate is disrespect for the thinkers, poets, and scientists of the past. The purportedly scholarly or scientific summaries to which I refer can easily silence or swallow up earlier generations of cosmologists; and, unfortunately, such chronological snobbery has also naturally worked its way into Hollywood movies and the other media (including school textbooks) through which many of today's youth are learning their history of science. Of course, it is no sin to produce summaries based on reliable sources. But firsthand examination of those sources is even better, promoting as it often does the virtues of accuracy and respect. It is my hope that *The Book of the Cosmos*, by allowing so many cosmologists to speak for themselves, will

provide some modest assistance to scientists and nonscientists alike in the exercise of such virtues.

One anxiety we understandably feel in reading about "old" ideas, however, is that they may be wrong, outdated, superseded. Leaving aside the neglected truism that today's up-to-date ideas may appear wrong, outdated, and superseded ten years from now, I think there are ways of approaching conceptions from the past without condescension and at the same time without disregard for the question of truth. Referring to the opinions of Aristotle, Aquinas, and Montaigne on the topic of consciousness, for example, one third-culture scientist complains that "these people have a vague hand-waving notion of what consciousness is about, with a religious tinge to it. Their work wouldn't fly at all in modern academics. Yet we're being told that if you haven't read them you aren't educated. Well, I'm reading them, but I'm not learning much from them."[5] The narrowness of the definition of learning implicit here is unfortunately part of what fosters disciplinary and chronological snobbery in the first place, as well as fueling a "now-centered," self-congratulatory tendency that I hope *The Book of the Cosmos* will help to subvert.

A much more useful approach to ideas of the past, or of the present for that matter, has been proposed by Daniel Dennett:

> If you look at the history of philosophy, you see that all the great and influential stuff has been technically full of holes but utterly memorable and vivid. They are what I call "intuition pumps"—lovely thought experiments. Like Plato's cave, and Descartes's evil demon, and Hobbes' vision of the state of nature and the social contract. . . . I don't know of any philosopher who thinks any one of those is a logically sound argument for anything. But they're wonderful imagination grabbers, jungle gyms for the imagination.[6]

Dennett's description of "intuition pumps" applies equally well to scientific thought experiments and to literary fictions or poetic "conceits." In accordance with this model, the eighty-five chapters of *The Book of the Cosmos* can function in a way that to varying degrees combines the scientific and the poetic—as exercisers of the imagination. In such discourse, truth is by no means irrelevant. Yet in modesty we must admit, even in up-to-date science, the circumscribed nature of our cognitive capacities: We may *approach* knowledge of the truth but cannot take undisputed possession of it. We do catch sight of it, but through a glass darkly. And so, in keeping with a technology central to the history of astronomy itself, I would like to propose a

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near equivalent of Dennett's device of the intuition pump and offer these eighty-five chapters as *telescopes for the mind*. For I hope that each of them, focusing on one aspect of the universe, be it the sun or the moon, Mars or a comet or the nebulae, the structure of the solar system or the shape of space—or on an aspect of how these things have appeared to human beings—may convey a meaningful glimmer of new instruction and delight as the mind's eye surveys the sweep, the richness, and the deep excitement of the human process of imagining the universe.

Before concluding my brief introduction, I must say a word or two more about this anthology's scope and limitations. As with any anthology, the book's selections reflect the tastes and interests of its compiler. There is no getting around this personal dimension, even if (as I hope) readers of *The Book of the Cosmos* might discern some objective grounds for the choices I have made in putting it together. Moreover, one of the hardest tasks of an anthologist is to draw the line and choose *not* to include some attractive selection. Such acts of exclusion, however, are aided by the constraints of space and economics, and in the end they are really neither avoidable nor regrettable—unless one wants an anthology too big to carry.

But there are two further, more specific limitations that I would like to mention. First, *The Book of the Cosmos* is a book that surveys the history of *western* cosmology. I initially thought I could also include stories about the universe and its origins from Africa, eastern Asia, North American aboriginal cultures, and so on. But such a collection would have been an encyclopedia rather than a book with closely connected historical joints and sinews. From quite early on I realized that simple demands of coherence would require a narrower scope than the one I had originally envisaged. Nevertheless, although it does make sense from a historical point of view to speak of *western* cosmology—as in the cases, for example, of those seventeenth-century European discoveries regarding laws of planetary motion or gravitational theory—the adjective *western* is increasingly inapplicable to the science and cosmology of the present. In spite of those who insist (with some justification) on the culturally "situated" nature of knowledge, there today seems little point in speaking of *western* optics or *western* gravitation, even though the *history* of current theories concerning them is predominantly western. Accordingly, I hope that the worldwide relevance of the history of western thought to present-day transcultural fascination with the cosmos will make this collection interesting and useful to readers in Tokyo, Beijing, New Delhi, and Nairobi as well as to those in London, New York, Vancouver, and Auckland.

The other limitation I will mention has been a more frustrating one to deal with, though for present practical purposes similarly unavoidable. An an-

thologist is dependent upon the availability of materials, and to my sincere regret there is still a paucity of published writings by cosmologists who are women. There are many historical reasons for this, some of them irremediable. However, the work of numerous women whose contributions to astronomy and cosmology are now acknowledged is either unavailable in English or else not yet adequately accessible in published form. For these reasons some women who perhaps ought to be in this anthology—such as Maria Cunitz from the seventeenth century and Jeanne Dumée and Louise du Pierry from the eighteenth—aren't. Neither is Antonia Maury, who in 1888, working for twenty-five cents an hour classifying stellar spectra at the Harvard Observatory, irritated the observatory's director, E. C. Pickering, by pointing out flaws in his system for classifying stellar spectra and employing a superior, independent system of her own.[7] Nor is Henrietta Swan Leavitt (although I summarize her main contribution in Chapter 64), simply because her most famous article, published in 1912 under Pickering's name, is simply too technical for the purposes of this anthology. Other distinguished as well as eloquent cosmological writers such as Mary Fairfax Somerville, Maria Mitchell, Agnes Mary Clerke, Annie Jump Cannon, Cecilia Payne-Gaposchkin, and more recently Kitty Ferguson and Vera Rubin, I am pleased to say have been included. Even before any of these, Aphra Behn appears as a brilliant translator—not a trivial role in a book of literary cosmology. Still, there would have been more women in evidence here had I been more successful in my attempts to lay hands on suitable materials. Given time and the efforts of scholars who even now are taking up the job of excavating and editing the work of women in this field, the present lack should prove partly remediable (see "Further Reading" at the end of the book). Maybe someday one of my three daughters, or I myself if I'm so fortunate, will be able to revise this collection with a fairer representation of cosmological writings by women.

Editorial Procedure

In the eighty-five short chapters that make up *The Book of the Cosmos* I have aimed at presenting readable (not critical) texts. By this I mean that I have done everything I could within the constraints of historical accuracy to present the readings in a form accessible to today's educated general reader. For example, when using materials published in English I have taken the liberty (a daring and dangerous thing for a literary scholar to do!) of regularizing spelling, punctuation, and usage of such things as capitals and italics, as well as expanding unfamiliar abbreviations. For the most part I have also

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silently substituted English translations in cases where authors have interspersed their writing with brief quotations from other languages, particularly Latin. Otherwise I have followed familiar conventions, using ellipses (. . .) where something is left out and square brackets ([ ]) where something is inserted. As for writings originally in languages other than English, I have presented (a) direct excerpts from published translations or (b) my own adaptation of published translations or (c) my own English translation. The "source" note at the end of each chapter indicates clearly which procedure has been followed.

Notes

1. Alan H. Guth, *The Inflationary Universe: The Quest for a New Theory of Cosmic Origins* (Reading, Mass.: Addison-Wesley/Helix, 1997), p. xiv.
2. Charles Hartshorne, "Science as the Search for the Hidden Beauty of the World," in *The Aesthetic Dimension of Science*, ed. Deane W. Curtin (New York: Philosophical Library, 1980), pp. 95-96.
3. John Brockman, *The Third Culture* (New York: Simon & Schuster, 1995), p. 17–18.
4. Murray Gell-Mann, quoted in Brockman, *The Third Culture*, p. 22.
5. Roger Schank, quoted in Brockman, *The Third Culture*, p. 28.
6. Daniel Dennett, quoted in Brockman, *The Third Culture*, p. 182.
7. Dorrit Hoffleit, *Women in the History of Variable Star Astronomy* (Cambridge, Mass.: American Association of Variable Star Observers, 1993), pp. 2–3.

I

We Have Seen But Few of His Works

Torah, Sacred Poetry, Apocrypha, New Testament

The two principal ancient legacies informing western cosmology are the Greek and the Hebrew. Although for centuries Christian philosophers and poets interwove and tried to harmonize Greek and Hebrew themes, Greek and Hebrew views of the world are strikingly contrary. Greek cosmology and cosmogony begin either with the world itself or with some form of primordial chaos that provides the stuff of the world, whereas biblical Hebrew teaching focuses on the world as a creation formed and governed by a transcendent creator.

The contrast can be expressed most simply as a contrast between models. The Greek model for the production of the world is agricultural or architectural. *In ancient Greek literature we read a great deal about elements, seeds, raw materials, geometrical shapes. If the gods are involved in the process of creation at all, they are like farmers who plant seeds and then amuse themselves elsewhere while the seeds sprout on their own. Or else they are like the mind as it seeks mastery over the moving parts of its own body; or like a craftsman who does the best he can with whatever raw materials are available.*

The Hebrew scriptures, however, present a contrast that begins with vocabulary itself. Cosmos *is a Greek word and a Greek concept, so to talk about "Hebrew cosmology" may already skew the discussion. The Hebrew expression* the sky and the earth *(or traditionally,* the heavens and the earth*)*

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is more collective than is "cosmos," and it much less readily bespeaks a comprehensive unitary whole.

In this sense the ancient Hebrew conception of the world is more contingent than the Greek, and more fragmentary. Its model of production is more poetic or narrative than agricultural or architectural. (Ancient Hebrew agriculture was often nomadic; and, although biblical writers do occasionally present God as a builder, there was no indigenous Hebrew architecture comparable to the Greek.) To use an only slightly anachronistic term, the Hebrew sky and earth are a literary production. *Like the Torah or the Covenant, which provided the "framework agreement" governing the conditions for religious life from generation to generation, the world itself was spoken into existence by God, who is its author.*

And God said

In Genesis, the first book of the Bible, the creation story forms a framework narrative for the longer though more narrowly focused narratives that follow. It is a book not only of genesis but of genealogy: It tells its audience where they have come from, and to whom they are related. And the creation, resoundingly, is brought into being by one who speaks.

Chapter 1

In the beginning when God created the heavens and the earth, the earth was a formless void and darkness covered the face of the deep, while a wind from God swept over the face of the waters. Then God said, "Let there be light"; and there was light. And God saw that the light was good; and God separated the light from the darkness. God called the light Day, and the darkness he called Night. And there was evening and there was morning, the first day.

And God said, "Let there be a dome in the midst of the waters, and let it separate the waters from the waters." So God made the dome and separated the waters that were under the dome from the waters that were above the dome. And it was so. And God called the dome Sky. And there was evening and there was morning, the second day.

And God said, "Let the waters under the sky be gathered together into one place, and let the dry land appear." And it was so. God called the dry land Earth, and the waters that were gathered together he called Seas. And God saw that it was good. Then God said, "Let the earth put forth vegetation: plants yielding seed, and fruit trees of every kind on earth that bear fruit with

the seed in it." And it was so. The earth brought forth vegetation: plants yielding seed of every kind, and trees of every kind bearing fruit with the seed in it. And God saw that it was good. And there was evening and there was morning, the third day.

And God said, "Let there be lights in the dome of the sky to separate the day from the night; and let them be for signs and for seasons and for days and years, and let them be lights in the dome of the sky to give light upon the earth." And it was so. And God made the two great lights—the greater light to rule the day and the lesser light to rule the night—and the stars. God set them in the dome of the sky to give light upon the earth, to rule over the day and over the night, and to separate the light from the darkness. And God saw that it was good. And there was evening and there was morning, the fourth day.

And God said, "Let the waters bring forth swarms of living creatures, and let birds fly above the earth across the dome of the sky." So God created the great sea monsters and every living creature that moves, of every kind, with which the waters swarm, and every winged bird of every kind. And God saw that it was good. God blessed them, saying, "Be fruitful and multiply and fill the waters in the seas, and let birds multiply on the earth." And there was evening and there was morning, the fifth day.

And God said, "Let the earth bring forth living creatures of every kind: cattle and creeping things and wild animals of the earth of every kind." And it was so. God made the wild animals of the earth of every kind, and the cattle of every kind, and everything that creeps upon the ground of every kind. And God saw that it was good.

For Democritus and other ancient Greeks, man is a little world, a microcosm. However, in the Hebrew writings human beings are made not in the image of the world but in the image of God. Accordingly, their role in the world is not to be well functioning, ordered units but in one sense to be "above" the world, to perform an ongoing creational and "cultural" role—husbanding and cultivating the garden. Genesis continues:

Then God said, "Let us make humankind in our image, according to our likeness; and let them have dominion over the fish of the sea, and over the birds of the air, and over the cattle, and over all the wild animals of the earth, and over every creeping thing that creeps upon the earth."

So God created humankind in his image,
in the image of God he created them;
male and female he created them.

God blessed them, and God
the earth and subdue it; and
the birds of the air and over
God said, "See, I have given
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for food. And to every beast
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Chapter 2

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God blessed them, and God said to them, "Be fruitful and multiply, and fill the earth and subdue it; and have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth." God said, "See, I have given you every plant yielding seed that is upon the face of all the earth, and every tree with seed in its fruit; you shall have them for food. And to every beast of the earth, and to every bird of the air, and to everything that creeps on the earth, everything that has the breath of life, I have given every green plant for food." And it was so. And God saw everything that he had made, and indeed, it was very good. And there was evening and there was morning, the sixth day.

Chapter 2

Thus the heavens and the earth were finished, and all their multitude. And on the seventh day God finished his work that he had done, and he rested on the seventh day from all his work that he had done. So God blessed the seventh day and hallowed it, because on it God rested from all the work that he had done in creation.

Here following chapter 2, verse 3, there is an important narrowing of focus. The Author of creation, who so far has been called simply God ("Elohim") is now referred to as the LORD *God ("Yahweh"), a more intimate name, less abstract, and more expressive of the relationship between the Maker and the human creatures with whom he speaks. Typical of the style of Genesis, just before the narrative "zooms in" on a detail of the larger picture already painted, the narrative backs up a little and recapitulates what has already been presented, here especially the intimate nature of the* LORD *God's creation of human beings.*

These are the generations of the heavens and the earth when they were created.

In the day that the LORD God made the earth and the heavens, when no plant of the field was yet in the earth and no herb of the field had yet sprung up—for the LORD God had not caused it to rain upon the earth, and there was no one to till the ground; but a stream would rise from the earth, and water the whole face of the ground—then the LORD God formed man from the dust of the ground, and breathed into his nostrils the breath of life; and the man became a living being.

Later in Genesis (and elsewhere in the Old Testament) the stars are mentioned within a simile bespeaking incalculability. Modern commentators

have found this locution interesting given that from ancient Babylonian astronomy (which held that the stars numbered about 3000) until the invention of the telescope, the number of the stars was considered in principle to be countable. In Genesis 15:5 it is said that the LORD *"brought [Abraham] outside and said, 'Look toward heaven, and count the stars, if you are able to count them.' Then he said to him, 'So shall your descendants be.'" Elsewhere the innumerable stars are paired with the countless sands of the sea, as in Genesis 22:17 ("I will make your offspring as numerous as the stars of heaven and as the sand that is on the seashore") and Jeremiah 33:22 ("Just as the host of heaven cannot be numbered and the sands of the sea cannot be measured, so I will increase the offspring of my servant David").*

THE HEAVENS DECLARE

In the poetry of the Old Testament, we find exalted meditations on the majesty of the sky, though the purpose of the poetry is clearly religious rather than scientific. It emphasizes "who," not "how"; it reminds the speaker or the audience that God is "above" the sky and is their maker; and it leads to a humble, awed response on the human side of the relationship between creator and creature.

In the book of Job (38:4–12), the LORD *interrogates its longsuffering main character:*

> Where were you when I laid the foundation of the earth?
> Tell me, if you have understanding.
> Who determined its measurements—surely you know!
> Or who stretched the line upon it?
> On what were its bases sunk,
> or who laid its cornerstone,
> when the morning stars sang together
> and all the heavenly beings shouted for joy?
>
> Or who shut in the sea with doors
> when it burst forth from the womb?—
> when I made clouds its garment,
> and thick darkness its swaddling band,
> and prescribed bounds for it,
> and set bars and doors,
> and said, "Thus far shall you come, and no farther,
> and here shall your proud waves be stopped"?

> Have you command
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Although Job is said to "rep
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> O LORD, our Sovereign
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Again, in Psalm 19, a poetic
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Have you commanded the morning since your days began,
and caused the dawn to know its place?

Although Job is said to "repent in dust and ashes," he is nevertheless authoritatively declared to be the LORD*'s servant who has "spoken . . . what is right" (42:6–7).*

Similarly in the Psalms, the poet gives voice to an almost paradoxical sense of being at once humbled and exalted when he considers the sky, which God has created:

O LORD, our Sovereign,
how majestic is your name in all the earth!

You have set your glory above the heavens.
Out of the mouths of babes and infants
you have founded a bulwark because of your foes,
to silence the enemy and the avenger.

When I look at your heavens, the work of your fingers,
the moon and the stars that you have established;
what are human beings that you are mindful of them,
mortals that you care for them?

Yet you have made them a little lower than God,
and crowned them with glory and honor.
You have given them dominion over the works of your hands;
you have put all things under their feet,
all sheep and oxen,
and also the beasts of the field,
the birds of the air, and the fish of the sea,
whatever passes along the paths of the seas.
O LORD, our Sovereign,
how majestic is your name in all the earth! (Psalm 8)

Again, in Psalm 19, a poetic meditation on the sky sets the stage for recognition of the magnificence of God as creator:

The heavens are telling the glory of God;
and the firmament proclaims his handiwork.
Day to day pours forth speech,
and night to night declares knowledge.

There is no speech, nor are there words;
their voice is not heard;
yet their voice goes out through all the earth,
and their words to the end of the world.

In the heavens he has set a tent for the sun,
which comes out like a bridegroom from his wedding canopy,
and like a strong man runs its course with joy.
Its rising is from the end of the heavens,
and its circuit to the end of them;
and there is nothing hid from its heat.

This reflection on the communicative, created nature of the heavens and the earth flows into a meditation on the perfection of "the law of the LORD*" as engaged at a personal, human level, and the poet's response is thus confessional, as signalled by his "performative" vocative address to the Creator/Lawgiver: "Let the words of my mouth and the meditation of my heart be acceptable to you, O* LORD*, my rock and my redeemer" (19:14).*

Two further, lesser-known but beautiful cosmological "hymns" appear in the biblical Apocrypha, in the book of Sirach (or Ecclesiasticus). These harmonize with the psalmic presentation of the creation as a sign of the majesty of God. In the first of them, from chapter 1, the divine law is personified as Wisdom:

All wisdom is from the Lord,
and with him it remains forever.
The sand of the sea, the drops of rain,
and the days of eternity—who can count them?
The height of heaven, the breadth of the earth,
the abyss, and wisdom—who can search them out?
Wisdom was created before all other things,
and prudent understanding from eternity.
The root of wisdom—to whom has it been revealed?
Her subtleties—who knows them?
There is but one who is wise, greatly to be feared,
seated upon his throne—the Lord.
It is he who created her;
he saw her and took her measure;
he poured her out upon all his works,
upon all the living according to his gift;
he lavished her upon those who love him.

Sirach, chapter 43, return
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A man tending a furn
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Sirach, chapter 43, returns to something like the "significance/insignificance" paradox of Psalm 8: Human beings may revel in the spectacle of the sky and may praise their creator even while recognizing with awe the inadequacy of both human praise and comprehension.

The pride of the higher realms is the clear vault of the sky,
as glorious to behold as the sight of the heavens.
The sun, when it appears, proclaims as it rises
what a marvelous instrument it is, the work of the Most High.
At noon it parches the land;
and who can withstand its burning heat?
A man tending a furnace works in burning heat,
but three times as hot is the sun scorching the mountains;
it breathes out fiery vapors,
and its bright rays blind the eyes.
Great is the Lord who made it;
at his orders it hurries on its course.

It is the moon that marks the changing seasons,
governing the times, their everlasting sign.
From the moon comes the sign for festal days,
a light that wanes when it completes its course.
The new moon, as its name suggests, renews itself;
how marvelous it is in this change,
a beacon to the hosts on high
shining in the vault of the heavens!

The glory of the stars is the beauty of heaven,
a glittering array in the heights of the Lord.
On the orders of the Holy One they stand in their appointed places;
they never relax in their watches.
Look at the rainbow, and praise him who made it;
it is exceedingly beautiful in its brightness.
It encircles the sky with its glorious arc;
the hands of the Most High have stretched it out.

. . .

We could say more but could never say enough;
let the final word be: "He is the all."
Where can we find the strength to praise him?
For he is greater than all his works.
Awesome is the Lord and very great,

and marvelous is his power.
Glorify the Lord and exalt him as much as you can;
for he surpasses even that.
When you exalt him, summon all your strength,
and do not grow weary, for you cannot praise him enough.
Who has seen him and can describe him?
Or who can extol him as he is?
Many things greater than these lie hidden,
for we have seen but few of his works. (1–12, 27–32)

In Him all things hold together

At the center of the New Testament of the Bible is Jesus Christ, and one of his roles is seen as coinciding with the creative "speech-acts" of God in Genesis. Put theologically, the authority and efficacy of Christ as Redeemer are intimately linked to his "authorship" and agency as Creator. The classic statement of the doctrine that Jesus Christ is the very "speech" or the Word of God (Greek: logos*) is found in the famous prologue to the Gospel of John, which begins with a deliberate echo of the first words of Genesis:*

In the beginning was the Word, and the Word was with God, and the Word was God. He was in the beginning with God. All things came into being through him, and without him not one thing came into being. What has come into being in him was life, and the life was the light of all people. The light shines in the darkness, and the darkness did not overcome it.

There was a man sent from God, whose name was John. He came as a witness to testify to the light, so that all might believe through him. He himself was not the light, but came to testify to the light. The true light, which enlightens everyone, was coming into the world.

He was in the world, and the world came into being through him; yet the world did not know him. He came to what was his own, and his own people did not accept him. But to all who received him, who believed in his name, he gave power to become children of God, who were born, not of blood or of the will of the flesh or of the will of man, but of God.

And the Word became flesh and lived among us, and we have seen his glory, the glory as of a father's only son, full of grace and truth.

That Christ ("the Son") is the embodiment and manifestation of the creative power and glory of God is reasserted in a brief "cosmic" passage in St. Paul's letter to the Colossians (1:13–20). The Son, against the backdrop of Genesis 1, is here seen as replacing darkness with light and as consummating humankind's creation in God's image.

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SOURCE: *New Revised Stanc*
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TOGETHER

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anifestation of the creative 'smic" passage in St. Paul's ;t the backdrop of Genesis ınd as consummating hu-

[God] has rescued us from the power of darkness and transferred us into the kingdom of his beloved Son, in whom we have redemption, the forgiveness of sins.

He is the image of the invisible God, the firstborn of all creation; for in him all things in heaven and on earth were created, things visible and invisible, whether thrones or dominions or rulers or powers—all things have been created through him and for him. He himself is before all things, and in him all things hold together. He is the head of the body, the church; he is the beginning, the firstborn from the dead, so that he might come to have first place in everything. For in him all the fullness of God was pleased to dwell, and through him God was pleased to reconcile to himself all things, whether on earth or in heaven, by making peace through the blood of his cross.

The agency of Christ in creation is declared once more in the book of Hebrews (chapter 1), where again the Christian teaching is tied carefully to that of the Old Testament, here by means of direct echo of the Psalms:

[God appointed his Son] the heir of all things, through whom he also created the worlds. He is the reflection of God's glory and the exact imprint of God's very being, and he sustains all things by his powerful word. When he had made purification for sins, he sat down at the right hand of the Majesty on high, having become as much superior to angels as the name he has inherited is more excellent than theirs.

For to which of the angels did God ever say,

"You are my Son,
today I have begotten you?"

. . .

And,

"In the beginning, Lord, you founded the earth,
and the heavens are the work of your hands;
they will perish, but you remain;
they will all wear out like clothing;
like a cloak you will roll them up,
and like clothing they will be changed.
But you are the same,
and your years will never end."

SOURCE: *New Revised Standard Version Bible*, Catholic Edition, Nashville: Thomas Nelson, 1993.