

Interpreter

**A Journal of Latter-day Saint
Faith and Scholarship**

Glaciers, Plant Succession, and the Sheer Wonder of It All

Daniel C. Peterson

Article Print

Pages vii–xvi

© 2026 The Interpreter Foundation. A 501(c)(3) nonprofit organization.



This work is licensed under a Creative Commons Attribution — NonCommercial — NoDerivatives 4.0 International License. To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

ISSN 2372-1227 (print)
ISSN 2372-126X (online)

Mission Statement

Supporting The Church of Jesus Christ of Latter-day Saints through scholarship.

The Interpreter Foundation supports the Church in the following ways:

- **Promotion:** We provide tools to encourage and facilitate personal learning by study and faith, and disseminate accurate information to the public about the Church.
- **Explanation:** We make the results of relevant scholarship more accessible to non-specialists.
- **Defense:** We respond to misunderstandings and criticisms of Church beliefs, policies, and practices.
- **Faithfulness:** Our leadership, staff, and associates strive to follow Jesus Christ and be true to the teachings of His Church.
- **Scholarship:** Our leadership, staff, and associates incorporate standards of scholarship appropriate to their academic disciplines.

The Interpreter Foundation is an independent organization that supports but is not owned, controlled by, or affiliated with The Church of Jesus Christ of Latter-day Saints. The material published by the Interpreter Foundation is the sole responsibility of the respective authors and should not be interpreted as representing the views of The Interpreter Foundation or of The Church of Jesus Christ of Latter-day Saints.

This journal compiles weekly publications. Visit us online at InterpreterFoundation.org

Glaciers, Plant Succession, and the Sheer Wonder of It All

Daniel C. Peterson

Abstract: *According to current scientific understanding, our universe began in an inconceivable explosion of both space and time. And yet the laws that govern it took immediate effect, eventually governing the formation of galaxies and stars, the orbits of the planets, and even the colonization of sterile rock by lichens. If all this isn't cause for wonder, it's difficult to imagine what would be. Happily, the restored gospel promises us an unlimited future of learning, exploration, and, well, admiration.*

Years ago, I attempted to visit Alaska on two separate occasions. In the first case, the tour that I was to accompany as a lecturer fell through. In the second, I had been invited to deliver a lecture in Anchorage, but then an Alaskan volcano erupted. As a result, owing to the volume of particulate matter that the eruption ejected into the atmosphere, all airline flights into and out of the state were cancelled. I was able to travel as far as Seattle, where I spent the night in the airport hotel and then flew back home. I began to wonder if maybe I just wasn't ever meant to visit Alaska.

Recently, though, I finally succeeded in visiting “the last frontier,” thus checking an item off my bucket list — at a stage of advanced geezerhood when bucket lists are just a bit more pressingly urgent than they used to be. I thoroughly enjoyed it. There was much to see and to experience, much in which to take pleasure and delight.

Rather curiously, among the things that particularly struck me was the process of plant succession after glacial retreat. (As elsewhere around the planet, many of the glaciers in Alaska have been visibly

receding for generations—and, in recent decades, at an increasingly rapid rate.) There is much to be concerned about in connection with the apparent phenomenon of global warming, but there is also much from which we can learn. I listened with fascination to a naturalist's lecture aboard our cruise ship while we were visiting Glacier Bay National Park and Preserve, west of Juneau in southeast Alaska. I paid close attention again, and most particularly, at Hubbard Glacier in eastern Alaska's Wrangell-St. Elias National Park and Preserve and at Mendenhall Glacier, near Juneau.

The plant succession that occurs in the wake of a retreating glacier provides a textbook example of what botanists call "primary succession." I can't help but think that it must bear at least some resemblance, too, to the way in which the new, cooling, and barren Earth itself came to be filled with life—which, on our planet and biologically speaking, is as "primary" as it could possibly be.

And the Gods ordered, saying: Let the waters under the heaven be gathered together unto one place, and let the earth come up dry; and it was so as they ordered; And the Gods pronounced the dry land, Earth; and the gathering together of the waters, pronounced they, Great Waters; and the Gods saw that they were obeyed.

And the Gods said: Let us prepare the earth to bring forth grass; the herb yielding seed; the fruit tree yielding fruit, after his kind, whose seed in itself yieldeth its own likeness upon the earth; and it was so, even as they ordered. And the Gods organized the earth to bring forth grass from its own seed, and the herb to bring forth herb from its own seed, yielding seed after his kind; and the earth to bring forth the tree from its own seed, yielding fruit, whose seed could only bring forth the same in itself, after his kind; and the Gods saw that they were obeyed. (Abraham 4:9–12)

As a glacier recedes, it leaves behind a barren landscape of naked rock and gravel. This is the result of the seemingly irresistible centuries-long movement of enormous weights of ice over the ground, grinding and scrubbing what is beneath it. Little or no soil remains after the glacier recedes. Now, though, the territory relinquished by the glacier is once again exposed to the sun and, therefore, to its life-giving energy.

In 1980, the late astronomer, planetary scientist, and public

intellectual Carl Sagan published a book entitled *Cosmos*, which was designed to accompany his PBS miniseries *Cosmos: A Personal Voyage*. At one point in that book, he exclaims,

What a marvelous cooperative arrangement—plants and animals each inhaling each other's exhalations, a kind of planet-wide mutual mouth-to-stoma resuscitation, the entire elegant cycle powered by a star 150 million kilometers away.¹

Anyone who is familiar with the biblical book of Genesis or with the marvelous Book of Abraham, given through the Prophet Joseph Smith, may well remember, in this context, the scriptural accounts of Creation:

And the earth, after it was formed, was empty and desolate, because they had not formed anything but the earth; and darkness reigned upon the face of the deep, and the Spirit of the Gods was brooding upon the face of the waters. And they (the Gods) said: Let there be light; and there was light. And they (the Gods) comprehended the light, for it was bright; and they divided the light, or caused it to be divided, from the darkness. . . .

And the Gods organized the two great lights, the greater light to rule the day, and the lesser light to rule the night; with the lesser light they set the stars also; And the Gods set them in the expanse of the heavens, to give light upon the earth, and to rule over the day and over the night, and to cause to divide the light from the darkness. And the Gods watched those things which they had ordered until they obeyed. (Abraham 4:2–4, 16–18)

The observed process of post-glacial plant succession requires a century or more to be complete. Yet, it happens—and this is what primarily caught my attention—in at least four rather clearly distinct stages:

- During the "Pioneer Stage," which occurs over roughly the first two decades after a glacier's retreat, the nutrient-poor outwash and the bare rock that it has left behind are colonized by lichens. A wide variety of lichens flourishes in Alaska, bearing a wide variety of names. By a wide margin,

1. Carl Sagan, *Cosmos* (New York: Random House, 1980), 33, archive.org/details/cosmossa00saga/page/32/mode/2up.

my favorite among these names is “fairy barf” (*Immadophila ericetorum*). The lichens, along with mosses and cyanobacteria (which are also sometimes known as blue-green algae), break down the rock and add tiny amounts of organic matter, thus providing the very beginnings of soil.

- The “Herbaceous Stage” (lasting roughly from the twentieth year after glacial withdrawal through the fortieth) sees tough “pioneer” plants establish themselves. These include dryas (a genus of perennial cushion-forming evergreen dwarf shrubs that takes its name from the dryads or tree nymphs of ancient Greece), fireweed, and scattered grasses. Their roots stabilize the loose but still relatively meager soil that was created in the earlier stage and, thus, prevent its loss through erosion.
- From approximately the fortieth year to the century mark, the “Shrub Stage” witnesses the rise of deciduous shrubs and of trees such as willows and alders. Alders host nitrogen-fixing bacteria in the nodules of their roots, which greatly enriches the soil’s all-important nitrogen content.
- Finally, after a century or so, the boost in nitrogen afforded by the previous stage permits evergreen trees like Sitka spruce (Alaska’s official state tree) to take root. The spruce ultimately—and, in a way, rather sadly—shades out the alders, which played their required role in the cycle. To this extent at least, the alders “filled the measure of [their] creation” (Doctrine and Covenants 88:19). In turn, over the course of centuries, hemlock may eventually replace spruce. Thus is created a mature coniferous forest or what is called, as the fourth and final stage in the process of plant succession, a “Climax Forest.”

I was impressed with this sequence and, if you will, by the genius of it—a mere tiny fragment of the genius that is somehow inherent overall in nature. I thought of a substantial passage from Doctrine and Covenants 88:

All kingdoms have a law given; And there are many kingdoms; for there is no space in the which there is no kingdom; and there is no kingdom in which there is no space, either a greater or a lesser kingdom. And unto every kingdom is given a law; and unto every law there are certain bounds

also and conditions. All beings who abide not in those conditions are not justified.

For intelligence cleaveth unto intelligence; wisdom receiveth wisdom; truth embraceth truth; virtue loveth virtue; light cleaveth unto light; mercy hath compassion on mercy and claimeth her own; justice continueth its course and claimeth its own; judgment goeth before the face of him who sitteth upon the throne and governeth and executeth all things.

He comprehendeth all things, and all things are before him, and all things are round about him; and he is above all things, and in all things, and is through all things, and is round about all things; and all things are by him, and of him, even God, forever and ever. And again, verily I say unto you, he hath given a law unto all things, by which they move in their times and their seasons; And their courses are fixed, even the courses of the heavens and the earth, which comprehend the earth and all the planets. And they give light to each other in their times and in their seasons, in their minutes, in their hours, in their days, in their weeks, in their months, in their years—all these are one year with God, but not with man.

The earth rolls upon her wings, and the sun giveth his light by day, and the moon giveth her light by night, and the stars also give their light, as they roll upon their wings in their glory, in the midst of the power of God. Unto what shall I liken these kingdoms, that ye may understand? Behold, all these are kingdoms, and any man who hath seen any or the least of these hath seen God moving in his majesty and power. (Doctrine and Covenants 88:36–47)

Rereading that passage, which comes from a revelation given through the Prophet Joseph Smith at Kirtland, Ohio, on 27–28 December 1832 and 3 January 1833, I thought immediately of another statement from Carl Sagan, who was, as it happens, a vocal religious agnostic. "How is it," he asked,

that hardly any major religion has looked at science and concluded, "This is better than we thought! The Universe is much bigger than our prophets said, grander, more subtle, more elegant?" Instead they say, "No, no, no! My god is a

little god, and I want him to stay that way.” A religion, old or new, that stressed the magnificence of the Universe as revealed by modern science might be able to draw forth reserves of reverence and awe hardly tapped by the conventional faiths.²

Impressive as I find the process of post-glacial plant succession, though, it represents only the surface froth on a vast and deep ocean of unfathomably rich complexity. As Sagan put it in *Cosmos*, “If you wish to make an apple pie from scratch, you must first invent the universe.”³ Yes, you need ingredients like pie crust, apples, sugar, flour, cinnamon, lemon, egg, and nutmeg. And you’ll require an oven, as well as such tools as a mixing bowl, a rolling pin, a whisk, and so forth. But where do such necessary ingredients and implements come from?

Our current understanding suggests that the necessities ultimately emerged from a “singularity” in which all matter—the stuff of which all future amoebas, whales, people, and zebras, all eventual mountains, stars, planets, and galaxies would be composed—was condensed into an unimaginably tiny point. This singularity had zero volume, infinite density, and infinite gravitational pull, and the laws of physics as we know them did not apply.

However, 13.8 billion years ago the Big Bang occurred, and the laws of physics came into force. As time passed, stars formed, serving as the forges in which every atom of carbon and oxygen and iron in the universe was produced. They were the engines that scattered every element heavier than helium across the vast distances of space. Citing Carl Sagan again,

The nitrogen in our DNA, the calcium in our teeth, the iron in our blood, the carbon in our apple pies were made in the interiors of collapsing stars. We are made of starstuff.⁴

Gases, stellar dust, and water coalesced into planets, including our Earth, and eventually wheat and flour and pie crusts came into being, along with apples and sugar and lemon and nutmeg and pie tins and aluminum foil and both plastic and metal forks—and glaciers, lichens, grasses, willows and alders, Sitka spruce, and all coniferous trees. If

2. Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space* (New York: Random House, 1994), 50, archive.org/details/palebluedot00carl/page/50/mode/2up.

3. Sagan, *Cosmos*, 218.

4. Sagan, *Cosmos*, 233.

this emergence of everything from the singularity isn't worthy of awe and wonder, I cannot imagine anything that would be.

I turn for the moment from the agnostic Carl Sagan to the very religious Gerard Manley Hopkins, an English Jesuit priest and poet, and to his famous poem "Pied Beauty":

Glory be to God for dappled things —
For skies of couple-colour as a brindled cow;
For rose-moles in all stipple upon trout that swim;
Fresh-firecoal chestnut-falls; finches' wings;
Landscape plotted and pieced — fold, fallow, and plough;
And áll trádes, their gear and tackle and trim.

All things counter, original, spare, strange;
Whatever is fickle, freckled (who knows how?)
With swift, slow; sweet, sour; adazzle, dim;
He fathers-forth whose beauty is past change:
Praise him.⁵

"Science is not only compatible with spirituality," Carl Sagan wrote, "it is a profound source of spirituality."⁶ I cannot disagree with him, so I turn to another famous poem from Hopkins, "God's Grandeur":

The world is charged with the grandeur of God.
It will flame out, like shining from shook foil;
It gathers to a greatness, like the ooze of oil
Crushed. Why do men then now not reck his rod?
Generations have trod, have trod, have trod;
And all is seared with trade; bleared, smeared with toil;
And wears man's smudge and shares man's smell: the soil
Is bare now, nor can foot feel, being shod.

And for all this, nature is never spent;
There lives the dearest freshness deep down things;
And though the last lights off the black West went
Oh, morning, at the brown brink eastward, springs —
Because the Holy Ghost over the bent
World broods with warm breast and with ah! bright wings.⁷

5. Gerard Manley Hopkins, *Poems and Prose*, ed. W. H. Gardner (New York: Penguin Books, 1985), 30–31, archive.org/details/bwb_S0-DQU-858/page/30/mode/2up.

6. Carl Sagan, *The Demon-Haunted World: Science as a Candle in the Dark* (New York: Random House, 1995), 29, archive.org/details/demonhauntedworl0000saga/page/28/mode/2up.

7. Hopkins, *Poems and Prose*, 27.

“Personally,” wrote Carl Sagan, who did not believe it,

I would be delighted if there were a life after death—especially if it permitted me to continue to learn about this world and others, if it gave me a chance to discover how history turns out.⁸

Latter-day Saints are blessed to understand and to teach that learning and mind- and soul-expanding experiences will continue well beyond the end of this mortal life.

If you could hie to Kolob
In the twinkling of an eye,
And then continue onward
With that same speed to fly,
Do you think that you could ever,
Through all eternity,
Find out the generation
Where Gods began to be?

Or see the grand beginning,
Where space did not extend?
Or view the last creation,
Where Gods and matter end?
Methinks the Spirit whispers,
“No man has found ‘pure space,’
Nor seen the outside curtains,
Where nothing has a place.”

The works of God continue,
And worlds and lives abound;
Improvement and progression
Have one eternal round.⁹

“We . . . do not expect to cease learning,” declared President Brigham Young,

while we live on earth; and when we pass through the veil, we expect still to continue to learn and increase our fund of information. That may appear a strange idea to some; but it is for the plain and simple reason that we are not capacitated

8. Carl Sagan, *Broca's Brain: Reflections on the Romance of Science* (New York: Ballantine Books, 1980), 355, archive.org/details/brocasbrainrefle0000saga/page/352/mode/2up.

9. “If You Could Hie to Kolob,” *Hymns*, no. 284.

to receive all knowledge at once. We must therefore receive a little here and a little there.¹⁰

Accordingly, I hope and I trust that Carl Sagan is enjoying himself very, very much. As, I'm confident, is Brigham Young, who taught:

We can still improve, we are made for that purpose, our capacities are organized to expand until we can receive into our comprehension celestial knowledge and wisdom, and to continue, worlds without end.¹¹

Nothing less than the privilege of increasing eternally, in every sense of the word, can satisfy the immortal spirit.¹²

This sixty-ninth volume of *Interpreter: A Journal of Latter-day Saint Faith and Scholarship*, like all its predecessors, exists in part because of a divine command:

Seek ye diligently and teach one another words of wisdom; yea, seek ye out of the best books words of wisdom; seek learning, even by study and also by faith. (Doctrine and Covenants 88:118)

We believe that learning, the acquisition of knowledge, understanding, and wisdom, is an eternal imperative, that "the glory of God is intelligence" (Doctrine and Covenants 93:36). What an exciting vision of human potential!

As its forerunners did, this volume offers a wide variety of insights from faithful Latter-day Saint writers.¹³ I'm profoundly appreciative of what they've written, as I'm appreciative also of the donors, reviewers, source checkers, and editors who have made this volume possible. Most specifically, I thank Allen Wyatt, Godfrey Ellis, Brant S. Gardner, and Rebecca Reynolds Lambert for their dedicated editorial work on the essays and reviews in this volume. Both *Interpreter: A Journal of Latter-day Saint Faith and Scholarship* and The Interpreter Foundation more generally were created and continue to be largely sustained by

10. Brigham Young, *Discourses of Brigham Young*, ed. John A. Widtsoe (Salt Lake City: Deseret Book, 1925), 139, archive.org/details/discoursesofbrig028407mbp/page/138/mode/2up.

11. Young, *Discourses of Brigham Young*, 138.

12. Young, *Discourses of Brigham Young*, 142.

13. To be sure, there have been several authors in the span of sixty-nine volumes, now complete, who do not count themselves among the community of Saints. My comment is not meant to exclude those valuable voices, but to recognize that the vast majority are, indeed, just that—faithful Latter-day Saints.

the devoted contributions of volunteers and unpaid authors. I thank them for all that they do for the Foundation and, for that matter and much more fundamentally, for the Church and the Kingdom.



Daniel C. Peterson (PhD, University of California at Los Angeles) is a professor emeritus of Islamic studies and Arabic at Brigham Young University, where he founded the University's Middle Eastern Texts Initiative. He has published and spoken extensively on both Islamic and Latter-day Saint subjects. Formerly chairman of the board of the Foundation for Ancient Research and Mormon Studies (FARMS) and an officer, editor, and author for its successor organization, the Neal A. Maxwell Institute for Religious Scholarship, his professional work as an Arabist focuses on the Qur'ān and on Islamic philosophical theology. He is the author, among other things, of a biography entitled *Muhammad: Prophet of God* (Eerdmans, 2007).

Interpreter: A Journal of Latter-day Saint Faith and Scholarship is a peer-reviewed academic journal published by The Interpreter Foundation. Our mission is simple: Supporting The Church of Jesus Christ of Latter-day Saints through scholarship.