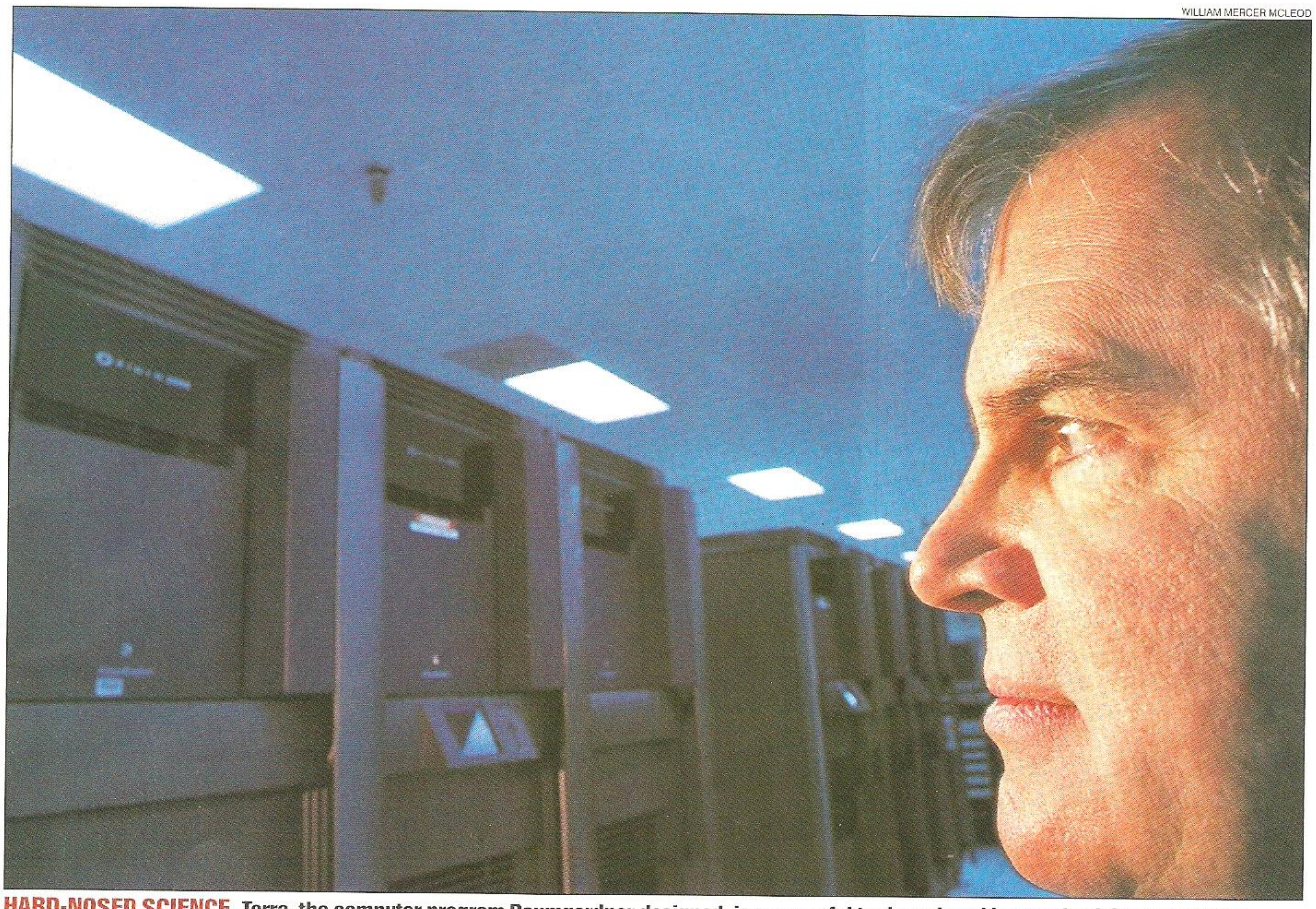
WILLIAM MERCER MCLEOD



HARD-NOSED SCIENCE. Terra, the computer program Baumgardner designed, is a powerful tool employed by geophysicists worldwide.

The geophysics of God

A scientist embraces plate tectonics—and Noah's flood

BY CHANDLER BURR

Up New Mexico's Interstate 25, north of the Precambrian gneiss that towers over the city of Albuquerque, beyond the basement rock of the Rio Grande graben—some of it 65 million years old—you turn west on Highway 4 and into the basalt canyons beneath the Jemez Mountains, created by volcanic explosions that began 1.2 million years ago. At the foot of these extinct volcanoes sits the town of Los Alamos with its National Laboratory of the U.S. Department of Energy.

The supercomputing facility lies behind an immense fence. Inside its doors, signs on the walls direct you to the Theoretical Division, home of a computer program named Terra. Terra was created by a Los Alamos lab scientist, the world's pre-eminent expert in the design of computer models for geophysical convection, the process by which the Earth creates volcanoes, earthquakes, and the movement of the continental plates. Terra is a fascinating program, but what is perhaps most fascinating about it is that it exists because its creator, John Baumgardner, is a fundamentalist Christian who believes, in accordance with the Bible, that the Earth was created by God less than 10,000 years ago.

In fact, Baumgardner created Terra expressly to prove that the story of Noah and the flood of Genesis 7:18—"And the waters prevailed, and were increased greatly upon the Earth; and the ark went upon the face of the waters"—happened exactly as the Bible tells it. Not only did he come up with a tool used by geophysicists around the world but his "numerical code" actually proves the Bible is correct. Or at least in Baumgardner's view it does.

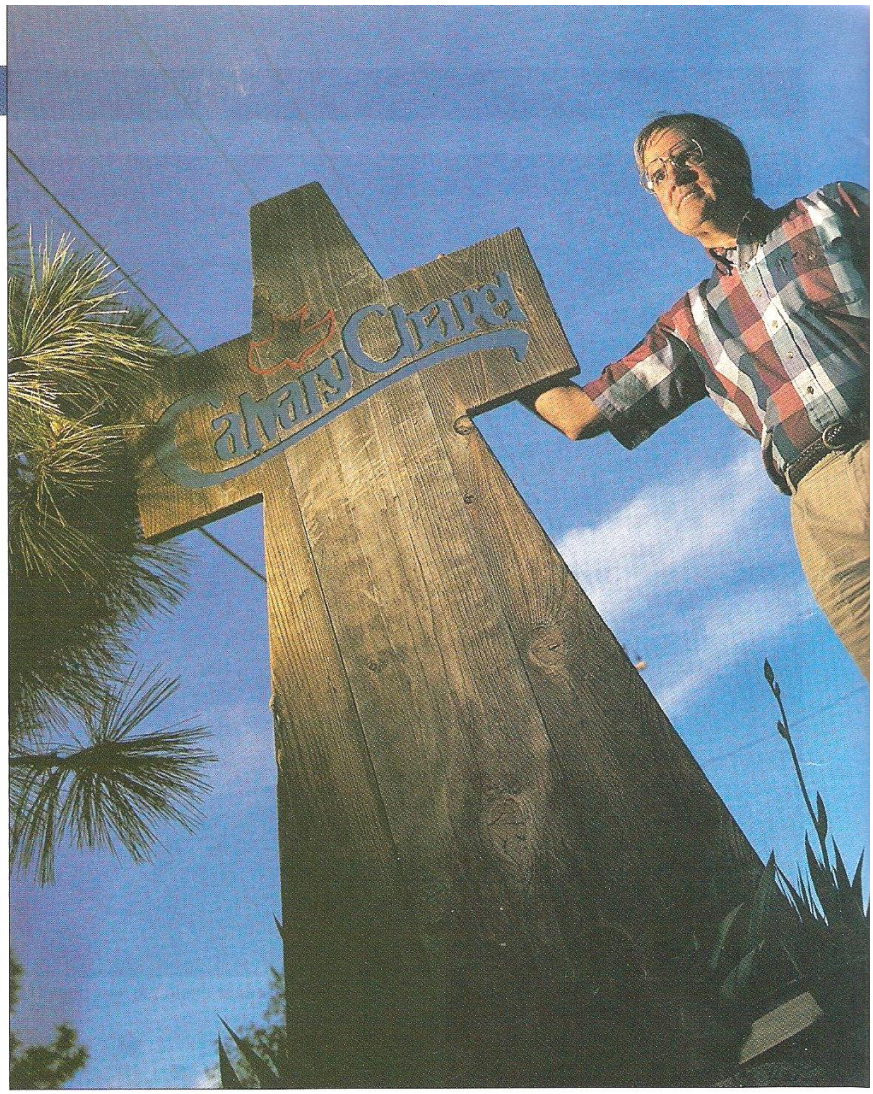
Back to Scripture. The question of origins has bedeviled Western civilization ever since the explanations offered by religion collided with science. Terra is an attempt to reconcile the most literal reading of Scripture with the most advanced science in existence. Written in the computer language Fortran, Terra takes the spatial

volume of the Earth's mantle—2,000 miles of silicate rock that surrounds the Earth's solid iron core—and imagines it as 10 million three-dimensional cells.

The mantle rock is in a solid state, but over millions of years it moves and flows, behaving as if it were a fluid, not a solid. Deeper than 100 miles inside the Earth, rock reaches 70 percent to 80 percent of its melting temperature—between 4,000 and 5,000 degrees Fahrenheit. The mantle rock churns or "convects" for the same reasons boiling water rolls in a pot: Cooler, heavier material (water in the pot, silicate in the Earth) on top sinks while hotter material nearest the heat source (the flame under the pot, the Earth's core) is lighter, and so rises. Terra divides the mantle into hexagonal cells, assigning each one a value for heat, direction, velocity, and other unknowns as if creating 10 million small blocks to make up an immense, three-dimensional Rubik's cube. Terra then "runs" each piece through time and watches where each will go.

Add all the pieces together, and Terra gives you a 3-D map of a huge mass convecting through time. A young computer expert named Jamie Painter last year created a powerful graphical program so that Terra can express in pictures what it is calculating mathematically. On a television in the lab you can watch the stunning images of the planet's interior moving before you. Neon greens and blues representing cooler material swirl with hot yellows and fiery reds inside a sphere, and you see how the mantle has pushed the continents around on the planet's surface from, say, 120 million years ago, during the Cretaceous Period, up until today.

Dramatic conversion. Baumgardner, however, believes that not only the Earth, which most geologists estimate is 4.6 billion years old, but also the universe itself, which astrophysicists peg at around 13 billion years, is actually only a few thousand years old. He did not always take the Bible so literally. Fifty-three years old and 6 feet tall, he grew up on a farm near Lubbock, Texas, the eldest of four children. His father was a professor of animal nutrition at Texas Tech, and his family was, as he tells it, essentially agnostic. But after getting a master's from Princeton in electrical engineering and returning to Texas (he also has a Ph.D. in geophysics from UCLA), he joined a Presbyterian college Sunday school class. "I'd never encountered people who were studying the Bible like one would study any other subject," he says. "It turned out they were studying the Gospel of John in the New Testament, verse by verse, which largely focuses on the question of who is this person, Jesus Christ.



STEELY FAITH. In the town of Los Alamos, Baumgardner attends Calvary Chapel regularly and takes issue with the teaching of evolutionary science in the schools.

And I had to admit that never in my life had I considered that question."

Baumgardner experienced what he calls "a dramatic conversion experience, something I didn't expect. My attitude toward the opposite sex changed significantly. I had been in a rather exploitative mode up to that point. I found that I used to drink to relax and be more friendly with people, and all of a sudden I found myself with a better high than I'd ever known before and I sensed that the alcohol was impairing it. It was like a curtain was pulled back on a dimension, a supernatural dimension, that I'd never known before. It was the biggest discovery of my life."

For the first five years after this epiphany, Baumgardner "didn't give that much attention to the issue of creation. I was well indoctrinated in evolutionary theory." But that changed as he moved deeper into Christianity, which brought him to the "conviction . . . that indeed there had been a major catastrophe in the Earth's past that accounts for a large fraction of the geological features we observe at the Earth's surface today."

Baumgardner believes that around 6,000 years ago, when "God saw that the wickedness of man was great in the Earth" (Genesis 6:5), he caused an enormous blob of hot mantle material to come rushing up at incredible velocity through the underwater midocean ridges. The material ballooned, displacing a tidal wave of sea water over the continents. This, Baumgardner says, was the flood on which Noah sailed, the water covering the mountains and destroying "every living substance . . . which was upon the face of the ground, both man, and cattle." Then, after 150 days (Genesis 7:24), the bubble retreated with equal speed into the Earth, and the continents began re-emerging

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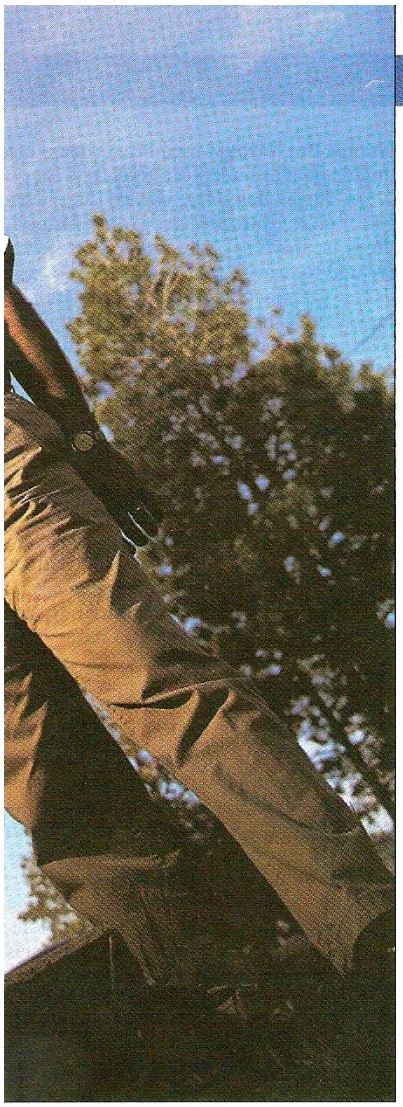


above the water, sending the runoff back to the oceans at around 100 miles an hour. (A very fast river with a huge erosion capacity runs at only about 10 miles an hour.) Baumgardner says that this runoff would have been sufficient to create the Grand Canyon and other massive geologic features and to deposit the various sedimentary layers in about one week.

The science Baumgardner uses to account for these extraordinary happenings is a sort of niche physics called runaway subduction. A theory proposed in the 1960s under another name by a physicist at General Electric, runaway subduction posits that the potential energy in the cold, heavy crust of the Earth is like the potential energy in a rock held above the ground. Drop the rock, and its potential energy is turned by gravity into kinetic energy, and into heat when it hits the ground. As gravity pulls the rock, so it pulls the gigantic, heavy plates of ocean floor under the continents into the hotter, lighter mantle, which is silicate rock.

As the plates deform the surrounding rock, the mechanical energy of deformation is converted into heat, creating a superheated "envelope" of silicate around the sinking ocean floor. Silicate is very sensitive to heat, so it becomes weaker, allowing the plates to sink faster and heating the envelope still further, and so on, faster and faster. As the plates pull apart, the gap between them grows into a broadening seam in the planet. This sends a giant bubble of mantle shooting up through these ridges. Which displaces the oceans. Which creates a huge flood. Which sets to floating a small, gopher-wood ark containing one human family and every animal, two by two.

By the numbers. Terra proves that this is true—or, more precisely, that it *could* be true, provided one accepts certain assumptions. Run Terra one way, and you can watch Noah's flood take place before your eyes, mathematically calculated by a supercomputer. Run Terra another way, and you get the standard geological story of 4.6 billion years. The results obtained from the code are—as Baumgardner readily points out—dependent on the numbers fed into it in the first place.

Almost all physicists calculate the age of the planet at 4.6 billion years because they assume that mantle viscosity—a measure of the rock's liquidlike flow—has been consistent throughout time and so use the value that applies today. They add other ingredients like the speed of the tectonic plates—measured, for example, by the displacement across the two sides of the San Andreas fault—and arrive at the conclusion that one full deformation cycle of the mantle occurs about every hundred million years, giving the 4.6 billion figure. But Baumgardner says scientists wrongly assume that geology happens consistently, that there could have been no catastrophe, no Noah's flood. "If you look at the geological record," he insists, "there are fingerprints of catastrophe everywhere one looks."

Baumgardner offers the following physical evidence for his views: He notes, first, that different radiometric dating methods give vastly different ages. To date rock, geologists commonly use three types of unstable (radioactive) "parent" isotopes—samarium, rubidium, and potassium—which decay into stable "daughter" elements: neodymium, strontium, and argon. The rates of decay of these elements are well known, and thus the ratio of parent-to-daughter elements in a rock reveals its age. But different isotopes yield different dates for the same rocks. As an example, Baumgardner points to

the Cardenes basalt, a Precambrian volcanic rock found in the Grand Canyon's inner gorge. He says the rock has been dated at 1.7 billion years using samarium, at 1.1 billion years with rubidium, and at 0.7 billion years with potassium. "All I'm saying as a scientist," says Baumgardner, "is that there's reason to question radiometric measurements."

He also cites several odd features about the layers of the sedimentary record, such as the common geological feature of erosional channels, like the sunken rivers running through Zion National Park. The walls of these channels, created by rainwater eroding uplifted terrain, show the cross sections of sedimentary layers laid down over millenniums. But while the evidence of erosion and sedimentation is all around (the Mississippi Delta, the Ganges taking soil from the Himalayas), surprisingly few erosional channels can be seen in the sedimentary layers themselves. "In my opinion, the present is emphatically not the key to the past as far as the geological record goes," Baumgardner says.

Fossil record. Another piece of evidence he points to is the fact that coal—fossilized plant matter—is found in concentrated seams rather than spread out, as forests generally are. This indicates to Baumgardner that a huge mass of water—a flood—swept floating trees together, depositing them in thick layers. He points out that the sedimentary layer in the Grand Canyon known as the "Tapeat sandstone," which contains the first evidence of multicellular life (trilobite trackways), also contains evidence of catastrophic violence. Baumgardner believes this layer marks the beginning of the Genesis flood, which killed every antediluvian creature, including the dinosaurs, which were not saved by God in Noah's ark. (Baumgardner believes that humans and dinosaurs coexisted before the flood and, citing Job 40-41, believes in fire-breathing dinosaurs—what we would call dragons.) This layer is the location of the Cambrian explosion—the fossil record of a sudden burgeoning of life, with almost every phylum represented, from starfish to vertebrates to arthropods.

Among geologists, there is universal agreement that Baumgardner's views are simply wrong. The fact that the sedimentary record contains anomalies is unremarkable, they say. There are always anomalies. The real debate is about physics and belief. Runaway subduction, these scientists add, requires the suspension of the most basic laws of physics. The theory requires a *Through the Looking Glass* world where nothing is as it seems and no scientific principle—from gravity and electromagnetism on down—exists as it exists today. Baumgardner himself says, "The only way to square the radiometric data with a flood that caused all these changes is to conclude that one aspect of the catastrophe was rapid radioactive decay." But what this means is that for a few years the universe behaved completely differently, compressing processes which now take millions of years into merely days.

This is not impossible. It just contradicts almost every existing piece of evidence. Brad Hager, a Massachusetts Institute of Technology geophysicist, notes that the time scale of the Earth is determined by how fast rocks conduct heat, or "thermal diffusivity." "If you were to choose," says Hager, "to believe that by some miracle the diffusivity of the Earth was different before we learned to measure it, then you could speed up these calculations. But it would mean that rocks conducted heat differently in the past."

Yet Hager has only respect for Baumgardner's computer program. Indeed, there is universal agreement that Terra, created to prove the Bible literally true, is one of the most useful and powerful geological tools in existence. "Baumgardner is seen as one of the world leaders in numerical models of mantle convection," says Hager. Agrees Gerald Schubert of the University of California–Los Angeles Department of Earth and Space Sciences: "As far as the code goes, Baumgardner is a world-class scientist."

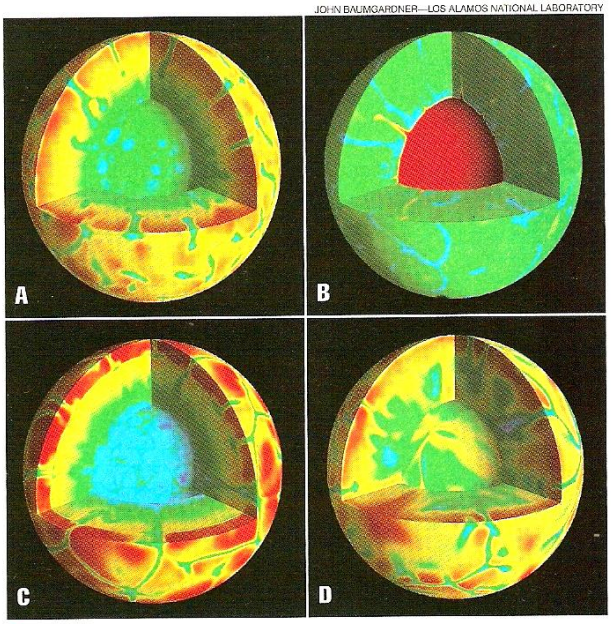
Baumgardner the Christian is well known in Los Alamos. Most people shake their heads wryly or with open irritation at the mention of his name. Abe Jacobson, an atmospheric scientist, says Baumgardner is "known here in the Los Alamos community as a Christian rabble-rouser. My wife is a schoolteacher here, and Baumgardner regularly takes issue with the teaching of evolution in the public schools, but personally he is nice enough."

Baumgardner the scientist, however, is accepted completely among scientists, perhaps because he so easily maintains what Jacobson calls his "disconnect." He does not push his religious views on his colleagues. "I've never become personally involved in these issues," says Hager. "I avoid discussing the topic with John."

In Los Alamos, Baumgardner, his wife, Jean, and their daughter regularly attend Calvary Chapel, which sits atop a mesa over the Rio Grande. Most members of the church believe, as Baumgardner does, that God created the river around 6,000 years ago. Terra can prove this for them. Or it can prove that the ancestral Rio Grande flowed massively across this plain in the late Tertiary Period, between 2 and 5 million years ago.

One can look down at the river from Calvary Chapel's mesa and believe whatever one wants to about it. Belief does not need the blessing of science. But to John Baumgardner, both a Christian and a scientist, apparently it does. ■

JOHN BAUMGARDNER—LOS ALAMOS NATIONAL LABORATORY



A. Terra models thermal convection of the Earth's mantle over time and can calculate its past and future, representing the flow graphically. B. In this frame, Terra adds heat from the Earth's core to the equation. C. Here, the program takes into account increasing pressure at greater depths inside the Earth. D. The model can also add the variable of density or strength, which increases with depth.

Chandler Burr is a contributing editor and author of A Separate Creation: The Search for the Biological Origins of Sexual Orientation *(Hyperion, 1996).*