ASTROPHYSICIST_RICHARD A. MULLER

One Disaster after Another

The father of the idea that a sibling of the sun periodically wreaks havoc on Earth finds inspiration in catastrophes

BERKELEY, CALIF.—I first meet Richard A. Muller during a record-breaking heat wave. The astrophysicist is on his way to get a refreshment. Bottles of his favorite cold dairy drink—mocha milk—are stacked in a nearby vending machine. Through the clear front, the scientist notices something out of place: a juice can trapped obliquely against the glass. "I'll get either two drinks or none," he predicts playfully, inserting his change and selecting the beverage he thinks is most likely to knock the can free. Muller is unconcerned (or perhaps oblivious) that this selection is vanilla, not the flavor he came for. His purchase grazes the target but fails to knock the bottle down.

Gambles like this one typify the life of Richard Muller—although usually the stakes are higher. The restless researcher loves to prowl for new scientific territory to conquer. "You need to have one interesting idea every day," he says. His graduate research concerned particle physics, but his accomplishments range from inventing an improved technique for carbon dating to designing an experiment for measuring the cosmic background radiation left over from the big bang about 15 billion years ago.

These and other accomplishments won Muller a MacArthur Fellowship in 1982, a year after these so-called genius awards began. It was a turning point. After that, Muller felt liberated to do "crazy things," as he puts it. "Just like James Bond has a license to kill, I had a license to depart from the normal path of a scientist."

RICHARD A. MULLER: SCIENTIFIC FREE SAFETY

- ***Born in New York City, 1944; wife, Rosemary, heads architectural firm; two daughters, Betsy and Melinda***
- ***Published novel on the life of Jesus, providing commonsense explanations of miracles (water walking done by surreptitious use of a submerged dock, for example)***
- ***Invention in progress: A way to spray water 10 kilometers or more to extinguish fires***
- ***Professional philosophy: "My best achievements have come when I strike out and do something crazy"***

EDWARD CALDWELL

On the surface at least, he fits the stereotype of a scientist. He will head to the lab in the middle of the night when an idea strikes him. His cluttered office, which overlooks the Berkeley campus of the University of California, where he has been since he received his Ph.D. in particle physics here 32 years ago, could be a set from an absentminded-professor comedy. There's hardly enough floor space for a visitor amid filing cabinets and desks and cartons overflowing with journals and papers. His in-box groans under a two-foot-high stack. "My research has been one disaster after another," Muller puckishly offers. This well-rehearsed line is quite literally true. He did work on the big bang. He studied the violent supernova explosion preceding the creation of the sun. And then there's his Nemesis.

"Nemesis" refers to a seemingly bizarre hypothesis concerning the evolution of life on Earth. Muller hatched it one day in 1983 when his mentor, Nobel laureate Louis Alvarez, enlisted the young physicist to debunk a research paper showing that Earth has sustained significant plant and animal extinctions at regular intervals—every 26 million years. Alvarez and his son, Walter, had recently advanced the theory that dinosaurs were the casualty of a Mount Everest–size comet that hit the planet 65 million years ago. At the time, the hypothesis was scoffed at; now it is generally accepted. Playing devil's advocate for Alvarez, Muller conjured up a scenario. Suppose, he suggested, the sun has a sibling around which it do-si-dos every 26 million years. And suppose that once each revolution the star swings through the Oort cloud, a calving ground for comets between four trillion and 10 trillion miles from us. Perhaps some of those icy balls, of which there are billions, would be knocked off-kilter and sent hurtling into Earth.

At first the idea seemed preposterous, even to Muller himself. But neither Muller nor Alvarez could think of any reason why the theory couldn't be true. With a touch of whimsy, Muller dubbed the star Nemesis, after the Greek goddess who fends off human folly. "We worry that if the companion is not found," he stated in the scientific article introducing the theory, "this paper will be our nemesis."

It seems counterintuitive that the solar system could be looping around an unknown star, but in fact most stars have partners: some 85 percent have some kind of companion. The only way to identify which, if any, of the catalogued stars is the sun's sibling requires measuring the distances to them. Muller says the elliptical orbit of Nemesis would get no farther than about 18 trillion miles from Earth, about three light-years away and three quarters the distance to the closest known star, Alpha Centauri. It could be a red dwarf star, which might be bright enough to be seen with a small telescope, or, less likely, a brown dwarf, which might not be visible at all.

When he dreamed up the theory nearly two decades ago, Muller thought he would locate Nemesis in just a few years. Given its putative distance and brightness, it should be easy to find such a star through parallax measurements—seeing how it shifts against the more distant stellar background as Earth moves along in its orbit. But the search, short on funds for telescope time, languished and stalled. Muller says most astronomers think his theory was disproved, when in fact it is simply in limbo.

It is no coincidence that so much of his career has been spent studying such tumultuous events. For centuries, scientists have predicated theories about Earth's evolution on the principles of uniformitarianism and gradualism, which posit that by and large the planet evolved slowly, relying on the same forces we see at work today, such as erosion and continental drift. Muller, however, believes infrequent, violent events are just as important—a doctrine some call catastrophism. Muller says neglect of catastrophic explanations gives him a strategic opportunity: "That's where the discoveries are."

Most recently, Muller has begun delving into the ice ages. Geologists still have a hard time explaining why they come and go. Muller insists the answer is of much more than academic interest. Springing from his office chair, he heads to a blackboard in an adjoining room—he couldn't locate any chalk in his office—and sketches a graph of global temperature since the industrial revolution. Overall, global temperature has gone up about 1.5 degrees Fahrenheit in the past 120 years—and 15 to 20 degrees since glaciers

INVADING ICE, from this January 1929 issue of *Amazing Stories*, sparked a young Muller's interest in ice ages.

receded 12,000 years ago. "Anything that can have an impact of 15 degrees is probably having an impact on the present climate," he reasons.

Ice ages come and go at approximately 100,000-year intervals. The conventional explanation, refined and popularized by Serbian mathematician Milutin Milankovitch in the decades before World War II, involves subtle irregularities in Earth's motion. The theory mainly posits that the eccentricity, or out-of-roundness, of Earth's orbit varies the amount of sunlight bathing our planet.

Painstaking reconstructions of Earth's past movements show that the planet's orbit around the sun goes from almost perfectly round to slightly oval and back in 100,000 years, matching the interval between ice ages. But there are problems. For instance, the modest change in orbital eccentricity does not make nearly enough difference in sunlight reaching Earth to produce ice ages. Another problem is that some ice ages appear to have begun before the orbital changes that supposedly caused them.

Although adherents think that more research will explain such conflicts, Muller believes the textbook Milankovitch theory is hopelessly flawed. His own answer rests on a different aspect of Earth's orbit: Imagine the solar system is a vinyl record. Earth travels precisely on the record, called the ecliptic, only some of the time. At other times, the orbit is inclined a few degrees to the disk. Over a 100,000-year cycle, Earth's orbit begins in the ecliptic, rises out of it, then returns to where it started. This slow rocking, Muller proposes, is responsible for Earth's ice ages. He says the regions above and below the ecliptic are laden with cosmic dust, which cools the planet.

Muller's inclination theory got a shot in the arm in 1995, when Kenneth Farley, a geochemist at the California Institute of Technology, published a paper on cosmic dust found in sea sediments. He began the research expecting to give Muller's theory a knockout punch but discovered that cosmic dust levels do indeed wax and wane in sync with the ice ages.

But most researchers seem to echo the sentiment of Wallace Broecker, a geochemist at Columbia University, who thinks Muller is fooling himself. In 1996 Broecker brought a group of top-flight climate researchers together to hear Muller's theory. He says they found the presentation "riveting," but "they didn't buy it."

"There's no mechanism attached to the idea," states Nicholas J. Shackleton, a marine geologist at the University of Cambridge and a leading proponent of the Milankovitch theory. He questions how small changes in interplanetary dust could result in effects as dramatic as the coming and going of ice ages. Muller responds that dust from space influences cloud cover on Earth and could have profound climatic implications. He says his theory, if viewed objectively, does just as well at explaining the facts as Milankovitch's.

Referring to football, Muller calls himself a free safety of science, a generalist who scores intellectual touchdowns because he is unrestrained by questionable preconceived ideas. "Every once in a while there's a fumble" that no one notices, Muller says, "and I can grab that ball and run into the end zone." *—Daniel Grossman*

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