

S. Warren Carey Rogue Scientist from Down Under

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Most of us would like to think that fact not dogma governs scientific research. But if Australian geologist S. Warren Carey is right, dogma and not fact dominates the science of continental drift. The dogma affirms that the earth's size has remained constant throughout the planet's history. The facts suggest otherwise. In his book *The Expanding Earth* (1976), Carey argues that the earth is doing just that – expanding – and he backs up his thesis with a mountain of evidence. Carey maintains that earth expansion is the fundamental cause of continental drift. He therefore rejects Plate Tectonics, the most widely held drift theory, and he is particularly critical of subduction, a hypothetical process essential to Plate Tectonics but one for which the evidence is at best equivocal and at worst absent. A basic tenet of current drift theory, subduction is dismissed by Carey as a myth that exists “only in the minds of its creators.”

According to Plate Tectonics, new crust is constantly being added to the earth's surface through a process known as seafloor spreading. The creation of new crust via seafloor spreading produces a net increase in the earth's surface area. In order to accommodate seafloor spreading without increasing the earth's total surface area, subduction was proposed as a means of eliminating crust from the earth's surface as quickly as it is formed. Subduction is believed to occur when two plates collide and overlap: one of the plates slides beneath the other and sinks back into the earth's interior. For every square mile of new crust created by seafloor spreading, an equal amount of old crust is consumed by subduction. Without subduction or some other crust disposal mechanism, seafloor spreading would cause an increase in the earth's total surface area and the earth would expand. By subtracting crust as quickly as it is added, subduction enables seafloor spreading to take place on a constant-sized earth.

The plate model – the production of new crust via seafloor spreading offset by the subduction of old crust – works well in principle and seems to account for the dynamics of continental drift. But the model runs into all sorts of problems when it is applied to the real world. These problems are particularly acute in places such as California where spreading and subduction are both believed to occur. To Warren Carey, this situation defies belief: “the notion of a spreading ridge crabbing obliquely down its own subduction sink under California, while continuing to excrete towards the Pacific but swallow from the Atlantic, is as hallucinatory as a maw vanishing into its own anus, or really the reverse, if that is any easier to conceive.”

Seafloor spreading, the process that created the Atlantic and separated the New World from the Old, is well established and universally accepted. Subduction is a different story altogether. Scientists can find little direct evidence of subduction, such as debris scraped off subducted plates in the Peru-Chile Trench and other “subduction zones.” Although absence of evidence is not necessarily evidence of absence, the facts that are known belie subduction. Oceanic trenches, the primary “subduction zones,” were formed by crustal extension and thinning, and not by compression as predicted by the subduction hypothesis. At the continental margins, subducted plates are supposed to slide beneath the continents. Yet the continents are wedded to the underlying mantle down to a depth of 200 miles. Carey calls the marriage of subduction to seafloor spreading a “shotgun wedding.” Imposed by dogma but at variance with the facts, “the case for subduction reduces to the faith that it is so.”

Ironically, Carey himself conceived of subduction in the late 1940s, years before it became fashionable. In its wisdom, the American Geophysical Union rejected the paper because the idea of subduction was considered “naive.” After subduction had become the rage in the 1970s, Carey, by then one of its critics, tried to resubmit his faded manuscript but to no avail. Once rejected, a paper would not be considered again for publication. A bemused Carey, who envisioned subduction at a time when few geologists even accepted the idea of continental drift, no longer believes in subduction. Subduction is superfluous on an expanding earth. Since the earth's surface area constantly increases, there is no need to offset the production of new crust. Hence there is no need for subduction.

A retired geology professor and a past president of the Australia-New Zealand Association for the Advancement of Science, Samuel Warren Carey conceives of continental drift as a direct and unavoidable consequence of earth expansion. According to Carey, the earth 200 million years ago was only a fraction of its present size. This smaller earth was completely enclosed by what we today call Pangaea, the ancestral supercontinent. Expansion split the earth's old crust (Pangaea) into two halves, Laurasia and Gondwana, and subsequently into numerous smaller pieces, the present-day continents. The isolated chunks of the earth's old crust “drifted” apart as newly formed crust, the modern oceans, emerged between them. In Carey's view, the continents are the shattered remnants of the earth's old crust from a time in the distant past when the earth was smaller than it is today.

Earth expansion as a possible cause of continental drift was first proposed as early as 1927; however, Carey did not endorse the idea until the late 1950s. For twenty years, he tried but failed to reconstruct Pangaea on a present-sized earth. No matter how Carey arranged the continents, huge gaps, which he called “gaping gores,” appeared between regions tied together by the local geology. “Again and again over the years,” Carey recalls, “I assembled Pangaea but could never attain a whole Pangaea without gaping gores which I knew to be false artifacts.” He could reconstruct parts of Pangaea but never the whole thing. Years of frustration tempted Carey to abandon his project. But in the end, Carey's zeal for accuracy paid off: “It was not my method that was at fault but my implicit assumption that the earth of Pangaea was the same size as the earth today. The assembly of Pangaea was not possible on an earth of present radius, but on a smaller globe... these difficulties vanished.” Freed from his prejudice, Carey actively explored the earth expansion hypothesis and found that it solved “many hitherto puzzling features of global tectonics.”

One of the “puzzling features” solved by earth expansion is the Pacific Paradox. Everyone agrees that the Atlantic, Indian and Arctic Oceans began forming after the breakup of Pangaea 200 million years ago; the continents are drifting away from those oceans. The Pacific, towards which the continents are presumably drifting, should have shrunk in size by the combined areas of the new oceans. Yet the circumference of the Pacific has not decreased, as it should have were the continents converging on that ocean, but has actually increased by nearly fifty per cent. According to Carey, “It is clearly impossible for the Pacific to reduce in area to about half, while its perimeter is increased by half.” The growth of the Pacific is topologically impossible on a constant-sized earth. Indeed, R. Meservey, writing in *Science* magazine, argued that this conclusion holds irrespective of any possible subduction around the Pacific perimeter.

“The only hypothesis that has been suggested thus far that resolves [this] paradox... is that in the past the earth's interior has expanded considerably.”

The Arctic Paradox implies that North America and Eurasia are each drifting away from the Arctic Ocean and towards it at the same time. Tectonic evidence indicates that seafloor spreading in the Arctic is pushing North America and Eurasia, the continents bordering that ocean, to the south, away from the Arctic. Conversely, pale climatic evidence indicates that North America and Eurasia were nearer the equator in the past than they are today, suggesting that these two continents are drifting north, towards the Arctic. How can North America and Eurasia drift away from the Arctic and yet be closer to it? On a constant-sized earth, they cannot. Carey maintains that “the only possible solution to this paradox is global expansion.” Seafloor spreading in the Arctic is pushing North America and Eurasia to the south. The continents apparent northward drift is actually the southward drift of the equator caused, Carey claims, by an earth expanding faster in the southern hemisphere than in the north. “The overall pattern of expansion is clear. Although the Arctic has opened, the much greater expansion of the southern hemisphere has caused the parallels to sweep [south] across North America and Eurasia.”

Carey points to the Arctic and Pacific Paradoxes as proof positive of earth expansion. “The convergence of the continents on an expanding Arctic, and the convergence of the continents on an expanding Pacific, are only possible on a grossly expanding globe.”

Nevertheless, most scientists reject Carey's theory. Critics cite two arguments in particular against earth expansion. First, as the earth expands, its daily rate of rotation should slow down. Based on counts of growth-lines (much like tree rings) in fossil corals and other invertebrates, critics claim to have proven that the earth's rotation rate has changed very little over the past 400 million years. Carey disputes this conclusion: he points out that the experts themselves cannot agree on the meaning of the fossil growth-lines. “The interpretation of counts in fossil shells would seem to depend on the answer hoped for by the investigator.”

The second criticism is based on paleomagnetic studies. Paleomagnetic data from a single continent for a single geological period are combined in pairs to calculate which paleoradius produces the “minimum scatter” of magnetic poles. This statistical method appears to rule out any change in the earth's size. But Carey rejects these findings because “the method contains an inherent fallacy such that on an expanding earth, the minimum scatter would always appear at that radius on which the field measurements are made,” which is to say, the modern radius. He maintains that the practitioners of this method oversimplify the geometrical complexities of an expanding sphere, which nullifies their results. Carey therefore dismisses the minimum scatter of poles as little more than “statistical hocus-pocus... backed by computer authority.”

Despite Carey's criticisms, these arguments are frequently cited as conclusive proof against earth expansion. In a recent study published in the British journal *Nature*, M. W. McElhinny used the minimum scatter method to disprove earth expansion once-and-for-all. But not everyone is convinced. “The fact is,” wrote Peter Smith in his commentary on McElhinny's article, “whether Carey is right or wrong [about expansion] his criticism [of the minimum scatter method] exists and apparently has never yet been refuted explicitly.”

Why then does the scientific establishment discredit Carey's ideas? A hint at the real answer may be found in a review of Carey's book. Published in *Science* and entitled "A Minority View in Geophysics," the review begins "The idea of significant expansion of the earth is anathema to most earth scientists, but not to S. Warren Carey, who has advocated it for a long time." The evidence is not disputed; neither is the logic. Rather, it is the idea that is "anathema." Are ideas rejected simply because they are distasteful or unorthodox? Alas, they often are, even by the greatest scientists.

Galileo risked his life before the Inquisition in defense of the heliocentric theory of Copernicus. Yet he never accepted Kepler's discovery that the planets follow elliptical orbits around the Sun. Galileo, one of the most enlightened thinkers of all time, firmly believed in an ancient Greek dogma that held that all natural motion – including planetary motion – is necessarily uniform and circular. He therefore rejected Kepler's evidence because it conflicted with this archaic principle. In choosing dogma over facts, Galileo was compelled to invoke epicycles to "save the appearances" of planetary motion.

The situation today is analogous. Continental drift triggered a Copernican revolution in the earth sciences. Yet many of the "revolutionaries," despite being first-rate scientists, refuse to take Carey seriously because of their devotion to the dogma of a constant-sized earth. Belief in this dogma compels these latter-day Galileos to embrace subduction – the modern equivalent of the epicycle – in order to "save the appearances" of continental drift on a constant-sized earth. Continental drift has revolutionized our ideas about the earth. But if Warren Carey is right, the revolution has just begun.