



**Geological Society of America
Structural Geology & Tectonics Division**

**2009
Best Paper Award
Presented to Brian Atwater**

Atwater, B.F. (1987) *Evidence for great Holocene earthquakes along the outer coast of Washington State*. Science 236, 942-944.

Citation by Darryl Cowan

I want first to review what Brian wrote in his paper, which is barely 2 ½ pages long, including three figures and references, and then tell you why I nominated it.

Brian acknowledged that he was not the first person to recognize coseismic subsidence and uplift accompanying major earthquakes at convergent margins. However, he wrote that he was the first to, and I quote, “consider Cascadia’s seismic potential in light of geologic evidence for recurrent coastal subsidence.” He included a figure showing where he predicted subsidence would be observed, and he went to look. Armed with the most sophisticated geological tools—a canoe and a spade and almost certainly a hand lens—he found and documented evidence in several estuaries for recurrent and rapid subsidence of vegetated coastal lowlands, which he argued was cyclical and very likely coseismic rather than interseismic. Moreover, he found sandy layers mantling some of the buried lowland deposits, which he presciently and correctly interpreted as having been deposited by earthquake-related tsunamis. He concluded that six great earthquakes had affected the Willapa Bay estuary since 7000 ybp. Recognizing that the size of the earthquakes would have been directly related to the length of the ruptures, and he proposed that other stretches of the coast be investigated for similar evidence.

Why did I nominate this paper? Brian uses an oblique reference to baseball and I’ll do the same. Most or all of us here tonight love what we do, and we want to tell our colleagues by presenting talks and posters at meetings like this one and by publishing. Every so often someone here hits a home run: presents a talk or writes a paper that attracts the attention of the structure-tectonics community, just as a real home run immediately galvanizes the fans and sometimes even wins a game. Home runs are much less frequent than base hits, and grand slams even more rare. Brian hit a grand slam. Simply stated, his paper changed the way we have thought about and investigated a significant tectonic problem that also happens to be of great societal importance to those of us living in the Pacific Northwest and the US and Canada as a whole. His paper immediately redirected the efforts of a wide spectrum of research scholars in unanticipated ways, and has led to: further investigations of subsidence along the coast; dating tree rings in a drowned forest that enabled Brian and colleagues to show that the last mega-earthquake occurred at about 9 p.m. on January 26, 1700; and I would claim also led to greatly enhanced geodetic and seismological studies of what we thought was a pretty ordinary region, seismologically speaking.

I’ll close with two more personal comments. As you all recognize, we are sitting tonight on the hanging wall of the Cascadia megathrust. Now, as a resident of Seattle, I kind of wish Brian had never gone to Willapa Bay so we all could have continued living in our naïve ignorance about giant earthquakes. But in truth, his paper and continued work heralded the dawn of a new era of public awareness about the seismic hazards in the Pacific Northwest. Finally, I want to emphasize again that the foundation of this singular contribution was Brian’s skills as an observer. He used the simplest of tools: his mind and his eyes. For me, no paper better illustrates the power and importance of working in the field.

Response by Brian Atwater

Please accept three tokens of thanks to the Structural Geology and Tectonics Division, and to Darrel Cowan. Let’s call these tokens Mission Theater, Left Field, and The Supply System.

Mission Theater: Professor Cowan excused my absence tonight so I can have a beer at a nearby pub. The beer counts as public outreach thanks to GSA and the Oregon Museum of Science and Industry, or OMSI. OMSI sponsors informal public talks in a series known as Science Pub. GSA teamed up with OMSI for this week's Science Pub, which focuses on Oregon earthquakes. I signed on as a speaker back in March, before Michelle Cook and Claudia Lewis told me of the Best Paper Award. The venue, formerly a church and a union hall, now serves "pub fare and handcrafted ales, wines, and spirits." These accompany movies and the occasional OMSI talk. At the moment I'm probably setting the stage for the next speaker. She'll be describing a program to reinforce Oregon schools against earthquakes bigger than those for which they were designed. The Cascadia subduction zone is the main source of those earthquakes.

Left field: Though the findings in tonight's paper may seem to have come from an unexpected direction, a journal referee saw them otherwise. He or she rightly described the paper as using old methods to help solve an interesting problem. Tidal marshes weren't all that far out in left field, even in 1985. That October a dry public gathering on earthquake hazards took place in a Seattle hotel ballroom. A USGS group was staging the launch of a multi-year study of the region's seismic hazards. A great subduction earthquake had just killed nearly 10,000 people in Mexico City. Could Cascadia do that kind of harm in Seattle? I attended as a newcomer. The USGS had recently helped me move to Seattle for care of a disabled daughter. The geology department of the University of Washington had given me office space, library privileges, and entrée to the university's Earth-science community. Perhaps nobody in that ballroom expected tidelands to reveal Cascadia's earthquake and tsunami history. Yet many surely knew that intertidal evidence—raised barnacles, submerged spruce—had largely revealed the tectonics of the 1964 Alaska earthquake, even before "plate tectonics" was coined. Furthermore, geologists had already documented stratigraphic records of the 1964 earthquake and of the 1960 Chilean tsunami. Geophysicists in the ballroom were asking questions that these kinds of geology could, and would, largely answer.

The Supply System: Tonight's paper got published a few months after it failed as a project proposal. In this backstory, discoveries about Cascadia's earthquake hazards are hastened by the ambitions of the Washington Public Power Supply System, or WPPSS, and by the vigilance of the Nuclear Regulatory Commission. WPPSS in the 1970s had undertaken the construction of five nuclear-power plants. At the time, the Cascadia subduction zone was seen as dead or benign. Two of the plants, near Satsop, were sited 50 km from the Washington coast. With the Satsop plants and one or two others in mind, the NRC supported research into Cascadia earthquake hazards. The first recipient, a seismologist, encouraged me in 1986 to propose follow-up work based on the findings in the paper cited tonight, which was then in manuscript form. The NRC at first declined my proposal for lack of objectivity. From left field I was promising estimates of how big Cascadia's great earthquakes can get and how often they happen. But the NRC soon reversed this decision and proceeded to support radiocarbon dating that eventually helped link Cascadia to a far-field tsunami in Japan. That link, strengthened by the findings of tree-ring scientists in North America, gave an exact date (26 January 1700) and an approximate size (magnitude 9) for Cascadia's most recent great earthquake.

Clues to the 1700 Cascadia earthquake and its predecessors have been coming to light for decades and continue to be found. They result from the efforts of a great many people and organizations, the unsung heroes behind tonight's award.