

The  
Great *Columbia* FLOOD



**N**ext to the Columbia River, south of the Yakama Indian Reservation in Washington, sits a little park near the community of Roosevelt. On the grass rests an angled boulder half the size of a Volkswagen Beetle. A sign before this rock explains that it originated upriver but was transported downstream thousands of years ago by the Spokane Flood. This makes it an “erratic,” one of many displaced boulders scattered throughout the Columbia River Gorge and across the landscape stretching from Lake Pend Oreille in Idaho south to Eugene, Oregon.

An inspection of these erratics made one geologist particularly curious. What forces, he asked himself, were strong enough to carry rocks, some weighing 200 tons and the size of a master bedroom, hundreds of miles from their point of origin? This geologist was J. Harlen Bretz, a Seattle schoolteacher who left his job to study for a doctorate in geology at the University of Chicago. In the summer of 1922 he returned to the Pacific Northwest—to eastern Washington—to perform field research. For seven summers Bretz continued this work, picking at rocks and crystals that kept him curious about what forces wrenched this land into its convoluted shape. Bretz named the gnarled geology of eastern Washington the Channeled Scablands, describing it thus: “Like great scars marring the otherwise fair face of the plateau are these elongated tracts of bare, or nearly bare, black rock carved into mazes of buttes and canyons.” John Elliot Allen and Marjorie Burns recount his adventures in their book, *Cataclysms on the Columbia*:

*Bretz’s earliest investigation was all by foot; he could not at first afford a car; but even later, when he acquired an early model, enclosed-body Dodge, much of the Scablands was nonetheless inaccessible to motor vehicles. Either way, by foot or car, Bretz and his party (typically composed of wife, son, daughter, collie dog, and a collection of students) were primarily limited to sighting across the broken and fragmented expanse of the Scablands.*

Without the aid of satellite photographs, Bretz used his memory and field notes to piece together an overview of eastern Washington’s features. The more he looked at dry waterfalls and channeled topography, the more convinced he became that this region once hosted a natural catastrophe of epic proportions.

Several things led him to this conclusion. Bretz wondered why canyon mazes were braided throughout the Channeled Scablands. Erosion was too slow to have created their appearance. Rivers usually munch away at their beds and banks, cutting downward to form a single, deepened channel as their path. But the scablands looked too rough, gouged, and slipshod to be caused by simple erosion. The land appeared as though carved by some quick, strong, sloppy force.

With maps in hand, huffing over this bizarre landscape, Bretz also inspected potholes such as those at Quincy Basin near Grand Coulee. When a river rushes, it carries stones that swirl around eddies, eroding surrounding rock and eventually creating bowl-shaped depressions. Bretz was acquainted with such potholes. But their dimensions in eastern Washington—acres in size—were outrageous. Again, Bretz wondered what mighty force could have created them.

## An Epic Geologic Event that Shaped Landforms and Ideas

BY TOM MULLEN

**OPPOSITE PAGE:** Harlen Bretz coined the term “scablands” to describe the channeled gorges in eastern Washington that were carved by a massive flood.

**BELOW:** Erratics are boulders that did not originate where they are found. The Bretz floods slammed boulders, such as the one in the photograph, dozens of miles downstream from their point of origin.



Bruce Bjornstad photo

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*Dry Falls at Grand Coulee, was a three-and-a-half-mile-wide cataract with a 400-foot drop—the largest waterfall known to have existed on earth. Violent floods that hacked out the scablands carried such immense quantities of water that they carved huge depressions out of the basalt, some of which later became lakes.*

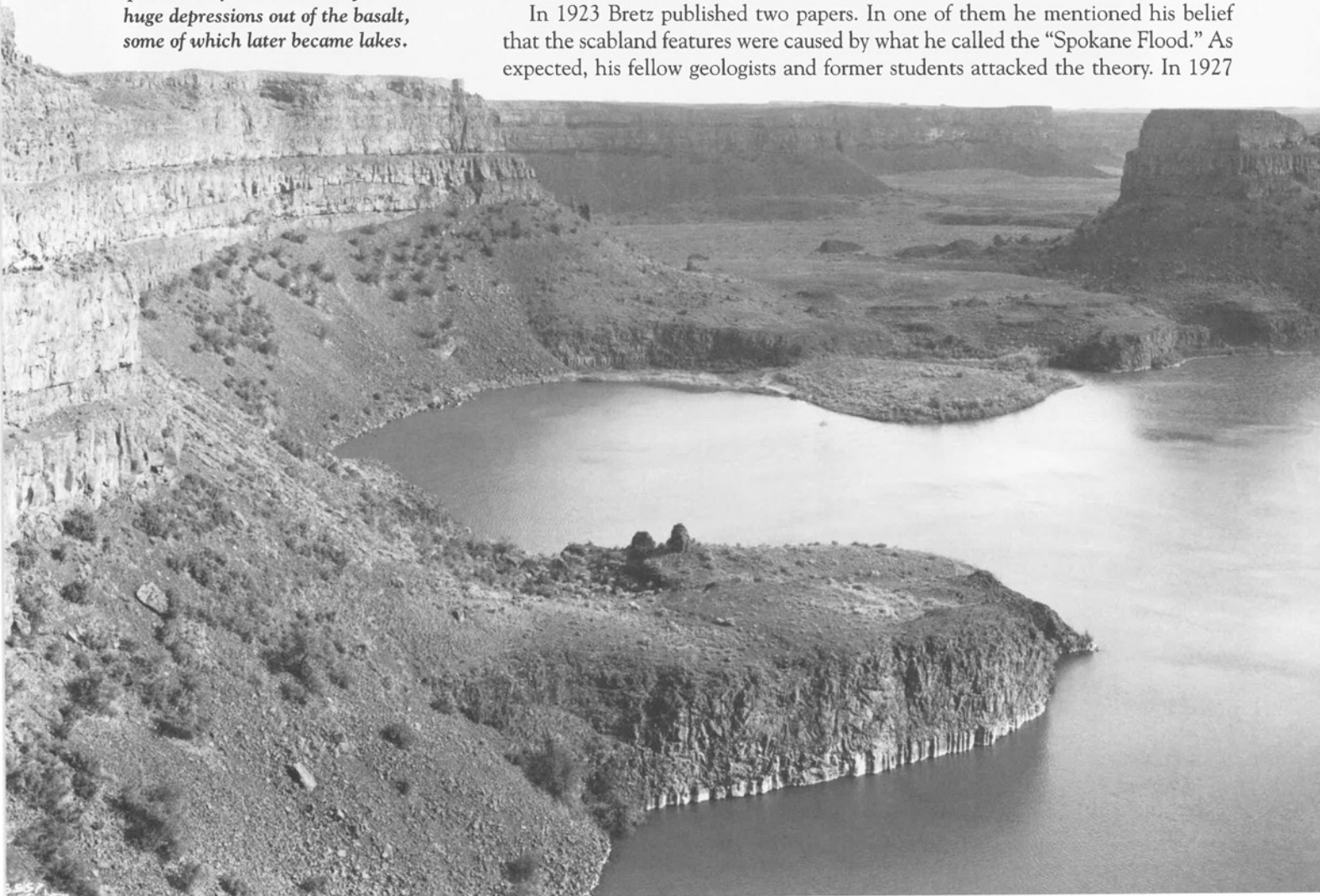
Another eastern Washington landscape feature that perplexed Bretz was the profusion of huge dry waterfalls that looked as though they were lifted from a land of giants. Dry Falls in Grant County, north of Pasco, stands 400 feet high and some three and a half miles wide. Although the falls are now dry, Bretz thought the quantity of water that ran there must have been immense.

In addition to scoured channels, gargantuan potholes, and massive dry waterfalls, the erratic rocks transported down the Columbia River Gorge mystified Bretz. Respecting the value of field work and common sense, Bretz matched the land he viewed with knowledge gained from education, then formulated a theory about how this oddly shaped geography gained its features. He concluded that the force that ripped, shook, carved, and blasted this landscape thousands of miles in area must have been a flood.

Bretz knew that his theory had two problems. The first was one of perception. His notion was untimely. In the geological community, floods and catastrophes were out of vogue as significant agents of topographic change. The more biblically aligned theories of cataclysms having shaped earth's features (including Noah's flood) had been replaced by a more moderate precept of "gradualism," in which erosion and long stretches of time were the principal devourers and builders of canyons and mountains. Gradualism implied that earth's topography was molded at an infinitesimally slow rate over many millennia. Bretz knew that his flood theory was likely to be met with skepticism.

A second problem was physical. Where could the water for such a huge flood have originated? What prehistoric lake could have supplied enough liquid to crash down river carrying 10 times the volume of all the rivers on earth combined? Uncertain of the answer, Bretz considered glacial runoff from the Cordilleran ice sheet during the last ice age as a possible source.

In 1923 Bretz published two papers. In one of them he mentioned his belief that the scabland features were caused by what he called the "Spokane Flood." As expected, his fellow geologists and former students attacked the theory. In 1927



colleagues invited Bretz to Washington, D.C., to speak about his flood, then took turns bashing the theory. In the face of overwhelming disdain, Bretz stood his ground. He suggested that his critics consider the big picture of how the scablands were formed and not just apply inadequate theories about how fragments of the land's features originated. As always, he grounded his answers in field experience.

After Bretz proposed his flood theory, a simple question loomed: where did the water come from? In 1910, more than a decade before Bretz proposed his theory, a geologist named Joseph Thomas Pardee described ancient Lake Missoula. This great glacial lake existed in the late Pleistocene epoch, before the last ice age began receding some 15,000 years ago. Pardee wrote to Bretz in 1925, suggesting that he consider waters from glacial Lake Missoula as the source of his flood. However, Bretz did not actively pursue this possibility.

In 1940 Pardee presented a paper at a meeting in Seattle, Washington, of the American Association for the Advancement of Science. He unveiled evidence showing how ancient Lake Missoula could have been the flood source that carved the scablands into their intricate forms. Pardee's approach was low key, but the facts in his paper, "Ripple Marks in Glacial Lake Missoula," riveted the audience. He described wave marks in the land—features 15 meters high, spaced roughly 150 meters apart—carved by an ancient surge of water. In the decades following this presentation, Bretz's flood theory finally gained universal acceptance.

**T**he most recent ice age, the Pleistocene, began 2 million years ago. During this era virtually all of Canada was repeatedly covered by glacial ice sheets—slow-moving rivers of ice—which also covered Alaska, Idaho, Montana, and northern Washington. Over time glaciers advanced and retreated—the most recent advance reaching farthest south about 15,000 years ago. Ice moved through the Purcell Trench in northern Idaho near today's Lake Pend Oreille. It dammed the Clark Fork River in northwestern Montana and created Lake Missoula behind a 2,500-foot wall of ice. In other words, this glacial lake was created when the Cordilleran Ice Sheet branched into the Bitterroot Mountains and plugged up Clark Fork River. The backed up waters ran thousands of feet deep and comprised a volume of 500 cubic miles, a quantity equal to that held today in lakes Erie and Ontario combined.

Between 13,000 and 17,000 years ago, Lake Missoula covered 3,000 square miles of land. As the lake water deepened, it put pressure on the ice dam, forcing water to slip *under* the ice and eventually causing the dam to fail catastrophically. This break hurled almost 400 million cubic feet of water per second across eastern Washington, a deluge that raced at speeds up to 65 miles per hour, with a volume 60 times the flow of the Amazon River. The flood whooshed across more than 400 miles of the state. Imagine the volume of 10 times all the rivers on earth rushing at once across the Columbia Plateau—enough liquid to inundate 16,000 square



**TOP:** As the Cordilleran Ice Sheet moved south from Canada, a towering ice dam was created on the Clark Fork River in northwestern Montana.

With the flow of water blocked, a giant lake was formed. Gradually the water found its way under the ice dam, pushing it up and eventually weakening it to the point of collapse.

**BOTTOM:** The failure of the ice dam released a 2,000-foot wall of water that rushed to the prairies of eastern Washington. The Columbia River's channel could not contain this vast flood, and the waters spilled out across the Palouse region, eroding a series of intertwining river canyons (coulees) across eastern Washington.

Terry Voss photo



*Palouse Falls was formed when water from the Bretz floods fell over a precipice extending the entire width of the plateau pictured above and created a massive backward “eddy” that scoured away the rock below and created the broad waterfall that exists today.*

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miles in silt-fogged water hundreds of feet deep. This flood wrenched 50 cubic miles of sediment out of its path and carved chunks of Washington and Oregon into fluted channels.

In the 1950s geologists realized that several such floods had flowed over thousands of years. Layered sediment deposits indicate that not one but perhaps as many as 40 such floods had run across these lands.

**B**retz withstood decades of criticism before his theory was embraced. The rebuttals he faced were similar to those thrown at Alfred Wegener, a German climatologist who proposed a new, monumentally significant theory of geology. For years before Wegener was born in 1880, cartographers making maps of

the world noticed how Africa and America looked as though they were once joined. Yet the majority of the scientific community—renowned and educated specialists—considered this possibility nonsensical. In his 1915 book, *The Origin of Continents and Oceans*, Wegener wrote that 200 million years ago the continent of Pangaea broke into two lesser continents—Laurasia and Gondwanaland. Twenty million years later, these two smaller continents split apart again. He postulated that these pieces have constantly drifted over a basaltic ocean floor to become the continents that exist today.

In 1924, just a year after Harlen Bretz published his paper about the scablands, Wegener’s book was translated into English. Like Bretz, he was bombarded by criticism. Wegener perished on the snows of Greenland in 1930, by which time his Continental Drift theory had been largely forgotten. It was not until the 1950s that the theory was revived, accepted, and used as the basis for a modified theory of plate tectonics that is now unquestioned.

Acceptance of Wegener’s theory vindicated a centuries-old suspicion bolstered by common sense: any child looking at a map of the world can see that certain continents look as though they were once joined. In a similar way, any geologist regarding a vista of the entire Channeled Scablands would see that they appeared—as Bretz noticed—to have been formed by a massive deluge.

Bretz was more fortunate than Wegener in that he lived long enough to see his theory accepted. In 1979, when Bretz was over 90 years old, the Geological Society awarded him the Penrose Medal, the nation’s highest geological award. A plaque dedicated to Harlen Bretz in 1994 states that he “patiently taught us that catastrophic floods may sometimes play a role in nature’s unfolding drama.” On that plaque there is a quotation from Bretz, one that Wegener certainly would have agreed with:

“Ideas without precedent are generally looked upon with disfavor and men are shocked if their conceptions of an orderly world are challenged.”

Although his theory was at first unpopular, Bretz believed the evidence provided by field research. His decades of patient persistence were well rewarded.

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# COLUMBIA

THE MAGAZINE OF NORTHWEST HISTORY ■ SPRING 2005

## To Our Members 2

## History Commentary 3

"It Takes Humor As Well As Whimsy to Name Names"

By Austin Post

## Nineteen Forty-Nine 8

The year a turning point was reached for development of the Columbia River Basin.

By William L. Lang

## History Album 16

Miss Columbia.

## Sold Our Canoes for a Few Strands of Beads 17

The changing role of canoes on the Columbia River stretch of the Lewis and Clark expedition.

By Bob and Barbara Danielson

## From the Collection 28

The Tacoma Japanese Telephone & Address Directory.

## Tsugiki, a Grafting 29

Reflections of an immigrant generation taking root in a new land.

By Gail Nomura

## The Great Columbia Flood 40

A Seattle schoolteacher-turned-geologist came up with a radical theory to explain eastern Washington's erratic boulders.

By Tom Mullen

## Notices/Additional Reading 45

## Columbia Reviews 46

COVER: This drawing by contemporary artist Roger Cooke depicts the members of the Lewis and Clark expedition in stormy weather, resolutely paddling their canoes along the Columbia River between what William Clark called "Dismal Nitch" and "Point Distress." The inhospitable shoreline combined with adverse weather to give the canoes a severe pounding and halt the party's progress toward the Pacific Ocean for several days. See related story beginning on page 17. (Museum Collections, Washington State Historical Society)