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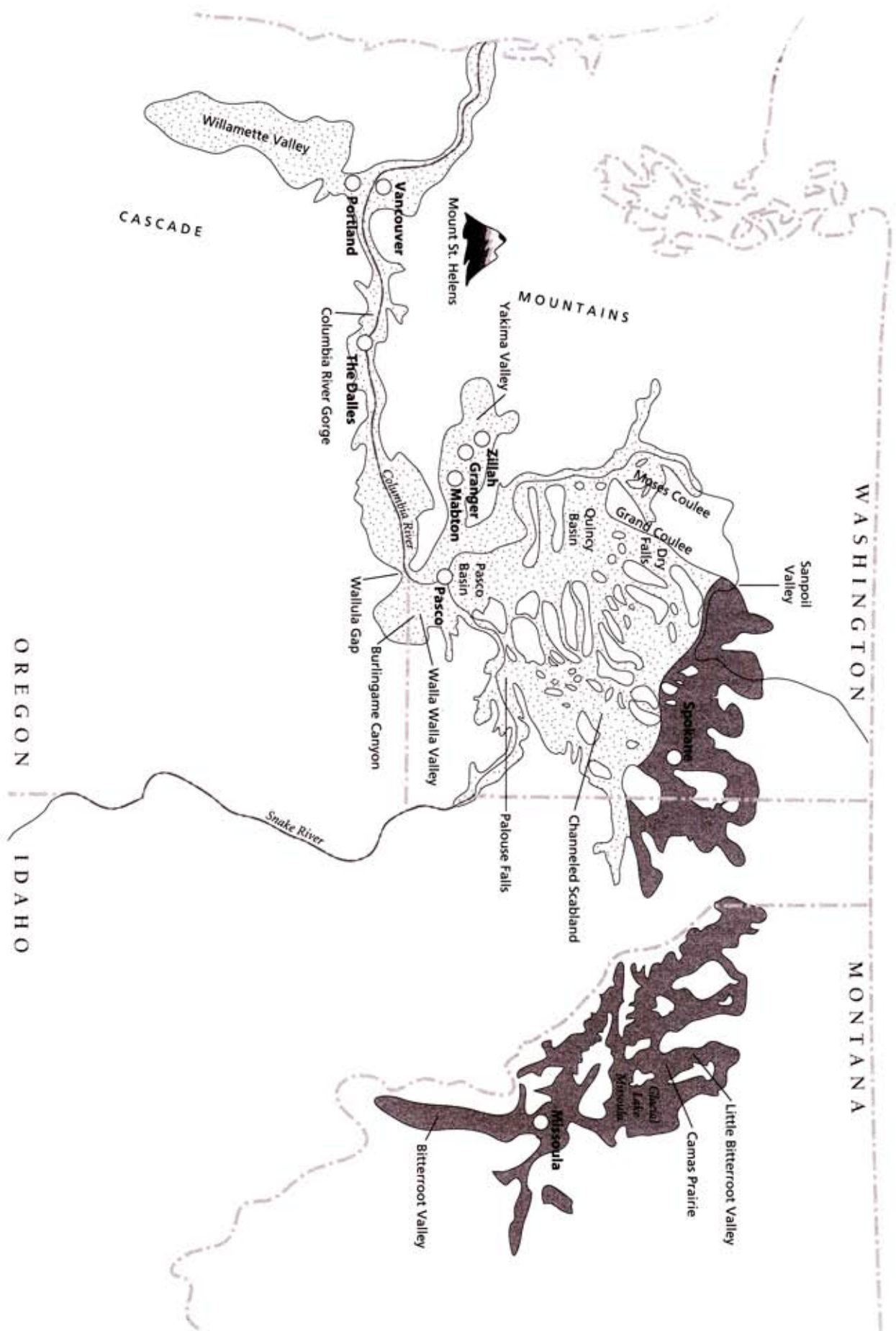


Figure 1.1 Map of the Pacific Northwest showing glacial Lakes Missoula and Columbia along with the Channeled Scabland of eastern Washington.

Chapter 1

THE FLOOD OF CONTROVERSY

Today it is hard to imagine the storm of controversy that was ignited when the geological community heard J Harland Bretz's hypothesis of a gigantic flood that roared through eastern Washington. To the scientists of the day it sounded far too much like the Biblical Flood, a Flood that scientists were convinced never occurred. It was not until the evidence for the Lake Missoula flood became overwhelming and irrefutable that it was finally accepted—40 years later.

BRETZ'S "OUTRAGEOUS HYPOTHESIS"

In the 1920s J Harland Bretz proposed a monstrous flood in the Pacific Northwest of the United States. He deduced that each coulee in eastern Washington was once a channel that was formed only if the *entire* coulee had been filled with water. A coulee is a generally dry trench-like valley with vertical walls and a flat floor. Since the coulees intersect, and the major coulee tracts head at the same elevation, he concluded that water had to be running through all of them *at the same time*. This area of eastern Washington is called the Channeled Scabland because of all the intersecting coulees. The width of the flood was about 100 miles (160 kilometers). Even more alarming to the scientific community, he calculated the flow depth at hundreds of feet (about 100 meters). Bretz first unveiled his hypothesis in 1923 in the *Bulletin of the Geological Society of America* (Bretz, 1923a) and the *Journal of Geology* (Bretz, 1923b). He suggested the source of the floodwaters was the rapidly melting Cordilleran Ice Sheet to the north, which he mistakenly believed had spread south of Spokane. (Later it was learned that the ice sheet remained north of Spokane.) The topographical evidence caused him to conclude the flood originated from somewhere around Spokane, so Bretz called it the Spokane flood. Unconvinced geologists had another name for it; they called it

the "Bretz flood." To them the flood was truly an "outrageous hypothesis." It was only later, after it was accepted, that it was renamed the Lake Missoula flood after the source of the water. Figure 1.1 is a map of the Pacific Northwest showing the features of the scoured rock of eastern Washington.

Because the theory seemed so ridiculous to the scientific community, numerous well-known geologists became outraged and took action. In 1927, Bretz was invited for a showdown at the Geological Society in Washington, D.C., where they verbally ambushed him (Baker, 1978a, pp. 7-9). An array of bewildering hypotheses and objections were flung at Bretz, but he held his ground.

During all this early contention, Bretz quietly continued his fieldwork in eastern Washington. He compiled a massive case for the Spokane flood (Bretz, 1928c). During this time he was open to alternative hypotheses, since he was just as perplexed by the scale of the event as his critics. He carefully analyzed all the many hypotheses invented to explain away the observations. He found the evidence easily refuted these hypotheses (Bretz, 1928a, b). After nearly ten years, Bretz completed his research and submitted a monograph conclud-



Figure 1.2 Upper Grand Coulee, north central Washington (view north from near southern Banks Lake).



Figure 1.3 Lower Grand Coulee and the Coulee Monocline (view south from Coulee City, Washington).

ing that the Upper Grand Coulee (Figure 1.2) and the upper parts of the Lower Grand Coulee (Figure 1.3) that encompasses Dry Falls were the result of gigantic receding waterfalls (Bretz, 1932).

Bretz's own words attest to the fact that he accepted the flood hypothesis with great trepidation and searched for an alternative hypothesis:

I think I am as eager as anyone to find an explanation for the Channeled Scabland of the Columbia Plateau that will fit all the facts and will satisfy geologists. I have put forth the flood hypothesis only after much hesitation and only when accumulating data seemed to offer no alternative (Bretz, 1927, p. 468).

Bretz (1930a, p. 422) was not given to wild, sensational claims and seems to have been a traditional uniformitarian geologist:

The writer, at least normally sensitive to adverse criticism, has no desire to invite attention simply by advocating extremely novel views. Back of the repeated assertions of the verity of the Spokane Flood lays a unique assemblage of erosional forms and glacial water deposits: an assemblage which can be resolved into a genetic scheme only if time be very short, volume very large, velocity very high, and erosion chiefly by plucking of the jointed basalt.

Uniformitarianism is the philosophy that all past geological processes work at about the same rate as we see today. It can be remembered by the simple phrase *the present is the key to the past*. An easy way of thinking about uniformitarianism is to think of the word *uniform*—uniform, present processes

shaped the world we see. Within this philosophy it would take millions of years for landforms, such as seen in eastern Washington, to be shaped by erosion. Because of his thorough research and his slowness in postulating the Spokane flood hypothesis, Bretz was better able to counter the barrage of criticism that fell upon him. In the early 1930s, Bretz changed his mind about the flood emanating from the melting of the Cordilleran Ice Sheet (Bretz, 1930b; Baker, 1978a, p. 9) and concluded instead that the bursting of glacial Lake Missoula caused the Spokane flood. This was a reasonable deduction that should not have generated any controversy, given the size of the lake and its upstream location. As will be discussed in Chapter 3, the evidence

for glacial Lake Missoula had been known since the late 1800s. But, in the typical uniformitarian lockstep of the era, Joseph Pardee declared the glacial lake had drained “slowly.” There is proof, however, that Pardee was not fully convinced of his own published beliefs, but in truth, thought the ice dam really burst catastrophically and caused the Lake Missoula flood. This was even *before* Bretz published his research, but his superiors who were dead set against any type of catastrophe dissuaded him against suggesting a catastrophic flood:

Indeed, there are indications that in 1922 Pardee possessed key evidence supporting Bretz's hypothesis, but that he was dissuaded from revealing this by his superior, W.C. Alden, and by other colleagues of the U.S. Geological Survey...It is also probable that in 1922, before Bretz's work on the topic, Pardee had independently realized the cataclysmic origin of the Channeled Scabland, but had been prevented from publishing the idea by his superiors. Until 1940 he had remained silent on the topic (Baker et al., 1987, p. 418).

This shows the strength of peer pressure and the desire to conform to *preconceived* geological assumptions in spite of the evidence.

Bretz, himself, very likely knew of the existence of glacial Lake Missoula by 1925, but for some inexplicable reason chose to ignore the significance of Pardee's evidence for such a monstrous lake dammed by ice. Even up until 1932, he thought the bursting of the pro-glacial lake was only a *possibility* (Waitt, 1994, pp. k2-k3; Baker, 1995). It could have been that Bretz was overly cautious at this point, having endured years of ridicule.

OUTRAGEOUS ALTERNATIVE HYPOTHESES

Bretz's critics fell all over themselves trying to explain his provocative observations in the Channeled Scabland. They developed many alternative hypotheses. Looking back at these alternative hypotheses from the vantage point of history demonstrates how desperate geologists were to oppose any hint of catastrophism, the idea that large catastrophes shaped the surface of the earth. Convinced of uniformitarianism, they could only accept slow changes over immense periods of time. They were more comfortable with wacky alternatives that were contrary to field evidence rather than to give an inch towards catastrophism.

W.C. Alden, one of the chief opponents who believed it was impossible for the Cordilleran Ice Sheet to produce so much water under any condition, remarked that the Channeled Scabland was simply formed by collapsed lava tubes. The bars, discussed in the next chapter, were the result of repeated flooding from much smaller volumes of water.

O.E. Meinzer, the father of modern hydrology, postulated a commonly held view that the Channeled Scabland was simply caused by the shifting of the course of the mighty Columbia River, a river that was much larger during the ice age. He concluded that swollen ice age rivers could easily have cut Dry Falls and deposited the great Ephrata gravel fan in Quincy Basin. He countered what he called Bretz's "violent claim," that all four spillways of the Quincy Basin were filled with water at the same altitude and at the same time, by contending the spillways were cut at different times and at different altitudes. He claimed that later earth movements eventually brought them all to the same altitude.

E.T. McKnight suggested the scablands were formed by erosion along the edge of the ice sheet as it shifted locations. Bretz had earlier concluded that the hanging valleys in the soft sediments of the Koontz channels, 150 to 400 feet (46 to 120 meters) higher than the Columbia River near Hanford, Washington, could have formed only if the Columbia was flowing *above* the altitude of the highest overhang (see chapter 2). This meant that the flood was up to 400 feet (120 meters) deep! McKnight (1927), who actually took part in the topographic mapping of the area, countered Bretz by suggesting that the Columbia River deepened its channel in post-glacial time leaving the Koontz channels hanging. Bretz (1927) demonstrated that McKnight's hypothesis did not work, since McKnight had ignored the unconsolidated nature



Figure 1.4 Columbia River Gorge of the Columbia River, a large water gap between Oregon and Washington. (View west from White Salmon, Washington).

of the sediments.

James Gilluly, in typical uniformitarian lockstep, agreed with others and simply stated that the channels of eastern Washington were the result of long-continued erosion and deposition by swollen ice age rivers. He easily showed that Bretz's two suggested sources for the floodwater were inadequate. As a result, Gilluly's arguments were all the more persuasive.

G.R. Mansfield also claimed without evidence that the scabland channels were not occupied by water at the same time. He thought the scablands were better explained by persistent ponding and the overflowing of lakes at the edge of the shifting ice sheet.

As for the streamlined and scarped silt "islands" that overlie the basalt of eastern Washington within the channels, G.O. Smith proposed that the islands were a product of rainwash and erosion caused by wind rising up over the lower basalt cliffs.

H.G. Ferguson suggested that river ice jams may have ponded the water in channels high enough to overflow onto the silt tracts forming high-divide crossings that Bretz had pointed as proof of water depth. But, the divided crossings are several hundred feet above the scabland floor!

On and on the hypotheses were invented. Pardee, who was an expert in the local geology and should have known better, simply stated that the scabland tracts were the results of "unusual glaciation." Pardee obviously was trying to avoid the subject, probably secretly agreeing with Bretz, but was fearful for his career and reputation (Allen, Burns, and Sargent, 1986, p. 56).

Amazingly, most of the geologists who criticized Bretz's