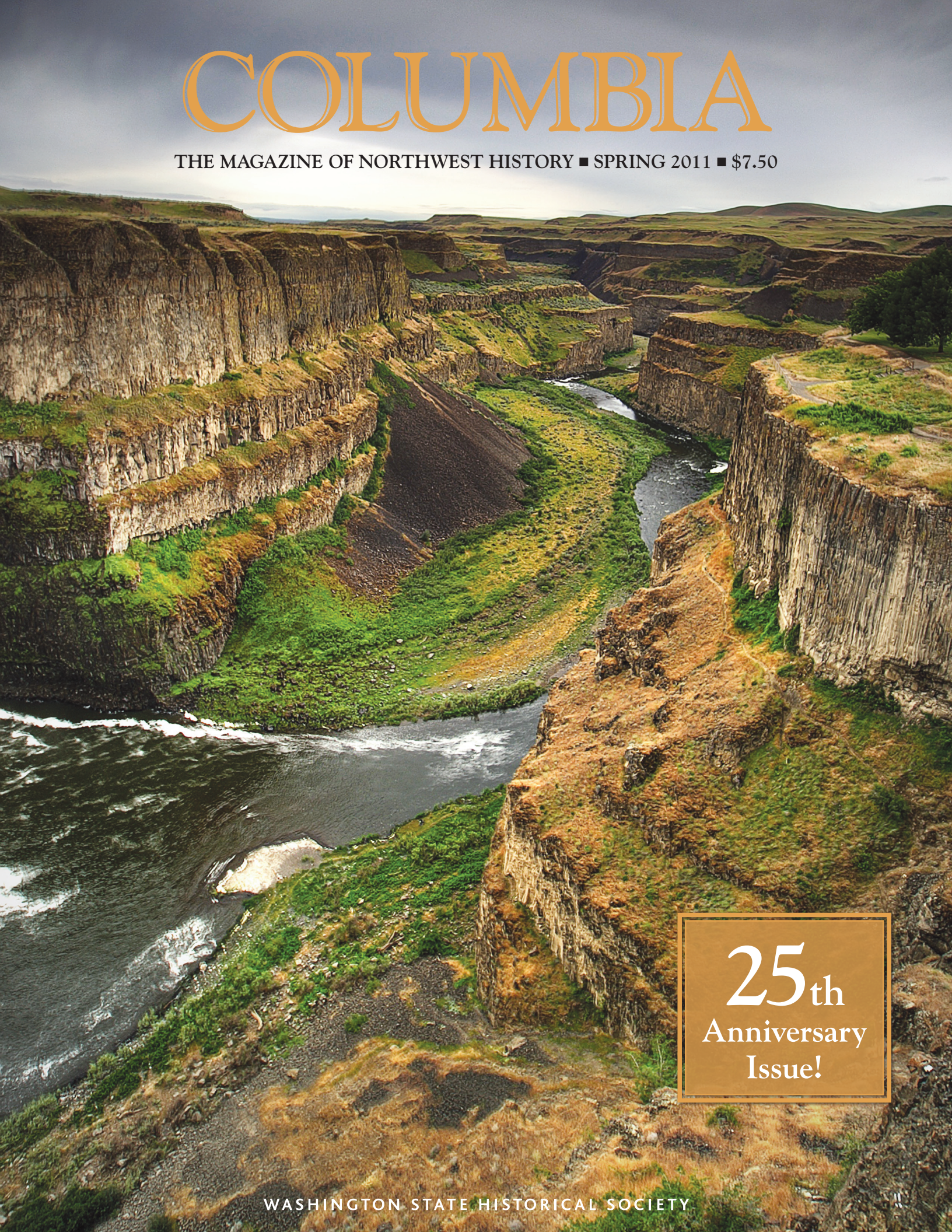
COLUMBIA

THE MAGAZINE OF NORTHWEST HISTORY ■ SPRING 2011 ■ $7.50



25th Anniversary Issue!

WASHINGTON STATE HISTORICAL SOCIETY

By John Soennichsen

Courtesy Bretz family

J Harlen Bretz

THOUGH HE NEVER LIVED in eastern Washington, colorful University of Chicago geologist J Harlen Bretz was a familiar figure there each summer during the 1920s and early 1930s as he trekked on foot through the region of ragged, basalt-lined coulees, potholes, and dry channels that he dubbed the "channeled scablands."

His theory—that a massive flood had long ago swept through the area and carved this fantastic landscape in a matter of days or weeks—was met with condemnation by the bulk of the geologic community, primarily because his hypothesis violated the cardinal rule of uniformitarianism. Under this basic tenet of the science, geological features on earth take thousands, even millions of years to form. Suggesting so dramatic and expedient a cause as that espoused by Bretz was tantamount to geological heresy, and the outspoken professor found himself defending his "outrageous theory" for more than four decades before it began to be accepted.

This excerpt from Bretz's Flood: The Remarkable Story of a Rebel Geologist and the World's Greatest Flood *(Sasquatch Books, 2009), looks at the first visit J Harlen Bretz paid to the eastern Washington scablands. His flood theory had yet to be developed, and he was inclined to seek out an explanation more consistent with the doctrine of uniformitarianism.*

A Toe in the Water

J Harlen Bretz's First Field Exploration of Eastern Washington's Channeled Scablands

In 1921, W. C. Alden, head of Pleistocene geology at the U.S. Geological Survey, sent J. T. Pardee, a junior survey geologist, to visit a region of scabland terrain south of Spokane. Most of Pardee's earliest geological work had involved the field study of glacial features in Montana. For the most part, he was unfamiliar with the topography in and around Spokane. For six weeks, Pardee piloted his Model T along dusty country roads that skirted the edges of the Palouse hills, dropped into and climbed out of scabland channels, and often ran right across the rocky tracts of exposed basalt within the region. Whenever he reached interesting spots, he would stop and set out on foot, hiking across these strips of scabland while taking note of the unique geological features to be found there.

Upon completion of his field study, Pardee wrote a brief article for the publication *Science*, which concluded that the Cheney-Palouse scabland tract was created by glaciation "of rather unusual character." One possible explanation Pardee offered for the region's unique topography was that this area of rough and pockmarked basalt beginning just south of Spokane and extending as far south as the Pasco area had been formed by subglacial water erosion. In other words, Pardee felt that ice had covered the land as far south from Spokane as 100 miles or more, and that the movement of water beneath this sheet of ice had formed the scabland terrain.

The following summer found J Harlen Bretz unloading his bags at Spokane's Northern Pacific train station, accompanied by a handful of advanced geology students from the University of Chicago. Dressed in khaki pants and matching shirt, Bretz also sported a fedora in those days and cut a striking, almost Indiana Jones-like figure as he stood on the platform and looked at the bustling scene.

Spokane was truly a thriving center of commerce and transportation at the time of Bretz's visit. Virtually all cross-country travel in the northern half of the United States involved a stop here. Then as now, it was the second-largest city in Washington and the commercial hub for an interstate region dubbed the Inland Empire. It was also the regional center for mining, agriculture, timber, and transportation. With the advent of the automobile and paved streets, the city had begun living up to its promotional slogan: "All roads lead to Spokane."

But J Harlen Bretz had not come to Spokane to wander through the formal gardens at Manito Park, enjoy the "haute cuisine" at the Silver Grill, or spend a night at the city's elegant Davenport Hotel. His plan was to provide a season of field geology for his students in the Cascade Mountains, and Spokane was merely a jumping-off point for the group. His friend Thomas Large, a Spokane teacher with a keen mind and an interest in regional geology, provided him with a Model T. Bretz planned to travel west to the north Cascade Range and explore the "live glaciers" found there among its highest peaks.

For a variety of reasons, Bretz and his students failed in this objective; they returned to Spokane with just a few weeks remaining before they needed to depart again for Chicago. It's not clear whether it was Bretz himself or Large who came up with the idea to use the remaining time in a study of the scablands, but that's exactly what Bretz did in the waning days of summer 1922.

Given the brief amount of time remaining, Bretz decided to limit his exploration to the northern part of the scablands. Making the most of each long day, Bretz began by touring the region just south of Spokane, including scabland tracts near the towns of Cheney, Spangle, Lamont, and Sprague. He and his students poked around area lakes such as Williams, Badger, Fish, and Rock. One of the first things he observed was that all of these were narrow, elongated bodies of water flanked by sheer walls of rough basalt, in some cases as much as several hundred feet high.

ABOVE: When J Harlen Bretz described Dry Falls in his first few professional papers, he pointed out that the cascade would have been 10 times the size of Niagara when Ice Age floodwaters passed over their three-mile wide rim.

OVERLEAF: Ice Age floods forcibly invaded the Palouse River from the north, cut through a divide that formerly separated the Palouse from the Snake River, and sent it through a deep canyon over a nearly 200-foot falls, then through another deep canyon to join the Snake River at Lyons Ferry.

Tom Foster photo

Their drives expanded to the south and west, where they briefly examined some of the largest coulees in eastern Washington, deep gashes in the earth with names like Washtucna, Moses, and Grand. These proved to be much more massive gouges in the ground than Bretz could ever have guessed, even after having reviewed topographic maps of the region. Most spectacular of all was the Grand Coulee, with its coarse basalt walls towering to 1,000 feet and its width reaching as much as three miles in places. Bretz and his students even managed to pay a quick visit to the Quincy Basin, site of the mysterious Potholes Coulee, which—in the form of a topographic map—had intrigued him 12 years earlier. To view this spectacular set of dry falls out here at the edge of the sun-baked, gravelly basin he had previously seen only in maps must have given Bretz a moment of sheer delight. For him it was just as critical to journey to geologically significant sites as it is for a detective to visit the scene of a crime.

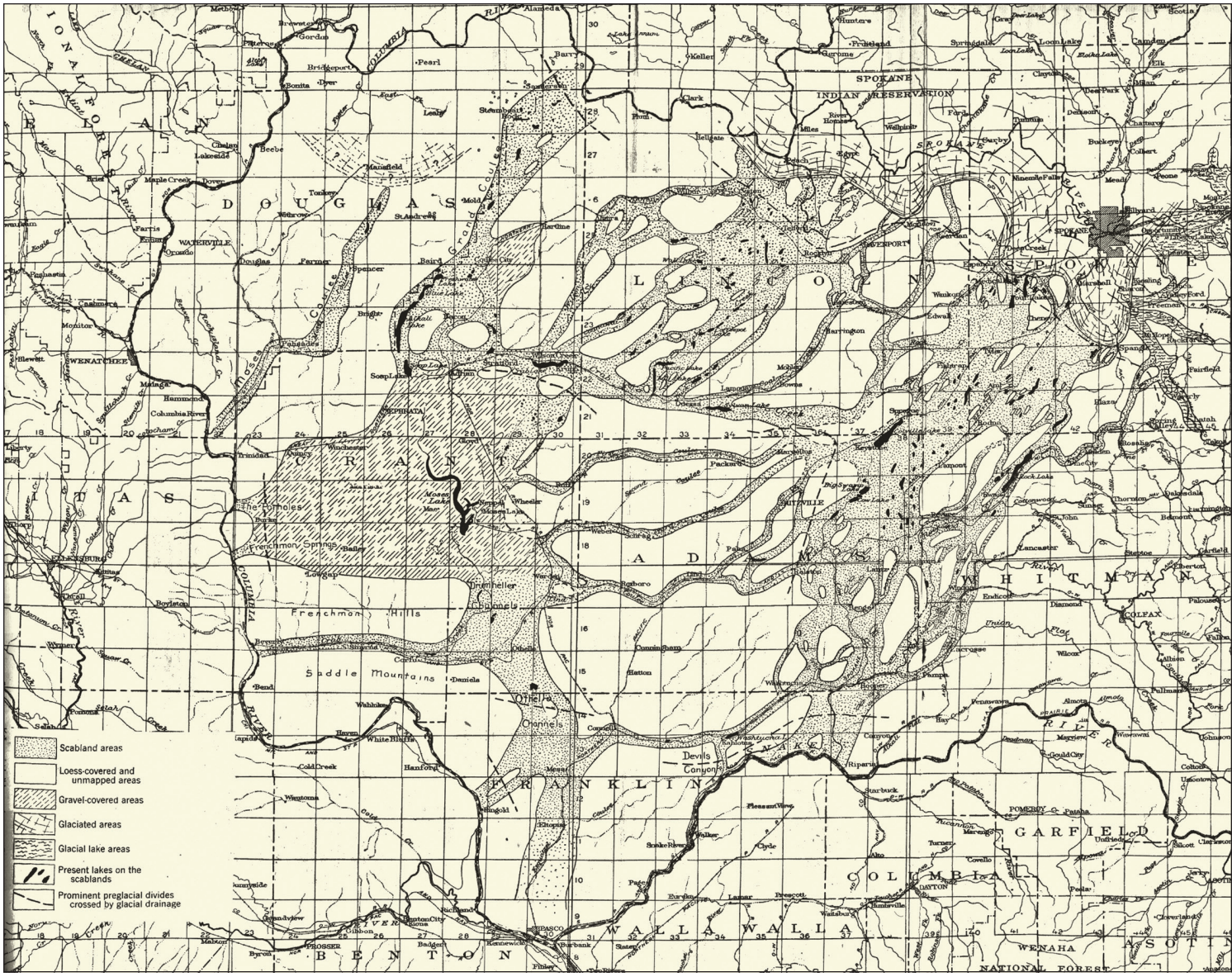
When Bretz took his first steps into the northeasternmost section of the scablands, he did so with a foundation of knowledge about the underlying geology of the region, an ancient scenario that most geologists accepted as fact. The area in which the scabland topography dominates was fairly well known even at the turn of the 20th century as a region where ancient lava flows had oozed forth from fissures in the ground many millions of years ago. These flows spread lava out over thousands of square miles of land that would one day make up parts of Idaho, Washington, and Oregon. As the lava cooled, it became a form of dense, dark volcanic rock called basalt. This basalt—thousands of feet deep in some places— was so heavy that it actually compressed the crust of the earth beneath it and created a shallow but expansive hollow or dip in the region, now called the Columbia River Plateau.

Bretz and other geologists also knew that hundreds of thousands of years after the basalt had cooled and hardened, rolling hills of a kind of silt called loess (a German word pronounced LUSS) had been built atop the rigid basalt, covering it completely in most places. The current research into the source of the loess suggests that it accumulated chiefly from the wind's reworking of silts found in basins to the south and west, including the Pasco Basin and Walla Walla Valley. As the winds continued to swirl around this region for thousands of years, they transported this material as far east as the present-day border of Washington and Idaho. The silt then became the parent material for the rich soil that eventually changed the scene from one of black basalt desert to rolling hills covered with grass and small trees.

At the same time that some of these geologic changes were occurring—about 2 million years ago—ice ages in North America caused the continental ice sheet to advance south and then retreat again multiple times. American geologists call the most recent advance of ice the Wisconsin Glaciation. According to Vic Baker, professor of geosciences at the University of Arizona, "The Wisconsin glaciation is a complex of about two or three smaller advances and retreats, extending from as old as about 110,000 years ago, but reaching its maximum extent, in most areas, about 20,000 years ago. The Wisconsin is generally thought to extend to about 10,000 years ago, the time that marks the beginning of the Holocene, our present interglacial period."

The Wisconsin event moved ice as far south as the 47th–48th latitudes, a short distance south of the Canadian border with Washington. Bretz and other contemporary geologists knew this, and they even had a name for the ice sheet—the Cordilleran—but the precise southern limits of the ice were not always clear. The specific path and extent of the ice sheet constituted much of the geological research being conducted in the early decades of the 20th century.

The first thing Bretz did on his whirlwind 1922 visit to the region was to get a feel for the scabland environment. Probably one of the first things he noticed was that the temperature was pretty high there in the summertime. Moreover, the farther south and west from Spokane he and his boys traveled, the hotter it got. The elevation dropped, too, as he headed south and west. In and around Spokane, pine trees grew in abundance. To the southeast of Spokane was the region called the Palouse, named after a Native American tribe related linguistically and culturally to the Nez Perce tribe. Here, family farms of both early white settlers and newly arrived immigrant farmers grew wheat, lentils, and other crops. The Palouse area



Special Collections Research Center, University of Chicago Library

Bretz drew this map to accompany his second paper on eastern Washington's channeled scablands. The accuracy with which he depicted the myriad flood-carved channels—without the aid of an aerial view—is considered by geologists to be an incredible feat.

of gently rolling hills followed the Idaho–Washington border from Spokane all the way to the towering bluffs above Lewiston and the Snake River Valley.

It was the region immediately south of Spokane that attracted Bretz's attention, for here was a vast area of land where the rich hills of loess were increasingly interrupted by ragged tracts of exposed basalt, as though the soil that composed the Palouse area had not accumulated here, or had piled up but then somehow been removed. It should be noted that basalt is a black/brown volcanic rock that characteristically cools into multisided columns. In many cases, Bretz observed that these columns formed cliffs on either side of deep channels, or coulees, some containing lakes, others dry as a bone. Then the Palouse hills would continue for a time before again being interrupted by more stretches of basalt, or scabland, as the locals called it.

THE AREA SOUTH of Spokane has long been known for its numerous small- to medium-size fishing lakes. One of the first things Bretz noticed was that nearly all of these lakes were elongated in shape, and their lengths always ran in a northeast to southwest fashion across the landscape. In some cases there were curious strings of lakes laid out in the same northeast to southwest line, with abrupt cliffs or low channels separating one lake from another; generally these channels were streamless. Nearly all of the lakes appeared to be gashes cut into the surrounding basalt rock and filled with water—in some cases, fairly deep water. Bretz observed that virtually all the lakes on the Columbia Plateau were located in areas of scabland, while there were no lakes at all in the Palouse area.

In the extreme northeast part of the region, where elevations are generally 2,000 feet or above, these lakes are fringed with pines, seem to love the native soil in the northern scablands. This is a dry upland soil averaging just 16 inches deep, underlain by coarse gravel and stones to a depth of another 40 to 60 inches. Beneath this lies the basalt bedrock. Because the pines like this well-drained, fairly dry soil, the northern scablands are covered by forests of the evergreens. They cluster in the channels and line the ridges of basalt cliffs. Ferns and other native greenery grow in profusion in the bottomlands near the water, while grassy clearings beside the lakes create comfortable spots for tent camping or small fishing cabins.

The farther south and west from Spokane Bretz traveled, however, the drier the terrain became, even around the lakes. He noted that the elevation dropped and the landscape was almost desert-like in appearance. It was also much hotter there in summer; temperatures in the triple digits were not uncommon in late July and early August.

With such a huge area to study and just a few weeks to do it, Bretz began by making basic visual observations, taking soil samples, and looking for landscape features common to different areas. Perhaps the first thing he discovered when trying to assess the cause of the region's geological features was that he might have to abandon some of the basic tenets of geological study he had learned at the University of Chicago.

One of the initial observations Bretz made, for example, was that the many channels, or coulees, in the region were anastomosed—or braided—unlike a typical branching drainage pattern of small streams flowing into larger streams, which in turn enter still larger streams and rivers, and so forth.

Bretz's continued use of the word "channels" in his field notes also showed that he recognized these as something other than typical river valleys. Even the cross-sectional form of individual channels was unlike the usual V-shaped river valley. Typically, as a river flowing over thousands of years slowly cuts into and deepens its own bed, forces such as wind and rain erode the edges of the river channel, and gravity sends the eroded portions tumbling down to the river's edge. In this manner, over thousands of years, traditional V-shaped river valleys form. But the dry channels Bretz saw in the scablands were U-shaped, with little apparent erosion of their banks other than the piles of broken rock fragments at the base of the basalt cliffs. Geologists call these mounds of broken basalt talus slopes, and they know that the piles of broken material increase over time as weathering sends more pieces of rock tumbling over the edges of the cliffs above. Because of the way continual weathering increases the height of talus slopes, Bretz believed he might later be able to compare the relative age of the various channels and coulees he visited. If the talus slopes in two distinct channels were each about half the height of the two channels' cliff faces, for example, Bretz felt safe in concluding that the channels had likely been formed at about the same time.

Bretz observed several instances where huge erratic rocks of granite were scattered here and there around the predominantly basalt landscape. Erratics are simply rocks or boulders that don't naturally belong where you find them. If you transport a granite boulder from Montana in the trunk of your car and take it to your backyard rock garden in Los Angeles, it could be considered an erratic boulder because it now lies somewhere far from where it originally formed. When erratics appeared in nature, however, without the aid of tourist transport, geologists of Bretz's time generally assumed that glaciers had carried them to their present position during one of the ice ages. When the ice receded, the erratic rocks would be left behind, some as large as small houses and now resting far from their original locations.

In the middle of the Grand Coulee—separating its upper and lower sections—was a set of dry cataracts more than 400 feet high and nearly three miles wide, dwarfing Niagara Falls many times over.

In the case of the scablands, Bretz found erratics in locations far south of the presumed southern limits of the latest—the Wisconsin—glacial advance. How could this be explained? The easy solution would be to alter his ideas about how far south the ice had advanced. Doing so might have partially legitimized Pardee's notion that glacial ice could have covered the landscape nearly as far south as the Oregon border. But Bretz was more inclined to come up with other reasons for the erratics.

What intrigued Bretz most was the location of some of these large granite boulders. One might expect them to be found in low spots along the course of glacier-borne streams or in glacier-carved valleys where the ice had traveled. But near the town of Spangle, for example—about 15 miles south of Spokane—Bretz found erratic rocks "as high as 2,500 feet above tide [sea level] on the slopes which face the scabland, and within 100 feet of the hill tops." In his mind, glacial ice had not traveled this far south, nor climbed this high, so how had the erratics arrived at these places?

Moving his field studies farther west, Bretz examined the vast channels known as the Grand and Moses coulees. In the Grand Coulee, where the walls are as much as 1,000 feet high in places, Bretz was intrigued by the volume of water that would have been necessary to carve such a deep channel. The Grand Coulee was as much as three miles wide in some places. In the middle of the coulee—separating its upper and lower sections—was a set of dry cataracts more than 400 feet high and nearly three miles wide, dwarfing Niagara Falls many times over.

About 15 miles west of the Grand Coulee, Bretz detoured to take the dusty road through the Moses Coulee, which—with its 900-foot walls and slightly less organized set of falls in its center stretch—he found to be quite similar in structure to the Grand Coulee. Why were these two monumental channels

located where they were, at the western edge of the scablands and just 15 miles apart? Were they related to the other scabland tracts much farther east? And if so, what overwhelming force could have affected the landscape here as well as some 100 miles to the east?

The final region of scabland Bretz visited was the Quincy Basin, south of the southern end of the Grand Coulee. This shallow, bowl-like depression in the earth covered some 600 square miles of terrain. Bretz found that the region was filled with small particles of basalt debris to a depth that was later determined to be 400 feet. Where had all this debris come from and when? At three specific points on the western and southern edges of this structural depression, which Bretz began referring to as a "catch basin," were geological features that appeared to be outlets from the Quincy Basin. Bretz immediately saw these as places where water that had been held in the catch basin broke through the ridges that enclosed it and spilled out toward the Columbia River. But how much water? And when had this event occurred?

When he visited Potholes Coulee, Bretz was flabbergasted by the apparent force and volume of water that would have been necessary to carve this topographical feature.

Bretz chose to call the southernmost outlet from the Quincy Basin the Drumheller Channels, after the Drumheller family ranch located nearby. Bretz was clearly impressed by the complex maze of channels occupying this low-lying terrain east of the Frenchman Hills. The group of channels began as three canyons of about the same size but was "scored and gashed," wrote Bretz, "by hundreds of similar smaller channels."

Two additional features on the western edge of the Quincy Basin indicated other places where water had at some time exited the region. One was a set of abandoned cataracts at the Frenchman Spring, and the second was that initial object of curiosity for Bretz: the Potholes, or the Potholes Coulee, as the locals called it. When he was at last able to visit this remarkable site where huge "notches" had been slashed through the western edge of the Quincy Basin, Bretz was again flabbergasted by the apparent force and volume of water that would have been necessary to carve this topographical feature. Two cataracts began as channeled scabland, ran for 2 miles toward the Columbia River—deepening as they neared the river—then split into two major falls that plummeted 200 feet to a ridge below. A continuation, or second tier, of these falls then dropped another 125 feet to the "bench" of basalt, forming the eastern bank of the Columbia River at this point in its circuitous route through eastern Washington.

As the summer of 1922 passed all too quickly into fall, Bretz and his students were obliged to leave Spokane and take the train back to Chicago. Upon his arrival, Bretz scarcely had time to organize his field notes before heading off to Wisconsin with his family to teach a month-long course prior to the start of fall classes at the University of Chicago.

Bretz then spent the rest of the fall reviewing his notes, compiling his maps, and honing his descriptions of the geologic wonders he had seen during those two short weeks in the scablands. As he worked with his field notes, he continually found himself making references to the large quantities of water that had to be involved. Indeed, he had only reached the third sentence of the introduction to his first scabland paper before he made this point: "Besides contributing to the geological history of the region, this article endeavors to show that glacier-borne streams, under proper conditions, are erosive agents of great vigor over large tracts far from the front of the melting ice."

Although this first paper was chiefly a detailed description of the region in question, Bretz did come to a number of conclusions even at this early stage. In a general statement about the section of the Cordilleran sheet that he called the Spokane glaciation, Bretz first stressed his belief that the glacial ice had not extended very far south of Spokane and then in fact dismissed the ice sheet as having been a factor at all in the transport of the area's erratics.

Instead, he wrote, he believed these large boulders were one of the following: knobs of granite that had been trapped in the basalt flows and later exposed, large boulders that had been transported by icebergs during widespread ponding, or large boulders that had been transported by glaciers or icebergs in a much earlier ice age.

For the first time, Bretz used the word "channel" in his paper, to describe a drainage area south of Spokane where he claimed that "a glacial stream [had] filled it from side to side for a depth of tens of feet." And although he was describing a channel formed during the last ice age, Bretz noted that there were "no well-defined depositional forms." In stating this, he was conjecturing that the vigorous flow of water from glacial streams had happened over a fairly short period and did not have enough time to create the typical sort of river valley deposits built up over centuries.

Bretz next described the relationship between the scablands and the Palouse region to the east, referring to the "isolated groups of Palouse hills" near Cheney and other places west of the Palouse wheat country. "In topography and soil," he wrote, "these tracts are identical with the Palouse wheat country to the east and southeast; but the gentle concave lower slopes of maturity, so characteristic of these hills, is absent on the peripheries of the isolated groups. Instead, these outer slopes are much steeper and are generally convex. They meet the roughened plain of the scabland with a definite angle."

The Palouse hills, in other words, were typically composed of gently sloping angles on all sides of any individual hill, whereas those hills bordering scabland featured gentle slopes on the sides facing away from the scabland and much more sharply angled slopes where they confronted the scabland terrain. Therefore, Bretz concluded that whatever force had

created the scabland tracts must also have affected the shape of the Palouse-type hills bordering them. He also noted that the isolated tracts of Palouse hills in the midst of the scablands "are elongated northeast–southwest, in harmony with the elongation of the channels on the basalt surface and with the scabland tract as a whole."

There was clearly some undeniable connection between these two vastly disparate types of terrain, and Bretz described the overall relationship almost lyrically when he wrote that tracts of scabland and those of Palouse hills throughout the region were "interfingered and interlocked."

As Bretz continued to review his notes describing features such as deep channels, sheer cliffs, and "gashed basalt," he found it impossible to avoid using phrases in his paper such as "torrential water," "large volume abruptly introduced," and "invading but short-lived floods." This is not to say that he had completely abandoned the notion that some of the northern scabland features could have been formed at least partially by ice from "glaciations earlier and more extensive than the Wisconsin." Accepted geological principles demanded that the sculpting power of glaciers had been the chief culprit, since these scabland tracts bordered the approximate southern limit of the glacial ice. Yet the impact of glacial runoff seemed indisputable too.

Glacial stream runoff, as typically envisioned by geologists, is the by-product of gradually melting glaciers in retreat at the close of an ice age. Slow melting over a long period of time creates a glacial stream that flows across the land as would any well-established stream or river. Because glacial streams can become part of a landscape for hundreds of years or more, the total volume of these streams can be quite great over the length of their existence. But Bretz's language in his first scabland paper was clearly on the borderline between describing glacial runoff and something else quite different. In his paper, Bretz summarized the relationship between scabland tracts and areas of the Palouse hills by concluding,

> *The hills which have disappeared averaged 200 feet in height and in some places the glacial torrents eroded 100 to 200 feet into the basalt. The flood originated at several places along the ice-front. Great river channels exist among the remaining hills in the flood-swept region. The area overridden by the ice itself has lost every trace of Palouse hills.*

Bretz dubbed the scabland region west of Spokane the Crab Creek drainage. Here, he wrote, drainage from sections of the ice sheet in north-central Washington had created a separate series of tributaries forming "youthful canyons in basalt." Again, Bretz noted that these canyons, some of them quite deep, "are but the deepened channels of ice-born rivers, and not true valleys. Like the scablands of the Palouse region, invading but short-lived floods traversed the area."

Bretz and his students had next moved to the dramatic features of the Grand and Moses coulees. He described these in his paper briefly, then expressed his belief that glacial streams from an earlier ice age had likely formed the basic shape of these large coulees, or perhaps the Columbia River itself had been blocked by glacial ice and was redirected through one or both of these routes at some point in the distant past. Then the waters from the Spokane drainage had found the already-formed coulees at a later time and followed the course as the path of least resistance.

Bretz described the Quincy Basin as an outlet basin for waters that had ponded as a result of glacial flooding and that eventually found exit points via the Drumheller Channels, Frenchman Springs, and Potholes Coulee. He closed his report with a discussion of the Wisconsin Glaciation and his thoughts as to the distance south it had traveled. As for the erratics found at elevations surprisingly higher than one might expect, Bretz concluded that they had been carried to their current positions by floating ice, and he cited two possibilities for why they were

Bretz, second from left with fedora and pipe, in Spring Coulee, a flood-carved canyon east of the Grand Coulee, during one of his legendary summer treks into the channeled scablands.

Frank W. Guilbert photo, Northwest Museum of Arts and Culture, #95-111.106

COLUMBIA

The Magazine of Northwest History

A quarterly publication of the

WASHINGTON STATE HISTORICAL SOCIETY

VOLUME TWENTY-FIVE, NUMBER ONE

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FOUNDING EDITOR
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COLUMBIA (ISSN: 0892-3094) is published quarterly by the Washington State Historical Society. Articles appearing in this journal are abstracted and indexed in *America: History and Life*. **SUBSCRIPTION INFORMATION:** Direct subscription and membership queries to WSHS Membership Desk, 1911 Pacific Avenue, Tacoma, WA 98402; 253/798-5902. **EDITORIAL CONTRIBUTIONS:** Inquiries and submissions should be directed to *COLUMBIA*, Washington State History Research Center, 315 N. Stadium Way, Tacoma, WA 98403; 253/798-5918; or cdubois@wshs.wa.gov. All unsolicited manuscripts and photographs submitted must include return postage (in stamps) and suitable packaging to ensure their safe return. Although reasonable care will be taken with materials received, no responsibility can be assumed for unsolicited materials, including photographs. **BOOK REVIEWS:** Address all review copies and related communications to Robert C. Carriker, Department of History, Gonzaga University, Spokane, WA 99258. **POSTMASTER:** Please send address changes to Washington State Historical Society, 1911 Pacific Avenue, Tacoma, WA 98402.

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THE MAGAZINE OF NORTHWEST HISTORY ■ SPRING 2011

COVER: Palouse Canyon, like the rest of the Channeled Scablands, was formed by the powerful Lake Missoula floodwaters that swept across eastern Washington during the Pleistocene era and carved through hundreds of feet of basalt in the geological blink of an eye. See related story beginning on page 13. (Courtesy Justin Martin, Fluxn Photography)