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Contents

Message from the President 2

L&C Roundup: Hiking the Natchez Trace and visiting the National Parks 3

Remembering: John E. Foote 5

Letters: Gorski responds to Guice; Jouett and Clark; Ionia Volcano revisited 5

After the Deluge: Flood Basalts, Glacial Torrents, and Lewis and Clark’s “Swelling, boiling & whorling” River Route to the Pacific. Part 1. 7
By John W. Jengo

John Collins and Northwest Brewing 22
By Jim Hardee

Reviews: Swagerty, The Indianization of Lewis and Clark, reviewed by John Fisher 31

Along the Trail: The Tamástslikt Cultural Center inside back cover

On the cover: Hat Rock, noted by William Clark while traveling down the Columbia River, October 19, 1806. Photo by John W. Jengo

We Proceeded On welcomes submissions of articles, proposals, inquiries, and letters. Writer’s guidelines are available by request and can be found on our website (www.lewisandclark.org). Submissions may be sent to Robert Clark, WSU Press, P.O. Box 645910, Pullman, WA 99164-5910, or by email to robert.clark@wsu.edu.
President’s Message

A Message from the President

Spring is in full bloom as I write this message, and my thoughts have turned to seeing many of you at our annual gathering this summer in Richland, Washington. If you do not make it this year, perhaps we will see you in Kansas City, Missouri, in 2015, or even farther east at Harpers Ferry, West Virginia, in 2016. Coming together once a year to share our passion about the Lewis and Clark Expedition and places on “The Trail” is one of the “perks” and satisfactions I reap from being a member of the Lewis and Clark Trail Heritage Foundation. Not only do we learn more about the expedition, but it is often an annual ritual for many of us to be able to cuss and discuss any number of unsolved mysteries, new angles to old stories, and to explore new places. Perhaps (what I describe as) our collective enthusiasm to participate in the sport of intellectual debate is our way of continuing in the spirit of the Age of Enlightenment from which the expedition was spawned. It is one of the values of our organization which I personally enjoy. Was it murder or suicide? What was Lewis really thinking when he celebrated his thirtieth birthday? Where is Sacagawea buried? How did she pronounce her name? What happened to the iron boat? And many more questions about which we thirst to know more.

It is also a time for great minds to gather and deliberate on what our foundation should be doing with our staff, volunteer time, and funding to further our mission as “Keepers of the Story and Stewards of the Trail.” I appreciate that many of our members are not shy about making suggestions about what we “otta be doin.” Since there are unlimited Lewis and Clark projects, programs, and activities we could support, updating our strategic plan is a useful tool to help guide decisions, priority use of staff time, and funding. It is a necessary discussion for our board if we are to carry out our responsibilities of being good stewards of our organization’s resources. This past year the board has met several times to wrestle with these choices, working on an action plan to help guide our future choices.

The draft action plan is posted on our website—please look it over and make sure we are spending your membership dues and donations in ways that are true to the Lewis and Clark Trail Heritage Foundation’s vision and mission. Plans are never set in concrete, and I anticipate that it will be a living document, updated regularly. I am hoping it will help new board members and others have a greater understanding of who we are as an organization and what our priorities are for the future. If you have insights you think we missed, please share them with us.

Of course, implementing the many actions listed in the plan requires the help of an army of volunteers. When I get overwhelmed by the amount of work ahead, all I have to do is look back at all the work our members have done. When the Board met in Kansas City last March, we teamed up with the Oregon-California Trail Association and the Santa Fe Trail Association to learn from each other and discuss ways we can work more closely together on common goals. We shared stories about our successes and challenges to preserve and interpret the extensive network of historic trails in the metropolitan areas of Kansas City

(continued on page 4)
Andra Watkins, L&C novelist, hikes the Natchez Trace

A South Carolina novelist fought freezing rain and motorcycles to trek the 10,000-year-old Natchez Trace and arrive in Nashville on April 3, 2014, in completion of a 444-mile tri-state journey.

Andra Watkins walked 15 miles a day, six days a week. She started at the famous trail’s sign in Natchez, Mississippi, followed the parkway through Alabama, and ended in Music City just in time for a book signing of her novel at Parnassus bookstore in Green Hills.

The inspiration for her trip was a fascination with Meriwether Lewis of the Lewis and Clark Expedition, the protagonist in her paranormal historical novel To Live Forever: An Afterlife Journey of Meriwether Lewis (Word Hermit Press, 2014).

In his final days Lewis traveled on the Natchez Trace, traveling to Washington, D.C., from St. Louis in 1809 to meet with Madison administration officials concerning accounting issues surrounding his duties as governor of Upper Louisiana. He met his demise at Grinder’s Stand on the Trace, and the cause of death is debated to this day.

Watkins’s novel imagines an afterlife adventure of Lewis as he seeks release from a purgatory by coming to the aid of a young girl in peril from his nemesis, James Wilkinson.

Although challenging in many ways, Watkins said hiking the Natchez Trace was an “incredible experience.” Readers from as far away as Canada and New York came to the parkway to walk portions of the trail alongside her.

[Modified from an April 4, 2014, article in The Tennessean by Alex Beecher.]

Calvert is “401 and Done”

Chris Calvert, Lewis and Clark Trail Heritage Foundation member, was seventeen and had never before been to a national park. Then, in drizzly, gray weather he and his parents arrived at Olympic National Park on the first day of summer in 1980. Disappointed but undeterred, they drove up a winding road to Hurricane Ridge. The route was dark and wet, but with each turn, the day seemed to get a little brighter. Three decades later, Calvert can still describe what happened in passionate, crystalline detail:

“Almost instantaneously, the clouds just kind of fragmented. There was this kaleidoscopic effect of these tatters and wisps of mist flying away, and all of a sudden above us was brilliant blue sky,” he says. “In the foreground was this intense, green, subalpine meadow just bespangled with wildflowers of every imaginable color. It went down into this valley that was lined with these deep, dark, conifers—this ancient, Northwestern, old-growth forest—and beyond that the Olympic Mountains rose up. I followed my vision up into the mountains where these snowcapped, glacier-clad crags were just sparkling in the intense sunlight, and I was overwhelmed.”

“I said, ‘If this is what the national parks are about, I have to see all of them.’”

It was a commitment Calvert never abandoned. In 1993, after he’d visited all 49 national parks, he set his sights on seeing every single unit in the system. In October, at age 50, he reached his goal with a trip to the Carter G. Woodson Home National Historic Site in D.C., his 401st site.

The Woodson home is now closed to the public for planned restoration work, so Calvert couldn’t go inside. “I touched the window sill and the wall, and that was the best I could do,” he says. “So hopefully history will forgive me.”

Afterward, he sent a note to friends reading “401 and Done!” It had taken him thirty-three years, three months, and twenty-eight days.

Since Olympic, he has visited at least two park sites every year, and once, in 1998, he hit 36. As soon as one trip was over, he started planning the next—sometimes reading as many as 15 books from the vast collection of national park material in his home library. Calvert had intentionally saved the Woodson site for last. He hiked there from his suburban Maryland home, collecting friends along the twelve-mile route until they were thirteen strong at their last stop.

Even when Calvert was still at this last site, he was thinking of his next move. He has so much work to do, he says—travel notes to transcribe and slides to organize. He’s already planning the next trips: his annual pilgrimage to the Great Smokies and a possible return to the Grand Canyon. Something else was on his mind, too, as he surveyed the brick row house and the circle of friends at his final destination. “The biggest thought, the thing that’s sitting out there, is that this is just temporary,” he says. “I’m just counting time until 402 comes along.”

[Condensed from a story by Rona Marech in the Spring 2014 issue of National Parks Magazine.]
and Independence, Missouri. One of the most inspiring presentations was given by a gentleman who has worked for decades to develop a modern trail system to preserve and connect the historic trails through these cities that were essentially founded as the jump off points for westward expansion. His presentation reminded me of how much one person can accomplish when they are passionate and persistent. It is truly amazing how small steps can lead to big successes over time. The ranks of the Lewis and Clark Trail Heritage Foundation are filled with heroes from throughout the country who have made and are making a difference for their community and for the trail. Folks in the Ohio River Chapter are making progress toward having the Eastern Legacy portion of the Lewis and Clark story marked on the ground and interpreted. Doing so builds support for its future official recognition as part of the National Historic Trail. Members in the Washington Chapter continue to watchdog impacts to the trail in the Columbia River Gorge, and movers and shakers in the Jefferson River Canoe Chapter are hard at work to create public access to the Missouri River headwaters. That will be their legacy to future generations. And there are many more examples across the country where the hard work and persistence of one person is making a difference.

Our new and improved Strategic Action Plan can help point the way forward, but you, our members, are the horsepower we need to get us there.

As we move toward our organization’s fiftieth anniversary year, I urge you to get more involved in what we do, either with the national office or a local chapter. Let us know. I am sure we can find a project or committee to suit your passions and skills. We have had many enthusiastic members help create who we are today. I look forward to fresh faces that will bring new perspectives and ideas to lead us into our next 50 years.

And finally, I would be remiss if I failed to mention that you still have an opportunity to strengthen our ability to share the expedition’s story by donating to the “Double the Dar” campaign (for the Darwin Burroughs Education Fund), launched in the last issue of We Proceeded On and highlighted during the annual meeting. Any amount, large or small, helps. I am encouraged with the results so far, but it is not too late to help us reach this fund raising goal. Thank you!

Margaret Gorski is President of the Lewis and Clark Trail Heritage Foundation and Chair of the Bicentennial Trail Stewardship Advisory Committee.

President’s Message (continued)
Letters

To John D. W. Guice from President Margaret Gorski:

John, thank you for your letter that appeared in the May 2014 issue of We Proceeded On responding to my president’s message that appeared in the prior (February) issue. In it you referenced that you were troubled by what you interpreted as my inference that we should not continue to search for the truth about the death of Meriwether Lewis and that you “pleaded” with me to re-visit your letter published in the August 2013 issue where you addressed the discoveries of Tony Turnbow concerning James Neely.

I wish to clarify the inference about the death of Lewis. I did not intend to suggest that ongoing investigation about this subject is not warranted. My point is that it is important for our organization to support new research and to help grow new scholars. I believe, as President Jefferson did, the future strength of our democracy relies on an educated populace. Learning from our nation’s history is vital to our nation’s future. It is also why I strongly encourage all our readers to participate in our “Double the DAR” campaign so that we can grow our “Dar” Burrows Education Fund, created for that very purpose.

Thank you for your ongoing dedication to spirited and challenging dialogue about how historians use evidence to pursue truth.

Jouett and Clark

The cover image on the February 2014 WPO issue [portrait of George Rogers Clark by Matthew Jouett] provides a gateway to other connections to Lewis and Clark beyond serving merely to illustrate the featured article. Several similarities exist between the younger brothers of Matthew Jouett and George Rogers Clark. Like the Clarks, the Jouetts were born in Virginia and settled in Kentucky. Their older brothers were both the second sons in a large family, while William Clark and Matthew Jouett’s brother Charles De Witt Jouett themselves were the youngest of several sons. Like William, Charles was known to Thomas Jefferson and was appointed by him as an Indian Agent. Charles Jouett served first in Detroit, where he signed a treaty at Fort Industry on the Miami of the Lake River (at today’s Toledo, Ohio, on the Maumee River) with neighboring Indian tribes on July 4, 1805, the exact same day that the establishment of the Louisiana Territory took effect.

Charles Jouett then began the first of two terms as Indian Agent in Chicago, the initial one from 1805 to 1811, after which he returned to Kentucky with his bride Susan Randolph Allen. Following the War of 1812, Charles was reappointed to his position in Chicago, where he served from 1816 until resigning in 1818. Like William Clark, Charles Jouett was a tall, confident, physically strong man unafraid of confronting potentially hostile Indian leaders when duty demanded.

One of Charles’ final acts as an Indian Agent was witnessing the Indian Treaty signed at St. Mary’s, Ohio on September 17, 1818. Charles

Remembering John E. Foote

John E. Foote, 69, formerly of Billings, passed away on February 22, 2014 at his home in Bigfork, Montana, with his wife and daughter by his side. He was born November 13, 1944, in Missoula to Don C. and Stella Foote.

John was raised in Billings. His work in real estate development, and well as his many other interests and avocations, included stewardship of Pompey’s Pillar National Landmark that had been purchased by his father, and federally designated in 1965. Eventual ownership of the landmark was transferred to the BLM. He married Pat in 1966 and their daughter Andrene was born in 1967. After John’s graduation from the University of Montana, the family moved to Los Angeles where son Jason was born in 1970. After five years in Los Angeles working for Union Carbide and Security Pacific Bank, John and his family returned to Billings where John managed Foote Enterprises and developed the Billings Commerce Center.

John served as president of the Lewis and Clark Trail Heritage Foundation in 1986-87. He chaired the foundation’s annual meeting in 1987. John and Pat enjoyed their travels, hobbies, and building homes in Sedona, Jackson Hole, Scottsdale, and Bigfork.

John will be missed by his family and all of his wonderful friends. He left us entirely too quickly. John is survived by his wife of forty-seven years, Pat of Bigfork, daughter Andrene Potts of El Dorado Hills, California, son Jason Foote of Suhuara, Arizona, as well as three grandchildren.

A celebration of his life will be held this summer at their orchard in Bigfork.

John E. Foote

Letters
then occupied a judgeship for six months in 1819-1820 in Arkansas Territory, which had been carved out of the Missouri Territory administered by William Clark.

Charles Jouett died in Lexington, KY in 1834, and at the time of his death it was written, “Few men in the United States Indian Department ever showed more devotion to the interests of the Government, more unbending integrity of purpose or promptitude of action, or more impartiality and justice to the Indians; few had more the confidence of the Government. The management, finesse and double-dealing, by which so many of the Indian Agents have enriched themselves from the spoils of the Indians, whose rights it was their duty to maintain, had no place in the school of honor where he was educated.” (Quoted in Henry Higgins Hurlbut, Chicago Antiquities, pp. 107-08.) Something similar could have been said about William Clark as well.

Lou Ritten
LCTHF Lifetime Member
La Grange Park, IL

The Ionia Volcano Location

In a WPO article by Mr. John Jengo in the February 2011, edition of WPO he questioned the traditional site of the so-called “Ionia Volcano” visited by Lewis and Clark on August 24, 1804. The “traditional site” is often referred to as the “Newcastle site” because of its proximity to the village of Newcastle, Nebraska. He believes the true site to be several miles upstream northeast of Wynot, Nebraska. His article is related to the “Burning Bluffs,” his term for the “Ionia Volcano” commonly used, at least in this area.

My letter to WPO questioning his conclusion regarding the true site of the “Ionia Volcano” was published in May, 2012. In the August 2012 issue of WPO Mr. Jengo responded to my letter, reiterating his contention as to the true site of the “Ionia Volcano.” He referenced Clark’s estimated distance from “Rologe Creek” (today’s Ayowa Creek) as 29.25 miles. Mr. Jengo then stated that “the distance from Ayowa Creek to the present-day Ionia Volcano is only 13 miles.” THAT really caught my attention. The “thirteen miles” is fairly accurate IF you are traveling by air (or, “as the crow flies”).

I have a decades-long familiarity with the Missouri in this general area and quite a number of maps, including a copy of Clark’s map of the area in Volume 1 (Atlas) of Moulton’s edition of the Journals of the Lewis and Clark Expedition.

My report of the river mileage between Clark’s “Rologe Creek” (today’s Ayowa Creek) is determined by reference to an official map of the U.S. Army Corps of Engineers and by my decades long familiarity with the local Missouri River. Specifically, the map is entitled: “Orthophoto Map Book Missouri River Gavins Point Dam to Sioux City Iowa.” The book bears the date of August 21, 1997. This map indicates that today’s Ayowa Creek joins the Missouri River near Missouri River Mile 745, southeast of Ponca, Nebraska. The Ionia Volcano lies near Missouri River Mile 768. This is a distance of 23 miles. Further, in the 1950s, the Corps of Engineers shortened the river by pretty much eliminating the curving Miners Bend, which was just above the mouth of the Ayowa Creek. Even with the shortening, the distance from the Ayowa’s mouth to the Ionia Volcano is far more than the 13-mile distance reported by Mr. Jengo.

Clark’s map of the area close to the Ionia Volcano, referenced above, is an important key to interpreting the distances. The site of present-day Vermillion, South Dakota, is not far from the Ionia Volcano site—in fact the “volcano” site is visible from Vermillion. Vermillion occupies a distinctive terrain that existed at the time Lewis and Clark visited the area. This terrain makes it easy to locate the future site of Vermillion on Clark’s map. On Clark’s map there is a hand-written “volcano” south and east of Vermillion and at or near the historic site of the Ionia Volcano.

Along the roughly 4,000 miles of the Lewis & Clark journey there are only about fifty sites where one can say with certainty “Here they stood.” The Ionia Volcano site is one of these and its true location is the traditional “Newcastle site.”

J. M. Peterson
Past-president, LCTHF
Vermillion, South Dakota

Attention Lewis and Clark Trail Stewards!

October 1 is the deadline for submitting a Bicentennial Trail Stewardship Endowment Grant request for the 2015 grant year. See www.lewisandclark.org/grants/ for the application and guidelines.

Call Lindy Hatcher at 406-454-1234 if you have questions or need help with the application.
Flood Basalts, Glacial Torrents, and Lewis and Clark’s “Swelling, boiling & whorling” River Route to the Pacific

PART 1: THE SNAKE RIVER AND COLUMBIA PLATEAU

by John W. Jengo

October 24, 1805: here a tremendous high black rock presented itself high and steep appearing to choke up the river...I determined to pass through this place notwithstanding the horrid appearance of this agitated gut Swelling, boiling & whorling in every direction. Clark

Of all the terrains the Lewis and Clark expedition traversed between 1803 and 1806, the route down the Snake and Columbia Rivers, amongst dark menacing rocks and through ferocious whitewater rapids, was perhaps the most thrilling, dramatic, and geologically fascinating. What Sergeant Patrick Gass observed to be “so much uniformity in the appearance of the country,” belied an exceptionally active and relatively recent geologic history. This volatile past included lava flows of vast extent interspersed with periods of intensive fluvial erosion and sedimentation, punctuated by far more explosive volcanic events. These were followed by the deep scouring of the entire landscape by tremendous volumes of glacial meltwater bursting out from massive glacial lakes and rushing headlong from the Rocky Mountains to the sea. In historic times, volcanic eruptions and immense landslides in certain locales physically altered the course of the Columbia, the West’s mightiest river. It is a geological story that could not have been imagined by Meriwether Lewis or William Clark, yet the observations of the corps along the Snake and Columbia Rivers provide evidence of catastrophic geological events scientists would not untangle and correctly interpret for nearly a century. Following their descent of the Clearwater River, the Lewis and Clark expedition passed through what is commonly referred to as the Columbia River Basalt Group (CRBG), one of the most extensive accumulations of basaltic lava on earth, deposited by eruptions that occurred between 17.5 and 6 million years ago. Basalt, of which more than 90 percent of all volcanic rocks are composed, is hard and dense with a dark,

Columnar-jointed basalts of the Pomona Member of the Saddle Mountain Basalt, located 4.5 miles west of the confluence of the Snake and Clearwater rivers at Clarkston, Washington, and Lewiston, Idaho. Lewis and Clark never described these uniquely characteristic rocks as basalt, despite the fact they were the predominant geologic feature along the nearly 450-mile route down the Snake and Columbia Rivers to the Pacific Ocean. The outcrop scale is indicated by the one-foot-long rock hammer on the small ledge at center, indicated by the arrow. Unless otherwise noted, all photos by John W. Jengo.
crystalline appearance. Unweathered surfaces of basalt are black, grayish-black, and dark to medium gray, but the rock weathers readily to a spectrum of lighter grays and rusty-colored appearances (such as reddish-gray, reddish-brown, yellowish-brown, and yellowish-orange) because of oxidation of its iron-rich mineral content.

For our purposes, it is unnecessary to describe the exhaustively complex sequence of over three hundred individual basalt flows of the CRBG, but it will be useful to know the general sequence of the major eruptive episodes in reference to the various basalt formations the Lewis and Clark expedition encountered. Initial eruptions between 17.5–17 million years ago formed the geographically limited Imnaha Basalt, but it was the more than one hundred individual lava flows between 17 and 15.5 million years ago that resulted in the Grande Ronde Basalt, the most voluminous and extensive formation composing 85 percent of the CRBG’s total volume. Later lava flows between 15.5 and 14.5 million years ago formed the Wanapum Basalt, which was followed by a long sequence of eruptive events lasting between 14 and 6 million years ago that deposited lavas collectively known as the Saddle Mountain Basalt. Despite their low representations in volume, the expedition would encounter Wanapum Basalt and the Saddle Mountain Basalt rocks quite frequently during their journey because of their greater surface exposure.

The areal extent of these lava flows is simply astonishing, covering the upper third of the state of Oregon, the lower half of Washington State and much of the western border of Idaho, some 163,700 km² in extent. That is 63,205 square miles, an area the size of Pennsylvania, New Jersey, Delaware, and Connecticut with enough lava left over to cover Washington, D.C. five times over. Geologists often refer to the CRBG lavas as “flood basalts,” which concisely summarizes their behavior when they broke out onto the earth’s surface. Such a flowable tendency explains why some CRBG lavas, discharging from fissures or vents located in northeastern Oregon, eastern Washington, and western Idaho, could flow westward at speeds of 3 to 9 miles per hour (or faster) for hundreds of miles and, in some instances, breach both the ancestral Cascade and Coast mountain ranges, and reach the Pacific Ocean.

“dark ruged Stone”: The Absence of Basalt Nomenclature in the Journals

Our “following the floods” story begins as the Corps of Discovery proceeded down the Snake River (beginning at present-day Lewiston, Idaho, and Clarkston, Washington, where it meets the Clearwater River) near the eastern edge of the basalt flows. This is where the expedition journal keeper’s observations of this dark-colored rock commence:

[October 11, 1805:] The hills on the river are…rocky; the rocks of a dark colour. *Gass*

[October 12, 1805:] The hills or assents from the water is faced with a dark ruged Stone. *Clark*.

Despite the brevity of these and subsequent observations, the journal keepers captured the prevailing geologic feature, cliffs of dark-colored basalt, along this part of the Snake and Columbia Rivers route. An enduring mystery, however, and a question with no satisfactory answer, is why they never described the rocks they were encountering over the next several hundred miles as “basalt.” It is true that the mineralogical nature of basalt was unknown at this time, and that modern expertise in mineralogy and diagnostic indicators such as paleomagnetism are required to distinguish one basalt flow from another. Yet, there was an unmistakable description of basalt and its common columnar shape in Richard Kirwan’s *Elements of Mineralogy*, believed to be the only geology and mineralogy reference book carried by Lewis and Clark. Kirwan’s descriptions of basalt were easily recognizable and distinctive, whether he was describing the color (“greyish black, sometimes bluish, or brownish black; when withered [weathered], the surface is greyish, or reddish brown”), shape (“generally of a columnar form, straight or curved, perpendicular or inclined”), geometry (“pentangular, hexangular, octangular”), or occurrence (“found in considerable masses”).

There is strong evidence the captains referred to *Elements of Mineralogy* at various times throughout the expedition, but it remains unexplained why they did not attempt any rock identification of this dominant lithology. This absence of basalt nomenclature in the journals is particularly puzzling given that virtually all the consolidated rocks the expedition encountered here were volcanic basalts, including miles upon miles of the
characteristic hexagonal, columnar-jointed columns evident all along this portion of the route.

**Uniquely Shaped Rocks as Geomorphic Landmarks**

When retracing the expedition’s route down the Snake and Columbia Rivers today, observers must reconcile themselves with the disappointing prospect of not seeing most of the dramatic river-centric features that filled the expedition journals:

October 13, 1805: bad rapids, rocks in every direction. *Clark*

The expedition’s three hundred-mile river route from today’s Lewiston, Idaho, to Bonneville Dam has been drowned by a total of eight federally-owned hydroelectric dams, including four dams on the lower Snake River, each about a hundred feet high and impounding from twenty-eight to thirty-nine miles of the river.¹³ The Snake River dams were constructed relatively recently (1961-1975) in the waning days of the dam-building fever that swept across the West. These four Snake River dams are now prime targets for removal in the next few decades to restore migratory fish passage, particularly for salmonid species, which could greatly enhance the restoration of their spawning runs up into the Clearwater and Salmon Rivers.¹⁴

Although it is not possible to directly observe the rocks around which the expedition maneuvered in the rapids, there are several large-scale geologic features that sit above the dam impoundments:

October 14, 1805: at 2½ miles passed a remarkable rock very large and resembling the hill [hull] of a Ship Situated on a Lard point at some distance from the ascending Country. *Clark*

Dubbed “Ship Rock” on Clark’s route map,¹⁵ but now known as Monumental Rock, this distinct outcropping of the Lower Monumental Member¹⁶ of the Saddle Mountains Basalt is located on the south bank of the Snake River in Walla Walla County, Washington, just upriver of Lower Monumental Dam. Like the
We Proceeded On August 2014

recorded comments on Hat Rock on the Columbia River passed by the expedition on October 19, 1805, this description is a fine example of the captains’ minimalist, but still informative, geological remarks. They were diligent in selecting unique geomorphic landmarks that enable us to precisely pinpoint important waypoints along their trek.

The Channeled Scablands

From the moment they dipped their paddles into the Snake River, the Lewis and Clark expedition would not only be following the path of multiple flood basalt flows, but also the route of the colossal Lake Missoula floods that so markedly scoured the basaltic landscape. During the last glacial period in the Pleistocene, a glacial lobe from the massive Cordilleran ice sheet advanced southeastward of present-day Lake Pend Oreille near the Idaho-Montana border. It dammed the natural outlet of Clark Fork River, thus creating a nearly two hundred-mile long impoundment in western Montana now referred to as Glacial Lake Missoula. Following the catastrophic failure of the approximately 2,000-foot high ice dam, along with multiple other large-scale releases of lake waters between about 15,000 and 18,500 calendar years ago, floodwaters repeatedly burst out of Lake Missoula and rushed westward seeking a route to the sea. The largest and earliest floods may have flowed freely through the northern Columbia River Valley, but subsequent releases from Lake Missoula encountered Glacial Lake Columbia, itself created by another Cordilleran glacial lobe damming the Columbia

Palouse Falls is a spectacular example of Miocene-age igneous flood basalts that were subsequently abraded and carved by the colossal Pleistocene-age floods. Its broad, eroded valley and outsized plunge pool were not formed by the present-day flow of the Palouse River, but by tumultuous, ice-laded floodwaters from Glacial Lake Missoula that swept over the Channeled Scablands.
River. With no outlet in that direction, Missoula floodwaters spilled over the low drainage divide to the south in a myriad of stupendous cascades and torrents moving upwards of thirty to sixty miles per hour or more. The sheer force, volume, and speed of this ice and rock-laded water instantaneously denuded the landscape, stripping away soil and vegetation and carving deep canyons along its flood path throughout an area now known as the Channeled Scablands, while also depositing oversized sand and gravel bars.

The entire expedition route on the Snake and Columbia Rivers is marked by evidence of these gargantuan floods, including the 184-foot high Palouse Falls, the only active waterfall left along glacial flood path in the Channeled Scablands. Located about five miles up what the captains named “Drewyers River,” the expedition members did not see the falls because they did not reconnoiter that far upstream. Had they seen it, certainly the beauty of the falls and its basaltic flow architecture would have been worthy of mention, but how curiously undersized the river and narrow falls were compared to its broad, eroded valley and outsized plunge pool might not have been noted by the explorers. Such an insight would require imaging the entire landscape being abraded and torn asunder under hundreds of feet of tumultuous, ice- and rock-laded Missoula floodwaters.

Close examination of the expedition journals reveals that Lewis, Clark, and the other journal keepers took note of key physical evidence of epic flooding events. For example, Clark noted on October 11 and 12, 1805, primarily in his courses and distances, the “stoney” composition of the islands in the Snake River, while Gass remarked on October 11 that the “bed and shores of the river are very stony” and the stones were of “a round smooth kind.” These were pre-Missoula flood deposits, which are the predominantly stony sediments found from the confluence of Snake and Clearwater Rivers to about 7.5 miles eastward of the mouth of the Palouse River. An excellent exposure of these “stoney” deposits can be found on the north bank of the Snake River at Central Ferry, fortunately still visible above the impounded water of Lake Bryan behind Little Goose Dam. These pebble, cobble, and boulder-sized stones are comprised of many different lithologies but their markedly well-rounded shapes disclose a final turbulent, shared journey from perhaps as far distant as the ancestral Salmon River.

Clark was a bit more descriptive of flood depositional features on October 15, 1805:

The Islands of different Sizes and all of round Stone and Sand.

Because the easternmost discharge of the Missoula floods was the Palouse River (which the floods re-routed from its original course down Washtucna Coulee), the “round Stone” Clark described on October 15 (downstream of the Snake-Palouse River confluence) was a Missoula flood outburst gravelly deposit. Geologists

Representative exposure at Central Ferry, Washington, of the “stoney” deposits of “a round smooth kind” encountered by the expedition along the Snake River. These pebble, cobble, and boulder-sized stones, and the gravelly deposits observed farther downstream, were deposited by enormous flooding events in the Snake River valley.
can differentiate between pre-Missoula flood deposits such as the aforementioned Central Ferry exposure and Missoula flood gravels because the latter deposits are almost completely comprised of basalt gravels (>95%), direct evidence that the Missoula floods swept over, and plucked, wrenched and scoured rocks from a nearly uniform basaltic landscape. Ever diligent in his observations, on October 16, 1805, Clark would correctly describe another one of these Missoula flood outburst deposits as a “gravelly bare.”

The Enigmatic “Keffekill” Mineralogical Specimen

Upon reaching the “great Columbia river,” Clark’s initial observation as the expedition set out downriver captured the essence of the area’s geology and geography:

[October 18, 1805:] the river passes into the range of high Countrey at which place the rocks project into the river from the high clifts which is on <both> the Lard. Side about ⅔ of the way across and those of the Stard Side about the Same distance, the Countrey rises here about 200 feet above The water and is bordered with black rugid rocks.

The “range of high Countrey” was the Horse Heaven Hills and the “black rugid rocks” that are its foundation at Wallula Gap consist of dramatic exposures of the thick Frenchman Springs Member of the Wanapum Basalt capped by the Uma-tilla, Pomona and Elephant Mountain Members of the Saddle Mountains Basalt. Along this stretch of river Meriwether Lewis apparently collected an enigmatic and long-missing mineral specimen that was never documented in the expedition journals or in any expedition-related specimen list or correspondence. The documentation of this specimen’s existence is only found in the c. 1812 hand-written mineralogical specimen catalogue of Adam Seybert, physician, gentleman-scientist, and Philadelphia’s leading mineralogy expert:

“Keffekill. found at the Wallenwaller nation on Columbia River. Captn. Lewis.”

This was the same Adam Seybert who added supplemental mineralogical com-

ments to augment Lewis’s original descriptions of the mineral specimens sent back from Fort Mandan in April 1805. Identifying the locale as being coincident with the “Wallenwallar” [Walla Walla] nation, where the expedition encountered the hospitable Chief Yellepit, places the collection site somewhere in the vicinity of the Columbia-Walla Walla River confluence or perhaps a short distance downriver. The specimen is lost along with its presumed identification tag, so it is not known whether Lewis originally assigned the “kefekill” classification using the Kirwan volumes as a guide or if this was Seybert’s identification. We know Lewis was still referring to Elements of Mineralogy because of his attempt at Fort Clatsop in January 1806 to describe the mineralogy of the “white earth” specimen collected on Tillamook Head, but it is more probable Seybert made the identification in Philadelphia.

In the early nineteenth century, “kefekill,” also known as meerschaum, was described as a very fine-grained, yellowish, grayish-white, or white clayey marl soft enough upon excavation to be readily made into tobacco pipes or mixed with water to make a cleansing soap. Whatever specimen Lewis did collect, it was probably not the hydrous magnesium silicate mineral sepiolite, the present-day equivalent of “kefekill” and “meerschaum.” If not actually “kefekill” then,
what was the presumably yellowish to grayish-white deposit Lewis did sample and secondly, what would such an apparently incongruous light-colored deposit be doing in an extensive terrain of black basaltic rocks? The numerous islands and natural river banks along this stretch are drowned by the impoundment behind McNary Dam, frustrating any direct inspection, so if we want to contemplate “keffekill” sample possibilities, we should start with the Missoula floods that created the Channeled Scablands.

The “high clifts” of Wallula Gap the expedition passed on October 18, 1805, were the upstream funnel constriction of the Missoula flood outbursts, being the sole outlet for the Columbia River watershed of eastern Washington. Despite being a mile wide, Wallula Gap could “only” pass about 211,900,000 cubic feet per second (cfs) of flow during the greatest of the Lake Missoula outbursts through the Channeled Scablands (a staggering 1.59 billion gallons per second), which was not nearly enough capacity to discharge the full floodwater volume roaring down the Columbia River. The excess sediment-laded floodwaters, constricted for days from flowing through the hydraulic dam at the Gap, rose to heights up to 900 feet over normal river level and backflooded up the Snake, Walla Walla, and other Columbia River tributaries. This immense temporary lake would be named Lake Lewis in the twentieth century in honor of Meriwether Lewis. When the backwaters of each glacial outburst slackened with decreases in current velocity, sedimentary sequences of sand and silt called rhythmite were deposited.

Exposures of these rhythmite deposits can be seen along stream banks, and in road and railroad cuts, including at the present-day mouth of the Walla Walla River’s confluence with the Columbia River. Close examination of these outcrops and other superb exposures just north of the town of Touchet, Washington (which lent its name to these Touchet Beds), reveal multiple layers of a yellowish gray to grayish-white, fine-grained to very fine-grained sand and silt. An intriguing “keffekill” sample candidate for sure, especially given the wide distribution of Touchet Beds in this area, thus increasing the odds of an encounter with the mineralogy-minded Meriwether Lewis. Yet, Touchet Bed silts in this area are not as fine-grained as clayey marl, one of the distinguishing characteristics of true keffekill that would have convinced either Lewis or Seybert that the expedition specimen was “keffekill.” Perhaps Lewis sampled a layer of thinly laminated clayey fine silt found associated with some Touchet Bed rhythmites or one of the thick clay and silt coatings lining the walls of near-vertical clastic dikes that permeate certain Touchet Beds locales.

Because the expedition passed through this area twice, we don’t know if the faux “keffekill” specimen was collected in October 1805 or April 1806, but an April 1806 collection date is favorable for several reasons. Firstly, such a specimen was more likely to survive the trip back East having missed the precarious journey to Fort Clatsop and back. Secondly, the expedition spent three nights (April 27-29, 1806) in the vicinity of likely collection sites, affording Lewis more time to conduct his mineralogical sampling. Lastly, their encampment of April 29, 1806, placed the expedition in very close proximity to extensive exposures of light-colored deposits, including Touchet Beds along the banks of the Walla Walla River, a water body we know Lewis examined very closely.

The Columbia Plateau and “emence piles of rocks”

Over the next two days (October 19-20, 1805), Clark would dutifully note significant geomorphic features along the expedition route, most famously the stovepipe hat-shaped outcropping of Hat Rock (shaped by Missoula floods) near present-day Cold Springs, Oregon. Hat Rock is mentioned twice by Clark, as “a rock in a Lard. resembling a hat” in his Elkskin-bound Journal on October 19, 1806, and “a rock on the Lard. Shore resembling a hat” in his courses and distances summary. Hat Rock is an outcropping of the Pomona member of the Saddle Mountain Basalt, about 6 million years older than Monumental Rock. Clark also observed on October 19 the “knob” that is Sillusi Butte, a distinctive outcropping of the Umatilla and Pomona members of the Saddle Mountain Basalt just downriver of the present-day McNary Dam. The next day, Clark noted the “high countrey…on the Stard. Side” that is Alder Ridge, another Saddle Mountain Basalt exposure that was aptly described by Lewis on April 25, 1806, as “the river hills are about 250 feet high and generally abrupt and craggy in many places faced with a
perpendicular and solid rock. this rock is black and hard.”37 Most river-centric features worthy of note in the journals are now completely submerged by both McNary and John Day Dams (all the rapids and most of the islands, although the tops of a few islands can be seen in the Blalock Islands area).

About halfway through the October 21, 1805, traverse, Clark commented:

on the Lard. Side emence piles of rocks appears as if Sliped from the Clifts under which they lay.

It can be a challenge to precisely locate some of Lewis and Clark’s geological notations that were not landmark-specific. The October 21, 1805, rock fall observation is rather general, but is likely referring to mass-wasting

Sunrise on the Horse Heaven Hills at Wallula Gap, passed by the expedition on October 18, 1805, and described by William Clark as a “range of high Country.” The cliffs, comprised of the Frenchman Springs Member of the Wanapum Basalt capped by various flows of the Saddle Mountain Basalt, were scoured multiple times by Lake Missoula outburst floods.

Another geomorphic landmark noted by the captains was Hat Rock, an outcropping of the Pomona Member of the Saddle Mountain Basalt.
features along a fourteen-mile long stretch of dramatically steep slopes visible today between Blalock Canyon and the John Day River on the Oregon side. Along this route, one can observe multiple alluvial fans, talus slopes and landslides that have careened down from the basalt cliffs of Wanapum Basalt. Some of these erosional features have been vegetated, having the appearance of enormous sand dunes blanketing the base of the cliffs, while other rock falls appear much younger, comprised of unweathered angular rocks splayed out in overlapping fan-shaped arrays. Like many other fresh mass-wasting features along this reach of the Columbia River, they likely post-date the last of the major Missoula floods, because those flooding episodes would have scoured the cliff slopes clean of debris.

The Dalles of the Columbia

Over the next three days (October 22-25, 1805) the expedition would be navigating through one of the most exciting and difficult stretches of the entire water route to the Pacific, raging torrents compressed through narrow slots of bedrock with several sets of daunting falls and pitches. Several outstanding geological features were noted on October 22, 1805 such as “a large Island of high, uneven [rocks], jutting over the water” at the mouth of the Deschutes River. This is now Miller Island, still visible today as a large outcropping of the Frenchman Springs Member of the Wanapum Basalt, and evidently isolated by Missoula floodwaters from comparable member rocks on the north bank of the river. And there was “a very Considerable rapid,” formerly the Deschutes Rapids, now drowned,
where Clark “beheld an emence body of water Com-
pressd in a narrow Chanel of about 200 yds in width,
foaming over rocks maney of which presented their
tops above the water.” That formidable rapid was a har-
binger of the exceedingly convoluted river course to
come.

The corps first encountered what they called the
Great Falls of the Columbia, subsequently known
as Celilo Falls (and referred to as such hereafter), in
the late afternoon of October 22, 1805, near today’s
Wishram, Washington, where Clark noted:

> the waters is divided into Several narrow chanels which
   pass through a hard black rock forming Islands of rocks
   at this Stage of the water.42

The expedition passed through the falls the follow-
ing day, via portage, paddling, and cording the canoes
over “a pitch of 8 feet in which the chanel is divided
by 2 large rocks.” The next day, Clark would detail
more specifically the route through Celilo Falls, while
astutely noting evidence of a much higher water level:

> [October 24, 1805:] The first pitch of this falls is 20 feet
   perpendicular, then passing thro’ a narrow Chanel for 1
   mile to a rapid of about 18 feet fall below which the water
   had no perceptable fall but verry rapid...It may be proper
   here to remark that from Some obstruction below, the
   cause of which we have not yet learned, the water in high
   floods (which are in the Spring) rise <nearly> below these
   falls nearly to a leavel with the water above the falls; the
   marks of which can be plainly trac’d around the falls.

The expedition did not have to travel far to find
out which “obstruction” was causing the backflood-
ing at Celilo Falls: the daunting “narrow chanel” of the
Short Narrows whose width (45 yards) was particularly
noteworthy:

> [October 24, 1805:] at this place the water of this great
   river is compressed into a Chanel between two rocks not
   exceeding forty five yards wide and continues for a ¼ of
   a mile when it again widens to 200 yards and continues
   this width for about 2 miles when it is again intercepted
   by rocks. This obstruction in the river accounts for the
   water in high floods rising to Such a hite at the last falls.
   The whole of the Current of this great river must at all
   Stages pass thro’ this narrow chanel of 45 yards wide.
   Clark

Or as Patrick Gass would explain in his October
23, 1805, journal entry, with perhaps some welcomed
clarity contributed by his editor David McKeehan:
“The reason of this rise in the water below the falls is,
that for three miles down, the river is so confined by
rocks (being not more that [than] 70 yards wide) that
it cannot discharge the water, as fast as it comes over
the falls.” Thus, the expedition journal keepers were
describing a seasonal flow occurrence here at the Short
Narrows that was a microcosm of the Missoula back-
flooding phenomenon during the massive floods thou-
sands of years earlier at Wallula Gap.

Clark does not divulge a relative height of the
“marks of which can be plainly trac’d around the falls,”
stating only that these spring floods rise “nearly to a
leavel with the water above the falls.” In order to ascertain what that flooding height might have been, we can refer to the journals of Patrick Gass, John Ordway, and Joseph Whitehouse to learn the height of the falls—37 feet, eight inches. However, it is presumed herein that these journal keepers were referring to the whole mile-long Celilo Falls complex because Gass stated “the whole height [emphasis added] of the falls is 37 feet, 8 inches”43 and Ordway stated “the height of the particular falls in all [emphasis added] is 37 feet eight Inches.”44 If this is correct, we can then surmise from the journals the expedition members observed a flooding level at the falls of about thirty-eight feet. However, both Patrick Gass and John Ordway mention a different and greater high water mark:

[October 23, 1805:] The high water mark below the falls is 48 feet, and above only 10 feet four inches from the surface of the water: so that in high water there is nothing but a rapid, and the salmon can pass up without difficulty. Gass

[October 25, 1805:] the River between these narrows and the great falls rises at high water 48 feet perpendicular by its being confined by the different narrows. Ordway45

Reconciling this forty-eight-foot measurement with Clark’s statement that high water rises “nearly to a leavel” with the water above the thirty-seven-foot, eight-inch Celilo Falls complex is possible if we speculate that this forty-eight-foot estimation of flood height was measured farther downriver and therefore included an elevation drop of the river between the foot of the Celilo Falls and the Narrows.

Having successfully negotiated the Short Narrows, Clark prudently scouted the protracted obstacle of the Long Narrows on the evening of October 24 in preparation for running the rapids the next day:

[October 24, 1805:] walked down three miles to examine the river Over a bed of rocks, which the water at verry high fluds passes over…The evening being late I could not examine the river to my Satisfaction, the Chanel is narrow and compressed for about 2 miles, when it widens into a deep bason to the Stard. Side.

[October 25, 1805:] This Chanel is through a hard rough black rock, from 50-100 yards wide. Swelling and boiling in a most tremendous maner.

There is a lot of revealing information in Clark's brief description. He astutely noted the bench he was walking on, elevated from the low water flow of the Columbia River, would become inundated at higher flows. In terms of the channel's rather restricted width, later explorers and surveyors would describe the Long Narrows as essentially a “mill race”46 because it ran nearly straight and true, almost canal-like in its consistent alignment. Clark's observation of the “deep bason” that is present-day Spearfish Lake (formerly Big Eddy) indicates he may have taken a sounding; if so, he would have found holes some 120 feet deep, which at this locale would measure about 90 feet below present-day sea level. This has suggested to geologists that entrenched channels like the Long Narrows may have been excised by the Missoula floods,47 albeit on a smaller scale than most of the canyons and coulees in the Channeled Scablands.

Not only are the Celilo Falls and the Short and Long Narrows rapids a distant memory because of the completion of The Dalles Dam in 1957, the rocks the captains observed at close range scouting the rapids, careening through them, and portaging around them are also submerged. We are left with brief riveting narratives, which began with William Clark's vivid first-hand impressions. Unfortunately, the very few comments recorded by Meriwether Lewis of the Narrows and Great Falls, such as when he noted “the long narrows are much more formidable than they were when we decended them last fall there would be no possibility of passind either up or down them in any vesel” lack his usual flair for descriptive detail.48 We have serviceable descriptions of the geology by later explorers and surveyors, the most articulate of which were written by men who were eagerly seeking ways to defeat the falls and rapids with canals and dynamite. And then there are the evocative black and white photographs taken in the first half of the twentieth century, which provide the proof of the ferocious beauty, intricacy, and scale of the rapids, falls, and channels that have been inundated.

INTERLUDE

Upon navigating a set of rapids below the Long Narrows, the expedition had a welcomed respite from the perilous whitewater:
[October 25, 1805:] we proceeded on down the water fine, rocks in every direction for a few miles when the river widens and becomes a butifull jentle Stream of about half a mile wide. Clark

As noted by Clark that same day, “we formed our Camp on the top of a high point of rocks, which forms a kind of fortification.” The expedition would spend three nights at what was termed “Fort Camp” on Clark’s route map, which we know today as “Rock Fort,” on a prominent rock bench of the Priest Rapids Member of the Wanapum Basalt (yet another surface shaped by Missoula floods). We will pause here also before we follow the expedition’s plunge through the heart of the Columbia River Gorge. Lewis and Clark’s journey up to this point from the Clearwater-Snake River confluence was through a dry landscape whose foundation was poured millions of years ago by extensive flood basalts, subsequently scarred with an erosional memory of colossal glacial floods from several thousand years ago. Yet, pushing off from Rock Fort on the morning of October 28, 1805, the expedition would be hastening into a lush terrain of more immediate volatility, including shattering geological events that preceded their arrival by mere decades.

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Notes
1. Part 2 of this article will appear in a future issue of We Proceeded On.
2. Gary E. Moulton, ed., The Journals of the Lewis & Clark Expedition, 13 volumes (Lincoln: University of Nebraska Press, 1983-2001), 5: 331; 333. All Lewis or Clark journal quotations for October 1805 in the ensuing text are from volume 5, by date.
3. Moulton, ed., Journals, 10:155. All Gass journal quotations in the ensuing text are from volume 10, by date.
4. The study of the Columbia River Basalt Group has focused primarily on subdividing thousands of feet of undifferentiated volcanic deposits into different lava flows, fluvial deposits, and other types of volcanioclastic sediments. Modern scientific advances that have facilitated this difficult work included determining that lava beds could be differentiated by their unique mineralogical oxide compositions, trace and rare earth elements, presence/absence of plagioclase phenocrysts, and paleomagnetic polarity. One particularly insightful outcome of this research was recognition that the ancestral Columbia River occupied different channels over time and that these former courses of the river were filled by lava flows from subsequent eruptions.
5. Terry L. Tolan, Marvin H. Beeson, and Beverly F. Vogt, “Exploring the Neogene History of the Columbia River: Discussion and Geo-logic Field Trip Guide to the Columbia River Gorge—Part 1 Discussion,” Oregon Geology, 46:8 (August 1984): 87-97. The Miocene Epoch was 23 to 5.3 million years ago. Some geologists use the physiographic term “Columbia Plain” because even the highest elevations of this region are bordered by mountains, but I opted to use the more familiar term “Columbia Plateau.”
6. Donald A. Swanson, Kenneth A. Cameron, Russell C. Evarts, Patrick T. Pringle, and Joseph A. Vance, “Cenozoic Volcanism in the Cascade Range and Columbia Plateau, Southern Washington and Northernmost Oregon,” 28th International Geological Congress (IGU) Field Guidebook T106, July 3-8, 1989 (Washington, D.C.: American Geophysical Union, 1989). In addition to 85 percent of Grande Ronde Basalt, the CRBG is comprised of about 2 percent of another 17-15.5 million year old geographically limited unit called the Picture Gorge Basalt, 5.5 percent of Imnaha Basalt, 6 percent Wanapum Basalt, and 1.5 percent Saddle Mountain Basalt.
7. Ibid. The composition of basalt and how it differs from other extrusive volcanic rock requires a brief digression into the functional mineralogy of magma. If the silica (the same silicon-oxygen compound of ordinary beach sand) content of a magma is relatively low (<50-55 percent), it will form basalt, whose dark colors are a result of greater concentration of iron and magnesium. Progressive increases in the silica content in the magma, coupled with lessening concentrations of iron and magnesium, will form andesite and rhyolite, much lighter-colored rocks. What is important for our discussion of the geology of the CRBG is that basaltic lava is much less viscous than andesitic or rhyolitic lava, and thus, can flow more readily and over far greater distances.
8. Terry L. Tolan, Stephen P. Reidel, Marvin H. Beeson, James Lee Anderson, Karl R. Fecht, and Donald A. Swanson, “Revisions to the Estimates of the Areal Extent and Volume of the Columbia River Basalt Group,” in Stephen P. Reidel, and Peter R. Hooper, eds., Volcanism and Tectonism in the Columbia River Flood-Basalt Province, Special Paper 239 (Boulder, Colorado: Geological Society of America, 1989), 1-20. Although some geologists are now including basalts of the southeastern Oregon Plateau in the CRBG, thus changing the long-established volume percentages of the five basalt formations I just listed, and also increasing the overall areal extent of the regional basalt flows, I have excluded the Oregon Plateau basalts herein to remain representative of only the “Columbia River Basalts” province the expedition traversed.
10. Marvin H. Beeson, Rauno Perttu, and Janice Perttu, “The Origin of the Miocene Basalts of Coastal Oregon and Washington: An Alternative Hypothesis,” Oregon Geology, 41:10 (October 1979): 159-166. Several reasons have been proposed to explain how CRBG lavas, which were actually more viscous than modern Kilauea lava, could have traveled westward over such long distances. These include a 1 to 2 degree slope from east to west, the sheer volume of the lava, and rate
of eruptions that were 3-4 orders of magnitude faster than Hawaiian eruptions. See Swanson, *et al.*, “Cenozoic Volcanism,” 23.


13. The dams on the Snake River, moving downstream from the confluence with the Clearwater River, are Lower Granite (completed in 1975, 100-foot high with a 39.3-mile long impoundment), Little Goose (completed in 1970, 98-foot high with a 37.2-mile long impoundment), Lower Monumental (completed in 1969, 100-foot high with a 28.1-mile long impoundment), and Ice Harbor (completed in 1961, 100-foot high with a 32-mile long impoundment).

14. In this author’s opinion, there are ample renewable energy and efficiency options to replace the modest amount of power generated by these dams and their limited use for barge traffic. The most biologically assured way to benefit all Columbia River Basin salmon and steelhead stocks now listed under the Endangered Species Act would be to remove these insurmountable obstacles to upriver migration, which would also eliminate the high mortality rate of fish returning downriver, curtail further losses of genetic diversity caused by hatchery fish interbreeding, and replace the warm, stagnant reservoirs with a more oxygenated, free-flowing river habitat. For the economically-minded, dam removal would end the spending of billions of dollars on ineffective fish recovery, transport, and hatchery efforts, and restore/create thousands of fishery-related and river-based recreational jobs.


16. Geologists have grouped lithologically comparable rock units into formations and individual lava flows closely spaced in time into formation members as a way to organize the bewildering number of lava beds into some semblance of order.


18. During the Pleistocene Epoch, which began about 2.588 million years ago, much of southwestern Canada was repeatedly glaciated by a series of Cordilleran ice sheets that extended into northern Washington, Idaho, and Montana. In North America, the most recent glacial period is termed the Wisconsin, which began about 85,000 years ago and ended around 11,700 years ago.

19. The cyclic ice damming/filling and subsequent release of Glacial Lake Missoula floodwaters occurred numerous times in the late Wisconsin, most probably between 12,700 and 15,300 radiocarbon years Before Present. See Richard B. Waite, Jr., “Case for Periodic, Colossal Jökulhlaups from Pleistocene Glacial Lake Missoula,” *Geological Society of America Bulletin*, 96:10 (October 1985):1271-1286. It is common to encounter other age ranges for the Missoula floods in the scientific literature (such as between 13,350 and 15,550 radiocarbon years Before Present) so I could have alternatively cited an age range of 15,500 to 18,700 calendar years ago. Subsequent research has broadened the potential time span of flood events from post-22,600 calendar years ago to perhaps hundreds of years past 15,000 calendar years ago, but I opted to cite the more narrowly defined and commonly accepted time span.

20. It is believed these flooding events were separated by a few years to six decades, per Richard B. Waite, Jr., “Periodic Jökulhlaups from Pleistocene Glacial Lake Missoula—New Evidence from Varved Sediment in Northern Idaho and Washington,” *Quaternary Research*, 22:1 (July 1984):46-58. Jökulhlaup is an Icelandic term for a large, abrupt outburst flood that occurs from the release of water below a glacier.

21. Gerardo Benito and James (Jim) E. O’Connor, “Number and Size of Last-Glacial Missoula Floods in the Columbia River Valley between the Pasco Basin, Washington, and Portland, Oregon,” *Geological Society of America Bulletin*, 115:5 (May 2003):624-638. I have excluded from my discussion the very last, post Lake Missoula floods (referred to as “non-Missoula” floods) that were restricted to the Columbia River valley in the waning years of the continental deglaciation. Those events bypassed the Channeled Scablands.

22. One can find different Missoula flood speed estimates in virtually every reference work of this phenomenon, depending on whether a researcher is referring to flow in a hydraulically impounded reach (where speeds from 11 to 45 mph have been estimated) to nearly 80 mph where floodwaters were funneling through a constriction (accelerating according to the Venturi effect). See Benito and O’Connor, “Number and Size,” 115:5, 634-635.

23. Two exceptional geologists, J [no period after the J] Harley Bretz and Joseph T. Pardee, are credited with deducing the erosional mechanism and water source that created the Channeled Scablands. Starting with his first published papers in 1923, Bretz recognized that only flowing water could have carved such features, but he did not have a source of the massive volume of water required to form them. In fact, he named the outbreak the “Spokane Flood” because he thought the source of the water was near Spokane, Washington. Commencing his work in 1910, Pardee deduced the existence of Glacial Lake Missoula; subsequent study of valley-scale ripple marks much larger than those found in ordinary rivers or streams convinced Pardee that such features could only be created by massively deep and vigorous currents associated with cataclysmic draining of the lake. It was the unification of these two theories that explained the creation of the Channeled Scablands and the numerous sedimentological features to be found along the flood path.

24. The lip of Palouse Falls is notched into oldest flow of the Frenchman Springs Member of the Wanapum Basalt, and the underlying cliffs are comprised of the Grande Ronde Basalt.
25. According to the geological map of this region, and verified through my own field observations, these light to dark gray, greenish gray, olive gray, grayish red, grayish red purple, grayish orange pink and blackish red pre-Missoula flood deposits are comprised of approximately 30% basalt and 70% percent metatranscanclastic, porphyritic, granitic, and metamorphic rocks, with quartzite particularly notable. See J. Eric Schuster, Charles W. Gulick, Stephen P. Reidel, Karl R. Fecht, and Stephanie Zurendo, *Geologic Map of Washington—South- east Quadrant*, Washington Division of Geology and Earth Resources Geologic Map GM-45, 1997, Sheet 1, scale 1:250,000.


27. For details on the important role Adam Seybert played in the subsequent fate of the entire Lewis and Clark mineral collection and how he likely obtained at least thirty-four Lewis and Clark mineralogical specimens for his private collection, including the “keffekill” specimen, see John W. Jengo, “Specimen of the Stone: The Fate of Lewis and Clark’s Mineralogical Specimens,” *We Proceeded On*, 31:3 (August 2005): 17-26.

28. Lewis was attempting to ascertain whether there was “magnesia” or “silex” [silica] in the “white earth” specimen. It is interesting that Kirwan also listed these minerals as the principal components of keffekill. See Kirwan, *Mineralogy*, 1:144-145.


31. Roger P. Denlinger and Daniel R.H. O’Connell, “Simulations of Cataclysmic Outburst Floods from Pleistocene Glacial Lake Missoula,” *Geological Society of America Bulletin*, 122:5/6 (May/June 2010): 678-689. This discharge of 211.9 million cfs, which I calculated from the Denlinger and O’Connell’s modeling result of 6 million cubic meters per second, is over 1,100 times greater than the mean annual flow of the Columbia River at The Dalles today.

32. A higher modeling result of 10 million cubic meters per second (353.1 million cfs) through Wallula Gap was calculated by James E. O’Connor and Victor R. Baker using a 1-dimensional step-backwater model, “Magnitudes and Implications of Peak Discharges from Glacial Lake Missoula,” *Geological Society of America Bulletin*, 104:3 (March 1992): 267-279, and confirmed in Benito and O’Connor, “Number and Size,” 115:5, 636, but I chose to cite the more conservative 6 million cubic meters per second (211,900,000 cfs) value because it may more accurately account for the downstream flow restriction through the Columbia River Gorge as modeled by Denlinger and O’Connell using a geometrically more sensitive 2-dimensional computation, “Simulations,” 122:5/6, 686. Either way, with estimates of the peak inflow into the Pasco Basin ranging from 22 to >25 million cubic meters per second, it is readily apparent why more than half of the greatest Missoula flood discharges hydraulically ponded upstream of the Wallula Gap constriction.

33. The exact number of Missoula floods, which could number more than 89, may never be completely established, but at least 40 separate catastrophic Missoula floods have been identified in the Walla Walla River valley, per Richard B. Waitt, Jr., “About Forty Last-Glacial Lake Missoula Jökulhlaups through Southern Washington,” *Journal of Geology*, 88:6 (November 1980): 653-679. There is recent consideration that the number of floods in the Walla Walla Valley may have been between 50 and 62. Current thinking has early, larger floods carving much of the Channeled Scablands and leaving higher elevation deposits, with subsequent, smaller events flooding less and less of the Channeled Scablands and depositing lower-elevation rhythmite sections; see Benito and O’Connor, “Number and Size,” 115:5, 637. Even these dozens of “smaller” floods, discharging at least 1 million cubic meters per second, were 185 times greater than mean annual flow of the Columbia River at The Dalles today.

34. Two other possibilities for the “keffekill” sample should be considered, although the opportunities for encountering these deposits were much less likely than the extensive Touchet Beds. The first would be a yellowish-gray, grayish white to white Mazama ash layer originally deposited in this region from a massive eruption of Mount Mazama (present-day location of Crater Lake, Oregon) about 7,700 calendar years ago, or perhaps one of the older, but much thinner, Mount St. Helens tephra deposits that are interbedded with certain Touchet Bed rhythmites. If the “keffekill” specimen were collected downstream of Wallula Gap, the other possibility could be a slackwater deposit from former Lake Condon, which was the enormous temporary lake formed when Missoula flood waters were constricted from passing readily through the head of the Columbia River Gorge some 120 river miles downstream.

35. According to his journal entry for April 29, 1806, Lewis noted the width, water depth, and bank height of the Walla Walla River, and its river bed composed of “gravel principally with some sand and mud,” thus we can establish that he reconnoitered an area with prospective Touchet Bed exposures. See Moulton, ed., *Journals*, 7:182.


37. Moulton, ed., *Journals*, 7:166. The Elephant Mountain Member of the Saddle Mountain Basalt is prominently exposed along Alder Ridge. It’s tempting to interpret Lewis’s use of the word “perpendicular” as a hint of recognition of columnar basalts, but he was probably just describing vertical cliff faces.

38. The cliffs are primarily the Frenchman Springs Member capped by the Priest Rapids Member, with some indication of the Roza Member along the slopes in the westernmost section nearer the John Day River.

39. There is a greater incidence of fresh rock slides along the westernmost five-mile stretch of cliffs from just west of I-84 mile marker 120 to the John Day River.

40. Connor and Waitt, “Beyond the Channeled Scabland—Part 2,” *Oregon Geology*, 57:4 (July 1995): 77. In fact, O’Connor and Waitt suggest numerous Columbia River and tributary valley landslides...
may have been triggered by the floods because rock strata were under-
cut of their supporting foundation by flood inundation and scouring.

41. Another island feature described by Clark on this day, “a high
dry rich Island of about 400 yards wide and 800 yards long” at the
mouth of the Deschutes River, was footnoted as being Miller Island
(see Moulton, ed., Journals, 5:326, n. 8), but I believe this was actu-
ally another geomorphic feature, perhaps a sand or gravel bar. An
Elkskin-bound Journal sketch map (Moulton, ed., Journals, 5:316,
fig. 21) illustrates a distinctly linear feature and it is clearly distin-
guishable from the larger Miller Island.

42. The expedition’s route through Celilo Falls and the Short and
Long Narrows is dominated by the Frenchman Springs Member
of the Wanapum Basalt, but intricate faulting in this area has also
exposed the Priest Rapids Member of the Wanapum Basalt and the
older Grande Ronde Basalt.


44. Moulton (ed.), Journals, 9:244. Only by assuming these jour-
nal keepers were referring to the whole mile-long falls complex can
the 20-foot height of the “first pitch of this falls,” as noted by Clark
on October 24, 1805, be reconciled with these 37 foot, 8 inches
measurements.


46. Although there are several excellent mid-nineteenth century
descriptive narratives of Celilo Falls and the Short and Long Nar-
rrows by explorer John Charles Frémont, Henry Abbot of the U.S.
Corps of Topographic Engineers, and others, the most useful to me
from a geological perspective from the first 100 years after Lewis and
Clark are the Annual Reports of the War Department, which include
this superb description of the “mill race” that was the Long Narrows
at low water: “Here, for the distance of about 9,000 feet, the total
low-water discharge of the Columbia is forced between high banks of
solid rock nearly vertical and in some places not over 160 feet apart,
the low-water surface having a fall of 11.2 feet in this distance. The
banks are solid basalt rock, precipitous, and from 40 to 60 feet high,
and the bottom is a succession of pockets 40 to 60 feet deep.” See
Captain William W. Harts, “Survey of Columbia River Between The
Foot of The Dalles Rapids and the Head of Celilo Falls, Oregon and
Washington, with a View to the Construction of Canals and Locks,
in Annual Reports of the War Department for the Fiscal Year Ended June
30, 1901, Report of the Chief of Engineers (Washington, D.C.: Govern-
ment Printing Office, 1901), Part 5, Appendix XXV, 3509.

47. O’Connor and Waitt, “Beyond the Channeled Scabland—Part
2,” 57:4, 77. It is also possible that post-glacial age river flows carved
the channel-bottom topography, perhaps aided by steeper river gradi-
ents during the time that sea levels were lower than today.

48. Moulton, ed., Journals, 7:136. This is the point on the return
journey where the expedition began to abandon the river and procure
horses for the journey east, although Patrick Gass and several other
men would continue upriver in two canoes until they passed the John
Day River and rejoined the main party on the evening of April 23,
1806.

At the time of the Corps of Discovery’s exploration of the West, United States Army rations included a serving of liquor each day. A gill, or four ounces, of distilled spirits such as rum, brandy, or whiskey, was passed out to all enlisted soldiers, though General George Washington had authorized “one quart of good spruce or malt beer” for his Continental Army some years earlier.1 The soldiers of the Massachusetts Militia had gone one step further, insisting their molasses allocation be delivered to them timely so they could brew their own beer.2 Eschewing ales and lagers, Meriwether Lewis estimated 120 gallons of whiskey would be enough alcohol for the Corps of Discovery’s entire trip, but that supply was exhausted within fourteen months of their departure.

The culture of alcohol consumption and manufacture in early nineteenth-century America was very different from our contemporary ways. In those days, making beer was common in most households. Prior to the consistent availability of potable water, beer was considered the soft drink of the day and was a regular accompaniment with food.3 Since boiling was a part of the brewing process, beer was often healthier than many water sources.

William Clark was apparently fond of such fermented libations because he was known to have stored porter while at Camp Dubois. On January 28, 1804, he bemoaned, “at 6 oClock 14° abov 0, Porter all frozed & several bottles broke.”4 This style of beer was relatively low in strength, being typically about 4% alcohol. It was a dark, bitter ale, made with several styles of malted grains that were partly charred or browned during the malting process. Porter was a favorite of George Washington, himself a home-brewer. General Washington decided the Continental Army should underwrite the cost of beer for the troops, recommending that “If spruce beer, or any other kind of small beer, could be provided, it ought to be given gratis.”5

The expedition’s instigator, President Thomas Jefferson, was also a gentleman brewer. He had experimented

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_Doth it not show vilely in me to desire small beer? … (William Shakespeare, Henry IV)_

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The Ale House Door by Henry Singleton (1766-1839). Oil on canvas, 10 x 12 inches, circa 1790. The original can be found at the Victoria & Albert Museum in London.
with corn, rather than barley, as a fermentable starch and
had also brewed wheat beer. At Monticello, beer was a
“table liquor” often served during dinner, and the earli-
est designs for Jefferson’s plantation included spaces for
brewing and storage of beer. To make his ales, Jefferson
bought local hops and used malt purchased from his
neighbor William Meriwether, cousin of Meriwether
Lewis.6

Jefferson viewed brewed beverages more positively
than distilled spirits. In 1816, the
retired president wrote, “I wish to see
[beer] become common instead of
the whiskey which kills one-third of
our citizens and ruins their families.”7

Jefferson’s friend, distinguished Phil-
adelphia physician Benjamin Rush, served as medical
advisor to the Corps of Discovery. Twenty years before
the expedition’s flotilla pushed off into the Missouri
River, Rush had also discussed the use of beer:

The grain from which these [malt] liquors are obtained…
contain a good deal of nourishment; hence we find many
of the poor people in Great Britain endure hard labour
with no other food than a quart or three pints of beer,
with a few pounds of bread a day. As it will be diffi-
cult to prevent small beer from becoming sour in warm
weather, an excellent substitute may be made for it by
mixing bottled porter, ale or strong beer, with an equal
quantity of water.8

In addition to liquor, a soldier’s daily ration
included a pound of bread flour. In preparation
for their extended tour of exploration, Captains Lewis and
Clark laid in plenty of flour and bread as well. Of the
ten tons of food stuffs stockpiled in St. Louis prior to
their departure, a quarter of the weight was attributable
to flour and “biscuits.”9 The latter were hardtack, an
unleavened cracker common in military rations of the
period. Various cakes and loaves made from assorted
roots and grains would supplement these staples, often
acquired through trade with Native Americans encoun-
tered along the way.

And on at least one occasion, Private John Collins
used Nez Perce bread to augment the liquor shortage—
he made beer.

Since the Corps traveled predominantly by water, keep-
ing provisions dry was a relentless problem, especially
for the flour. Expedition journals include numerous
entries that describe gear getting spread in the sun to
dry after being soaked in boats continually splashed by
waves, taking on water, or sinking in the current. Addi-
tionally there were numerous occasions where drench-
ing was caused by torrential rain. Sergeant John Ord-
way described a typical experience on April 8, 1805.
While in present North Dakota, he wrote that “the per-
ogues had evidently filled and every thing in the per-
ogue was wet—damaged a keg of pow-
der a bag of biscuit and a number
of other articles.”10 Three days later,
Lewis reported making “a comfort-
able dinner on a venison stake and
beavers tales with the biscuit which
got wet on the 8th inst. by the accident of the canoe fill-
ing with water before mentioned.” The dampened gun
powder had also been spread out to dry and most of it
had been salvaged as well.11

Apparently, soggy bread was better than no bread
at all. At the end of November 1805, Clark mentioned
that Sacagawea “gave me a piece of bread made of flour
which She had reserved for her child and carefully Kept
untill this time, which has unfortunately got wet, and
a little Sour — this bread I ate with great Satisfac-
tion, it being the only mouthfull I had tasted for Sev-
eral months past.”12

But it was the soggy bread that did not get eaten
which concerns us. On Monday, October 21, 1805,
after paddling down the Columbia River, the expedi-
tion halted near the mouth of modern John Day River.
Following a dinner of boiled dog meat and fish, Clark
wrote “J. Collins presented us with Some very good
beer made of the Pa-shi-co-quar-mash bread, which
bread is the remains of what was laid in as [a part of our]
Stores of Provisions, at the first flat heads or Cho-pun-
nish Nation at the head of the Kosskoske river which
by being frequently wet molded & Sowered &c.”13

The next day, Clark sketched a map in his elk-skin-
bound journal showing the course of travel over the last
few days. Private Collins’s refreshment was apparently
still on Clark’s mind, for at the bottom of the page he
jotted “Collins made Some excellent beer of the Pa-sheco
quar mash bread of roots which was very good.”14

Cast thy bread upon the
waters… (Ecclesiastes 11)
This beverage brewed by John Collins may sound unique, but in fact, making beer from bread is as old as civilization itself. Cultural Historian Dr. Cecil Munsey explains:

We don’t know when, where or by whom the first beer (or “liquid bread” as it is often called) was brewed. Although an exact date for the discovery of that first brew is not known, some historians believe it occurred 10,000 years or more ago in Mesopotamia (modern-day Iraq), when a jar containing bread became soaked with water and the resulting “slop” began to ferment. Someone then most likely had the curiosity to sample the resulting liquid and found it not only tasty but that it imparted a slightly euphoric feeling.\(^\text{15}\)

Ancient Sumerian drawings and cuneiform scripts indicate early brews were made from half-baked, moist loaves of barley bread that were crumbled into crocks of water and fermented spontaneously by airborne yeast. The result was a murky alcoholic quaff, full of crumbs and floating husks.\(^\text{16}\) It would have been classified as a “small beer,” low in alcohol and, because it would not keep long, meant to be consumed directly after brewing.\(^\text{17}\)

Yeast, a single-cell organism, is classified with fungi since it contains no chlorophyll and thus cannot produce its own food supply. To grow, yeast feeds on starches, such as those found in bread, yielding byproducts of carbon dioxide and water, but not alcohol. To produce alcohol, the yeast must work on sugar.\(^\text{18}\) The sugars Collins needed for his beer came from the bulbs the Nez Percew had used to make the unleavened bread for which Lewis and Clark had traded. The root was *Camassia quamash*, commonly known today as blue camas, and it served as a substitute for the grains and malted barley typically used in brewing.

Traditionally, camas bulbs were baked in a pit, often left in underground ovens for several days. Once the cooked roots had been dried, they were pounded and formed into cakes. Meriwether Lewis wrote a lengthy description of the plant, its preparation and its uses. According to Lewis, to make bread the roots were “pounded after the fi[r]st baking between two stones untill they are reduced to the consistency of dough and then rolled in…cakes of eight or ten lbs.” These cakes were returned to the oven “in order that the steam may get freely to these loaves of bread.” After this additional baking, “the women make up this dough into cakes of various shapes and sizes usually from ½ to ¾ of an inch thick and expose it on sticks to dry in the sun, or place it over the smoke of their fires.”\(^\text{19}\)

Camas was a mainstay for many Salish tribes, including the Nez Perce. On September 20, 1805, Clark recorded having received from the Nez Perce, “roots in different states, some round and much like an onion.” He reported that from these tubers the Indians made a type of “Bread or Cake … called Pas-she-co Sweet.” Ordway declared it “Sweet and good to the taste,” while Sargent Patrick Gass thought the bread “tastes like that sometimes made of pumpkins.”\(^\text{20}\)
Gary Moulton, editor of the Lewis and Clark journals, explained

The term pasigoo (Clark’s “Pas-she-co”) is the Shoshone designation for the camas and its edible bulb, historically a staple food. The word literally means “water sego,” in reference to the sego lily, a common food in the region. Lewis and Clark wrote this word together with “quamash,” that is, čem’es, the Nez Perce term for camas, from which the Latin and English designations derive.²¹

Lab analysis shows camas rich in protein and a good source of fiber, calcium, phosphorous, and iron.²² Camas also contains high levels of the carbohydrate inulin, a starch that cannot be processed by humans due to lack of the required digestive enzymes. Consequently, inulin passes through the stomach into the intestines where bacteria ferments it into methane and hydrogen.²³ Lengthy cooking was necessary for maximum conversion of the inulin into fructose, a digestible sugar. The sugariness of cooked camas encouraged its use as a sweetener and enhancer for other foods, including Collins’s beer-making.²⁴ Fermentation of this simple sugar was the process by which yeast converted fructose to ethyl alcohol and carbon dioxide gas—giving the camas beer its potency and slight carbonation.

The men of the Lewis and Clark Expedition had consumed copious amounts of camas in many forms from the time they were introduced to this food source. Eating the bulb often caused indigestion and terrible gas, as shown repeatedly in the journals from late September through mid-October. For example, Clark noted on October 5, “Capt Lewis & my Self eate a Supper of roots boiled, which filled us So full of wind, that we were Scercely able to Breathe all night.”²⁵
The party had passed “the head of the Kosskoske river,” as Clark called the junction of the Clearwater and the Snake rivers, on Wednesday, October 10, 1805.26 The following day was the last on which anyone traded for camas bread prior to Clark sampling Collins’s homebrew. A couple of days later, while running rough whitewater, a “Canoe in passing thro a Short rapid opposit the head of an Island, run on a Smoth rock and turned broad Side … The Canoe filed and Sunk.” According to Clark, all of their camas was in that sunken canoe. He reported that every article was wet, “all our loose Powder two Canisters, all our roots prepared in the Indian way, and one half of our goods.” The gear was spread to dry—even staying put the next morning for more time in the sun—then they “loaded & Set out, our Powder & Provisions of roots not Sufficiently dry.”27 Though the Corps passed numerous rapids in the days prior to and after these events, the bread Collins would convert to beer was likely doused at this time.

There are no details describing the ale created by Collins nor the methods he may have employed. For a brew kettle, he could have used one of the now-empty casks or kegs mentioned regularly in the Journals. Between containers of pork, flour and a myriad of other provisions, plenty of vessels would have been available for use as a mash tun or to hold the fermenting wort.28

The larger, heavier barrels of provisions which the captains had purchased prior to the expedition had been re-packed into smaller kegs and loaded aboard the keelboat. These smaller casks were also suitable for traveling by canoe. These containers may have been firkins, which held upwards of five gallons or so; the sizes were not all that standardized amongst frontier cooperers.29 Along the way, as barrels were emptied, they were often reused. For example, empty barrels were packed with rendered bear’s grease and empty kegs were filled with water to drown out prairie dogs. At Fort Clatsop, “2 small iron-bound kegs” were loaded with twelve gallons of salt.30 There is a reasonable chance Collins used a five-gallon firkin in which to make beer.

Good water is a mainstay of good beer. Successful beer-making begins with pure fresh water, referred to as “liquor” by brewers, and is the main ingredient in beer by volume. Collins would have needed clean, fresh water to blend with the fermenting camas bread. The waters of the Columbia were described as being “remarkably Clear,” such that salmon could “be seen at the debth of 20 feet.”31 While he could have dipped from the Columbia, he was surely aware “this part of the river is furnished with fine Springs which either rise high up the Sides of the hills or on the bottom near the river and run into the river,” as Clark had noted.32

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He was a wise man who invented beer. (Plato)
The recipe for making beer from bread is simple. In fact, historians believe the first beers were accidents, developing from bread that spontaneously fermented. The baked camas loaves Collins used contained fructose, easily fermented by yeast. Thus, the mashing process required to convert starch to sugar through boiling and steeping the liquor was unnecessary. Once Collins noticed the bag of soured camas bread laying on the floor of his dugout, he probably followed a simple process of brewing like this:

1. Fill up a container with bread, stale pieces or crumbs (camas in this case).
2. Fill up the container with water.
3. Cover with a loosely woven cloth so air circulates while keeping bugs out.
4. Let this stand for 1-2 days.
5. Strain through cotton material to remove the solids.
6. Measure the amount of liquid that has been drained out.
7. For each pint of liquid add 2 tablespoons of sugar, syrup, or honey and stir thoroughly.
8. The bread and the open air will allow airborne yeast to generate.
9. Once fermentation begins, cover the jar with an air-tight lid.
10. The beverage will be mildly carbonated and low in alcohol after 2-3 days of fermentation.

A fine beer may be judged with only one sip, but it’s better to be thoroughly sure. (Czech Proverb)

All of the breads mentioned throughout the journals were made without yeast. In a frontier kitchen, if yeast was desired, some early cookbooks described adding “emptins” to bread dough. These “leavings of fermenting ale or barm” contained yeast and essentially made sour dough. Collins may not have known that the amount of alcohol yeast can produce from sugar decreases as the oxygen supply increases. By installing an air-tight seal on his brewing vessel during this phase, thereby cutting off oxygen, the working yeast would convert the wort to its highest alcohol content. Even then, small beers such as this were not very potent.

Hops were not available to Collins, but many early beers were made without this ingredient. Originally, “ale” was not hopped and “beer” was.

The men poured what today is often referred to as “cask ale” or “cask-conditioned” beer, an unfiltered, unpasteurized beer that has been conditioned and served straight from the keg without additional nitrogen or carbon dioxide pressure.

An affinity to alcohol may have induced John Collins to try making beer. During the first winter the Corps spent together he sometimes visited a nearby grog shop rather than hunting as ordered, and returned to Camp Dubois drunk. Collins had been court-martialed early in the trip for sneaking into the Company liquor keg. On June 19, 1804, Clark reported:

The Court Convened agreeable to order and proceeded to the trial of the Prisoners Viz John Collins Charged “with getting drunk on his post this morning out of whiskey put under his Charge as a Sentinel and for Suffering Hugh Hall to draw whiskey out of the Said Barrel intended for the party.”

Private Collins had been a discipline problem for the expedition’s leaders early in the corps’s organization. On January 5, 1804, he and another man went...
hunting, found part of a butchered hog hanging in the woods, brought it back to camp, and passed it off as bear meat. Collins was subjected to military courts more than once, receiving a total of 150 lashes on his bare back for his two convictions. Fortunately, these infractions occurred in the first few months of the trek, after which he appears to have settled down to become a valued member of the corps, particularly as a hunter.41

Having been raised in Maryland, Collins was doubtless no stranger to good beer. Though brewing was not widespread in the state during the eighteenth century, makers there were creative in manufacturing their ale. Edward Kimber, a British traveler passing through Maryland in the mid-1700s, commented: “The beer they brew is excellent, which they make in great Quantities, of Parsimons, &c., of Molasses; for few of them are Come to malting their corn, of any kind, at which I was much surprized; as even the Indian Grain, as I have found experimentally, will produce an wholesome and generous Liquor.”42

Collins’s resourcefulness raises the question of why there were no plans for producing home brew from natural resources available throughout the course of the Corps’ journey. Other extended expeditions affected by diseases such as scurvy had relied on spruce beer as a preventative treatment. George Vancouver had done just that in 1792 when he first explored the very waters Private Collins used to concoct his camas ale.43 Dr. Rush surely would have been familiar with the potential risk for scurvy and using spruce beer as potential cure.

Lewis had accessed Vancouver’s logs while in Philadelphia preparing for the expedition.44 Said one historian:

If he had studied Vancouver’s narratives (and those of his lieutenants) as carefully as he studied the Vancouver surveys and maps of the West Coast, Lewis would have read of the excellence of their spruce beer. This brew had been made from pine, fir and spruce trees of Northwest shores, following the example and methods recorded earlier by Captain Cook. It was then considered a rewarding refreshment and a specific scurvy fighter.45

Reasons Lewis had for not brewing along the way, though not recorded, might be as simple as never having learned how to make beer. As it turned out, he could have relied on men in the company, at least Collins in any case, to tutor him. Perhaps the relatively short life of a small beer’s freshness dissuaded the captain from further consideration of beer to supplement the soldiers’ liquor ration. Additionally, Lewis may have been concerned with the time and focus that brewing would take away from other, more important duties. There was certainly ample time for brewing during their lengthy encampment among the Nez Perce in the spring of 1806 as they waited for the snow to melt prior to crossing the Bitterroot Mountains.46

Simple beer brewing methods like those used by Private Collins were known to some Native American people. However, prior to Euro-American contact, the use of alcoholic beverages in what is now the United States seems primarily confined to American Indian groups in the Southwest. Evidence indicates the native peoples of the Northwest Coast of America did not brew or distill intoxicating beverages. Lewis confirmed this on January 8, 1806, when writing about the Clatsops; “These people do not appear to know the use of spirituous liquors, they never having once asked us for it.”47 The one known exception comes from the Kwakiutl nation on Vancouver Island. These people made a beverage of elderberry juice, black chitons and tobacco which they claimed, “made them dizzy.”48

William Clark was pleasantly surprised that the simple brew offered by Collins was so good, but perhaps months of abstinence had altered his perception. Given that the Corps of Discovery had drained the last of their whiskey barrels more than three months earlier while celebrating Independence Day, it had been a while since any of the men had tasted alcohol. Clark was the only diarist who recorded having been served this frothy draught so it may be that “us” represented only the two Captains. If there was enough to go around, the captains would surely have shared.

Two Nez Perce men, Twisted Hair and Tetoharsky, were present when Collins proffered his quaff to William

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From man’s sweat and God’s love, beer came into the world. (Saint Arnold of Metz, The patron Saint of Brewers)
Whether Collins offered the pair their first taste of beer will never be known. If a full five-gallon barrel was brewed, there was enough for each member of the Corps of Discovery to fill their cup at least once. The enjoyment of Collins’s creative concoction was a historic moment in Pacific Northwest brewing, a region well-known today for its many craft brewers who produce excellent ales and lagers. William Clark had labeled John Collins a “blackgard” early in the Expedition, while still at Camp Dubois. Perhaps Blackguard Camas Ale would be an appropriate name for the first beer brewed on the Columbia Plateau. John Collins, the West’s first master brewer, truly understood the Corps’ value of beer.

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END NOTES:

The author wishes to thank Rob Mullin, brewmaster at Grand Teton Brewing Company in Victor, ID, and John Fisher, Lewis and Clark authority who hails from Juliaetta, ID.

1. William A. Ganoe, The History of the United States Army (New York, NY: D. Appleton and Co., 1924), 13-14. Gill is pronounced “jil.” The liquor ration was abolished by 1832 when whiskey was replaced by coffee and sugar.


11. Ibid., 4:22.

12. Ibid., 6:97

13. Ibid., 5:318.

14. Ibid., 5:316. Moulton includes an image of this journal page.


17. It was common practice at the time to refer to “strong beer,” “table beer,” “ship’s beer,” and “small beer.” There was no distinction of strength, though the latter was the weakest and would not keep long. “Strong beer” had the longest shelf life, and it was not unusual for gentlemen to have barrels of this beer alongside the wine in their cellars. See, Baron, Brewed in America, 16.


20. Ibid., 5:222, 9:228, 10:146.

21. Ibid., 5:222, 224n15.


23. David A. Dalton, The Natural World of Lewis and Clark (Columbia, MO: University of Missouri Press, 2008), 64. This process is similar to what familiarly happens when someone eats beans, although in that case the culprit is called raffinose rather than inulin.


27. Ibid., 5:261, 271-272, 275.
28. A mash tun (pronounced as *mash ton*) is a vessel used in the mashing process to convert the starches in crushed grains into sugars for fermentation.

29. Robert H. Hunt, “Gills and Drams of Consolation; Ardent Spirits on the Lewis & Clark Expedition, Part 1,” *We Proceeded On* 17 (August 1991): 19. Clark created a table of kegs stowed on the keelboat. Based on those dimensions, Hunt calculated that at least eighteen of these kegs would hold about five pounds. As for variations in volume, see the list of fifty barrels of pork recorded by Lewis on April 16, 1804. These containers average about seventy-four pounds, but range in size from sixty-eight to one hundred pounds; Moulton, ed., *Journals*, 2:203-04. Information on barrel capacities from John Fisher.


31. Ibid., 5:286.

32. Ibid., 5:318.

33. Dornbusch, “The World’s Oldest Malt and Brew House.” In brewing beer, “mashing” is the process of combining grain (typically malted barley) and water, then heating this mixture to allow enzymes in the grain to break down starch into simple sugar. The resulting malty liquid is called “wort”; Audrey Ensminger, et. al., *Foods & Nutrition Encyclopedia*, 2 vols. (Boca Raton, FL: CRC Press, LLC, 1993), 1:188.

34. This bread beer recipe is found on line at https://sites.google.com/site/yankeeharp/breadbeer (accessed 10-28-13).


39. In modern parlance, “beer” and “ale” are relatively interchangeable terms. The two main categories of brewing today are “ales” and “lagers”—the main difference being the type of yeast used. Ales are fermented warm and made with a top-fermenting yeast. Lagers are made with a cold-fermenting yeast that sinks to the bottom of the brew during fermentation. While ales can be brewed in as little as 7 days, lagers traditionally need to age before their brewing process is complete. Ales are generally stronger and more forceful in taste than lagers because of their relatively fast and warm fermentation. Lagers are generally cleaner, smoother, crisper, and mellower tasting. See more at: http://www.beer-faq.com/difference-ale-lager/#sthash.xRX-hFJzs.dpuf.


46. For an in-depth examination of this period, see Allen V. Pinkham and Steven R. Evans, *Lewis and Clark among the Nez Perce, Strangers in the Land of the Nimipuu* (Washburn, ND: The Dakota Institute Press, 2013). Although the explorers were eager to get home, they found time for rest and relaxation among the Nez Perce, competing in foot races, horse races, pitching quoits, and playing “prison base,” which some sources report may be an early form of baseball—and what goes better with baseball than beer?


50. Moulton, ed., *Journals*, 2:148. What is today known as Lolo Creek, a tributary of the Clearwater River in Idaho, was dubbed Collins Creek by the captains in September 1805; Moulton, ed., *Journals*, Atlas, PL 71. Collins had redeemed himself enough to have a stream named for him, so naming a beer for him is appropriate as well.
After reading a complimentary review by Jay Buckley in the summer 2013 Museum of the Fur Trade Quarterly I eagerly ordered these two volumes. I could not have been more disappointed.

After a long, heavily documented and somewhat tedious discussion of the many examples of cross fertilization of Euroamerican and Native American cultures, on page 40 of the Introduction Swagerty explains his goal. He intends to demonstrate “how Native America influenced Lewis and Clark and their Corps of Discovery.”

Chapter 1 on “Race and Material Culture in Jeffersonian America” was very interesting and it contained excellent tables and maps. Chapter 2 analyzed the expedition personnel accurately in great detail.

With chapter 3’s discussion of outfitting the expedition, I began to wonder if any experts had critiqued the manuscript because dozens of factual errors, misinterpretations, and overreaching conclusions began to appear. Swagerty failed to note the latest research by Ernie Cowan and Rick Keller on the short rifle carried on the expedition. (pp. 152-3). In Chapter 4 (page 214), Swagerty has Sacagawea losing her child’s bedding in a canoe accident instead of the flash flood near the portage route.

In the chapter on “Regional Foodways and Health, 1750-1820,” (p. 223) Swagerty makes a serious misinterpretation that he will repeat throughout the rest of the volumes. He assumes that because the expedition used techniques the Indians also used, they must have learned it from the Indians. Here he says that “They also used smoking and drying, new techniques learned from Indians as the expedition progressed.” Smoking and drying meats have been independently invented by cultures all over the world and the distant ancestors of Euroamericans were doing the same. Not noted by Swagerty were the hundreds of pounds of salt carried by the expedition to help cure meats, which the Indians did not use.

Despite almost 150 footnotes in this chapter and more in later chapters, Swagerty has a very incomplete understanding of the medicine practiced on the expedition. All but one of the many herbal medicines used on the expedition can be traced back to Lewis’s mother. Euroamerican cultures used some of the same herbs and techniques Indians used. This is only one of many examples of medical misinformation.

Swagerty repeatedly cites the work of nutritionist Elaine Nelson MaIntosh in whose book “The Lewis and Clark Expedition: Food, Nutrition, and Health,” I found over 60 factual errors. On page 258 Swagerty states that “pemmican would become an essential part of the Corp’s diet.” In fact the few hundred pounds produced made up a miniscule portion of the 70 to 90 tons of food eaten on the expedition.

Of the half dozen errors and incomplete interpretations in Chapter 6 on leather clothing, Swagerty states that “Not a single man is recorded with frostbite” (p. 280). In fact frozen feet and frostbite was mentioned each winter, affecting at least six expedition members and noted in well over a dozen journal entries.

Again Chapters 7, 8, and 9 deal with food and sickness on the expedition and yet we find more than a dozen factual errors and misinterpretations. Part of the problem is again the secondary sources such as “Feasting and Fasting with Lewis & Clark” by Leandra Zim Holland, which contains dozens of errors and misinterpretations. Terms like “pickle” (p. 334), “8 stave reel” (p.336), and biological/ecological information on (pp. 351, 427) are misunderstood or misinterpreted. Chemical information on “concoctions of salt” (p. 442) indicates a lack of understanding of chemistry and no proof reading by subject experts.

On the opening page (485) of Chapter 10 on “Useful Things, Indian Made Technology and Transportation,” he suggests that dugout canoes of the Southeast were technologies adopted from the Indians, when
in reality the technology was independently invented in cultures all over the world, and in Europe predates the arrival of Europeans in America. On the next page he suggests that Euro-Americans learned and adapted buckskin to their western lifestyle, overlooking the fact that leather tanning was developed thousands of years ago all over the world. It was often all that was available and would have been used whether there were Indians on the continent or not. Swagerty missed an opportunity to show true Indianization by failing to note the brain tanning technique used on the expedition instead of the several other methods used and developed in Europe and Asia. On the next page Swagerty's errors continue regarding Lewis's branding iron which was used to brand trees and not horses, which were branded with a stirrup iron. Misinterpretations made by poorly researched references lead Swagerty to describe the red pirogue as planked (p. 501). Later, as the men carve dugouts out of cottonwoods at Ft. Mandan, Swagerty states that "Lewis would learn many additional uses of cottonwood." (p. 503) It is an exaggeration to imply that the men learned from the Indians how to use cottonwood to make fires, build forts, or hollow out canoes (which the local Indians did not make or use). Lewis was surprised to learn that cottonwood branches fed to the horses kept them healthy throughout the winter.

I could go on listing many dozens of factual errors and misinterpretations made by Swagerty throughout the two-volume set. Though he has almost 1900 footnotes and a bibliography of over 500 books, his reliance on some poorly researched books sometimes leads him astray, not to mention over reaching examples of Indianization that actually represent Euro-American knowledge. Unlike Moulton, who consulted over a hundred experts and whose work has remarkably few errors, Swagerty apparently failed to run his manuscript past experts and those with firsthand knowledge, and thus contaminated the many appropriate examples of Indianization that he did cite. It is apparent that several previous reviewers of this book either lacked expertise on the material culture of the expedition or overlooked the many flaws. I deeply regret advising that Lewis and Clark fans save their money for other literature. There is a story here, but it would be less than 300 pages and would need extensive review before publishing.

—Reviewed by John W. Fisher, an independent scholar and interpretive consultant for the museum at the Ft. Mandan Foundation at Washburn, ND.
The Tamástslikt Cultural Institute, Pendleton, Oregon

Located at a critical intersection of an Indian-blazed path from the east, later followed by Lewis and Clark and the ensuing Oregon Trail, Tamástslikt Cultural Center tells the story of three American Indian tribes, the Cayuse, Umatilla and Walla Walla, who for more than ten thousand years inhabited the Plateau region of the Pacific Northwest.

In 1805-1806 they welcomed and assisted the Lewis and Clark Expedition, and Clark documented these contacts in his journal. Some forty years later, the Oregon Trail cut through the heart of their homelands. Tamástslikt brings the story alive with a fourteen-thousand-square-foot space that incorporates artifacts, photography, video, and interactive multi-media in world class exhibits.

The permanent exhibits are housed in a round wing of the building, designed to capture the feel of the circle, a cultural concept of life in the round. It opens in the Seasonal Round, where the four seasons are presented as periods of harvesting, processing, and manufacturing.

Subsequent exhibits reveal the extent of trade prior to the arrival of non-Indians, using maps and displays of trade goods of the time. A full-sized lodge constructed of tule reeds reveals the traditional form of the highly mobile and effective style of housing predominant in the tribes’ region.

Additional exhibits highlight the fur traders—first sign of the new immigrants—followed closely by the missionaries, then the settlers. On the heels of these exhibits come more stories of disruption, war, forced treaties, and boarding schools, and the parceling away of reservation land.

The “We Are” exhibits make apparent that the contemporary tribes are upbeat and active members of their larger community.

Finally, in “We Will Be,” tribal members young and old speak on video about their hopes and plans for a future, holding up the continuum of their unique culture while dealing with the disruption of the past two centuries in a healthful, holistic manner.

The Research Library and Archives, a key element of the Tamástslikt Cultural Institute, is a repository for historical records, manuscripts, reference books, photographs, sound recordings, and other resources that document the history and culture of the Cayuse, Umatilla, and Walla Walla people. Tamástslikt makes available its holdings and resources to the tribal community, scholars, students, and the general public.

The Pendleton Center for the Arts and Crow’s Shadow Institute of the Arts provide great opportunities to view, buy, and make art. The Wild Horse Resort & Casino, near the institute, offers lodging, fine dining, and gaming.

Tamástslikt is located at 47106 Wildhorse Boulevard, at the far end of the main driveway of the Wildhorse Resort & Casino, 10 minutes east of Pendleton, Oregon. Tamástslikt can be reached via Exit 216 off Interstate I-84 or by following the “Mission-LaGrande” sign south off Highway 11 onto Highway 331. (541) 429-7700. Email: info@tamastslikt.org. Website: www.tamastslikt.org.

Thanks to Michelle Liberty for providing information on the institute used in this feature.

Note: Attendees of the annual meeting of the Lewis and Clark Trail Heritage Foundation in Richland, Washington, August 3-6, 2014, will enjoy a day at the Tamástslikt Cultural Center, and enjoy demonstrations, tours, and a traditional salmon lunch.