Palouse-Cheney Tract of the Channeled Scablands, Eastern Washington: A One-Day Field Trip From Moscow, Idaho

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PALOUSE-CHENEY TRACT OF THE CHANNELED SCABLANDS, EASTERN WASHINGTON: A ONE-DAY FIELD TRIP FROM MOSCOW, IDAHO

by

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DISCUSSION OF SCABLAND TOPOGRAPHY

INTRODUCTION

The Cheney-Palouse tract of the channeled scablands trends northeast to southwest from Spokane to Lyons Ferry in Washington. It is the easternmost of three major flood tracts and is bounded on the north by the Spokane River and Okanogan Highlands and on the west by loess islands and other scabland channels. To the east the Palouse Hills provide a striking contrast to the scoured topography of the Cheney-Palouse scablands. Southern boundaries include the Snake and Tucannon Rivers, which are deeply incised into basalt flows of Miocene age.

The Cheney-Palouse scablands form a great erosional unconformity dissected into the loess of the Palouse Formation and the underlying Columbia River Basalts. Nested within the scablands are landforms and features whose origin challenges the imagination. Giant gravel bars, high elevation stream divide crossings, loess islands, anastomosing

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channels, coulees, giant current ripple marks, and boulders of exotic lithology to the area are common features observed in the Cheney-Palouse scablands (Bretz, 1923, 1932, 1929, 1959; Bretz and others, 1956). Slackwater deposits displaying up-stream current bedding are found in many streams draining into the Cheney-Palouse tract. Similar deposits are also found in tributaries of the Snake and Clearwater Rivers, from Lyons Ferry, Washington, to Cottonwood Creek, Idaho (Bretz, 1929, Cochran, written communication). During the past 60 years several hypotheses have been developed to explain the scabland features.

HISTORY OF INVESTIGATIONS

J Harlan Bretz (1923; 1928) proposed in his own words "an outrageous hypothesis" that the erosional and depositional features in the channeled scablands of eastern Washington were produced by catastrophic flooding. At that time Bretz (1923) could not adequately explain a source for the flood water other than to speculate upon a combination of events that included rapid melting and ablation of glacial ice combined with torrential rainfall.

Allison (1933) speculated that large streams became jammed by ice which diverted streams into new courses across drainage divides. The "Touchet Beds" in the Pasco Basin accumulated in a lake temporarily blocked near Columbia Gorge by a combination of ice and landslide debris and possibly by lava flows. Allison attributed the scabland gravels of the Columbia Basin to an earlier episode of widespread filling.

Flint (1938) visioned a large lake that was rapidly filled thereby permitting aggraded streams to breach divides and form new courses. Post-lake draining and subsequent downcutting and erosion produced the landforms found in the area of Cheney-Palouse scablands.

Pardee (1942) published the results of his Lake Missoula study. He introduced evidence for an impoundment of 500 cubic miles of water behind an ice lobe that crossed the Clark Fork River in northern Idaho. Other evidence indicated that the ice dam had suddenly failed, releasing the impounded water. The water source for the catastrophic flood was no longer a problem.

Flint's fill and cut hypothesis was further discredited by Bretz and others (1956) who found giant ripple marks on terraces through the use of air photographs. Allison's theory of ice jams lacked supportive field evidence. Bretz's flood theory for the scabland features combined with Pardee's idea of a rapidly emptying Glacial Lake Missoula supported a catastrophic origin of the channeled scablands of eastern Washington. However, many problems concerning hydrologic conditions remained unresolved until Baker (1973) provided a quantitative hydrologic approach to catastrophic flooding. In the Tucannon River drainage Baker recognized sedimentary structures that he interpreted as being produced by turbidity currents. He noted an up-stream fining of sediments that also exhibited many up-stream directional current features.

PROBLEMS

Many other problems concerning catastrophic scabland flooding remain unresolved. In what depositional environment were the Touchet Beds deposited? Are there more than one set of slackwater deposits as Allison (1933) suggests? Are slackwater sediments in the Pasco Basin contemporaneous to similar deposits in the Vantage region and the Lewiston Basin? Slack water deposits in the Pasco and Vantage areas contain a couplet and triplet volcanic ash similar to Mount St. Helens set S (Moody, 1976, 1977; Smith and others, 1977), radiocarbon dated at about 13,000 B.P. (Mullineaux and others, 1977). Does the absence of the ash in slackwater deposits in the Lewiston Basin and adjacent areas merely reflect air fall distribution? Or do these deposits represent two different events? Do the scabland gravels and slackwater deposits represent separate phases of the same event or do they represent separate events? Undoubtedly, as these questions are answered, more will be generated.

This field trip and road log will generate even more questions than there are answers. It has been designed to provide to the interested student the physical evidence that the channeled scablands of eastern Washington were indeed produced by catastrophic floods. But which flood and when?

Figure 1 summarizes major geologic events for southeastern Washington.

ROAD LOG FOR ONE-DAY SCABLANDS FIELD TRIP

INTRODUCTION

The scablands "story" involves a large geographic area. However, a part of the story can be easily understood by studying the sediments and geomorphic landforms in the Cheney-Palouse tract. This tract, 75 miles (120 km) long and up to 25 miles (40 km) wide, extends southwest from the vicinity of Cheney to the Snake River Canyon at its junction with the Palouse River. The Cheney-Palouse tract is an excellent place to examine Bretz's (1959) theory of glacial flood origin for scabland topography. Mapping in this tract shows more than 75 loess islands and

		14 C yrs. B.P. Appx.	Deposit	Event
HOLOCENE			Several weak soils developed on loess	Neoglacial aeolian deposition with intermittant periods of soil formation
		6,700	Mazama Ash moderate soil developed on loess	Multiple Mazama eruptions postglacial loess deposition
PLEISTOCENE	LATE	11,000	Glacier Peak Ash	Multiple Glacier Peak eruptions
		13,000	Flood gravels and associated deposits	Last major scabland flood
		20,000	Moderate soils developed on various loess sheets	At least two advances and two retreats of Pinedale ice sheets
	EARLY	? 120,000	Flood gravels Moderate to strong petrocalcic soils on weathered loess	Pre-Pinedale ice advances and recessions
			Weathered flood gravels	Earliest known flood

Figure 1. Generalized stratigraphic column for the Cheney-Palouse scabland tract.

at least ten major westward spillovers (divide crossings) into the Grand Coulee-Quincy Basin drainage system.

The Cheney-Palouse tract cuts across a preglacial drainage. Several semiparallel creek valleys converge to join the Palouse River in the south part of the tract. The Palouse River enters the tract near its midpoint from an unviolated drainage to the east. The preglacial Palouse River followed a route through the Hooper and Washtucna area and down the present streamless Washtucna Coulee to where it joined the Snake River about 50 miles to the southwest. The flood waters, however, crossed a divide between Washtucna Coulee and the Snake during peak flooding and beheaded the Washtucna Coulee. The new path is 50 miles (80 km) from the old path and has a drop of 900 feet (274 m) in only 10 miles from Hooper to the Snake River.

The field trip is designed so that we will generally follow the movement of flood waters (Figure 2). We will enter the Cheney-Palouse tract near Winona on the north and follow the water path southward to its junction with the Snake where the water split and some flowed up (eastward) the Snake River. Our trip will follow that eastward surge up the Tucannon Creek until its end near Dodge. Thus, we can imagine ourselves "surfing" the frontal waves as the waters crossed stream divides, swashed in eddies, crashed against canyon walls, and scraped against loess hills.

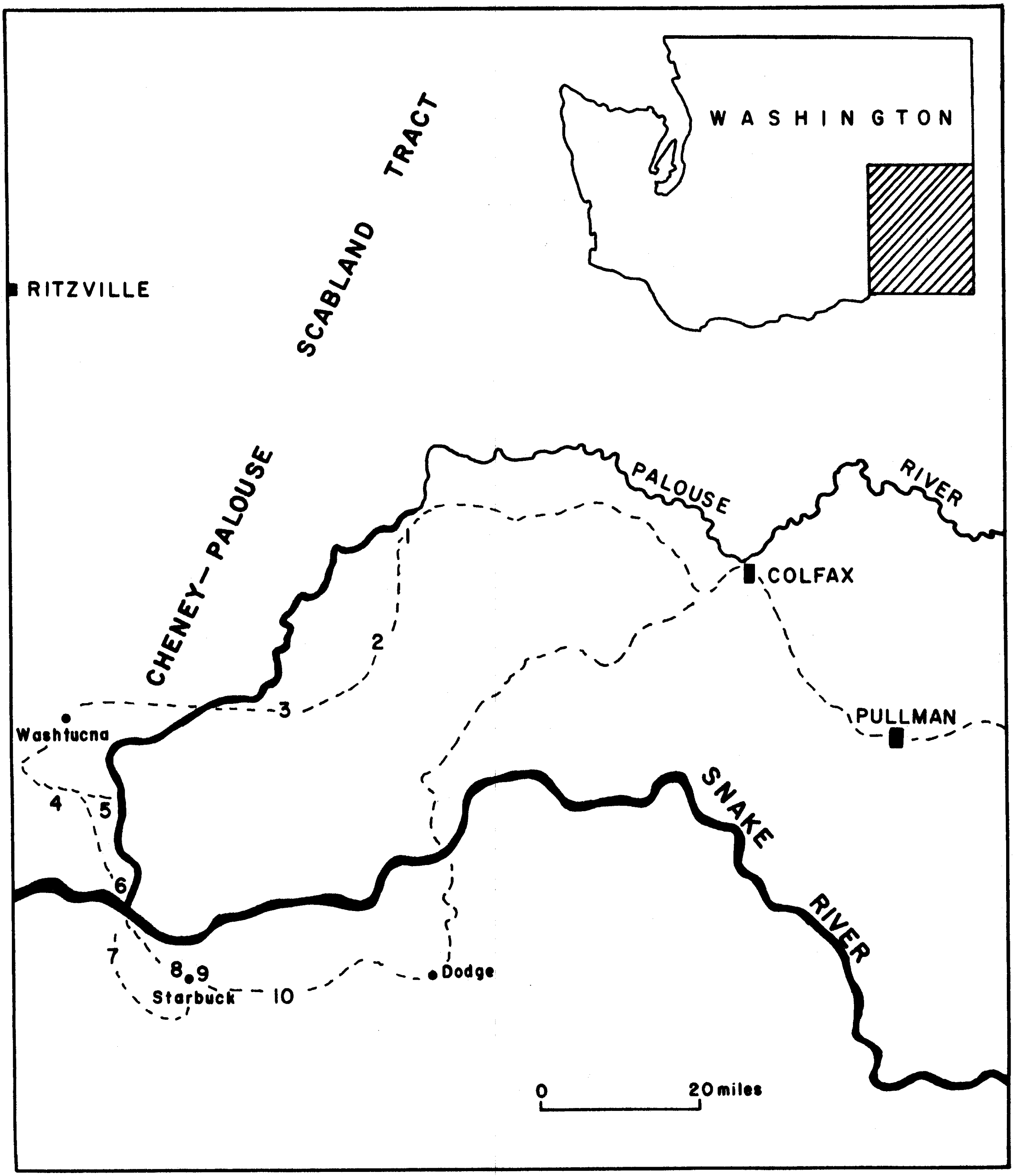

Figure 2. Index map of Cheney-Palouse Scablands Tract in Eastern Eashington showing stops on field trip. Dashed line indicates travel route.

Mileage		
Cumulative	Difference	Notes
0.0	0.0	Junction of Line Street and Washington Highway 270. Proceed towards Pullman.
2.5	2.5	Small roadcuts in basalt. These flows are correlative with nonporphyritic flows of the Wanapum Formation of the Miocene Columbia River Basalt group. See Figure 3.
7.1	4.6	United Paving Company quarry to the south of the road. Loess cover on the basalt ranges from about 15 to 30 feet or more. The thickness of the loess is greater here because the pit is on the northern slope of a buried basalt hill. The loess has drifted into the protected north slopes of the preloessial topography, and the loess cover normally is thinner on the south-facing slopes and thicker on the north-facing slopes.
8.1	1.0	Entrance to Washington State University.
8.9	0.8	Junction with Lewiston-Colfax Highway. Turn right.

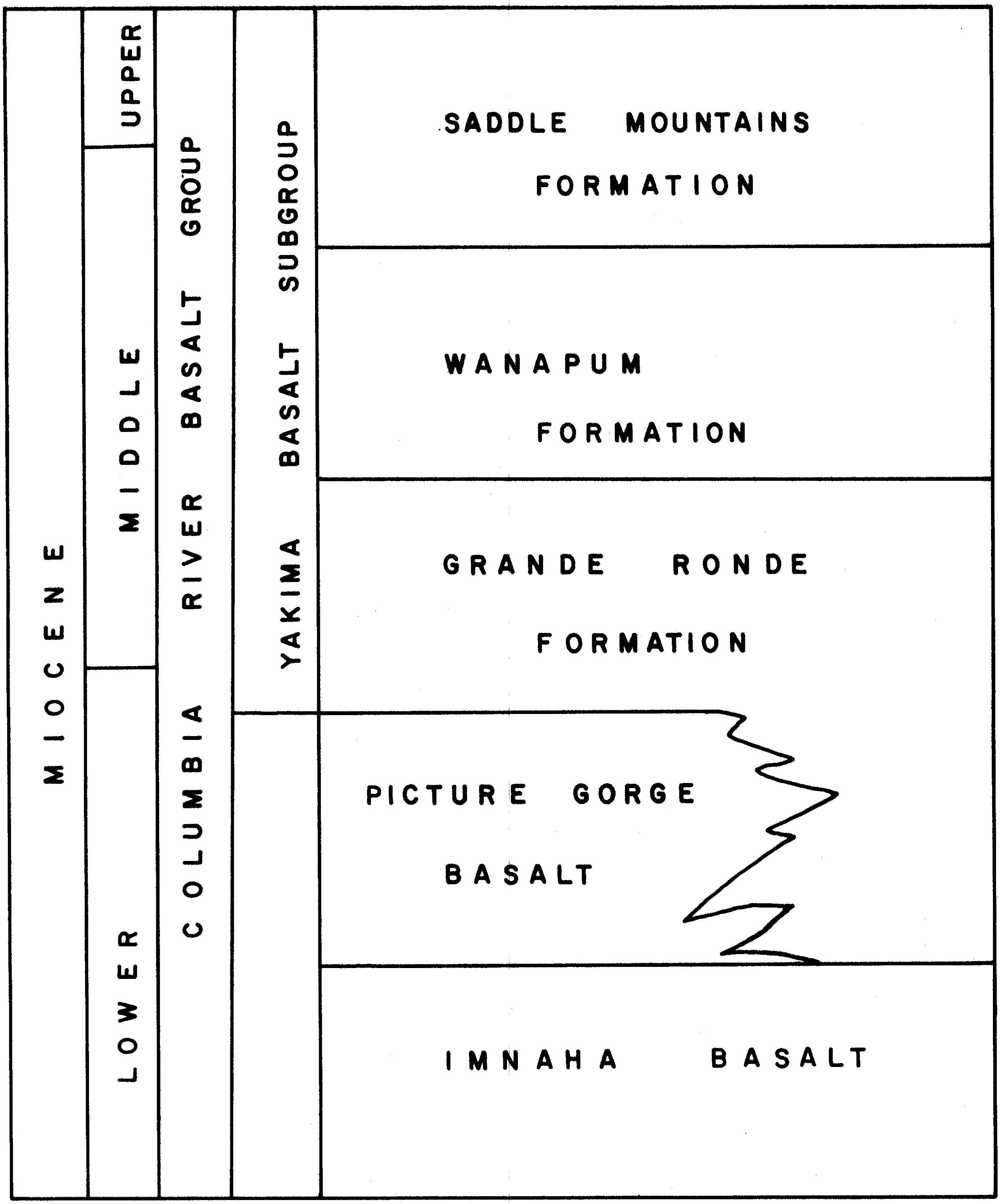

Figure 3. Generalized stratigraphic section for the Columbia River Basalt Group.

Mileage		
Cumulative	Difference	Notes
9.0	0.1	Junction with U. S. Highway 195. Turn left to Colfax.
10.0	1.0	Junction. Turn right on U. S. Highway 195 toward Colfax. For the next several miles we get a good view of the strong asymmetry of the loess hill topography. The very gentle slopes face south and the rather steep slopes face north.
23.1	13.1	Entering Colfax. Most of the basalt outcrops in the low elevations of Colfax belong to a porphyritic flow of the Wanapum Formation. Until we reach Palouse Falls later in the day, we will be traveling over gently southwestward-dipping flows of the Wanapum Formation, which thickens from about 250 feet (78 m) near Colfax to over 500 feet (153 m) at Palouse Falls. Follow 195 through most of downtown Colfax.
26.0	1.6	Junction with Washington Highway 127. Turn left to Walla Walla.

Mileage		
Cumulative	Difference	Notes
29.9	3.9	Junction with secondary highway near Fairgrounds. Turn right to Winona.
34.8	4.9	Town of Olamond.
45.3	15.4	Town of Endicott.
49.5	4.2	Exposures along creek banks exhibit reworked Mazama ash underlain by early Holocene alluvium.
51.6	2.1	Town of Winona. Turn left to Lacrosse. The town lies on the eastern edge of the Cheney-Palouse tract. The cinderlike outcrops have been interpreted as near-vent material for one of the Columbia River basalt flows.
54.6	3.0	Three-way road junction. Keep to the right.
56.1	0.6	Sharp left turn across railroad tracks. Park on gravel road ahead for STOP ONE.

Mileage		
Cumulative	Difference	Notes
		STOP ONE. Orientation and discussion of trip agenda. From this locality on the eastern edge of the tract, isolated islands of loess can be seen on clear days. From this locality to STOP THREE we will be traveling parallel to water movement.
63.0	6.9	Entrance to Lacrosse. STOP TWO. Brief restroom stop at city park. Continue through the town following signs to Dusty.
63.6	0.6	Junction with U. S. Highway 26. Turn right. From here to STOP THREE we will be driving over and through deposits of Willow Creek Bar.
69.6	6.0	STOP THREE. Small pullout on left (south) side of road, just beyond mile post 99. Necessary to cross fence and walk to east on old road bed. Features of interest at this point include thin postflood loess, cobble- to boulder-sized gravel, battered basalt columns, soft sediment deformation

Mileage

Cumulative	Difference	Notes
		features, silt boulders, poorly developed graded beds, and foreset beds, which indicate both eastward and westward current direction.

ADDITIONAL DISCUSSION: The deposits here are believed by Baker (1973) to be eddy bar deposits which form in the mouths of the tributary valleys marginal to the high velocity sections of flooded channels. At this locality eddy bar deposits blocked the mouth of Willow Creek. Eddy bars contain a wide range of grain sizes and bedding structures. Interfingering occurs between poorly sorted boulder gravel, laminated silts, cross-bedded granule gravel, and graded sand-silt layers. Although not obvious at any one locality, the mixture of sediment types occurs in crudely upward-fining couplets that as a group also fine upward. Poorly defined foresets in the boulder gravels mostly dip away from the main scabland channel. However, the smaller foresets in the

Mileage

Cumulative Difference Notes

granule gravels dip back toward the main scabland channel. Giant current ripples are rarely found associated with the eddy bars. It is believed that these deposits are a result of poorly understood macro-turbulent phenomena as described by Matthis (1947) and most recently rediscussed by Baker (1973).

In summary, Willow Creek Bar deposits are believed to have been formed by eddies, with the stronger currents carrying the coarsest flood debris up the tributary valley and the weaker return currents depositing the finer granule gravels. The method of deposition is open to controversy and we welcome your comments.

These deposits extend miles upstream from this locality. However, the abundance of coarse materials decreases as sand and silt increases. As the sediments fine away from the blockade at the triburary mouth, they are termed slackwater deposits.

Mileage		
Cumulative	Difference	Notes
69.6	6.0	Proceed westward on U. S. Highway 26. We will be traveling across the Cheney-Palouse tract through typical scabland topography.
76.1	6.5	Pillow basalts exposed in Wanapum Flows.
81.2	5.1	To the south the Palouse River makes a right-angle turn across the preglacial Palouse-Snake Divide. Our route continues westward down the preglacial valley of the Palouse River.
85.2	4.0	Junction with Washington Highway 260 at Washtucna. Turn right and proceed through the center of town. Most of the eastern part of Washtucna is built on a point bar made of flood gravels. Several deposits of flood gravels are easily seen in and above railroad cuts along the east side of Washtucna Coulee for the next five miles. Only a few deposits of flood gravel are found along the west side of the Coulee. The flood waters traveled down this coulee

Mileage		
Cumulative	Difference	Notes
		to the area of Connell, 24 miles to the west, where they joined with waters from other scabland tracts. Simultaneously, water was spilling over drainage divides through shorter routes where the present Palouse Falls Park and Devils Canyon are located.
91.7	6.5	McAdam Junction. Turn left on Washington Highway 261 to Lyons Ferry.
92.1	0.4	Gravel bar, which obstructs the mouth of a tributary valley, is visible on the right.
92.6	0.5	Exposures of Mazama ash.
97.5	4.9	STOP FOUR. View of H & U cataract. Necessary to cross fence at gate opening on south side and walk 1,000 feet for view of cataract. Please respect property rights. The large cataract forms the head of Davin Coulee, which leads to the Snake River 4 miles to the south. The cataract

Mileage		
Cumulative	Difference	Notes
		is approximately 280 feet from the brink to the bottom of the plunge basin. There are numerous cataracts like this within the Columbia River Basin. From this point, joint-controlled drainage valleys and steep plow-pointed loess islands are visible. Return to vehicles.
99.7	2.2	View of smooth-shaped loess islands to the right. Bretz and others (1956) interpreted these hills as fluvially eroded loess islands. Baker (1973) has shown that many of these hills were eroded subfluvially, by pointing out that the streamlined shapes bear a close resemblence to airfoils, thus supporting Bretz's contention that they were streamlined by a rapidly flowing fluid.
101.3	1.6	Junction. Turn left onto road to Palouse Falls.

Mileage		
Cumulative	Difference	Notes
103.7	2.4	STOP FIVE. Lunch. Palouse Falls State Park. Palouse River now flows over an old flood cataract recessional scarp 185 feet high. The course of Palouse River is completely joint controlled and remarkably angular (Fryxell and Cook, 1964). Even the small tributary canyons are along joints. This canyon was a flood shortcut to the Snake River, from which the Palouse River never rejoined its old channel west of Washtucna. The top of the waterfall marks the approximate contact between Wanapum basalts above and Grande Ronde basalts below.
106.1	2.4	Return to main Washington Highway 261. Turn left to Lyons Ferry.
107.0	0.9	View of lower Palouse Canyon.
107.9	0.9	STOP SIX. Optional. View of confluence of Palouse and Snake Rivers from beneath the railroad trestle. The basalt knob on

Mileage		
Cumulative	Difference	Notes
		the south side of the Snake River split the flood waters. See Figure 4. The water that was diverted downstream along the Snake River deposited the gravel bar to the west of the knob. The bar is covered with giant current ripples whose asymmetry clearly indicates that flood waters flowed down the Snake River valley. The water which was directed upstream deposited Midcanyon Bar (visible ahead to the southeast) that is covered by giant ripples whose asymmetry clearly indicates movement up the Snake River valley. Our direction of travel will be across the bridge to Midcanyon Bar. From there, we will take a side trip following the water movement through the saddle shown on Figure 4 and then to the top of the knob in order to look down on the unnamed gravel bar.
109.2	1.3	Turn right across railroad tracks on Deruwe Road.

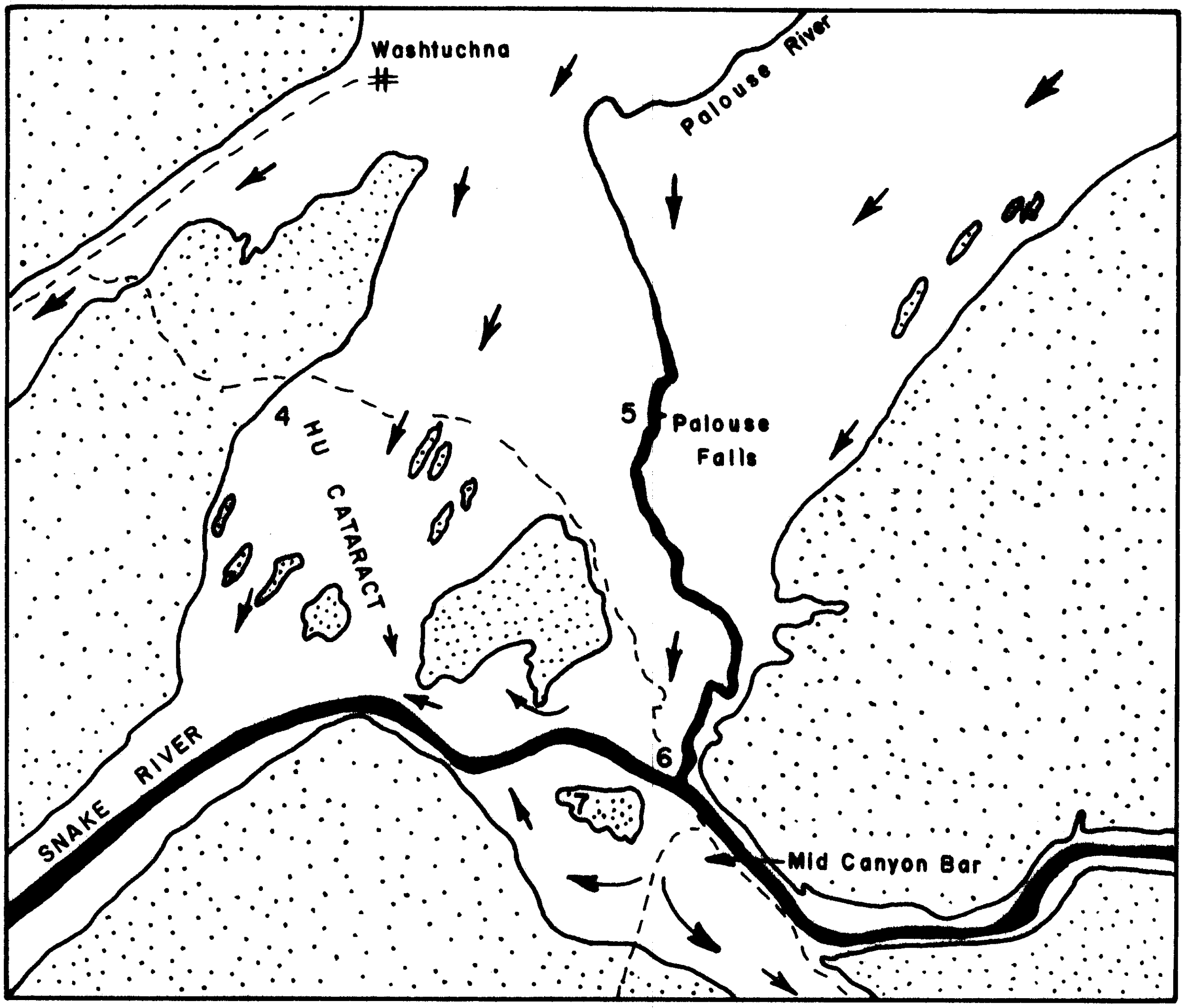

Figure 4. Generalized location map of the confluence of the Cheney-Palouse floodwaters with the Snake River in eastern Washington. Pattern shows unscoured loess-covered areas. Inferred paleo-flow directions are shown by arrows. Dashed lines are paved roads, and numbers are STOPS on roadlog.

Mileage		
Cumulative	Difference	Notes
111.2	2.0	Turn right immediately before power lines. At this point, we will be following the water movement as it was attempting to return to the Snake River.
111.4	0.2	Turn right on poorly defined road towards old water tank. Proceed on this road until Snake River becomes visible.
112.2	0.8	STOP SEVEN. View of the confluence of Palouse and Snake Rivers, the unnamed bar with giant ripples, and the mouth of Davin Coulee. The current direction of the ripples can easily be seen from this vantage point. Gravel was taken from the bar to build an unsuccessful protective dike around the Marmes Rockshelter located along the Palouse River upstream from its confluence with the Snake River. An interesting sidelight concerning the Marmes Rockshelter is repeated from Webster and others (1976, p. 18): *This archaeological site received worldwide attention in the spring of 1968*

Mileage		
Cumulative	Difference	Notes
		when human remains were discovered in situ 14 feet beneath the surface of the modern flood plain. These remains were established reliably as being at least 10,000 years old--the oldest well documented human remains in the New World. Numerous artifacts, cultural features, and animal bones were associated directly with the human remains.
115.2	3.0	Return to junction with Washington Highway 261. Turn right. Road will cross Midcanyon Bar. The gently undulating ridges and swales cut by the road are giant current ripples, 10 feet in height and 225 feet between crests. Mouth of Tucannon River. The Tucannon has eroded through the bar of flood gravel that originally blocked this tributary valley. The road cuts on the opposite bank of the river show poorly sorted boulder and cobble gravel containing large rip-up silt clasts. Junction with road to Powers. Note the flood gravels on the crest of the ridge to the left as we proceed on Washington Highway 261 towards Starbuck. Note: We will be following the path of water as it moved up the Tucannon drainage. The next three stops will be in

Mileage		
Cumulative	Difference	Notes
		slackwater sediments, each stop being further from the mouth of the Tucannon River, and further from the source of the flood water.
120.3	5.1	STOP EIGHT. Junction with Little Goose Dam Road. Park and walk back to road cut on left showing backwater deposits. At this stop and STOPS 9 and 10, features to look for are graded beds, flame structures, ball and pillow structures, clastic dikes, and lateral changes in relative grain size. Webster and others (1976) have described the next three stops in detail. Most of our descriptions are modified versions from their field guide.
		ADDITIONAL DISCUSSION: Preflood tributaries to the Cheney-Palouse scabland tract recorded surges from the main channel back up the tributary valleys. The evidence for this is recorded in erratic boulders, sand, and loess-derived flood silts carried miles up the tributaries. Most of the

Mileage

Cumulative	Difference	Notes

cross bedding in the deposits indicates up-valley currents. Moreover, grain sizes of the sediment decrease up the tributaries, away from the scabland channels. Bretz (1969) suggested that these slackwater deposits might contain a record of successive flooding; however, he emphasized that the mechanics of slackwater deposition is poorly understood.

Locally, the graded sand-silt intervals of the slackwater deposits may be divided into the following vertical sequence:

(1) a basal layer of structureless coarse sand and granules;
(2) horizontally stratified medium and fine sand;
(3) current ripple bedding in the uppermost fine sands and lowermost coarse silts;
(4) parallel lamination in the medium and fine silts.

Occasionally, this sequence will overlie an even lower layer of poorly sorted, angular flood gravel. Few of the coarser members of the sequence are present in the

Mileage		
Cumulative	Difference	Notes
		upper Tucannon Valley. Return to vehicles and proceed to Starbuck.
121.2	0.9	<u>STOP NINE</u>. Optional. Road cut exposure on left of backwater deposits with ice rafted boulders and clastic dikes. The graded sand-silt intervals of the Tucannon Valley show considerable evidence of deformation. This deformation occurs as local settling and as sediment-filled fissures called clastic dikes. Lupher (1944) believed that the melting of buried ground ice was largely responsible for these features. He suggested, however, that a few fissures might have been formed by landslides. All the clastic dikes, he believed, were filled from above by cycles of lake advances and retreats. Alwin and Scott (1970) concluded that the dikes represent filled crevices of permafrost origin.

Mileage		
Cumulative	Difference	Notes
122.1	0.9	Road cut on left exposes more slackwater deposits.
124.3	2.2	Road cut shows silt with only minor amount of basalt sand. Similar slackwater deposits are in most road cuts for the next 4 miles.
128.2	3.9	STOP TEN. Junction with U. S. Highway 12. Turn left. The road cut exposes very fine-grained slackwater deposits. Similar deposits are visible in the few road cuts for the next 5 miles.
		SUMMARY: Baker (1973) offered a unified hypothesis to explain the slackwater facies of Missoula Flood sedimentation. The preflood tributary valleys, such as the Tucannon River, behaved as settling basins adjacent to main flow channels. Any disturbance of the water level in the main scabland channels was propagated up these tributaries as transient surges (water surface waves). Such surges would

Mileage		
Cumulative	Difference	Notes
		bring into the tributary valleys a mixture of main channel flood sediments as either density flows or turbidity currents. The coarsest material would be deposited as an eddy bar at the junction of the tributary and the main channel. Further up the valley, sands and silts would settle out as a fining upwards turbidite. The proportion of silt versus sand would increase up-valley. Reverse, down-valley transients, analogs of reflected waves in stilling basins, might initiate weaker, down-valley turbidity flows. Further changes in the main channel's water surface could initiate new up-valley surges. The result of successive surges would be a vertical sequence of numerous turbidites as seen along the Tucannon valley. The vertical units would result from the attenuation of the successive surges. The slumping of sediments deposited in earlier surges could account for the clastic dikes, faulting, and other deformation of the slackwater deposits.

Mileage		
Cumulative	Difference	Notes
136.8	8.6	Dodge Junction. The shortest route to Moscow is on U. S. Highway 295 to Dusty. Proceed straight ahead at Dodge Junction. It is a 67 mile return trip to Moscow.

End of Log.

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