INTRODUCTION.

Silver Creek Falls State Park and adjacent Public Recreational tract comprise in all some 34 sections of land, located in Marion County, Oregon. The area lies approximately 25 miles east and slightly south of Salem and 16 miles southeast of Silverton. Secondary State Highway 214 separates the Park from the much larger Public Recreational tract which lies southeast of it.

Field work of the reconnaissance type was done during the first three weeks of June, 1937, in a period of almost continual rainfall. This and necessary office work (Minutes of the Annual Meeting of Geologists of the Service) interfered with the investigation in the field to some extent. In the time available not all details concerning the geology of the Area were recorded, though the important features were ascertained. Hence, this should be regarded as a preliminary rather than final report on the area.

It should be noted that nothing has been published in geological literature regarding the Silver Creek Falls district, though a report (1) pertaining to a region farther south has proved helpful.

(1) "Structure of the North Santiam River Section of the Cascade Mountains in Oregon" by T.P.Thayer, Jour.Geol., Vol.XLIV, No.6, Aug.-Sept. 1936.

PHYSICAL CONDITIONS.

The area contains a thick mantle of residual soil which supports a dense forest growth. Douglas fir, hemlock, cedar, and maples appear to be most abundant. Rock outcrops are confined largely to road cuts and stream channels. Except for the vegetative cover, the topography of the area reminds one of portions of the Colorado plateau, where gently dipping beds have been subject to considerable erosion and the streams are entrenching themselves in deep gorges.

Elevations in the area decrease from 3200 feet in the southeast to 700 feet in the northwest, a total relief of approximately 2500 feet. The drainage is north and west to Silver Creek, which is a consequent stream flowing northwestward in the general direction of the dip. The valley of this stream in the Northwest corner of the area is about 400 feet deep. It is narrow and V-shaped. These characteristics together with the occurrence of numerous falls along the tributaries of Silver Creek, within the Park, testify to the youthful stage of erosion of the valleys.

The falls are spectacular and constitute one of the chief attractions of the area. There are nine in all within the present boundaries of the Park. They are enumerated below, together with available data regarding height and elevation.

Stream	Falls	Height of falls.	Elevation on top of falls
North Silver Creek	North Falls	146'	1445'
do	Twin Falls	25'	
do	Middle North Falls	116'	1186'
do	Drake Falls	27'	
do	Lower North Falls		1070'
Hult Creek	Double Falls	189'	
Winter Creek	Winter Falls	140'	1400
South Silver Creek	South Falls	184'	1308'
do	Lower South Falls	100'	1073'

These falls will be described further under "Local Geologic Conditions". It should be mentioned that in addition to these listed above, there are several other falls along Silver Creek, ranging from 5 to 20 feet in height, which lie within the acreage to be added to the Park on the northwest side.

GEOLOGIC CONDITIONS.

(A) Regional:

As indicated in Fig. 1, the area under discussion is entirely within the western Cascade Mountains, near the western edge of the range.

The Western Cascades are composed of a thick mass of lava flows and associated tuffs and agglomerates - largely Miocene in age - which rest

upon an irregular floor of older rocks that are in part Oligocene.

In certain sections of the western Cascades, middle Miocene lavas are intruded by diorite. The intrusion probably occurred simultaneously with orogenetic movement in the Cascades, near the end of the Miocene, which produced the broad gentle folds indicated in Figure 1.

The western Cascades were raised in early or middle Pliocene by movement along the Cascade fault. It is believed that the region was elevated as a rigid block and possibly tilted towards the west. The present elevation of the western Cascades is thought to be largely due to this uplift.

The rocks of the region have been deeply weathered and covered with a thick mantle of residual soil.

(B.). Local

The position of the axis of the Mehama anticline with respect to the area under consideration, is shown in Figure 1. This fold is a very broad and open one with closure in the lavas of about 1000 feet. It apparently plunges toward the northeast.

Dips are difficult to determine in Silver Creek State Park and the adjacent Recreational land as it is almost impossible to trace contacts between flows or beds of tuff due to the heavy cover of soil and vegetation. However, some dips were observed and it is evident that the

lavas and associated rocks comprising the area, dip from nearly horizontal to a maximum of 2 or 3 degrees westward.

It was desirable to work from the irregular floor upon which the lavas were extruded upwards through the section. The nearest exposure of this floor was found in Silver Creek near the north line of Section 4 T.8 S., R.1 E., about one-half mile downstream below the acreage that is to be added to the northwest corner of the Park. There a basalt flow with slight northwest dip was found resting upon a tuffaceous sandstone carrying Oligocene pelecypods and gastropods. These beds also showed a flat dip apparently to the south, though its direction could not be determined with certainty. Fossils were collected from this locality and submitted to Dr. S. L. Packard, Dean of Oregon State College, who stated that while they are not specifically determinable they include Spisula near Albaren Mateia. Dr. Packard feels sure that the marine fauna represented is close to that of the Eugene Oligocene.

Walking downstream from the contact towards Silverton, a considerable area of these Oligocene beds are traversed, then the basaltic lava is once more encountered in the creek bed before the Oligocene sandstone again appears near Silverton. The occurrence of lava between the two Oligocene areas appears to be due entirely to the unevenness of the floor upon which the lava was extruded. In the North Santiam region Thayer found more striking examples of the irregularity of the Oligocene floor.*

* Personal communication.

The series of lava flows immediately overlying the Oligocene are exposed in stream channels and road cuts in the Park and Recreational tract. The series appears to be here about 400 feet thick. This estimate is somewhat speculative for the following reasons: first, the flows rest upon an irregular floor; and, second, the dip of the lavas cannot be determined with precision since no individual flow can be followed across the area due to the thick mantle of soil and vegetation.

The lavas of this series are dark gray in color and range in composition from andesite to basalt. However, most of the sample examined contained olivine and the series is therefore regarded as predominantly basaltic.

Only one bed of tuff was found within the series. It carries no fossils and lies beneath the uppermost flow, being well exposed at North Falls.

Lying conformably upon the basalt flows just described are tuffs and conglomerates totalling approximately 1600 feet in thickness. They form a considerable part of the Recreational area and are exposed along State Highway 214 south and west of the Park.

The formations briefly described above correspond generally in character, succession and thickness with those Thayer found along the North Santiam River. There middle Oligocene beds are overlain unconformably by 200 feet of lava beds called the Stayton lavas, which are believed to

be equivalent to the Columbia River basalts of middle or upper Miocene age. The Stayton lavas are in turn overlain by some 1500 feet of tuffs and conglomerate to which the name Fern Ridge Tuffs has been given and, since they overlie the Stayton lavas conformably, they are considered Miocene in age.

There are so many points of similarity between the geologic section of the Park and Recreational tract and the section Thayer describes along the North Santiam River, that the former may be safely correlated with the latter. Accordingly, the names of the formations of the Silver Creek area, their ages and thicknesses, may be summarized as follows:

Formation	Age	Thickness
Fern Ridge Tuffs	Upper Miocene	1500'
Stayton Lavas	Middle or Upper Miocene	400'
	Unconformity	
Eugene Oligocene	Middle Oligocene	?

Although the rocks of the Park were examined in considerable detail and various C.C.C. projects inspected, there was not sufficient opportunity at the time of this visit to complete the investigation of the Recreational tract. There accumulations of gravel and boulders were found which appear to be due to local glaciation and these deposits along with other details pertaining to the geology of this tract must be carefully studied before a final report on the area can be submitted.

The difference in topography from the rolling land formed by the thick formation of soft Fern Ridge tuffs to the deep canyons developed in the underlying Stayton lavas is readily observed. The falls lie

entirely within this series of lava flows, the most spectacular being North and South falls, both of which occur in the upper flow of this formation. Winter Falls is another high falls and the others descend from lower flows of the series. A brief description of the falls follows:

At North Falls the 25 foot tuffaceous bed already referred to, is exposed below the upper flow. The water drops from a protruding lip of basalt overlying the tuff 146 feet into a pool below. In the tuffaceous bed there is a cave of striking proportions (Figure 2). The reason for the development of this cave is easy to explain. The water curves inward as it falls and sucks air behind it which pulls sprays of water on the tuff cliff behind the falls, softening this rock so that particles break off. This process, of course, occurs when the underlying rock is less resistant to erosion than the rock at the top of the falls, but when hard rock is underlain by soft, as in this case, a relatively large cave develops. The excavation of this cavern is hastened during winter months by freezing, which causes the water in the tuff to expand, producing fractures, and thawing causes pieces of tuff to drop away from the surface, thus enlarging the cave.

At South Falls (Figure 3) the water also descends over a lip of lava which protrudes near the center of the upper flow, dropping 184 feet into a deep pool below. Here also the rock is softer beneath the upper flow, being scoriaceous in character and also it was weathered before being

covered by the higher flow. Evidence of this former erosion surface may be seen on the contact of the upper flow with the lower, along which a cross section of stream channel is exposed behind the falls. This depression probably contained water when invaded by the lava of the upper flow, as there are tubes and tunnels in the basalt resting on this channel which appear to have been produced by steam. The wall behind the falls is gently concave and not greatly undermined.

Winter falls with its drop of 140 feet also occurs in the upper part of the basalt series. The other falls of the area are developed in the lower flows which show, in places, minor variations in character - the rock being vesicular, massive, or columnarly jointed. Changes from much jointed basalt to the massive variety may sometimes be seen in the same flow, where the rate of cooling of the molten lava was more rapid at the top than at the bottom of the flow. The falls are, of course, very slowly receding upstream as the creek lengthens its headwaters. Although the falls appear large and spectacular, at close range they are small for the large topographic features around them, and it is likely that the streams of the area were once considerably larger than they are at present.

HISTORICAL GEOLOGY.

Reference to geologic events which produced the present landscape has already been made, under both regional and local geology. These events are summarized briefly below in order of their occurrence.

1. In Middle or Upper Miocene time when the Columbia River basalts were being formed, flows of basaltic lava spread over the irregular floor of Oligocene sandstone in the Silver Creek Park and Recreational area.

2. These flows followed one another until they totaled about 400 feet in thickness in this area. Enough time elapsed, however, between the uppermost flow and the one immediately below it for partial erosion of the latter and deposition of tuff in places on its surface. The basaltic formation is called the Stayton Lavas.

3. Following the invasion of the lavas, volcanic ash and associated material were deposited conformably over the basalts until these tuffaceous beds attained a thickness of about 1500 feet. This formation is also Miocene in age and is called the Fern Ridge Tuffs. It is overlain by lava flows.

4. Near the close of the Miocene, orogenetic movement occurred which threw the western Cascades into a series of anticlines and synclines trending northeast-southwest. Simultaneously there were intrusions of diorite in an area to the south (North Santiam River). The Park and Recreational

tract lie on the gentle west dip of the Mehama anticline.

5. In Pliocene time the region west of the Cascade fault was raised as a more or less rigid block and tilted toward the west. Much of the elevation of this area is due to that uplift.

6. Erosion has since dissected the region to its present topography, and a thick mantle of residual soil covers most of the rock of the area.

RECOMMENDATIONS.

The trails passing behind the various falls are wet, slick, and somewhat narrow. It is possible that a visitor might slip off the ledge. Guard rails should be erected to prevent such an occurrence.

Any additional trails constructed in the park or Recreational tract should have an 18-inch tread so as to preserve the area as far as possible in its natural state.

A tunnel seems necessary near Lower South Falls to eliminate a high and unsightly series of steps. If this should be dug, care must be taken to put it as far as possible from the outer surface of the rocks which are much jointed and weathered in this locality.

The model of the area being constructed by the Resident Landscape Architect should be painted various shades of green to indicate various type of vegetation. Basalt outcrops should be shown in dark gray and tuffaceous beds in buff. A collection should be made of the rocks and fossils of the area which shouold be properly identified and labeled for exhibit with the model.

Respectfully Submitted:

(signed) Donald K. Mackay.