JOHN DAY FOSSIL BEDS
A
STATE PARK
OF THE
YESTERDAYS

MILE POST SITES AND DEED DESCRIPTIONS

The John Day Fossil Beds State Park, Grant County, Oregon, is made up of eight disconnected units, distributed along the ascending John Day River, paralleling or astride the John Day Highway (State 19). All excepting two minor tracts, are west of its junction with the Ochoco Highway, where State 19 ends and the John Day becomes U. S. 28 as far as Vale; thence over the Central Oregon Highway (U.S. 20) to Ontario and the Idaho line. Counting in the Pendleton-John Day Highway (U.S. 395), which connects with U. S. 28 at Mount Vernon, Mile Post 154.28, there are four avenues of approach to the fossil beds area - from Ontario, Pendleton and Arlington on U. S. 30, and Redmond on U. S. 97. All these routes may be said to converge at Picture Gorge, which is considered the focal point of the park area.

Beginning on U. S. 19, the first tract is at Mile Post 106, the Cathedral is M. P. 116; Johnny Kirk Springs 116.67; Turtle Cove, east of the Highway, is opposite M. P. 118; the Kennedy tract is approximately M. P. 120; the Cant wayside, between the highway and river is M. P. 121; an unnamed tract, divided by the river, holds M. P. 122; the lofty, pyramidal Sheep Rock is opposite M. P. 123; the Rock Creek tract, on the west side of the river, abreast of M. P. 124, is cut by Rock Creek and traversed by the Ochoco Highway as they reach Picture Gorge, M. P. 125. East of Picture Gorge, approximately M. P. 126.70, nearly a mile south of and 500 feet above the highway, is the William Mascall Overlook; and about seven miles east of Dayville, approximately M. P. 136, a small tract lies between the highway and river.

In their order, these are described as follows: Griffin tract in Section 31, Township 9 South, Range 26 East, 3 acres, the deed date June 18, 1945, Cathedral, in Section 7, Township 11 South, Range 26, East, 40 acres, a gift to the State by the United States, the deed date June 20, 1939; Johnny Kirk Springs in Sections 7 and 18, Township 11 South, Range 26, East, 0.79 acres, a gift to the State from Charles W. Hoffman, the deed date August 4, 1928; Turtle Cove in Sections 20 and 29, Township 11 South, Range 26 East, 200 acres, the deed date January 5, 1939; the Kennedy tract in Section 32, Township 11 South Range 26 East, 40 acres, the deed date July 17, 1945; the Cant wayside in Section 6, Township 12 South, Range 26 East, has 4.8 acres, the deed date September 14, 1935; an unnamed tract in Sections 1 and 2, Township 12 South, Range 25 East, and in Sections 5, 8, 18 and 20, Township 12 South, Range 26 East, 1602 acres, U. S. patent dated May 20, 1931. The Mascall Overlook, a tract of 3.8 acres in Section 29, Township 12 South, Range 26 East, is a gift to the State of Oregon from William Mascall, the deed date September 14, 1935. Situated in Section 7, Township 13 South, Range 29 East is a one and one-half acre tract lying between the highway and river, a gift to the State from the Eastern Oregon Land Company, the deed date January 31, 1931.

The state park units of the John Day basin, have been acquired over a period of years by successive Oregon State Highway Commissions. In part, they were selected and recommended for acquisition by S. H. Boardman, State Parks Superintendent, for some particularly scenic feature, or because of its outstanding geological or paleontological importance as recognized by the earth scientists.

While the park units contain some of the most scenic features of the area which are visible from the highways in passing; up to this time, they do not have the accommodations nor improvements usually found in state parks devoted to conventional recreational purposes. As Harvey Scott, the famed editor of the Oregonian

once commented: "People who go sight seeing are disposed to look at anything out of the ordinary that is brought to their attention". They are interested in natural features, especially those of antiquity, sites of historical pioneering endeavor, early structures, and evidences of old trail and road routes. The John Day country is rich in all these.

REGIONAL HISTORY

The John Day Fossil Beds State Park units, situated approximately in the center of the John Day River basin are in a region endowed with a richly romantic, and historically colorful, pioneering background; and a time history written in the rocks that reaches back into the milleniums of past geologic ages, which mark the beginnings of organic life in the Oregon country.

The John Day River was first identified by the Lewis and Clark expedition, who named it "Lepages River" when passing down the Columbia on October 21, 1805, It was called John Day River in 1812, after John Day, a Virginian, who was left seriously ill on the bank of Snake River in Idaho, by the overland Astor party under Hunt. Ramsay Crook, also of the party, chose to stay with him. When Day recovered, they started for the Columbia River. While making their way down the river the next spring, they were set upon and robbed by Indians, who left them naked. They were seen and rescued by Robert Stuart, also a member of Astor's Pacific Fur Company, when near the mouth of the river that since bears Day's name, and taken to Fort Astor, now the site of Astoria, to rejoin their former companions.

John Work used the name "Day's River" in his journal entry for June 25, 1825, when on his way to the Flathead Country. Peter Skene Ogden when leading a fur brigade to the Snake River country, mentions "John Day's River" in his journal entry of November 29, 1825.

On January 11, 1826, Ogden's party was in difficulties "on the sources of the John Day". On January 15, his journal reads "Five men absent since the tenth.

I am obliged to wait although we are starving. On January 26, is the entry ... "we leave the waters of Day's River. Since joining Mr. McDonald, allowing we had a hundred hunters, had we not our traps we must have starved to death". The inference being this section of the country was then so destitute of game that not enough meat to supply the party could have been obtained by any number of hunters. The very limited catch of beaver was all the food they had. On January 28 ... "our guide says six feet of snow in the mountains (Blue) ... Many in camp are starving. For the last ten days, only one meal every two days. Still the company's (Hudson's Bay Company's) horses must not fall sacrifice". (The Company's horses were preserved, at all costs, to return the bales of furs to the Fort). February 10, "on Burnt River. Two men could not advance from weakness. February 16, Gervais killed two small deer". (Joseph Gervais, later a French Prairie pioneer settler, after whom the town of Gervais, Marion County, Oregon, was named.)

Ogden also passed through this region in 1826-1827, and again tells of the scarcity of food and the wretched condition of the few natives, who were driven into this inhospitable area by the warlike Snake tribes. John Work, as chief trader in the Snake country, passed westward through the John Day country in 1832, and also noted the impoverished condition of the few natives and paucity of game. Some of his "people" were obliged to kill their own horses for food".

In Idaho and eastern Oregon which, generally speaking, are not now considered regions of inclement weather in late spring and early summer; Works journals, written one hundred sixteen years ago, show that from April 18, 1832, when on Lost River, Idaho; thence crossing through the Burnt River John Day country, and on to the Umatilla and Columbia Rivers to Fort Nez Perce, they experienced fifty-five days that were wholly, or partially, bad weather, and only twenty-four that were fair or fine.

Between the passing of the Hudson's Bay Company's large, well organized fur brigades in 1825-1826, 1826-1827 and again in 1832; who, if anyone, traversed this

region until 1845, is an apparent uncertainty. In that year the trek of the so called, "Blue Bucket" immigration party took place supposedly crossing the southerly sources, of the John Day, down Crooked River, down and across the Deschutes Canyon and on to the Columbia, by the notoriously bad, and almost disastrous, "Meek's Cut-off".

If anyone was in the John Day country prior to the Hudson's Bay Company's fur brigades, they did not leave a definite record. Scott's History of Oregon, refers to an article in the Oregonian of February 14, 1896, entitled 'The first discovery of gold in the Territory of Oregon' ... "related by a correspondent to have been by trappers of the American Fur Company, signed W. P. M. Lifford,Baker County, Oregon." He says: "It is generally believed ... that miners from northern California and southern Oregon ... in 1862 discovered the existence of gold in eastern Oregon ... they were not the discoverers nor the pioneers. Gold was first found on the John Day River by trappers in the employ of the American Fur Company, and they made their discovery known". The year of the trappers find was not given. It could very well have been during Ramsay Crook's administration of this Company's affairs, 1834 to 1848, when they were reputedly more or less active in this region.

Conceivably, miners could become trappers, temporarily; but the trappers employed by the fur companies in the early days of this industry were in no sense miners; nor, for many reasons, could they even be prospectors while attached to a fur brigade.

While it is quite possible the American Fur Company's trappers could have found gold nuggets while setting beaver traps along the John Day River or some of its tributaries, the place of its discovery, if it actually occurred, may never be known. There is, however, no doubt of the Meek's party having found gold in some stream they crossed; although Meek, with a party of thirty men, retraced their

trail the next year, and failed to find gold in any of the streams along their route, nor could they locate the brook from which the children were supposed to have picked the nuggets they had found in 1845.

Another Oregonian correspondent in 1896 also related that the first gold discovered in the John Day country was in Spanish Gulch, about mid-distance between the present towns of Dayville and Mitchell, but did not give the date nor the names of the discoverers.

Dr. Merriam, Volume 1, page 445, referring to the geology of Spanish Gulch, said: "Not far from this locality there is associated with the serpentine a considerable thickness of quartzite with quartz veins, which have produced some gold".

There is apparently no definite record of individuals or organized parties having traveled in this area after the "Blue Bucket" immigrant party passed; except Stephen L. Meek and his thirty odd disappointed gold seekers in 1846. Failing to locate the site of the Blue Bucket find, the party disbanded. Some returned safely to the Willamette Valley, some were killed by Indians and four or five continued prospecting, finding traces of gold, but apparently not in what they deemed to be in paying quantities.

Following the exciting days of the 1849 gold rush to California, adventuresome individuals spread over the northern part of the state, into Oregon, and eventually over the entire Northwest, even into British Columbia in the 1850-1860 decades.

'Scattering appearances of gold in 1853-54, were announced from Burnt River in Eastern Oregon, Yakima, Pend Oreille and Cour d'Alene rivers, but their significance was not then realized. "Not enough (gold) has yet been found to repay the labor of procuring it', "wrote Major Benjamin Alvord in 1853". Authorities do not agree upon the first discoveries in the interior country, but it is known that the real awakening came from discoveries near Fort Colville, im the Spring of 1855, and

on the Kootenai River about the same time. Later in the year the John Day Valley in Oregon was favorably prospected.

"Indian hostilities then delayed pursuit of gold in the interior country, ... The Idaho mines began activities in 1860, those of John Day and Powder River, in Eastern Oregon in 1861, .."[1]

These records indicate that prospectors from California and Southern Oregon had overrun the John Day Country, despite Indian troubles, some years previous to the protection afforded by the military expeditions of 1859 and later years.

The next organized party known to enter this territory was a well equipped military expedition, in command of Captain D. H. Wallen in 1859. They established their headquarters on Camp Creek, a few miles southeast of where Mitchell is now; under orders to survey and open a road to The Dalles; and explore the possibilities of a road to the "Great Salt Lake". The road to the Dalles was started and the Salt Lake mission was accomplished without untoward incident.

In the spring of 1860, General William Selby Harney, accompanied by Major Enoch Steen, arrived at the camp of the previous year with two commands; one under Captain Wallen, the other under Captain A. J. Smith.

General Harney and Major Steen, with an escort of dragoons, started for south-east Oregon. "They were resisted by the Indians and called for reinforcements. When these arrived they proceeded to and named the great fault in Harney County, now known as Steen's Mountain. Harney County, created February 25, 1889, was named after General Harney.

1 "The Pioneer Stimulus of Gold", by Leslie M. Scott, in Oregon Historical Quarterly, Volume 18, Number 3, September, 1917 - page 151. For details of John Day mines in 1855 see The Oregonian of July 21, 1855.

Road construction was continued by the military through 1860-1861, and later; attracting a few settlers who, despite the Indian menace, remained to become permanent settlers, mostly stockmen.

Although 1861 seems to be the year gold in paying quantities was found in the John Day River or its tributaries; the great influx of miners from Southern Oregon and Northern California took place in 1862. This was also the year when the definitely permanent settlement of the area actually began. Camp Watson, the military post established for the protection of miners, settlers and travelers from maurading Snake Indians and renegade whites, was first garrisoned in 1863 and occupied until its abandonment in 1869. By that time the Indians were no longer a menace and miners and settlers could care for themselves. Most of the permanent settlers were then, as now, engaged in stock raising, their cattle ranging on the abundant and nutritious bunch grass, which rapidly disappeared after sheep were introduced into the range country.

HISTORY OF EXPLORATION

On Page 438 of Dr. Merriam's graphic story of the John Day, he says: "The existence of fossil mammalian remains in Eastern Oregon seems to have been first noticed by a company of soldiers (dragoons) which passed through that region in 1861. When the party reached The Dalles on its return journey, a number of the men had with them fragments of bones and teeth from fossil beds in the Crooked River Country. The only specimen brought back by this party, of which any definite information is now obtainable, was a fine rhinoceros jaw, which was in the possession of Lieutenant Waymire.

"Professor Thomas Condon, who was then pastor of the Congregational Church in the Dalles, saw the fossils and obtained from members of the party considerable

information concerning their occurrence. Condon immediately concluded that an important field for paleontological research had been discovered and made use of the first possible opportunity of visiting the beds.[1] Early in the next year (1862) he was allowed to go with a company of soldiers taking supplies across to Harney Valley. On the way out he passed through the Crooked River Country and obtained a few fossils there. On the return trip, made by the way of Camp Watson, he discovered the large exposures at Bridge Creek and supposed them to be of the same system as the Crooked River beds.

"In passing through the John Day country on his return journey. Condon met Sam Snook, a resident of the region who had already taken some notice of the fossil bones, and engaged his services as a collector. The following summer, 1863, found Condon again collecting and exploring at Bridge Creek and along the John Day. In 1864, probably in company with Snook, he first saw the large exposures of John Day strata in what he has named Turtle Cove.[2]

"In 1870 or '71, some specimens of teeth from the John Day beds were sent by Condon to Prof. O. C. Marsh. Almost immediately he received a request from Marsh to guide an expedition from Yale into the new field. Marsh came out with a party of fifteen or sixteen persons in the fall of 1871, and under Condon's guidance visited some of the most important localities. ... While in the field Marsh engaged several collectors to carry on the work for him. Systematic collecting began in the following spring and was continued practically without interruption till 1877. Most

1 Professor Condon was born in New York State. In his youthful days he had taken an interest in geology, obtaining mollusk fossils from neighboring rock quarries. Hence, his enthusiastic concern in the mammalian fossils exhibited by the military party upon their return.

2 "The writer (Dr. Merriam) is indebted to Prof. Thomas Condon for the greater part of his information concerning the discovery of the fields. Mr. L. S. Davis, who has accompanied nearly all of the expeditions, contributed most of the facts concerning the later explorations".

of the work during this period was done by L. S. Davis and William Day, who explored practically all of the exposures in the region.

"Early in the winter of 1871, shortly after Marsh's visit to the field, Lord Walsingham, William de Gray, while on a hunting expedition, passed through the fossil fields and obtained some valuable specimens at Turtle Cove and on Bridge Creek. His small collection was presented to the British Museum and furnished material for Bettany's valuable contribution to our knowledge of the John Day Oreodontidae.

"In the summer of 1873, Professor Joseph LeConte, in company with Professor Condon, visited the western border of the field and made some important observations on the geology.

"Parties under Wortman and Sternberg collected for Professor E. D. Cope in 1878 and 1879, obtaining the material upon which Cope based his important publications on John Day vertebrates.

"In the summer 1880, Captain Bendire of the U. S. Army, with a large party of the 7th. U. S. Cavalry, made a short tour through the basin under the guidance of L. S. Davis. Collections of plants were made by him at Bridge Creek, Van Horn's Ranch, and probably also at Cherry Creek. ... Bendire's collections were turned over to the Smithsonian Institution. ...

"In 1882 Davis and Day collected under Marsh for the U. S. Geological Survey ... south of the Blue Mountains.

"No further work was done in the field till 1889, when Professor W. B. Scott spent the summer in the John Day basin with a large party from Princeton University ".

LITERATURE

"The first mention of the fossiliferous deposits in the John Day basin which appears in the literature was made by Dr. Joseph Leidy. In October 1870, Leidy

presented before the Philadelphia Academy of Sciences a short paper, in which he described a collection of fossils recently received for examination through the Smithsonian Institution, from Reverend Thomas Condon of Dalles City, Oregon. The collection consisted of remains of mammalia obtained by Mr. Condon from the valley of Bridge Creek, a tributary of John Day's River, Oregon.

In 1873 Professor Marsh described several new fossil mammals obtained by his exploring party in the John Day country in 1871. He referred two forms to the Miocene and one to the Pliocene, thus making the first statement regarding the age of the beds.

"In his paper on the great lava flood of the West, Professor Joseph Le Conte (1874) makes the first mention of the structural relations of the John Day formations. ... 'The lava in this region is underlaid by the remarkable fossiliferous Miocene lake deposit of the John Day Valley; erosion has cut through the lava cap into the soft strata beneath'".

"Professor Marsh prepared a general discussion of the John Day geology published in 1875. In this account we find the name 'John Day' first used for the principal fossil beds of the basin.

"In 1880 Professor E. D. Cope published a statement concerning the geology of the John Day country; - (See page (442).

In 1899 W. D. Matthew published a bulletin "on a provisional classification", separating the John Day beds. ...

In 1899 and in 1900, the University of California sent expeditions to the John Day basin in charge of Dr. John C. Merriam. Their findings were published in "Volume 1 of the Published Papers and Addresses of John Campbell Merriam, Published by the Carnegie Institution of Washington, Washington, D. C., entitled a Report on the Expeditions to the John Day Fossil Beds. The party included the late Dr. Merriam,

Mr. F. C. Calkins, Mr. L. H. Miller and G. B. Hatch, who assembled at The Dalles about May 20, 1899, and, accompanied by Mr. L. S. Davis as guide ... started for Bridge Creek.

The pertinent opening sentence of this report is: "The fossil field of the John Day region in eastern Oregon has been known to geologists for many years as one of the most important of the numerous West-American localities furnishing good remains of Tertiary mammals. During the past thirty years the leading paleontologists of the country have obtained from it large collections of remains containing a great number of new and interesting animals. Professor Marsh of Yale, Professor Cope of Pennsylavania, Professor Condon of Oregon, Professor Scott of Princeton, and others, have personally conducted expeditions into the field. Beside these expeditions, professional collectors have worked over the ground during more than a dozen seasons, Excepting the collection of Professor Condon, at the State University of Oregon, the whole of the great amount of material accumulated has passed into the possession of a few of the large Eastern museums.

"The John Day fossil beds are exposed in patches over a considerable area in Oregon, to the east of the Cascade Range. The principal exposures being along the John Day River and its tributaries, the name of the river has been applied to them, and they are now known technically as the John Day System. Their age, as determined by comparison of the fossils with those of other systems, is generally supposed to be Miocene.

"The exposure of the John Day beds at Bridge Creek is one of the best for studying the general geology of the deposits. The beds here are about fifteen hundred feet thick and are composed largely of volcanic materials mixed with sand and clay. They are nearly all strikingly colored, and probably vary somewhat in composition in the differently colored strata. At all the John Day exposures

visited by our party the lowest beds were a deep red, the highest ones buff or white, and the intermediate strata blue or green. One of the results of our geological work was the determination of the persistence of these three sets of beds over the whole region. By means of these horizons we were enabled to study the vertical range or distribution in time of the animal species they contain.

"From the character of the fossil remains found in the John Day beds, they are generally supposed to be deposits laid down in an inland sea or lake, once filling a somewhat irregular basin extending over a large part of eastern Oregon and portions of the adjoining states. The fossil remains consist of a few fresh water shells, a number of land shells washed into the lake by rains or streams, and the skeletons of a large number of vertebrates which were either drowned in the lake and buried entire in the mud, or, as was more frequently the case, which died upon the land, only portions of their dismembered skeletons being washed into the lake with river or rain wash.

"The Bridge Creek locality has probably been more thoroughly explored than any other in the country (up to 1899) and has for that reason furnished a large number of fine specimens. ....

"From Bridge Creek the party moved by slow stages to Turtle Cove conceded to be the best and most extensive collecting ground in the region"; discovered and named by Professor Condon in 1862, because of the many fossil remains of land tortoises and turtles. On their way to the Cove the party stopped at Cottonwood Creek and spent parts of two days collecting in what are now the Mascall beds, resting upon the lavas overlying "the John Day system and contain remains of a higher and more specialized fauna than that of the beds below the lava". They collected a few good specimens, "representing several species of horse, mastodon, rhinoceros, etc. The horse teeth serving to fill a gap in the evolutionary series

of horses already in our possession.

... "In the Cove two camps were made from which we worked a number of the best exposures. The largest outcrop, called by us the Blue Basin, is a veritable labyrinth of canyons, gulches and caves cut into the soft blue rock of the middle John Day beds by the heavy rains. The coloring of these beds is frequently most wonderful and of the most delicate shades. Passing along the bottom of any of the larger canyons, the wilderness of finely sculptured and delicately tinted peaks and pinnacles about frequently causes one involuntarily to pause and gaze, astonished that even nature could produce such magnificent architecture".

In Dr. Merriam's chapter on the "Classification of the John Day Beds", he concludes they are about fifteen hundred feet in thickness, and apparently contain a very large proportion of volcanic materials. They seem to rest uncomformably on a thick series of plant bearing, fresh water beds, which have been considered Eocene. The Columbian lavas, rest apparently uncomformably upon the John Day beds.

He divides the John Day system into "three divisions, lower, middle and upper John Day. The lower beds are mainly colored a brilliant red, and seem to have suffered more disturbance than the higher beds and are practically barren of fossils. The middle beds are blue, green or drab, and are in places quite fossiliferous. The upper beds are buff or white. They are largely made up of volcanic material. Many fossils have been obtained from this division. One horizon particularly is rich in rodent remains. ...".

In his chapter entitled a "Geological Section Through John Day Basin", he says the John Day river and its tributaries have exposed in the erosion of their canyons about 10,000 feet of strata, giving a full series of formations from Lower Cretaceous to Quaternary. The oldest rocks he noted in this region" are a series of altered sedimentaries in the northeastern part of the basin. They are pretty

certainly of pre-cretaceous age and are underlain by quartz diorite[1] ... .

"On Bridge Creek near Mitchell a great thickness of Cretaceous is exposed. The lower 2,000 to 3,000 feet are typical Knoxville. The upper 1,000 to 2,000 feet are Chico.

"Resting upon the Chico, near Mitchell, ...also showing at Clarno's ferry, is a presumably Eocene formation, called Clarno, and made up entirely of tuffs, ashes and lavas" containing many plant remains, apparently in part a freshwater formation.

"The Columbia lava, an extension of the lavas on the Columbia river to the north, rests unconformably on the crumpled John Day formation. ...

"The Cottonwood (an early term for the Mascall) formation, near 1,000 feet in thickness, rests on the Columbia lava. The Van Horn Ranch plants, generally considered as John Day are from this horizon. Remains of a true John Day flora, not previously known, were discovered by the University of California expedition in 1900.

... "Resting on the worn edges of the Cottonwood (new Mascall) beds is the Rattlesnake formation, comprising several hundred feet of gravel, tuff and lavas."

"In canyons cut through the Rattlesnake and Cottonwood are several terraces. Remains of elephants and later horses found in the lower terrace deposits show that they were formed in Quaternary time".

In his chapters entitled "A Contribution to the Geology of the John Day Basin", he remarks:"... Future investigations will certainly show that very many important things have been overlooked, and doubtless many weaknesses in the present discussion will be pointed out; the writers purpose will, however, be accomplished if the general stratigraphic succession and the sequence of major geological events are here set forth in such a manner as to make intelligible discussions of the extinct

[1] Determined by Frank C. Calkins

faunas and floras of this region which will follow this paper".

GEOGRAPHIC FEATURES

"The existing John Day basin of north central Oregon is a well-defined area almost completely surrounded by the triangular Blue Mountain Range. The rugged eastern ridges, rising to an elevation of over 6,000 feet, are composed largely of pre-Tertiary formations which have been much disturbed. ... The streams have laid bare magnificent sections of all the basin formations, affording unexcelled opportunities for stratigraphic and paleontological studies.

"... Excepting the mountain ranges and some of the highest interior ridges, which support a heavy growth of (Ponderosa) pine timber the country is only sparingly wooded. A fringe of cottonwoods, birches and willows along the streams, and a few scattered junipers comprise the most important part of its sylva."

GENERAL FEATURES OF THE GEOLOGY

"The section of the John Day formation, as it is known to the writer (Dr. Merriam), includes at least nine formations, showing the following sequence:

River terraces, with undisturbed Quaternary fossils.
Rattlesnake formation. Gravels, ash, tuff and rhyolitic lava.
Mascall formation. Ashes, tuffs, and possibly gravels.
Columbia lava. Basaltic flows.
John Day series. Ashes, tuffs and rhyolitic flows. Sands and gravels near the top. Lower, middle and upper division.
Clarno formation. Ashes, tuffs, andesitic and rhyolite flows.
Chico formation. Sandstone and conglomerates.
Knoxville formation. Black shales.
Pre-cretaceous sedimentaries, serpentines. Granitic masses of unknown age.

"The Knoxville and Chico are marine formations. ... From the Clarno formation to the top of the series, excepting a very small portion of the whole thickness, the deposits are made of eruptive materials. The Clarno, John Day, and Mascall are almost entirely composed of ashes and tuffs. They have generally been considered as being wholly lake deposit, but, as will be shown later, the character and occurrence

of the fossil remains which they contain are such as to make it doubtful whether they owe their origin to this mode of accumulation.

"The Rattlesnake deposits also contain a large proportion of erupted material, but is mainly composed of gravels derived from the Columbia lava.

"At the close of a long era of erosion following the Rattlesnake epoch, a series of terraces was formed along the main streams. Undisturbed Quaternary remains give definite evidence regarding the age of these deposits. ...Exposure of the John Day beds and other pre-Columbia lava formations are found only along the streams, where the lava has been cut through".

PRE-CRETACEOUS FORMATIONS

"The oldest fossil-bearing strata which have been found in the John Day basin north of the southern Blue Mountain Range are of Cretaceous age.

"... Near the head of Crooked River, south of the Blue Mountains, there are said to be exposures of Palaeozoic, Triassic, Jurassic and Cretaceous formations"

CRETACEOUS, CHICO AND KNOXVILLE

"Exposures of Cretaceous formations are to be found at several points on the western side of the basin. The best out crops are to be seen at Mitchell and Spanis Gulch. At Spanish Gulch a considerable thickness of conglomerate and sandstone... is found above the serpentine. Fossils (marine) are quite numerous in this formation, and considerable collections were made at two localities. ... One yielded eighteen species, the other eleven, "only four of which were different. One species represented by a single small specimen that seems to be identical with forms from Skidegate Inlet, Queen Charlotte Islands. It also occurs at Texas Springs, California and Jacksonville, Oregon.

"... The whole assemblage of forms in the above lists indicates a horizon