

A Report to the National Park Service
on the Significance, History of Investigation,
and Salient Paleontological Features of the
Upper John Day Basin, Wheeler and Grant Counties, Oregon

by

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INTRODUCTION

No discussion of the significance of the Upper John Day Basin can be meaningful without an understanding of its geography, topography and present climate. This report will therefore include a brief description of these attributes. Following this will be a description of the geology and chronology of the exposed rocks of the basin. With this background it will then be possible to discuss the history of the investigations, paleontology and interpretation of the significant aspects of this region.

There are over two hundred scientific papers concerning the geology and paleontology of the Upper John Day Basin. Direct reference will only be made to the most significant studies relative to the purposes of this report. In addition I will make reference to some unpublished papers and journals and my own close association with the area for the last twenty years.

For the purposes of this report the Upper John Day Basin is considered to be that area drained by the John Day River upstream from the gorge north of Clarno. Important tributaries include the North

and South Forks of the John Day River, Butte Creek, Pine Creek, Currant Creek, Cherry Creek, Bridge Creek, Service Creek, Kahler Creek, Haystack Creek, Rock Creek, Cottonwood Creek and Fields Creek. The basin occupies Wheeler and Grant Counties of North Central Oregon. U. S. Highway 26 passes through the basin from west to east and U. S. Highway 395 running north and south borders the eastern edge of the basin. State Highways 19, 207 and 208 and a number of paved county roads provide access to the remainder of the basin.

Visitors to the John Day Basin are immediately impressed with the high relief of the region. It exceeds 6,000 feet over the entire area and is often over 2,000 feet locally. The John Day River and its tributaries are thus deeply incised in rather narrow valley floors, sometimes only large enough to accommodate the stream. Although the high relief presents problems of access in the basin, it also reveals the geology spectacularly.

The region is semi arid with an average of twelve inches per year rainfall, some of which comes in local cloudbursts in the summer. The higher elevations support pine forests. Stream courses are bordered with willow and cottonwood. The middle elevations have scattered juniper and sage. This is in striking contrast to geologically earlier vegetation which will be discussed later in the report.

ROCKS OF THE JOHN DAY BASIN

The rocks exposed in the John Day Basin reveal an extensive record of earth history. The oldest rocks present are of the Paleozoic and Mesozoic eras hundreds of millions of years old. In these rocks are fossil clams and marine reptiles indicating the presence of the sea in the region at that time. However, exposed land was present nearby even at that time as evidenced by the presence of fossil plants and terrestrial reptiles. A near shore environment is thus postulated for the John Day Basin in its earliest history. This very early record is best known from the adjacent areas to the west, south and east, but only poorly represented by occasional windows into the distant past within the basin itself.

One of the reasons the very early record is not so abundant in the basin is that it is covered by a tremendous volume of younger Cenozoic era rocks, representing the history of the area of the last seventy million years. The Cenozoic era is sometimes referred to as the age of mammals because of their dominance during that time. It is divided into the Tertiary and Quaternary Periods in the geologic calendar. Most of Cenozoic time is represented in the Tertiary and only the last two or three million years in the Quaternary which includes the Pleistocene or, as it is sometimes called, the Ice Age. The Tertiary rocks will be of the most interest here because the majority of the rocks of the John Day Basin represent this period of time. It is subdivided into five ages in the geologic calendar: Paleocene, Eocene, Oligocene, Miocene and Pliocene. All but the Paleocene are recorded in the John Day Basin.

Clarno Formation

The oldest Tertiary rocks of the John Day Basin are those of the Clarno Formation. However, their geographic extent is much greater. To the west the Clarno Formation appears as far as the eastern foothills of the Cascades, to the north it extends nearly to the Columbia River and south beyond the Crooked River. Much of the lower part of the formation consists of basalts and rhyolites, extrusive lavas of volcanic origin. In the upper few hundred feet sediments derived from volcanic ash are common and contain fossil plants and animals. The total thickness of the Clarno Formation is 5,000 feet.

The fossil plants and animals from the Clarno Formation indicate an age of Late Eocene to Early Oligocene. Samples of the rocks from the upper part of the formation obtained by R. Hay and determined by the University of California laboratory at Berkeley gave an absolute age of thirty seven million years. These determination from the upper portions of the formation of course suggest that the bulk of the unit below is even older.

Within the John Day Basin the Clarno Formation is well exposed north and west of Mitchell in the southern part of the basin and along Pine Creek between Fossil and Clarno in the northern part of the basin.

John Day Formation

Overlying the Clarno Formation is the John Day Formation. It also has a considerable distribution beyond the basin. Exposures are present to the west in the Deschutes River drainage and to the south in the Crooked River drainage. Unlike the Clarno Formation the John Day

Formation has very few rocks, such as basalts and rhyolites, with a direct origin as lavas from volcanic sources except in its lower portion. One prominent volcanic rock, a rhyolitic ignimbrite averaging 120 feet in thickness, occurs near the middle of the formation and divides the formation into upper and lower parts of about equal thickness. The John Day Formation is at least 3,000 feet thick. Much of it consists of massive tuffaceous claystones.

R. L. Hay (1963) and R. V. Fisher (Wilcox and Fisher 1966) have recently studied the John Day Formation to determine the source and conditions of origin of the sediments. Their work indicates that the massive claystones which contain the fossils originated from eruptive clouds of ash, probably from source volcanoes in the vicinity of the Cascade Mountains. That these came as thin layers of ash at infrequent intervals and were incorporated into the ground by the action of roots, burrowing organisms and sheet wash which resulted in the massive structure rather than a fine bedded one. The ash weathered to clay. In the lower part of the formation weathering was completed at the land surface thus producing the distinctive reddish coloration commonly seen. Hay (1963) estimates that the lower 835 feet accumulated at the rate of 0.1 feet per 1,000 years and the next 850 feet at about one foot per 1,000 years. Such a slow rate of accumulation discourages any suggestion that massive destruction of plants and animals resulted from the ash falls and demands a less spectacular explanation. Some of the lower beds are reworked tuff deposited in a lacustrine environment whereas reworked tuffs in the upper beds are stream deposited.

The abundant fossil plants of the lower part of the John Day

Formation indicate a late Oligocene age. Fossil mammals are rare in the lowest part of the formation but are abundant higher up. They indicate an early Miocene age. Absolute dates reported by Hay (1963) provide an age of 31 million years for the lowest John Day Formation and an age of 25 million years for beds about half way up in the section.

Within the area of this report the John Day Formation is exposed frequently. The most significant exposures are north of Mitchell along State Highway 207, east of Clarno, north of Fossil, north of Picture Gorge along highway 19 at a number of places, and southeast of Monument.

Columbia River Basalts

The most ubiquitous series of rocks in the John Day Basin are the Columbia River Basalts which commonly appear overlying the John Day Formation. These basalts occur over much of north central Oregon. Geologists separate them into a lower series 300-1500 feet thick and an upper series of an additional 1,000 feet. They apparently flowed through a series of fissures which are revealed as dikes by erosion. Davis Dike along Highway 19 is an example.

The amount of time represented by this 2,500 feet thick series of basalts is not known. However, in places soil horizons developed between flows so that a considerable length of time may be involved. Since their deposition these basalts have been folded and faulted and partially removed by erosion. Picture Gorge provides the best point of easy access to see folding of the Columbia River Basalts.

Mascall Formation

The Mascall Formation overlies the Columbia River Basalts.

It is found now in a much more limited distribution than it previously occupied since a large portion has been removed by erosion. It is also seen outside the John Day Basin appearing in the Crooked River drainage to the southwest. The greatest thickness exposed at present is 2,100 feet, however, Thayer and Brown (1966) have shown that it may originally have been 6,000-7,000 feet thick. It consists for the most part of light colored, water-laid, altered volcanic ash. Locally other types of rocks are present in the Mascall Formation. It is best seen along the John Day River between the town of John Day and Picture Gorge. Just south of the Mascall Ranch it is spectacularly exposed in badlands topography.

The fauna and flora occurring as fossils in the Mascall Formation indicate a late Miocene age. Absolute dates determined from rock samples at other points in Oregon producing a similar fauna indicate an age of about 15 million years.

Rattlesnake Formation

Youngest of the Tertiary rocks in the basin, the Rattlesnake Formation overlies the Mascall and has a very similar distribution. The thickest section of exposed Rattlesnake Formation measures over 700 feet, however, Thayer and Brown (1966) suggest a probable thickness of over 1,000 feet. It consists of gravels, cross-bedded sandstones, tuffaceous sandstones, and a prominent welded tuff. The welded tuff occurs near the middle of the formation and is a hard cliff forming unit weathering similarly to a basalt. In many places the sediments above the welded tuff have been removed and the welded tuff appears as a cap giving a mesa-like topography. The sediments are both lacustrine and fluvial in origin.

The fauna of the Rattlesnake Formation is of middle Pliocene age. An absolute date on the welded tuff by means of KA determination is 6.4 million years. The Rattlesnake Formation may be seen along Highway 26 between John Day and Picture Gorge. It is best seen just south of the gorge.

Terrace Deposits

Terraces occur along the John Day River in a number of places. They have yielded Pleistocene fossils but no absolute date has been determined.

GEOLOGIC HISTORY

Several aspects of the geologic history of this region have already been suggested in the foregoing discussion. The most important is that a very long record is represented in the upper John Day Basin. The later portion of this record, that of the Cenozoic, is quite complete considering the amount of time spanned. The other aspect is not so obvious. All of the formations described above have a much larger geographic distribution beyond the limits of the upper John Day Basin. It is obvious that the depositional basin involved is considerably larger than the present drainage of the John Day River which is the basis for our limitations of the upper John Day Basin. The geologic history described here then is that of a wider area than that of immediate interest for the purposes of this report. However, it should be pointed out here that this history is best observed in the upper John Day Basin where all of the elements are well represented.

The early accumulation of volcanic rocks of the Clarno Formation were weathered and presented a low relief surface for the deposition of the John Day Formation. This surface was soon filled level by the accumulation of the early part of the ash and basalts of the lower John Day. Later, after a considerable amount of ash had accumulated, erosion created a gentle rolling surface with a maximum relief of 1,000 feet. This surface was filled and covered by the tremendous flows of lava of the Columbia River Basalts from numerous eruptive centers. Although some faulting had preceeded this, the major faults occurred after the appearance of the basalts and apparently after the deposition of the Mascall Formation which originally was very thick

and covered much of the John Day Basin to a depth of almost a mile. A structural trough comprised of both faulting and folding distorted the existing rocks in the region particularly between Picture Gorge and John Day. At the same time erosion was removing the greater part of the Mascall Formation. In fact, by the time the Rattlesnake Formation was deposited, the Mascall Formation had been completely stripped from large areas and the underlying basalts were being eroded. Much of the region has been attacked by erosion continually since that time providing the present local high relief. The combination of folding, faulting and erosion provides the opportunity to see so much of the previous record.

DISCOVERY AND HISTORY OF INVESTIGATIONS

In 1861 Thomas Condon came to The Dalles, Oregon, on the Columbia River as a minister. Soon after he arrived he began to find fossil vertebrates and plants in the Eocene rocks of The Dalles Formation. His interest in such things became well known and residents of the area visited his home and "cabinet" to see what he had found and to bring specimens for identification and explanation. Condon developed earlier in his life an ability to lecture and often gave brief lectures on geology and paleontology to interested young people during the winter months when time lay heavy on their hands. These young people were soldiers, wranglers, local residents, etc. In this way Condon instilled an interest in the people of the region and an appreciation for the significance of fossils as means of understanding earth history.

The Dalles was a terminus for the military road to Canyon City in the John Day Basin. It is not surprising then, that in 1864 soldiers found and recognized fossils while traveling through the basin and brought them to Condon's attention. From 1864-1871 Condon spent all the time and effort he could afford in the John Day Basin collecting and observing. He was often accompanied by soldiers and L. S. Davis, a local businessman of The Dalles. Davis became the guide to nearly all the expeditions in the region until 1900.

By 1871 Condon had developed an outline of the geologic history of the area and published it in the Overland Monthly (Condon 1871). During the intervening time he had appealed to others for assistance in the identification of the fossil plants and animals he had collected. Leidy saw some of the mammals and Newberry the plants. As a result the significance of the basin and its history was well known both in the

United States and Europe. This drew Marsh to the area where Condon guided him through and some collecting was done. Marsh engaged the assistance of L. S. Davis and William Day who collected for him in the John Day Basin until 1877. Condon showed LeConte of the University of California through the region in 1873 and exchanged views with him on the interpretation of the evidence of its earth history.

The John Day Basin attracted a number of collectors from 1875-1900. In 1878-1879 J. Wortman, C. Sternberg and L. S. Davis collected for E. D. Cope in the basin. They used the Mascall ranch as their headquarters. The last of the Indian wars occurred during their stay and they were forced to take cover as the Bannock Indians swept through the country. In 1880 Captain Bendire of the U. S. Army, guided by L. S. Davis, collected fossil plants. In 1882 Davis and Day were again commissioned by Marsh to collect for him, this time representing the U. S. Geological Survey. Much of this collecting was directed towards learning the fauna of the John Day Formation with a lesser amount of effort in the Mascall Formation. Most of the resultant publications were concerned with the naming of new species or genera. Cope alone published thirty papers on the fauna of the region between 1878 and 1889. By 1900 over 100 papers had been published on the geology and paleontology of the John Day Basin and nearly every major museum in the world had collections from there.

In 1899 J. C. Merriam brought a small party to the John Day Basin beginning an association with the area which lasted through his tenure at the University of California, his presidency of the Carnegie Institution and his short period at the University of Oregon. Merriam

brought a type of interest reminiscent of that of Condon's but with greater resources. He clearly depicted the geologic relationships and the nature of the faunas early in his efforts and brought to bear the interests of his students, Eustace Furlong, Chester Stock and Ralph Chaney. Each subsequently played an important role in the understanding of the area. The expeditions of 1899, 1900, 1901 and 1916 were particularly significant. The 1916 expedition brought back collections from the Rattlesnake Formation which first revealed the nature of the Pliocene fauna of the basin. Publication of these results (Merriam, Stock, Moody 1925) left only the fauna of the Clarno unknown.

Stock continued his interest in the fossil faunas of the John Day Basin until the late 1920's when he moved to the California Institute of Technology and transferred his interests to the basins of Southern California.

Although the fossil mammalian fauna had become relatively well known by the 1920's much of the study of the former vegetation had been carried out using inadequate samples usually collected by someone other than the investigator himself and with errors in stratigraphic information. Chaney began his work at this time with his study of the Clarno flora of the Crooked River Basin quickly followed by his classic study of the flora of the lower John Day Formation from the Bridge Creek exposures. It soon became clear that this basin provided an ideal set of circumstances for sequential floristic studies and in the next forty years Chaney took advantage of these to produce a series of highly significant papers providing the basis for much of modern paleobotany.

In 1942 the first glimpse of the nature of the fauna of the

Clarno Formation came when Lon Hancock discovered a tooth in the "nutbed" along Pine Creek east of Clarno (Stirton 1944). Later a mineral collector found a fragment of what appeared to be badly weathered bone in a saddle about one mile from the nutbed. He passed this on to Hancock who pursued it and found that bone was weathering out at that point. After a summer's work Hancock had opened a pit and found it to be a productive site. He brought this to the attention of J. A. Shotwell at the Museum of Natural History of the University of Oregon. These two joined forces and developed a large quarry producing a highly diversified fauna. This fauna is still being studied. Thus the earliest chapter in the history of mammals in the John Day Basin was uncovered one hundred years after the original discovery of the fossil field.

Reviews of the John Day and Mascall faunas were carried out in theses by M. Green and T. Downs (1956) in the last fifteen years. These works brought together the previous scattered information and revealed two important difficulties in our previous knowledge. One was the scattering of specimens of these two faunas over a large number of institutions making comparative studies very difficult. A more formidable problem lay in the inadequacy of early stratigraphic and locality data accompanying the collections. This made it impossible to determine if faunal changes had occurred in the eight to ten million years represented in the John Day Formation alone.

R. V. Fisher and R. L. Hay began studies in the John Day Formation aimed at understanding the origin of the sediments and recognizing useful stratigraphic markers. Previous workers had relied on the colors to indicate vertical position within the formation but these eventually proved to be unreliable. Fisher enlisted the aid of

J. Rensberger, also of the University of California, to recollect mammals in concert with his stratigraphic studies. The final results of this work are not yet published.

Over one hundred years since its discovery, the John Day Basin is still making substantial contributions to earth history.

HISTORY OF LIFE IN THE JOHN DAY BASIN

Although the most complete record of life in the John Day Basin is to be seen in the Tertiary rocks this is not the beginning of the record there. Pre-Tertiary rocks of more than one hundred million years in age are also present. The record they hold is spotty but documents the presence of the sea in the region at that early date. Near Mitchell, fossil shells of ammonites are seen. These distant relatives of the Nautilus are small but indicate some depth to the water at that point. In other areas near shore shells are found and swimming reptiles. Among these are the bones of gliding reptiles suggesting that land was not far away.

Tertiary Floras and Faunas of the John Day Basin

The Clarno flora and fauna are the oldest record of Tertiary life in the John Day Basin. For many years only the fossil plants of the Clarno Formation were known. They were well preserved. Even the fossil fruits of many of them were collected in large numbers. With no botanical training any observer could easily recognize that the fossil leaves represented quite a different flora than can be seen any place in Oregon today. Most of the leaves are large, apparently thick and with smooth borders. The laurel family is well represented in this fossil flora. Another common type of plant are the palms. Together they give a tropical aspect to the flora and in fact, paleobotanists have determined the flora to be sub-tropical in character. It was not surprising when the fauna was finally uncovered to see crocodiles as an important part of it. A large amphibious rhinoceros was also present as well as the great rhinoceros-like brontotheres and

much smaller tapirs. A tiny horse, a small running rhinoceros completes the list of highly diversified perissodactyl mammals known. Peccaries and oreodonts, the pig-like artiodactyls, are also present and are seen in many of the succeeding faunas.

The relief of the John Day Basin was very much less in Clarno time than it is now, probably only a few hundred feet in the form of low rolling hills. The plants required a high rainfall and could not have withstood freezing temperatures. A striking contrast with the basin today.

Within five million years the character of the vegetation and fauna had changed remarkably. This new flora and fauna is recorded in the John Day Formation. It persisted with only slight changes for at least seven million years and probably somewhat longer. The flora and fauna of the John Day Formation are the best known. By John Day time the flora looks more familiar to most Americans because of its temperate character although some of the plants represented have relatives living only in Asia. Oaks, elm, sycamore, chestnut, basswood, birch, hornbeam and maple are present and similar to those of the southeastern United States today. Metasequoia, the dawn redwood, and Katsura of Asia, are however, also important parts of the flora. But without knowing the identity of the individual plant species it is obvious that there is a great difference between the flora of the John Day Formation and that of the Clarno and that conditions must have changed in the intervening time. The leaves are smaller and thinner and their margins are not smooth. Palms are no longer present. Judging from the conditions of regions where floras of similar composition live today the John Day climate must have been a little dryer and somewhat cooler than that

of the Clarno.

One hundred and twenty species of fossil mammals are known from the John Day Formation. They range from small relatives of the opossum through saber-tooth cats, rhinoceros, oreodonts, horses, peccaries and giant hogs to beavers, dogs, rabbits, pocket mice and many others. In addition tortoises, lizards, snakes and land snails are commonly present in collections. This fauna differs almost as greatly from that of the Clarno as does the flora. However, a number of these fossil mammals have their ancestry in those of the earlier Clarno fauna or are at least closely related. The horses are much larger but still browsers, the oreodonts are much more highly diversified and the carnivores more modern in their appearance. The great brontotheres of the Clarno as well as the amphibious rhinoceroses left no descendants and never appear again.

The woodlands and forests of early John Day time occupied a fairly level plain but in later John Day time a rolling topography developed with a relief of nearly 1,000 feet with steep walled valleys dissecting the region. The climate was cooler than in Clarno time with some freezing weather and a moderate rainfall distributed throughout the year.

Another glimpse of the John Day Basin flora and fauna, about eight million years later, reveals other changes. This record is present in the Mascall Formation. Common plants are swamp cypress, black oak, hickory, sycamore, a small leafed maple, ginkgo, box elder, elm and over sixty other less common species of plants. They represent several kinds of local habitats, reflecting hillsides, ponds, stream borders and plains. In this varied habitat appeared the first grazing

horses of the John Day Basin. Three-toed, they probably occupied the Savanna, new to the region. With them occurred the elk-like Dromomeryx with its horns rather than antlers. Creodonts and peccaries persisted and many of the modern rodents of today first became recognizable in this fauna. It has a distinctly modern aspect and would not appear out of place today if it were not for its rhinoceroses and camels unless the observer were quite close to the animals. The first bears and mastodons of the John Day Basin appear in the Mascall fauna. Much of the fauna was derived from the earlier fauna of the John Day Formation, however, some elements arrived from Asia at this time and provided a different ancestry. Differences between the previous fauna and that of the Mascall thus represented changes in these animals which were previous residents and the appearance of completely new types.

The fauna and flora of the Battlemake Formation provides our last view of Tertiary life in the John Day Basin some seven million years ago. Changes were still the rule. Drier climate had reduced the vegetation to trees and shrubs along the stream courses and at some higher elevations, grassland had become extensive. The large single toed horse Elichippus had invaded the area from the south, rhinoceros, camels, peccaries and mastodents were common large mammals. The creodonts so abundant in earlier faunas were no longer present. The antelope, Sphenorhales, had invaded the basin with Elichippus. The elk-like Dromomeryx was gone. Small cloths from South America added to the number of species which were not derived from the previous residents and represent migrations into the John Day Basin from Asia, South America and the Central Great Basin of the Western United States.

The constantly changing flora and fauna of this region

over this long period of time is kaleidoscope in character. The changes are often spectacular but have order and sometimes seem to reoccur but with different types of animals and plants, climate, topography, geography, migration, extinction and evolution all playing their part.

SIGNIFICANCE OF THE REGION

The primary significance of the John Day Basin is in the record of Earth History, displayed in its rocks and fossils covering a considerable portion of time. Fortunately its early discovery was by a man who appreciated this and described this aspect of the region as follows: "---any record of the past as authoritative as that of a good geological field, covering an extensive range, and filled with minute details of events, can hardly fail to be instructive" (Condon 1871). J. C. Merriam also recognized the instructive value of the region and described it as follows: "Although there are other geological sections, particularly in western United States, which furnish as remarkable a history as that which has been barely outlined, in his previous statements there are probably none in which the relations of the various chapters to each other are more evident than they are in the record inscribed on the walls of the John Day Canon. The deciphering of the geologic story of most regions is accomplished through the enthusiastic labors, over wide areas, of men taught to see things which escape the notice of untrained observers. The John Day section tells its story so plainly that to one who sees the record a comprehension of its meaning is unavoidable." (Merriam 1901A)

Still another paleontologist, R. W. Chaney, who developed the knowledge of the floral history of the John Day Basin described it as follows: "No state is more richly endowed with the records of earth history. No region in the world shows a more complete sequence of Tertiary land populations, both plant and animal, than the John Day Basin" (Chaney 1948). These three men not only knew the basin best in

their time of investigation there but recognized its importance to the public as an educational tool, for the quotations listed are not from scientific journals of a technical nature but general publications for the public benefit. Condon's remarks are from the "Overland Monthly", Merriam's from "Harper's Monthly Magazine" and Chaney's from "Condon Lectures", a series of public lectures.

There is no questions of the national or even international significance of the John Day Basin. It has been clear for one hundred years. Neither is there any question of the clarity of the story to be seen by the visitor, this is its chief value.

Other areas now part of the National Park Service; Dinosaur, Agate Springs, Badlands and Florissant, all deal with single chapters or some unique aspect of single chapters in the history of life. The John Day Basin offers an entire book!

INTERPRETATION

History of Previous Efforts

J. C. Merriam was not only a student of the study of natural phenomena but was also very concerned about the emotional, religious, philosophical, conservation, and educational values of nature. His "Garment of God" (Nature in Human Experience) was his expression of this. In acts, this interest was strongly applied in the development of Grand Canyon and Crater Lake National Parks. During his tenure as president of the Carnegie Institution he organized a group known as the John Day Associates. This group consisted of scientists from nearly all fields of Natural History concerned about the conservation "of the John Day fossil beds and in developing public interest in the geological story so clearly told by the rocks and fossils of the region." (Stock 1947) They implemented their goals by acting as advisors to Sam Bordman, then director of the Oregon State Parks. He acquired tracks of land for the state in order that some of the more valuable areas might be retained in public ownership. These tracts were those which had the highest potential for interpreting the region to the public.

In 1954 Dr. J. A. Shetwell of the Museum of Natural History of the University of Oregon and the State Parks Department cooperated in the creation of a plan for the development of restorations, displays and observation areas for the interpretation of the area to the public. The site at Sheep Dock was chosen because of the ready access to Highways 19 and 26 and because of the extent of the record visible there. This proposal was not funded by the Highway Commission which administers

the State Parks Department. Since that time, the emphasis of the State Parks has been directed towards recreation. One of the results has been to allow pilfering of the areas originally acquired for conservation. This is encouraged by the publication of widely circulated brochures by the Travel Information Division of the Oregon State Highway Department inviting tourists to come and dig and includes a map showing "where to find them."

Suggestions for Interpretation

The John Day Basin presents a great number of possible sites useful in an interpretative development of the region for the public. These may be categorized depending on their nature. Some will be most useful for the illustration of particular aspects of the fauna or flora or geology; such as Turtle Cove, Donnelly Basin, Monument, or Haystack Valley. Some are most valuable as major points of interpretation of large sections of the record to be seen; such as the Sheep Rock Site and the Mascall Overlook. Others have particular scenic value; such as Cathedral Rock and the Painted Hills.

The wide geographic separation of the various points of interest in the John Day Basin rules out the establishment of a single contiguous development. However, several locations might be developed to illustrate particular aspects of the history displayed and a single or pair of localities developed as a major interpretative point and visitors center or centers.

A combination of the Sheep Rock and Mascall Overlook sites as major sites for interpretation of the geologic relations of the beds of the John Day Basin is highly desirable. These sites are only a

short distance apart and parts of the section visible from both locations could be used to provide continuity to the viewer. The combination provides both an instructive and a spectacular display of the salient features of the region. The Sheep Rock site allows a good view of the John Day Formation and overlying Columbia River Basalts. Less than a mile to the north along the river is an exposure of the very early pre-Tertiary rocks. The spectacular nature of this site and its direct access by both Highway 26 and 19 make it a highly desirable major visitors center. This center could include outside restorations, a small museum with displays and an observation area supported by interpretative works.

The Mascall Overlook compliments the Sheep Rock site by providing an excellent view of the younger beds atop the spectacular Columbia River Basalts exposed in the background at Picture Gorge which separates the two locations. The Rattlesnake and Mascall Formations are best exposed at this site. One of the high Rattlesnake Formation exposures is also visible from the Sheep Rock site as are the Columbia River Basalts. These two sites then, form an ideal natural setting for interpretation of complimentary aspects of the region.

Exposure of specimens and their development as "in place" displays is feasible but would require some protection from weather. Turtle Cove and the so called Foree area are ideal for exhibits of this type. The Sheep Rock and Mascall Overlook sites would not be as useful for this type of interpretation because of the separation of the visitor from the actual fossil beds; at Sheep Rock by the river and at Mascall Overlook by the nature of the topography.

The sites suggested here are in part property of the State Parks. They provide an ideal situation because of their proximity to each other and this is one of the reasons they were acquired.

Two additional features are not included to this point: The Clarno Formation and the Painted Hills. Development of a Clarno interpretative site might be done near Mitchell where the Clarno Formation is exposed. This would have the advantage of its proximity to the Painted Hills and Highway 26. However, the major fossil vertebrate sites are to the north along a paved road between Fossil and Clarno. A development in the northern part of the basin would have the advantage of allowing the visitor to see the many exposures of John Day Formation north of the primary interpretative sites and take him through the high elevation forests between Service Creek and Fossil where good camping facilities are available out of the summer heat. In addition access to Highway 97 is available on west from Clarno as well as Interstate 80 on north from Fossil so that a visitor could reduce the amount of back tracking necessary. The short cut from Service Creek to Mitchell passes by the Donnelly Basin and through the very early pre-Tertiary beds providing another possibility of routing and access to the Painted Hills. Likewise a side trip through Monument reveals many more and varicolored exposures of the John Day Formation and puts the visitor in easy reach of Highway 395 at Long Creek. The proposed development of a road from the Dayville area into the Crooked River drainage provides even more possibilities, particularly when considering the ease of reaching Highway 20 from there.

Obviously there are many combinations of routes and sites possible. And each has its advantages. In choosing sites it should be kept in mind that a visitor may be enticed to see more of the area and thus appreciate more of what is to be seen if he can do this without undue back tracking and leave the area at a point convenient to his travel goals. This is particularly important in the John Day Basin because of the Great size of the area and the long distances between sites in some instances. Thoughtful design of the development of the region can make the visitor more at ease and increase his enjoyment of the magnificent story to be seen there.

Nature has provided in the John Day Basin a unique opportunity to see Earth History under the most desirable conditions. The obvious events pointed out by interpretative aids such as restorations, displays of specimens both in place and otherwise arranged, and instructive signs will open a whole new world to many who never dreamed such things could be seen so clearly. It will not only increase their appreciation of the John Day Basin but will kindle interest in many other areas in which they may travel.

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