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THE ROCKS OF THE JOHN DAY VALLEY.

IN the controversies of the day on the Origin of Species, 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. The basin of the Columbia River with its tributaries offers such a history to the world, at once continuous and authoritative, reaching, in its field of operations, from the Rocky Mountains to the Pacific Ocean; and, in the time it covers, from the Cretaceous period to the Recent. It covers even the laying of the foundations of the country, and defines the narrow strips of land that first emerged from the ocean to become the frame-work of the great mountain-chains. As the elevation and extent of the land increased, the ocean water that first occupied the depressions between was displaced, and fresh water took its place, brought there by the now greatly increased flow from the land. Henceforth history written by the ocean ceased; history written by lakes and rivers commenced, in the storing away

of specimens of tree, and beast, and bird, and their effectual preservation as material facts in an unerring record. The sea, thus excluded, never returned to the region east of the Cascade Mountains. A vast lake-system took its place, and began at once to make, as well as to write, its own history.

There are many residents of the Pacific Slope who will remember having journeyed from The Dalles, on the Columbia River, to Cañon City, among the Blue Mountains. For sixty miles or more the road passes over volcanic materials, which have drifted there from the Cascade Range. Twenty miles farther, and this outflow thins out into a mere capping of basalt on the hill-tops. The hills themselves, and the foundations on which they stand, are here found to be sedimentary rock, wonderfully filled with the abundant records of former animal and vegetable life. Oldest of all in sight is the old ocean-bed of the Cretaceous period, with its teeming thousands of marine shells, as perfect to-day in their rocky bed as those of our recent

sea-shores; their cavities often filled with calcareous spar or chalcedony, as if to compensate for the loss of their own proper marine hues. Next in ascending order come the fresh-water deposits of the earlier Tertiaries, so full of the leaf-prints of the grand old forests that, during that age of semi-tropical climate, covered those lake-shores. The marine rocks form the outer rim, or shore-line, of what was in those early times a lake, of irregular outline, extending from Kern Creek Hill on the west to Cañon City on the east, and from the hills north of the John Day River to the Crooked River Valley on the south. Within this lake-depression, whose former muddy sediment is now elevated into chalky hills, so despised for their alkaline waters and unproductive soils, the geologist feels at home. How strangely out of place a score of palm-trees, a hundred yew-trees, or even a bank of ferns, would seem here now! And yet here these once lived, and died, and were buried; and beautiful beyond description are their fossil remains even now, as they are unburied.

Seen from the summit of Kern Creek Hill—its western border—this vast amphitheatre of lesser hills presents a wild, wonderful grouping of varied outlines and colors. A spur of the Blue Mountains—its nearest point, forty miles away—covered with a dense forest, forms the dark background of the view. The varying shades of brown that characterize the older marine rocks rise in vast border masses, almost treeless and shrubless, in an inner, irregular circle, while the lighter shades that fill the deeper depressions of the central portion mark the later sedimentary deposits; and then, like vast ink-blots on a painting, one sees, here and there, a protruding mass of dark-colored trap. Through the heart of this wild region winds the John Day River, running westward until it passes the middle ground of the picture, and

then turning northward to join the Columbia.

This stream, so insignificant in appearance, has done wonderful work among these hills. The river itself was, in the olden time, merely a series of connecting-links between a chain of lakes that extended from the Blue Mountains to the Cascades of the Columbia. It has for unnumbered ages gone on excavating vast gorges and *cañons*, as all other streams in central Oregon have done, till lake after lake was drained off, and their beds laid dry, stripped of enduring moisture, and slowly changed to a treeless desert. The deep excavations that resulted could hardly fail to lay bare important records of the past, cutting as they do through the whole extent of the Tertiary periods. In a deep *cañon*, through which runs a branch of Kern Creek, may be found the remains of the fan-palm, with abundant remains of a beautiful fern—gems of their kind—which no thoughtful mind can see without wonder and admiration. In another ravine are seen in great numbers the remains of a yew, or yew-like tree, that sheds annually, not its leaflets, but its branchlets; for in this form they are found imbedded in the rocks, of almost uniform length and structure. This tree was evidently abundant upon those ancient shores, for it can be found at almost every spot where a little stream washed its miniature delta into the lake. Oaks, too, and occasionally a fine impression of an acorn, or acorn-cup, are found at intervals from this place to the Blue Mountains.

But the great geological importance of that old lake-depression does not arise from the fossil remains of its forests—beautiful, varied, and abundant as these are—but from its finely preserved fossil bones. Two species of rhinoceros lived their quiet, indolent lives among the reeds that lined that old lake-shore. A little beyond the southern spur of that

distant mountain there evidently emptied a stream of some size, for its delta is strewn with fragments of silicified bones. Among these the bones of the rhinoceros are frequent; but the remains of an extinct animal, allied in some things to the camel, in others to the tapir family, are most abundant. Paleontologists have designated the *genus* by the name of *Oreodon*. The remains of three or four species of this animal are found in central Oregon. One of these, new to science, was discovered thirty miles from here, and was named by Doctor Leidy *Oreodon Superbus*, from its superior size. The shaly rocks in which these remains are found are very brittle; and the inclosed fossils partake of that brittleness to such an extent, that, if not handled with the utmost care, they crumble into small fragments. Two nearly entire heads were discovered, last spring, in a ravine that opens into Bridge Creek Valley. They had been exposed all winter to rain and frost, and were very brittle—almost ready to drop to pieces. They were passed by until the following day, when a careful treatment to several coats of good flour-paste was rendered the more efficient by additional pasting on of common paper. This was kept on for awhile, when it was carefully washed off, and a more permanent preparation applied. These specimens now make a very passable appearance. Mute historians are they of the far-distant past, uniting with hundreds of others to tell strange stories of the wonderful wealth of forest, field, and lake-shore of that period. A tapir-like animal, to which the name of *Lophiodon* has been given, lived here, too. His remains indicate an animal of the size of the living tapir. Not far from these last were found some bones of a fossil peccary, of large size. Another of the denizens of these ancient lake-shores bore some resemblance to the horse. The remains of this animal, the *Anchitherium*, were first discovered

in the Tertiary rocks of France, a few years ago; more recently, they were found in the "Bad Lands" of Nebraska, and within the past year, here, in the John Day Valley. But the richest chapters in the history of the Horse, in Oregon, are not from these rocks of the lower valley; for another, and a later, record in the upper part of the valley contains these.

Doubtless both portions of the valley were once continuous and formed one lake, but a stream of lava from the Blue Mountains seems to have run into it near the present site of Camp Watson, dividing it into an upper and a lower lake. The lower one seems to have drained off first, the upper one remaining a lake into the later Tertiary period, and receiving into its archives the remains of the animal types of a later age. The river was apparently turned northward by that outpouring of volcanic materials; and cutting for itself a new channel in the deep *cañon*, thirty miles or more away, formed a great bend, and excavated an immense basin, in these nearer and lighter-colored Tertiary rocks. Above that bend, that *cañon*, and that volcanic outflow, the valley opens again; and there, extending from Cottonwood Creek to Cañon City, are the remains of the upper lake-depression of the John Day Valley. This later lake-depression received into its sediment a larger amount of volcanic ashes and cinders than the lower one did. Several of its strata are pure volcanic ashes, rough to the touch as ground pumice-stone, which must have fallen on that lake in vast quantities. The purest was evidently that which had fallen directly into the lake; the less pure, that which, first falling on surrounding hills, had subsequently drifted from them by the action of the winds and waters, and became part of the lake-sediment.

Upon the hills that overlooked these lake-shores, there lived three or four

different species of the horse family. Their remains are easily distinguished; for the teeth are well preserved, and the teeth of the horse are well marked. Almost as well marked as these equine remains, were some teeth that apparently represented a member of the camel family—found there, too, in a fine specimen of a lower jaw, silicified completely, and in solid rock. Fossil remains of other species, too, giving a wide range of life-record, were found, all of which are now in competent hands, for determination and description.

But the most remarkable thing about this upper lake record is that which reveals the way in which its history of this period was brought to a close. The last rock of the series fills the place of a cover to the volume. Never was cover better defined, nor more distinctly separated from the well-written and well-illustrated pages it serves to protect. The cover itself, too, has a history worth reading. It extends for miles, varying but slightly in thickness, which amounts to twenty or twenty-five feet, and is throughout so entirely volcanic as to leave no room for mistake. Its materials are volcanic ashes and cinders; the cinders ranging from an inch across downward to the minuteness of the ashes. One can hardly look at a piece of this rock, without recalling the younger Pliny's vivid description of that shower of cinders from Mount Vesuvius, from which he saw people escaping with pillows tied on their heads, for protection. Such showers fell here, certainly, over hundreds of square miles, and in such vast bulk, that, pressed by the hydraulic force of later masses above it into a solid plate of rock, it now in this form measures from twenty to twenty-five feet through. No wonder it closed one of the finest life-records of that remote period, and with the record that volume—becoming at once the proximate cause of the change, and the upper cover of the volume it closed.

But this violent destruction of the life of the period did not destroy that lake-depression: it only partially filled its shallower portions, and added thirty feet or more of sediment to the rest. The lake remained, and still continued to receive, into its archives of hidden sediment, tokens of the forces at work among the hills around it. One remarkable change marked that transition: the laboratories of the hills seem thereafter to have lost the power to send forth from their secret recesses heated vapors laden with mineral materials, as they had done, capable of changing every thing they touched to stone. The old sediments of that lake, if originally clay, are found changed to argillaceous rock; if sand, changed to sandstone; if washed gravel, they are found cemented into conglomerate. The new sediments, if clay, remained clay; if sand, remained sand; if gravel, remained so, unaltered even now.

Long after that heaviest deluge of ashes had settled down into permanent rock, a new chapter was opened in the life-record of these lake-shores. The stratified materials that received these later records were washed from either shore into remarkably uniform slopes toward the middle line of the lake-depression. These slopes were evidently once continuous along both sides of the valley; but since the lake was drained off by the deeper wearing of its outlet, every little stream from the surrounding hills has cut its own ravine through these stratified sands, gravels, and clays, until what was once continuous, is now cut up into a remarkably uniform series of ridges, whose summit outlines stand in fine perspective, as far as the eye can reach. In the ravines that separate these ridges, the gold of this region is found; and in the diggings that result, the bones, teeth, and tusks of the elephant are often uncovered—a few of which have been preserved. In the loose materials that form these ridges, the closing annals of that remarkable

lake-period of central Oregon may be read as in a book. The last facts noted there are the records of the mammoth, the horse, the ox, and their contemporaries.

We have thus attempted to give four or five glimpses into the grand old panoramic life-record of the past in central Oregon—successive day-and-night glimpses of the past, along the shores of a series of lakes that once occupied the valley, now depressed, through which meanders the John Day River.

The first one of these views is characteristic of the old marine life of the original sea-bed. It is made up of a number of patches of sea-beach, strewn with shells; a tooth or two, of some extinct reptile; a vertebra of another—and the marine record closes. The shoals on which these marine remains lived became elevated into the frame-work of the future Oregon; while in the depressions between them, her earliest historic records at once began. Oregon's Eocene, Oregon's dawn! strange, beautiful coincidence of fact with system!

The next glimpse we get is of the Middle Tertiary period. It is distinct enough to enable us to recognize upon those lake-shores the rhinoceros, the oreodon, the tapir; and then closes abruptly, to give place to a record of fire and of violence—the fire of the volcano, and the violence of the earthquake—bringing upon the life of the period a blotted, illegible night-record in its history.

But another dawn came then; and we see, among the forms that move along those shores, the familiar ones of the horse and the camel. Again the legible record closes, and thirty feet or more of ashes and volcanic cinders cover the land, and choke and poison the waters.

A long, dark, nearly illegible part of the record follows, during which no life-history was written; but during which the old throes of violence seem to have passed away, and the laboratories of the

earth seem to have lost the power of forcing heated vapors to the surface, capable of changing all to stone that they touched.

The mammoth, the horse, and the ox appear in the light of the dawn that follows this long geological night; and not fire, as before, but frost, seems to have closed the record marked by their fossil remains.

This alternating of light of life, and darkness of death, as read in the rocks of that region, leaves us long periods of its chronology unwritten save by fire and flood. What are these blanks in that life-record? Have the materials upon which they were originally written been partially or wholly destroyed, or washed away? No; for, in a neighboring mountain, 1,500 feet in vertical section still remain, protected by a heavy capping of basalt. The pages are there, but they are defaced by fire and ashes. But were there not, or at least might there not have been, vast periods during which no record was made?

This supposition, too, is inadmissible. A lake existed here through the whole Tertiary period; and a continued lake-depression, surrounded by elevated ridges of hills, rising in many places into mountain magnitude, implies the deposit of continued sediment, and this necessarily becomes the page upon which the history of the life along its shores is written. The winds would always blow into the waters of the lake their burden of leaves, and the floods of winter wash there some fragments of the bones of the animals that characterized the period. It must have happened, then, that at the close of each great period, as indicated here, the animal life of these ancient lake-shores was entirely destroyed, by fire, flood, and the poisonous vapors that tainted earth, air, and waters, or else those to whom migration was possible, escaped to some other region. The supposition of their entire destruction

encounters this difficulty: the destruction of the entire fauna of Oregon, and even of the whole western slope of the continent, would not have secured the results observed, unless we suppose a like destruction extending to the Atlantic coast; for the same animals lived there, when they lived here. Their remains are found, even to identity of species, from Nebraska to New Mexico. It is difficult to assign their destruction there, to the same causes that destroyed them here; or to any cause operating at once, over a whole continent, while the climate remained unchanged, and food continued abundant. On the other hand, the supposition of the escape of a portion from these destroying agencies meets, among others, this difficulty: when here, in this John Day Valley, quiet had been again restored, the hills had been again clothed in verdure, and the waters had precipitated not only, but covered out of sight, their vast strata of volcanic ashes, then animal life returned too, but not the same that had previously existed. The whole fauna was changed; and even where the same type was restored, as in the case of the horse, it is in some new species: the old has passed away, and forever.

If any one supposes that all the difficulties that beset these lines of inquiry and research rest only in the path of the theologian who claims a separate creation for each great type of animal life, he greatly misapprehends the present state of these investigations. But it was no part of the plan of this article to advocate any existing theory, or to start a

new one, in this difficult field of inquiry, so full to-day of conflicting views; but rather, to call attention to the importance of the Columbia basin as a field filled, to an extraordinary degree, with the very facts needed to throw light on the question of the Origin of Species.

Three great ranges of mountains, and several minor ones, were elevated across its water-shed, making so many immense dams, holding back the waters in extensive lake-depressions, among which the river itself was, for ages, but a series of connecting-links. It is now almost certain that these vast lake-depressions continued, from their first formation, to be such, until the bones of the modern horse, ox, and elephant were received into their sedimentary deposits; thus including records covering nearly the whole period of ancient mammalian life upon the earth. Add to these facts, that all the rocks through which the streams of this region, during this long geological period, have been wearing their way, were those of the later and softer materials, and therefore the more rapidly worn down, not only in the *cañons* of the larger streams, but the ravines of the smaller ones, and upon every hillside, and we have a combination of favoring conditions, such as must make its geology accessible, very full, and important.

Indeed, one can hardly look over its historic archives of the Tertiary period, without a conviction that this Columbia basin is destined yet to be the great battle-ground of conflicting theories, upon the question of the Origin of Species.