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GENERAL REPORT ON A BOTANICAL SURVEY OF THE CŒUR D'ALENE MOUNTAINS IN IDAHO DURING THE SUMMER OF 1895.

By JOHN B. LEIBERG.

ITINERARY.

In compliance with instructions from the Botanist of the Department of Agriculture, dated June 3, 1895, to make a botanical survey of the Cœur d'Alene Mountains in northern Idaho with special reference to the economic features of the flora, I left Hope, Idaho, on June 11.

The field work was begun in the middle portion of the St. Mary basin, thence carried to the upper part of this stream, and extended along the divide between the St. Mary, St. Joseph, and the North Fork of the Clearwater, taking in as much of the densely timbered portion of the West and East forks of the St. Joseph as time permitted.

After finishing here, the work was gradually extended northward, and terminated with the exploration of the extreme western portion of the North Fork of the Cœur d'Alene River basin, in the middle of October.

The time actually spent in the field was divided between the various sections as follows: June 15 to July 6 was devoted to the central portion of the St. Mary basin and about the head waters of this stream. July 6 to July 14 was given to the summit of the high ridges which separate the St. Joseph's tributaries from the North Fork of the Clearwater and to the divides between the upper portions of the forks of the St. Joseph. From the 14th to the 17th of this month the work was in the lower part of the St. Joseph valley. From the 17th of July to the 7th of August I was engaged in the valley of the South Fork of the Cœur d'Alene River, with frequent side trips to the summits of the divides which separate this stream from the St. Joseph and into the valleys of the more eastern tributaries of the latter, which could not well be reached from the upper St. Mary. From August 7 to August 13, I was employed in examining the eastern rim of the basin of the North Fork of the Cœur d'Alene River. The time from August 17 to September 1 was spent in the valley of the Clark Fork of the Columbia, from the first easterly crossing of this stream of the Northern Pacific

Railroad to Cabinet Rapids, examining the northern rim of the mountains which inclose the North Fork of the Cœur d'Alene River. September 4 to September 19 was employed partly along the western rim of the North Fork basin and partly in making a second ascent of Wiessner Peak to obtain some meteorological data during the early snowstorms of the season. September 25 to October 9 was employed in a trip into the more western portion of the North Fork basin to obtain more data concerning the forest conditions of this particular region. With this the field work of the season ended.

TOPOGRAPHY.

The extent of country to which the name Cœur d'Alene should be applied has heretofore been rather indefinite. The common view limits it to the region drained by the South Fork and a small portion of the North Fork of the Cœur d'Alene River. By reason of the great mining industries which are carried on here these areas are by far the most important and most widely known of all in the Cœur d'Alene Mountains, and therefore are usually meant when the Cœur d'Alenes are spoken of. A broader view is here adopted, and one more in harmony with the geographical position of the region and its geological relations to the surrounding mountains, as well as with its peculiar and intricate topography, which latter feature very decidedly stamps the areas we shall here include under the general name Cœur d'Alenes as parts of one mountain system.

The Cœur d'Alenes, therefore, are here understood to include all the mountains or ridges, exclusive of the main Bitter Root Range, which form the drainage system of the streams flowing into Lake Cœur d'Alene. The geographical position of the region is between $115^{\circ} 20'$ and $116^{\circ} 40'$ west longitude, and between $46^{\circ} 40'$ and $48^{\circ} 40'$ north latitude, approximately.

Politically it is included within the boundaries of Kootenai and Shoshone counties, in Idaho, and its area may be roughly estimated at 9,000 square miles.

The Cœur d'Alene Mountains form in general a rugged and difficult region. The system is not what is generally understood as a range, though many of the maps, especially the older ones, so delineate it. There is no general "backbone" traversing the area and sending out laterals each way. All the larger ridges and principal divides join with the Bitter Root Range eventually, and but for the peculiar manner in which they extend and inclose the drainage basins of the river systems might be regarded as simply an immense western foothill region of the Bitter Root Mountains. The entire extent of country here called the Cœur d'Alenes forms a large, almost completely inclosed, triangular area. The apex of this triangle may be considered as abutting on the Clark Fork River at Cabinet. From this point the eastern side of the triangle, which has a length of about 190 kilometers (111 miles), is formed by the main range of the Bitter Roots.

The southern base of the triangle is formed by a high, nearly due east and west ridge, which divides the waters of the North Fork of the Clearwater from the Cœur d'Alene drainage system. This is about 160 kilometers (99 miles) in length. The western termination of this ridge is a heavily forested, quite conspicuous mountain, to which the name "Mount Carey" is sometimes applied. It forms the central knob of an extensive group of radiating ridges, among which lie the headwaters of the Potlatch and those of one of the principal tributaries of the Palouse. Its elevation is about 1,520 meters (5,000 feet).

The western side of the triangle, commencing at this mountain, extends northward a distance of 105 kilometers (65 miles), where a gap or break occurs. In this gap is situated a part of Lake Cœur d'Alene, a great natural reservoir, into which flows all the water discharged by the streams of the interior drainage basins of the Cœur d'Alenes. Commencing directly to the north of this lake, the western mountain rim resumes its extension northward, passing a few kilometers to the east of Lake Pend Oreille and joining the Bitter Roots at Cabinet, to form the apex of the Cœur d'Alene triangle, a distance of about 95 kilometers (59 miles).

The mountain rims which form the sides and base of this triangle are not to be regarded as straight and regular lines. On the contrary, they are extremely serpentine in their course, swinging often from east to west and from north to south, and vice versa, many kilometers from a straight line.

This twisting and turning of the divides with the numerous deep saddles and corresponding rises render the heavily timbered portion of the crest line of these ridges very difficult to follow.

From every rise or peak an extensive system of laterals is sure to radiate, and in every saddle a stream heads on each side of the ridge, so that unless the traveler knows the way, or is exceedingly careful, he is constantly in danger of being led off on these lateral ridges or into the side ravines from the main divide which he may be endeavoring to follow.

The region inclosed by the three mountain rims just described, is exceedingly rough and broken. It is a mass of long, steep, tortuous ridges, inclosing a multitude of deep, narrow canyons. The elevation of the ridges varies from 1,350 to 2,160 meters (4,400 to 7,000 feet), the average being about 1,500 meters (5,000 feet).

It is a remarkable fact that the highest elevations in the Cœur d'Alenes are not found in the main range of the Bitter Roots, but lie about 65 kilometers (40 miles) to the west in the divide which separates the waters of the Cœur d'Alene River from those of the St. Joseph. Here the ridge rises in a few localities to a height of 2,175 meters (about 7,100 feet).

There is also situated on the western mountain rim of the triangle, about 32 kilometers (20 miles) south from Cabinet, a mountain locally known as Pack Saddle. This has an elevation of about 2,400 meters

(7,900 feet), and is therefore probably the highest point in the Cœur d'Alene region.

The definite details of the configuration of the mountain system of the Cœur d'Alenes are almost impossible to describe in terms that will present a true picture to one personally unacquainted with the region. There are, however, certain features which appear in all portions of the system and which give to the whole a determinate character. We have first the very long, tortuous ridges extending from all sides of the inclosing mountain rims into the interior of the Cœur d'Alene basins. The sinuosities of these ridges are a repetition of those of the primary inclosing divides, but on a smaller scale. We have next the wavy crest line of the ridges, caused by a continual succession of saddles and the opposite rises. A level crest line for a greater distance than one kilometer is a rarity. We have next the system of lateral spurs radiating from the rises and peaks of the ridges, and the ravines which invariably head on opposite sides of the saddles. The features of wavy crest lines and lateral ravines and spurs heading in the saddles and rises are repeated over and over again to the very smallest spur of the system. It is this continual division and subdivision of the long laterals, sent out from the primaries, that give the Cœur d'Alenes the peculiar broken character which is such a distinguishing feature of their system.

The laterals, where they abut upon the larger valleys, terminate mostly in two ways—first, as a slender, low, attenuated point of rocks; secondly, and by far the most often, as a broad front more or less cut into by short ravines. The width of the base of the fronting part of the spur is approximately equal to the length of spread of all its lateral extensions. This feature is exceptionally well developed in the North Fork basin, and occurs there with great regularity.

The peaks, so called, of the Cœur d'Alenes are not exactly the form of mountain we are accustomed to call peaks. They are, in the majority of instances, simply the rising swells of the ridge between the saddles. Now and then a rocky eminence occurs which crowns the junction of several great radiating spurs, and rises perhaps 200 to 300 meters (650 to 1,000 feet) higher. In such cases they assume more truly the shape we are used to associate with that word. One of the best examples of the class is Wiessner Peak, situated on the divides between the South Fork of the Cœur d'Alene and the St. Joseph. The ridges of the Cœur d'Alenes are usually very steep, an angle of 40° being common. Along the higher divides are many localities where the slopes run up to 60° and even 70° . Perpendicular cliffs occur here and there. They are most numerous near the main range of the Bitter Roots and along the Clearwater divide. They are seldom over 250 meters (or about 820 feet) in height. An exception is found on the western slope of the ridges which form the western side of the Cœur d'Alene triangle. At the south end of Lake Pend Oreille are precipices having a slope

of over 80° and a height of 850 meters (or about 2,800 feet). There are more precipitous stretches on the larger east and west ridges than elsewhere, and they are almost invariably on the northern slopes. The reason for this appears to be that these divides are situated along great faulting lines. Notwithstanding the steepness of the ridges, they do not commonly present rocky sides. The solid bed rock of the country is more frequently deeply covered with *débris* and soil than exposed. The ravines are tortuous and narrow. Even the longest valleys are comparatively narrow when one considers the great number of side ravines which open into them. A width of 3.2 kilometers (2 miles) is a rarity, and is reached only in the slackwater portion of the valleys of the Cœur d'Alene and St. Joseph rivers. The average width of the valleys of the principal streams is about 1 kilometer (or about five-eighths of a mile). The width of the lateral ravines varies so much that no average can be given. It will often not exceed 10 to 15 meters (33 to 49 feet), with the ridges rising 300 to 500 meters (1,000 to 1,600 feet) above the floor of the ravine. Such narrow places are deprived of the direct sunlight during several months of the year.

The geological formations of the region are wholly composed of non-fossiliferous rocks. In the southern portion micaceous, granitic, feldspathic, and syenitic rocks abound. The southern base of the Cœur d'Alene triangle is almost wholly composed of these primary rocks. In the middle and lower portions of the St. Mary and St. Joseph there are large areas covered with basaltic outflows, which connect to the northward, near Lake Cœur d'Alene, with the basaltic rocks of the plains of the Columbia. The central and northern portions of the region have less of the primary rocks exposed. The prevailing formations here are siliceous magnesian schists, great masses of ferruginous quartzite, and here and there dolomitic and calcareous rocks. These two latter classes of rocks are especially abundant near Lake Pend Oreille, along the more northern portion of the western mountain rim, and appear to be the final southeasterly extension of the dolomitic rocks, which abound northwesterly toward the Colville region. The basaltic rocks are absent in the country north and northeast of Lake Cœur d'Alene, except over a small area which extends 10 kilometers (6 miles) northeast from the lake. The magnesian schists are frequently traversed by various kinds of igneous dikes. This is especially the case in the basins of the North and South forks of the Cœur d'Alene River. The quartzite rocks of the Cœur d'Alenes are prominent features in the geology of the country.

The thickness of the bedded rocks of the Cœur d'Alenes can not be told with absolute certainty. It is, however, not less than 3,000 meters (or about 9,860 feet). These figures have been computed from a careful measurement of the exposures of bedded rocks which occur along the east shore of Lake Pend Oreille and in the North Fork basin.

The geological age to which they belong has, to my knowledge, never

been determined. As before remarked, they are strictly nonfossiliferous. Judging from this fact and taking into consideration their highly metalliferous character, as well as the position, extent, contents, and general appearance of the mineral-bearing lodes which traverse them, I am inclined to place them among the pre-Cambrian rocks of the continent.

DRAINAGE.

The drainage system of the Cœur d'Alene basins is composed of two principal water courses, which divide and subdivide over and over again and form that most intricate system of lateral streams, some of them of considerable size, which is such a prominent feature of the region.

The primary water courses are the Cœur d'Alene and St. Joseph rivers. The waters of these streams flow into Lake Cœur d'Alene, which is thus in a measure a large storage reservoir for the entire drainage from all the interior basins.

The Cœur d'Alene River empties into Lake Cœur d'Alene about 32 kilometers (20 miles) south from the north end of the lake. At a distance of 65 kilometers (40 miles) above its outlet it divides into two streams, the North and South forks of the Cœur d'Alene River. The North Fork, which is the larger stream of the two, heads in the mountains near the north end of Lake Pend Oreille. It flows in an inclosed triangular basin, a repetition on a small scale of the greater Cœur d'Alene triangle. It is very tortuous, and its course on the whole lies near to the eastern side of the triangle; that is, to the main range of the Bitter Roots. Its exact length is unknown, but probably is about 175 kilometers (or nearly 110 miles). The elevation of the valley is about 1,200 meters (3,900 feet) in the upper portion and 670 meters (2,200 feet) at its junction with the South Fork. Near the town of Kingston it breaks through the basal ridge of its basin and effects a junction with the South Fork. It has here a width of about 70 meters (230 feet) and a mean summer stage of water 1 meter (3.3 feet) in depth. The South Fork heads in the ridges of the Bitter Roots a few kilometers to the north of Sohons Pass. Its basin is a rectangular area, its long diameter stretching east-southeast. From its junction with the North Fork to its head in the Bitter Roots is a distance of about 65 kilometers (40 miles). The elevation of its valley at the upper end is about 1,060 meters (3,478 feet) and at its junction with the North Fork about 670 meters (2,200 feet). At the point of junction its width is 30 meters (98 feet), with a summer stage of water of about 75 centimeters (2.5 feet).

In this report, unless especially stated to the contrary, whenever the North Fork or the South Fork is mentioned the respective fork of the Cœur d'Alene River is invariably meant.

The Cœur d'Alene River is navigable in high water from the junction of its two forks to its outlet into Cœur d'Alene Lake, a distance of about 65 kilometers (40 miles). The summer and fall stages of water do not permit navigation farther than to the old Cœur d'Alene Mission.

From this point to Lake Cœur d'Alene, a distance of 48 kilometers (29 miles), the river has an almost imperceptible current and a depth in low water of from 5 to 14 meters (16 to 46 feet). The width of the Cœur d'Alene River at the head of navigation is about 38 meters (125 feet), with a summer stage of water of 2.5 meters (8 feet). The total fall in the river from the head of summer navigation to Lake Cœur d'Alene is only about 5 meters (16.4 feet).

The St. Joseph River is the largest of the Cœur d'Alene streams, and drains the most extensive area. It empties into Lake Cœur d'Alene at the southern extremity, and is navigable for the lake steamers a distance of 42 kilometers (26 miles) from its mouth. The area covered by its basin is trapezoidal in shape. About 24 kilometers (15 miles) from its outlet into Lake Cœur d'Alene it receives its largest tributary, the St. Mary River. About 65 kilometers (40 miles) from its outlet it forks into three streams, two of which head in the ridges which form the divide between the North Fork of the Clearwater and the Cœur d'Alene basin. The third heads in the Bitter Root Range a short distance south of Stevens Peak. This latter is the longest of the tributaries, and might be regarded as the continuation of the main stream. If so, the length of the St. Joseph would be about 220 kilometers (or slightly more than 137 miles).

The elevation of the upper portion of the valleys of the St. Joseph forks is, in the mean, 1,500 meters (4,900 feet), and of the valley at the head of navigation 670 meters (2,198 feet). From the head of navigation to the outlet of the river into Lake Cœur d'Alene there is a fall of about 7 meters (23 feet). The navigable portion of the Cœur d'Alene and St. Joseph rivers is usually called "the slack water."

The St. Mary River, the largest tributary received by the St. Joseph, heads in part in the divide which separates the Clearwater from the Cœur d'Alene basin and in part in the divides in which the Palouse River heads. The upper portion of its valley has an elevation in the mean of 1,050 meters (about 3,400 feet), and the lower, at its junction with the St. Joseph, a height of about 675 meters (about 2,200 feet). It has a width at its junction of about 8 meters (26 feet), and a depth during the summer stage of water of about 3 meters (10 feet).

The lower and navigable portions of these streams all agree in having but a slight fall and a deep channel. This is due to the fact that this portion of their course is cut through a deep diluvial soil, clearly the old bottom of Lake Cœur d'Alene, which, not so very remotely in a geological sense, was far larger and extended well up into what is now in part the valleys of these rivers. Above the slack water the streams are clear, and do not deposit sufficient sediment to fill up the channels. The valleys rise rapidly, the mountains close in, and the current becomes swift, with shallow water during the summer season. The surface water, however, by no means represents the true amount which drains away by these streams. The subsoil in the valleys is a mass of porous gravel,

in most places overlying the bed rock to an unknown but certainly very considerable depth. This gravel is very permeable to water, and has everywhere a large underflow.

The multitude of canyons and ravines which branch off from the larger stream valleys in all directions have each a flowing stream at the bottom, which in its turn is supplied by the springs that break out at frequent intervals from the inclosing ridges along their course.

It has already been remarked that Lake Cœur d'Alene receives the entire drainage from the inclosed Cœur d'Alene areas. The outlet of the lake is the Spokane River. This stream is of great commercial importance to a large extent of country by reason of the water power it furnishes at various points. The stage of water in it depends wholly upon the amount of the annual precipitation within the Cœur d'Alene triangle. Owing to the peculiar situation of the lake, it would be possible to hold back a sufficient quantity of water in it to secure a nearly uniform flow in the Spokane throughout the year.

At a distance of 11.5 kilometers (7.15 miles) from the lake down the Spokane River is Post Falls. The stream here cuts through a dike of gneissoid or some other variety of metamorphosed magnesian rocks, and forms a fall of about 12 meters (39 feet) in height. By the cutting through of this dike the lake has been drained from its last high stage of water and the slack-water channels of the rivers of the Cœur d'Alene basins created.

Should it ever become necessary to store a large quantity of water in Lake Cœur d'Alene, it can readily be accomplished by dams at this point, and a nearly uniform stage of water throughout the year be secured for the points below. Such procedure, however, would overflow all the agricultural lands bordering on the slack-water portion of the rivers, as they now have only an elevation of 2 to 3 meters (6 to 10 feet) above *low* water.

The drainage which flows from the Cœur d'Alene Mountains outside the inclosed basins is disposed of as follows: The eastern slopes of the inclosing rims of mountains in the east drain partly into the Missoula River and partly into the Clark Fork of the Columbia by the channels of various small tributaries of these streams. The southern slopes of the divide which forms the base of the Cœur d'Alene system in the south drain in part into the North Fork of the Clearwater and in part directly into the main Clearwater. The western slopes of the northern half of the inclosing west rim drain in part into Lake Pend Oreille; south of the lake, and north of Lake Cœur d'Alene, the drainage flows into the upper Spokane plains and sinks as soon as it reaches these gravel-covered plains to a depth of about 100 meters (325 feet), whence it probably finds its way into the Columbia direct. South of Lake Cœur d'Alene the waters flow partly into Hangman Creek, a tributary coming into the Spokane River just below the city of Spokane, and partly into the Palouse, a tributary of the Snake River.

With reference to the Palouse, it is a curious circumstance that the explorers connected with the surveys for a north transcontinental route in 1853 and 1856 were determined to place the head waters of this stream far enough east to reach the main range of the Bitter Roots. It is so delineated on Governor Stevens's map accompanying his report. Other surveys tried as persistently later on to find a short cut by way of the Palouse to the Missoula River. It appears to have been a slow and difficult task to convince them that the great basin of the St. Joseph with the valley of its tributary, the St. Mary, intervened between the head of the Palouse and the summit of the Bitter Roots. The difficulty probably was due to failure to appreciate the true shape of the peculiar inclosed basins in which the interior drainage of the Cœur d'Alenes flows.

CLIMATE.

The most prominent feature of the climate of the region is its great annual precipitation. Exactly how large this is for all portions of the area we can not say. Meteorological data applying to the uninhabited portions are unobtainable, and they comprise much the larger portion. There are two well-marked periods during the year, a wet and a dry. The dry is comparatively short, on an average not above ten weeks. The wet includes the remainder of the year. The season's precipitation usually commences with light showers in the middle of September. Above elevations of about 1,600 meters (5,250 feet) these showers are snowstorms in part, but the snow does not remain long. After the first showers there is usually a short interval of dry weather. In the early part of October the rains begin again, increasing in frequency and duration until December is reached, when a storm may last, as it often does, twenty to thirty days, during which time either rain or snow falls incessantly. With the October showers the snow line creeps down rapidly, and in December usually becomes permanent at the lowest levels of the region.

The coldest weather of the season is experienced mostly in the early and middle portions of January, and is pretty sure to be followed soon after by the heaviest snowfall of the winter, considering its duration. This snowfall is often succeeded by a "chinook," a warm southerly wind, which may melt the accumulations of the lowlands wholly or in part. With this the spring commences. This season is often of great length. Rain and snow, freeze and thaw, alternate every few days, very often until the middle of May. There is then a season of dry weather until the middle of June, when a rainy period of two or three weeks sets in. After this has passed dry weather prevails until the fall rains begin.

The precipitation is not equally distributed over the whole region. Certain places receive far more snow and rain than others, even though they are at the same level. The upper portion of the St. Mary and St. Joseph basins and the western areas of the North Fork basin appear to receive more than any other, with the exception of some

localities in the main range of the Bitter Roots. I estimate that the places enumerated above, at an altitude of 1,200 meters (or about 4,000 feet), have an annual precipitation of 260 cm. (or about 100 inches) of water. For the remainder of the region it varies between 150 and 220 cm. (59 and 87 inches). The snow at elevations below 700 meters (about 2,300 feet) usually attains a maximum depth not exceeding 1 meter (3.3 feet) for points in the lower portions of the valleys and 1.5 meters (4.9 feet) for points in the central and upper portions. Above this the depth rapidly increases. At 1,500 meters (5,000 feet) it will average 5 to 6 meters (15 to 20 feet), and at 2,100 meters (6,900 feet) perhaps 7 or 8 meters (23 to 26 feet.) This, however, does not represent the true total amount of snow that falls. This is always quite damp and settles very rapidly; besides, there is no frost in the ground throughout the forested portions of the mountains, even at the highest elevations, and the snow melts constantly from beneath.

The amount of precipitation that is given for the various localities cited above is of necessity based upon estimates derived from other sources than actual yearly measurements. There are no complete temperature or precipitation records in existence for any point within the Cœur d'Alene basins. For the present we are obliged, therefore, to estimate from fragmentary observations.

Throughout the areas of maximum precipitation the average number of days during the year on which rain or snow falls is two hundred. For the western areas of the North Fork basin this number is the result of personal observations extending over a period of nearly nine years. For the St. Joseph and St. Mary basins I have no complete observations, but the denseness and size of the forest growth form a pretty accurate criterion by which to judge, and accepting these as a standard, the yearly period of rain and snow in these basins is no less than in that of the North Fork. Over these areas an average fall of rain or snow, reduced to water, is 2.2 cm. (about 1 inch) in twenty-four hours. I have many times measured the fall during twenty-four hours in the months of March, April, June, and October in the North Fork basin and found 4.5 cm. (about 2 inches) a common occurrence. A total fall of 15 cm. (about 6 inches), as a result of a rain storm of three days' duration in March, October, or November, has frequently been noted. In my estimates I have disregarded these measurements to some extent and placed the average daily precipitation during two hundred days at 1.3 cm. (somewhat in excess of one-half inch). We can also form some estimate of the amount of water that falls throughout these mountains by taking the forest growth as a basis. The amount of the yearly precipitation for Spokane has been given as nearly 90 cm. (about 35 inches). Spokane is situated, in a direct line, about 80 kilometers (50 miles) from the extreme western mountain rim of the North Fork basin and about 60 kilometers (37 miles) from the western base of the same. The city is located at the eastern termination of the open plains

region of the Columbia River in Washington, and the annual rainfall is barely sufficient to permit a moderate growth of the yellow pine and Douglas spruce there. Proceeding eastward from Spokane in the direction of the North Fork basin, a rapid increase in the density and size of the forest growth soon becomes noticeable. The white fir, the western tamarack, the white pine, and the cedar appear, all of them species requiring plenty of moisture for their development. Finding these trees on the same level and under the same soil conditions as exist at Spokane, we are forced to the conclusion that a greater amount of precipitation takes place where they grow than is the case at the former place, where they are absent. No other explanation for their distribution seems possible. Taking now the annual precipitation for Spokane as a basis, and considering the increase in the forest growth between that point and the one at the western base of the North Fork rim of mountains, an addition of 50 per cent to the annual fall of moisture is very far within the bounds of probability. This would give 135 cm. (about 53 inches) for a point about 20 kilometers (13 miles) east-northeast from Rathdrum, Idaho. The water draining from the adjoining ridges is excluded as a factor in the forest growth, for our station is chosen in a locality where no water flows on the surface and where no subwater is known to exist within 60 meters (about 200 feet) of the same. Proceeding easterly from the station, we encounter the mountain ridges, and the annual precipitation increases at a rapid rate as altitude is gained.

The winds that bring the moisture come from between the south and southwest. For some unexplained reason the exact point between these two directions from which the storms come varies slightly from year to year, but is pretty uniform for each year. It might be named the *dominant precipitation point*. The degree of inclination which this assumes each year in relation to the principal storm lines, the south and southwest, appears to decide the annual amount of precipitation. The nearer to the south the warmer and moister will be the winter; the nearer to a westerly direction the colder and dryer will be the season. But little attention has been given to this feature which I have called the dominant precipitation point, but that it exists is evidenced both by observations of the people living in the region and by certain conditions of the forests, which will be explained farther on. The latter class of records extends over at least two centuries. The circumstance noted here is of very great importance in relation to the conservation of the Cœur d'Alene forests, as we shall see presently. Many of the winter storms appear to come from the north. In reality this is only seemingly so. It is but the lower stratum of air which travels southward in these cases. Whenever we obtain glimpses of the moving cloud masses through the snow or rain during these storms we see that at elevations above 1,800 meters (5,900 feet) or thereabouts they come steadily from a southerly direction, no matter from

what quarter the wind blows near the earth's surface. When one of these storms especially distinguished from the more common form by its two strong air currents moving in opposite directions is about to occur, the first indication of its approach is afforded by the cloud formations about the peaks which rise above 1,600 meters (5,250 feet). There are seen heavy masses of grayish-colored clouds rolling from the north along the mountain summits. The lower limits of these clouds are pretty sharply defined. At very high elevations dark clouds are moving slowly from the south. Near the surface of the earth the air is calm. Suddenly the lower stratum of clouds descends to the earth, accompanied by a fierce northerly wind, the upper are much accelerated in their northward course and apparently sink lower, and blinding masses of snow begin to fall.

The northern current in these cases seldom lasts more than two or three days, after which the upper appears to prevail; at least it reaches the lowest levels and blows thenceforth more or less continuously from a southerly direction.

Occasional breaks in the lower cloud masses reveal now and then small clouds forming high up and drifting from the north. This would indicate a reversal of the air currents.

There are no two localities in the Cœur d'Alenes separated by 3 or 4 kilometers (2 or 2.5 miles), or even less, which experience exactly the same climatic conditions though the elevations may in all cases be the same. This statement is not intended to carry with it the implication that the precipitation and the mean annual temperature vary within these narrow limits. The variation consists principally in the unequal distribution of the daily temperature—that is to say, the nights or the days may differ in temperature conditions over such limited areas as here indicated. This circumstance is due to several causes, among which may be noted, first, the general trend of the neighboring ridges, which deflect the air currents in various directions; second, the distance each point is removed from the western rim of the mountains—for, as a rule, the farther east any place in the Cœur d'Alenes is situated the lower appears to be the mean annual temperature. The nightly interchange of air which takes place between the summits of the ridges and the bottom of the valleys or the open plains regions is also a powerful factor in causing local climatic variations. This interchange of air is more marked during the spring, summer, and autumn months than during the winter. When clear nights prevail there is a downward flow of cold air from the crests of the ridges and an upward flow from the valleys. The downward flow follows the canyons and valleys, the upward movement follows the slope. In the inclosed mountain basins it is difficult to estimate the force of this interchange. The downward flow of air is much obstructed by the forest, as is also the upward movement. Fog often forms during the night and is borne along on the downward current. Where no trees obstruct the way the

fog clouds are carried at a speed of about 10 kilometers (6 miles) per hour. It is on the surface of the mountain lakes where free traverse exists that we obtain a better conception in regard to the force of these descending air currents. Thus, on Lake Pend Oreille I have observed that the column of air moving out from the valley of the Clark Fork has often at sunrise a speed of fully 35 kilometers (21 miles) per hour. It is blown across the lake a distance of 30 kilometers (18 miles) with undiminished force. It now strikes a rocky, forested shore and is lost to view. The valley of the Clark Fork at the point where it opens out on the lake has a width of between 4.8 and 6.4 kilometers (3 to 4 miles). The front of the moving column of air where it leaves the lake has a width of not less than 24 kilometers (15 miles). We can estimate the width by observing the track of the wind across the lake. The depth of the air column appears to be under 300 meters (1,000 feet), as fog clouds resting upon the mountain slopes at this height are not carried along. The air current which moves out at the opening in the Cœur d'Alene triangle at the point where the Spokane River leaves Lake Cœur d'Alene is much greater in volume and travels at a higher rate of speed. I have felt the effects of this current at a distance of 80 kilometers (50 miles) from its point of emergence. It frequently moves with a velocity of 48 kilometers (30 miles) per hour at a distance of 20 kilometers (12.5 miles) from the above point. These currents of air lower the night temperature over the plains areas that are situated within their sweep and produce many a frosty night during the summer season. Certain conditions are necessary to produce this phenomenon; they are: warm days, clear nights, and a high barometrical pressure.

The deflection of the air currents is a very complicated matter, as might be predicted in a country so rugged and broken. It varies in each separate locality to a greater or less extent, and changes with each year according to the "dominant point" from which the storms come.

There are three principal lines in the Cœur d'Alenes which the deflected currents of air follow to a greater extent than any other, and these storm ways are very well marked by the large quantities of rain and snow that fall throughout their course. They are the valley of the Cœur d'Alene and that of the North Fork of this stream and around the northern apex of the Cœur d'Alene triangle and the upper portion of the St. Mary valley.

In the southern part of the territory the advancing clouds from the southwest first encounter the lower portion of the western rim of the Cœur d'Alene triangle. A portion of the clouds are here driven northward until they reach the gap in the mountains where Lake Cœur d'Alene is situated. They now enter a low region and are afforded a comparatively easy exit toward the east from the pressure behind. Another portion which has passed over the first mountain barrier is massed against the much higher ridges trending north and south

which lie to the east of the St. Joseph and which connect with the South Fork ridges at Wiessner Peak. Another deflection toward the Cœur d'Alene River occurs here. Now the ridges to the south of this valley and of its tributary the South Fork are much higher than they are to the northward. The consequence is that a very large proportion of the clouds which have accumulated here are driven northeasterly into the basin of the North Fork. This probably explains why the last-named area receives a larger precipitation than the other parts of the Cœur d'Alene.

The second line of deflection is near the northern part of the Cœur d'Alene triangle. The wind, blowing from the southwest across the plains of the Columbia, strikes with unbroken force the high ridges which form the northern half of the western mountain rim of the Cœur d'Alenes. As before, it is deflected toward the north. Its course is then by the south end of Lake Pend Oreille, over this lake, and eastward by the valley of the Clark Fork of the Columbia. As it approaches the south end of Lake Pend Oreille the rapidly moving column of air, many kilometers wide, is compressed between the Cœur d'Alenes and the mountain range to the west of the lake into a space which has a width of less than 5 kilometers ($3\frac{1}{8}$ miles). Passing through this narrow gap, it strikes the lake with terrific force, the wind sometimes reaching a measured velocity of 145 kilometers (90 miles) an hour. In their course up the valley of the Clark Fork the storm clouds deposit most of their burden of snow and rain in the lower portion. The reason for this lies, as in other similar cases, in the configuration of the mountains. The ridges bordering this valley on the north have an average crest line of 1,900 meters (6,200 feet) altitude for a distance of about 130 kilometers (81 miles) east from the lake. This keeps a far larger quantity of clouds confined in the valley than would be the case were these mountains of a lower elevation. Above Thompson the pent-up clouds begin to escape and spread out northeasterly by way of the valley of the Thompson River. Twenty kilometers (12 miles) farther up the Clark Fork valley, at Horse Plains, the northern ridges break away and permit a still further thinning out of the clouds.

We have, therefore, in the portion of the valley of the Clark Fork between Thompson and Lake Pend Oreille, a region of excessive precipitation, locally known as the "Snow Belt." Prior to the forest fires of later years this carried an exceedingly dense forest growth. Above Thompson the climate of the valley becomes one of very decided aridity, resembling in many features that which prevails east of the Rockies in this latitude, and having a flora which includes many of the species of that region.

The third area of deflection is in the upper St. Mary valley. The ridges which form the divides between some of the western tributaries of this stream and those which flow southward into the Clearwater are comparatively low, their mean elevation being about 1,250 meters (4,100 feet).

This permits the escape of a part of the cloud masses which are driven into the Clearwater valley, over into the St. Mary valley. They then follow the course of the valley northward until the northern end of the Elk range of mountains is reached. This range is simply the dividing ridge between the most western of the St. Joseph forks and the St. Mary basin. At the northern end of this range lies a broad plateau which extends from the St. Mary River to the St. Joseph. The air currents pass over this plateau eastward, and reaching the St. Joseph valley are again deflected northward to join the air masses traveling into the valley of the Cœur d'Alene.

The height at which the rain clouds travel varies with the season. The rainy season in the middle of June and the earliest rains in September usually begin from clouds floating considerably higher than 2,100 meters (7,000 feet) above sea level. After the rain has been falling for a few days the clouds go much lower, but seldom under the 1,300-meter (4,300 foot) line. These altitudes are known partly from observations of the height at which the lower or earth surface of the rain clouds travel in their course along and over mountain ridges and crests with known elevations and partly from ascensions of various peaks that have been made while rain and snow storms were in progress, the altitude having been ascertained by means of aneroids.

During the December precipitation the clouds float at their lowest elevation, which seldom falls below 800 meters (2,600 feet). The velocity of the wind during the storm where free and unobstructed traverse exists, as on the summit of the highest elevations, is subject to great variations, but is probably seldom less than 40 kilometers (25 miles) an hour. In the early part of the month of September when I visited the high ridges to the south of Wiessner Peak during the prevalence of one of the early storms of the season, the wind, coming from the southwest, reached at times a velocity of 95 kilometers (59 miles) an hour. This was on the summit of ridges having an elevation of about 2,100 meters (7,000 feet) and unobstructed by trees or higher mountains in the neighborhood. The temperature during the storm, which lasted three days, remained at 9° C. (48.2° F.), and the lower limit of the nimbus was about 1,500 meters (4,800 feet).

The peculiar circumstance was noted in connection with the rain cloud that the side toward the earth was in a continual state of rising and falling. The space through which this took place was about 220 meters (700 feet) in height. The barometer was not affected, but the character of the rain that was falling varied considerably. When I was thoroughly enveloped in the nimbus but little of the contained moisture fell as rain, but from the branches of every tree or upright object the water, condensing from the rain fog, was pouring in streams. Whenever the cloud lifted the rain fell in torrents.

Most of the severe storms begin with electrical disturbances. There are passing showers, accompanied by thunder and lightning which soon cease, and the storm proper begins. Local showers of short

duration may occur any time during the dry season and are especially abundant in the North Fork basin. They seem to be mainly a part of the great evaporation which ascends from these moisture-laden ravines during the day, and meeting with a colder current condenses and falls back.

Frosts are liable to occur at any time during the growing season in the bottoms of the valleys within the Cœur d'Alene triangle. Wet summers produce more frosty nights than dry. The reason for this is that the high barometer which follows a storm brings with it a cold, dry condition of the atmosphere. The frosts are most severe at the mouths of the canyons. Elevations of 50 to 100 meters (160 to 350 feet) above the floors of the valleys and the bench lands along the streams are very nearly free from summer frosts and have in general a higher temperature. This patent fact is not generally recognized as yet by the farmers of the region. The valleys would be far more frosty but for the fog which forms above them on clear nights. In the upper St. Mary valley at elevations of 800 meters (2,600 feet), where my opportunities for such observations were of the best, I found that after sundown the temperature would descend steadily until 4° C. (39.2° F.) was reached. It then became stationary and the fog began to form. After 1 a. m. the temperature began to rise, the thermometer indicating 5° to 7° C. (41° to 44.6° F.) at sunrise. Needless to say, the amount of dew which fell was very great.

The highest temperature recorded by me is 36.5° C. (97.7° F.) at Mullan on August 2, elevation 970 meters (3,200 feet). This is an unusually high temperature for this locality. The hot wave was followed by an equally unusual depression of temperature, producing frosts and severe freezing throughout the Cœur d'Alene valleys until August 14. Our lowest record for this period is -3.2° C. ($+26.2^{\circ}$ F.) at Wolf Lodge on August 14, altitude 750 meters (2,400 feet).

There is no permanent snow line on any of the Cœur d'Alene Mountains. Summers which follow unusually severe winters with heavy snowfall may witness a bank of snow remaining on the north side of some of the ridges throughout the season at elevations above 1,550 meters (5,100 feet). Generally, however, even the highest ridges are free from snow by the 1st of August. Exceptions to this occur on the north side of Stevens Peak, on the northeast slopes of the high rocky ridges some 10 or 12 kilometers (6.2 to 6.3 miles) east from Sunset Peak, and on the northern slopes of the ridges south from Wiessner Peak. In the last locality I found old snow in September with the fresh snow of the season covering it. This is due here, as well as in the other places mentioned, to the great drifts which are blown over the crests of the ridges and accumulate on the northern slope rather than to the elevated position they occupy. When the summer thaw begins great masses of snow are loosened and fall into the chasms below, where the summer's sun can not reach them with sufficient force. This is the case at the foot of the precipices on the northern slopes of Stevens

Peak, where a considerable accumulation of snow, 2 to 3 meters (7 to 10 feet) deep in August, seems to remain permanently.

The highest temperature noted on the high summits was 25.5° C. (77.9° F.) on Stevens Peak, August 5, at an elevation of 2,064 meters (6,800 feet), and the lowest, -2.5° C. (27.3° F.) on July 26, south from Wiessner Peak, at an elevation of 1,925 meters (6,350 feet).

Mention should be made of the chinook wind in connection with these notes upon the climatic conditions of the Cœur d'Alenes. This is a warm, either moist or dry, wind which is supposed to be especially characteristic of winter and spring months. It has decidedly remarkable powers to melt the snow and mitigate the winter's cold. Numerous theories are rife to account for this wind, but the one most commonly accepted is that it stands in some occult relation to the "black current" of Japan. The character of the chinook varies so considerably, however, that one may be pardoned for not readily yielding adherence to this orthodox theory. Now, the way the chinook manifests itself in the Cœur d'Alenes is this: There are clearly two kinds of chinook, a wet and a dry. The wet chinook is a most frequent accompaniment of a very severe snowfall in the latter part of January. This may have commenced with a low temperature, which gradually begins to rise as the storm advances. Finally a cessation of the snowfall occurs. Black heavy-looking clouds appear in solid masses in the southwest, a low soughing sound begins to be heard as the first indications of the coming wind. Soon fitful gusts of warm air flit by, and presently, with loud roarings and crashings and accompanied by torrents of rain, the chinook is on. During a wet chinook a high temperature prevails as far up as the most elevated summits in the Cœur d'Alenes and rain falls in great quantities on the absorbent snow. The duration of the chinook is very uncertain. It may last a week, and it may last only a few hours. After it has blown an indefinite time the wind veers a few points to the west. It then changes to a dry chinook and the temperature becomes much lower. The rainfall in the upper regions becomes snow and freezing weather sets in again in the lower elevations. Chinook winds may occur at any time in the winter, but they are generally absent during December and the greater part of January. Occasionally they do not come until March, and in such cases the region suffers from a late spring. These winds are absolutely essential to the early starting of vegetation in the Cœur d'Alenes, which would otherwise be delayed until the summer season. The chinook is a fitful and uncertain wind in other ways than in its duration. It sometimes blows only above a certain altitude and does not descend below a given point, as, for instance, the 1,000-meter (3,300-foot) level. When this occurs we have the spectacle of the snow melting at elevations above this height while the air is at freezing point in the lowest valleys.

Whatever may be its origin, it does not seem at all probable that the

black current of Japan can in any considerable degree exert an influence on the temperature of such a vast amount of air as must be in motion to account for the effects produced by this wind. It is more reasonable to suppose that the real origin of the chinook is in the equatorial regions of the earth, and that in truth it is an outflow of heated air from these regions toward the polar area. In order to pass the high snowy barriers of the Cascades, which it must do to reach us from the southwest, and still to retain a sufficient degree of warmth to exert the marked influence that it does when it reaches the Cœur d'Alenes, it would seem to be absolutely necessary that the initial temperature under which it starts should be very considerable.

The heat carried by the wind is so great that not only does it produce marked effects in the Rocky Mountain region, but it even extends in a lesser degree as far east as the Missouri River in North Dakota.

The supposition that the chinook blows only in the spring and winter is a mistake. My observations record the fact that a wind in every respect identical with the dry chinook prevails throughout the greater portion of the summer months on the summits of the high divides, while it is perfectly calm below.

It is noticed that an odor, frequently said to be "spicy," often accompanies the chinook. A popular fancy ascribes this feature to emanations from the spice gardens of Asia wafted across to the shores of America on the wings of the chinook. These winds certainly have a peculiar odor, but it can not be called spicy. It rather resembles that which comes with the hazy atmosphere of our so-called Indian summers.

MINERAL DEPOSITS.

The economic features of the Cœur d'Alenes group themselves very naturally under three heads: mineral deposits, agricultural capacities, and forest resources.

We will first consider mineral deposits, as at the present time the output of its mines is by far the most valuable product of the country.

The Cœur d'Alenes are essentially a mineral-bearing region, for, with the exception of the portion along the St. Mary and the St. Joseph rivers and the area northeast from Lake Cœur d'Alene covered with basaltic outflows, no considerable portion of these mountains has been found, when prospected, devoid of metalliferous veins.

It is a long time since valuable minerals were first discovered here. At the building of the Mullan road, in 1861, prospectors were found looking for and testing placers in the valley of Wolf Lodge Creek. Before this time some parties must have found their way into the North Fork basin, as very old prospect holes buried in the depth of the forest testify. Hudson Bay Company trappers doubtless found gold in this region at a very early date, but the records, if any, were unwritten, and in the process of time became mere dim recollections. It was not until the fall and winter of 1883 that it became generally known that valuable

placers existed on the eastern tributaries of the North Fork. As soon as these discoveries were published a stampede set in, the particulars of which are matters of recent record, and the region began to come into prominence as a producer of valuable minerals. For some time after the gold discoveries but little attention was given to anything else. A year or two later it was found that the great iron-capped veins which traverse various portions of the Cœur d'Alenes carried at certain depths enormous deposits of argentiferous ores. The placers and gold-bearing quartz veins now became of secondary importance. With the discoveries of the lead-silver ores commenced the great development of the mining industries which have made the Cœur d'Alenes known throughout the mining world. The basin of the South Fork is the most noted of all the mineral-bearing zones of this region. Commencing at the town of Wardner, an almost continuous line of large and valuable mining properties extends to within 5 or 6 kilometers (3 or 4 miles) of the main divide of the Bitter Roots. Many of these are great ore producers and are equipped with elaborate and expensive machinery. They give, directly and indirectly, employment to many thousands of persons when in full operation. A number of flourishing towns have sprung up around these mining camps. As these towns depend for their support exclusively upon the mines of the region, their prosperity is naturally inseparably linked with the successful and profitable exploitation of the mineral-bearing deposits which surround them. The low prices of silver and lead which have prevailed for so long, added to the labor troubles of the past two or three years, have very materially retarded the further development of the mining industries of the Cœur d'Alenes. The argentiferous ores of this region are of low grade in the majority of cases and require concentration into proper bulk and richness before they can be shipped to the smelters. As yet there are no smelters in the region. All the big ore producers have large and costly concentrating plants erected in connection with the mines.

The next in importance of the known mineral-bearing districts of the Cœur d'Alenes is the southeastern portion of the North Fork basin. It was here that the gold discoveries were made which first drew attention to the region. In development it has not by far kept pace with the lead-silver areas of the South Fork, notwithstanding the much richer character of its ores. The reason for this lies mainly in the circumstance that the argentiferous ores exist in immense bodies, while the auriferous ores do not; therefore, although the richness of the latter class of ores is much greater, the former have proved more profitable to the miner. The low prices of silver and lead have acted as a stimulus in the development of the auriferous lodes during the past few years, but so far as is now known the gold-bearing region of the Cœur d'Alenes is comparatively limited, and unless discoveries hereafter shall extend it the country will never be noted as a great gold producer.

The two areas enumerated above are the only ones in which any

mines have as yet been developed to ore-producing capacities. The total extent of country covered by the mineral-bearing zones here is not one-fifth of the space inclosed within the boundaries of the Cœur d'Alene triangle. That just as great and profitable mines will be discovered in the other four-fifths can scarcely be doubted. The same forces which have acted and the same conditions which exist in the proved mineralized regions appear to have been in operation and to be present in numerous localities elsewhere. In examining the areas where no ore-producing mines have been developed to date we find that there is no considerable portion of the country which has been prospected that does not show a greater or less number of recorded mineral-bearing lodes. The basaltic regions of the St. Mary, St. Joseph, and Lake Cœur d'Alene are exceptions to this.

In the upper St. Mary basin we have the placers and gold-bearing veins scattered about Gold Center. In the central portion, on the slopes of the Elk range, a number of mineral locations have been made. In the upper St. Joseph are placers and numerous lode claims.

In the southwestern portion of the North Fork basin is a nearly continuous line of lode claims extending along the valley of the Little North Fork from its junction with the North Fork to its head near Lake Pend Oreille. A great many mineral-bearing quartz veins are known to exist in the northern portion of the North Fork basin, but they are not much prospected, nor are they located under the United States mining laws as yet.

The development work on the majority of mineral-bearing lodes which lie beyond the limits of the two principal mining regions is confined to the annual assessment work of \$100 on each claim of 1,500 feet or less, as required by the mining laws of the United States. This means in most instances that a long time must elapse before even the best claims can reasonably be expected to become ore producers. Extensive developments of the mining industries in the Cœur d'Alenes will come in time, but will be matters of slow growth. The miners have many difficulties to contend with, chief of which are low-grade ores, the considerable depth at which the big ore bodies generally lie, the broken character of the country, which in many places renders access by a simple trail to a mining claim troublesome and costly, to say nothing of shipping facilities by rail or wagon roads, and, lastly, the extreme difficulty of inducing capital to invest in mines on areas where the character of the mineral deposits has not been proved to be profitable beyond a reasonable doubt.

As an extended account of the composition and value of the Cœur d'Alene ores would not be germane to the principal topics of this report, only a short general statement is here appended.

There are three main classes of Cœur d'Alene ores—the lead-silver the pyritiferous and free gold, and the dry or cupriferous silver ores. The lead-silver ores are the most common, occur in the largest bodies, and are at the present time the most profitable. Their assay values of

silver are very various, running from 20 up to 200 ounces per ton of crude ore. The percentage of lead also varies, though 60 to 70 per cent is a common value. The lead occurs mostly as a sulphide (galena), sometimes as a carbonate at shallow depths. The ores also carry a varying quantity of arsenic, antimony, iron, and zinc in diverse combinations. The lead-silver veins are remarkable for their great length, many having been traced 10 to 20 kilometers (6 to 12 miles), but outcropping ore deposits are only found at long intervals. The balance of the vein is either "blind"—that is, it does not break through the overlying country rock so as to be visible on the surface—or it spreads out and becomes "banded," in which case it is supposed to carry no ore. Veins of this class have in a measure the appearance of true fissures. None has been worked deep enough to be exhausted. They are often very wide where the ore bodies are found and have the appearance sometimes of chambered deposits. Their surface croppings are iron in various stages of decomposition, the so-called "iron cap." The thickness of this varies from 10 to 30 meters (33 to 100 feet) or more, depending upon the amount of surface wear to which it has been subjected.

The auriferous deposits embrace placers and lodes. The placers do not differ essentially from similar mineral deposits in any other region. A great deal of the placer ground of the Cœur d'Alenes remains unworked, by reason of the heavy expense entailed in dealing with the subwater, which is struck before bed-rock or pay dirt is reached.

The auriferous quartz veins are both pyritiferous and free gold bearing. Both kinds of ore are usually found in the same vein. The lodes are narrow and very frequently present the appearance of blanket veins, a feature which is apt to cause some doubt as to their capacity to hold out under long-continued working. There are no very deep excavations on them as yet; hence this point is unsettled. The free gold in these veins will probably turn to sulphurets when a sufficient depth is reached.

The cupriferous silver lodes are not very common. They have been found in the basins of the South Fork, North Fork, and St. Joseph rivers, but have been explored comparatively little. Generally their croppings consist of chalcopyrite or its oxidized or carbonized compounds. The richest ores produced by this class of veins are usually compounds of silver, antimony, and lead in varying proportions.

To sum up the mineral resources of the Cœur d'Alenes, they embrace gold, silver, copper, lead, and antimony, as well as most of the other commercial metallic elements. In the developed districts the four first named occur as great and lasting deposits.

AGRICULTURAL CAPACITY.

The areas fit for agricultural pursuits in this region are very limited in extent. By far the larger portion of the valleys and canyons are narrow and rocky and utterly unsuitable for farming purposes. The best and most extensive acreage of tillable land is found in the lower

part of the larger valleys along their slack-water portion. In their upper sections are circumscribed spots of meadow land here and there, but the total amount of this is comparatively small. The narrow lateral ravines which branch off from the larger valleys have practically none, and the hillsides are commonly too steep to utilize for these purposes.

Commencing with the St. Mary valley, we find some agricultural land along the valleys of its western tributaries. The largest and most important of these is the Santianne, which has a length of about 22 kilometers (13.6 miles). The agricultural lands here consist of a strip of meadow on both sides of the stream channel, averaging less than 500 meters (1,640 feet) in width. There are also some timbered bench lands bordering the valley which by clearing can be made tillable. The valleys of the other western tributaries of the St. Mary are similar in character, but have a much smaller area. The largest among these is Emerald Creek. The streams putting into the St. Mary from the east are mere rivulets and have no bottom lands. The lower portion of the St. Mary near its junction with the St. Joseph is bordered for a distance of 5 or 6 kilometers (3.1 to 3.7 miles) along the slack-water portion by a fertile strip of bottom land, which averages about 1.2 kilometers (0.75 mile) in width. Some parts of this are very swampy and springy, and are not utilized. Above the slack water the river runs through a gorge excavated through the basalt for a distance of about 12 kilometers (7.5 miles). No arable land is found here. Above the gorge the valley widens and small patches of low meadow land alternating with rocky bluffs line the stream. Further on, in the upper part, the valley varies from 0.5 to 1.2 kilometers (0.30 to 0.75 mile) in width, and strips of meadow land alternating with willow and poplar swamps make up the character of the bottoms. At elevations varying from 20 to 40 meters (60 to 130 feet) above the river are stretches of bench land, comprising in the aggregate perhaps 12,000 or 15,000 acres. These are pretty generally timbered with a more or less old and dense forest, varying in these respects with the severity of the fires that have swept over them in the past.

At a distance of 51 kilometers (31.7 miles) from its junction with the St. Joseph the St. Mary divides into several forks. Here is found the largest amount of agricultural land occurring in one body above the slack-water portion of the river. There are about 500 acres of it. Practically all the low-lying meadow lands and some of the timbered bench lands in the St. Mary valley below the forks and along its two principal tributaries, the Santianne and Emerald Creek, are occupied by settlers. The settlements on the St. Mary do not extend above the forks. There are no agricultural lands farther up the river.

In the St. Joseph valley the bottom lands, from the outlet into Lake Cœur d'Alene to a distance of 22 kilometers (13.7 miles) up the river, are fertile meadow lands, but in some cases so low as to form perennial

swamps. They are embraced within the limits of the Cœur d'Alene Indian Reservation, and are therefore not under settlement. A continuation of these open bottom lands extends to the head of navigation of the stream, and the space is quite generally occupied by settlers. Above the head of navigation are small patches of meadow, alternating with heavily timbered areas and wet cedar swamps, where settlements soon cease. The whole slack-water part of the St. Joseph valley is liable to extensive overflows each spring, occasioned by the filling of Lake Cœur d'Alene and the consequent backing up of the water over its ancient bottom. Part of it is always swampy and too low to be drained and therefore unfit for agriculture. Several small lakes are found in this part of the valley. The overflows from which the valley suffers more or less each year are said to have become a great deal worse since a dam was put in at Post Falls to improve the water power at that place.

Around the shores of Lake Cœur d'Alene is a narrow more or less interrupted series of benches. They are heavily timbered, and would in any case afford but small agricultural areas. For a distance of nearly 25 kilometers (15.5 miles) eastward from the north end of the lake is a rolling country, covered principally with the yellow pine (*Pinus ponderosa*). There are a number of farms scattered over this area, and, with the exception of the Wolf Lodge Creek bottoms and a small space at the outlet of Blue Creek into Lake Cœur d'Alene, the tillable land which they possess has been made by clearing off the forests. The valleys of the main Cœur d'Alene River and that of one of its branches, the South Fork, are the principal centers of population of the region and possess the largest area of agricultural lands. Greater efforts have been made here than elsewhere to transform the forest-covered valleys and benches into arable land.

This is due to the near and ready market afforded by the various mining camps for farm produce and the enhanced value of agricultural lands in consequence. The valley varies in width from 2.1 to 0.5 kilometers (1.3 to 0.3 miles), and settlements and cultivated areas extend throughout its whole length to a point within 10 kilometers (6.2 miles) of the main range of the Bitter Roots at Sohons Pass. The amount of bench lands along this valley is quite limited. The largest quantity of agricultural land in one body is adjacent to the old Cœur d'Alene Mission. There are here about 3,000 acres of good arable bottom lands, nearly clear and unbroken by mountain spurs, but wet and springy in places.

The valley of the North Fork has the least available agricultural land of any portion of the Cœur d'Alene region. The forest is in general so dense that the life of one generation is too short to hew out a farm of sufficient size to furnish support to even a small family. Here, as elsewhere, scattered pieces of meadow land occur and areas where some forest fire of more than ordinary fierceness has in a measure cleared the land.

In such localities small patches of cultivated ground are found at intervals up the valley for a distance of 50 kilometers (31 miles) from its junction with the South Fork. Similar small tracts of tilled land exist along a few of the larger tributaries of the North Fork, such as Beaver, Pritchard, and Eagle creeks, and the lowermost portion of the Little North Fork. Near the head of the North Fork are some meadow lands, but access to them is so difficult that they are not utilized, except in occasional seasons for their crop of wild hay.

The soil of the valleys varies considerably in its composition and fertility, depending upon the constituents of the rocks from which it is derived. In the upper St. Mary region the mountains are largely composed of soft, easily disintegrating, micaceous schists, which have been much worn down. As a result, the outlines of the ridges have been softened and the comparatively large quantities of low bench lands formed which constitute so conspicuous a feature of this area. The basaltic outflows of the Tertiary dammed the stream in its central portion and created a large lake, which extended toward its head. In the still waters of this lake were deposited the wash from the surrounding micaceous mountains, and to it is due the flat character of the upper part of the stream valley and the enormous quantity of finely comminuted silt mixed with vegetable mold which covers so deeply the bed rock of the bottoms.

In the middle portion of the valley the soil has received a very large admixture of alkaline elements, derived from the basaltic rocks which border the stream, and, though not of such depth as in the upper part, possesses a greater fertility. The character of the soil in the main St. Mary valley is repeated in those of its tributary streams.

The slack-water area of both the St. Joseph and the St. Mary have soil of unknown but undoubtedly very great depth, as it represents the accumulation of diluvium deposited over the bottom of Lake Cœur d'Alene during many centuries when it stood at a much higher level than at present.

The soil in the valley of the South Fork along its slack-water portion is similar to that which exists in the St. Joseph in like situations. There is also a decided element of alkaline deposits due to the leachings from the basaltic rocks around Lake Cœur d'Alene and the St. Joseph.

Above the old Cœur d'Alene Mission the land becomes much less fertile. The mountains adjacent to the valley are composed of highly siliceous rocks, and the soil in consequence is unduly rich in silica. The same conditions prevail in the valleys of the upper St. Joseph and in the whole North Fork basin. In addition, the mold is rather thin, resting upon beds of coarse gravel and sand, the detritus brought down from the main divides by the feeble glacial action which doubtless once operated there. There is also another cause that has aided to impoverish the soil in the upper part of the South Fork, and it is one that operates

everywhere in the Cœur d'Alenes under like circumstances. This is fire, which is largely employed to clear the land of its forest covering. There is a stratum, 30 to 75 cm. (12 to 30 inches) in thickness, everywhere in the forest, except in the yellow pine portion, composed of a humus made up of pine needles and woody débris generally in a state of decay. This burns readily, and the ashes which are left as a sort of compensation soon wash off and are lost.

Furthermore, a great quantity of ferruginous matter is held in the soil, possibly in part as sulphides and in part as carbonates. The heat oxidizes this element and the land assumes a fiery red color. Soils which have been oxidized to this extent become exceedingly infertile. The richest lands in the higher parts of these valleys are the beaver flats. Centuries ago the beavers were very numerous here. They dammed the streams in many localities, causing extensive pools. A great amount of alluvial washings accumulated in these places as time passed on. With the disappearance of the beavers their dams were broken down and the places formerly covered by their ponds furnish now some choice agricultural areas, though limited in extent.

On the whole, the land fit for cultivation in the Cœur d'Alenes is circumscribed in area, and the configuration of the country is such that no extensive agricultural operations are possible even were the forests wholly cleared off. Another serious drawback to farming in these mountains is their liability to frosts during the growing season, which are pretty sure to occur with greater or less severity every year. There is no way to mitigate them. The removal of obstructions in the shape of logs, brush heaps, and the like in the streams may create a deeper channel, as it causes a more rapid current, and in consequence a better drainage of the adjacent lands. If this should prevent the formation of the dense fogs which rise on cold nights and serve as a sort of blanket to the earth, it would only result in a greater lowering of the temperature. The removal of the forests also contributes to bring on frosty nights, for it has been abundantly demonstrated that a denuded area in the forests of the Cœur d'Alenes experiences sharper differences and a wider range in the daily temperature than do the places sheltered by the growing timber.

AGRICULTURAL PRODUCTS.

These are the common grains and vegetables. By far the largest quantity of farm produce is hay. In the basin of the St. Mary this is principally timothy. Very little grain is raised here. I saw but a single small field of wheat, and that was raised somewhat as an experiment. There were small garden spots around the farms, on which were planted potatoes and a few of the more hardy vegetables. There were a number of very small orchards; the trees in these were in some instances 8 or 9 years old. They had never fruited, as the frosts during the growing season had invariably killed the blossoms. Small fruits—

strawberries, raspberries, currants, and gooseberries—were seen here and there. The low bench lands had been selected for these gardens and orchards, because their elevation gave them a higher night temperature on an average than the bottom lands possessed. The cultivation of the bench lands in this valley would render possible the production of a far greater variety of farm produce than is practicable upon the land now used. They are, however, for the most part heavily timbered, and when cleared the soil dries and bakes so hard that irrigation becomes imperative, although the annual precipitation is so large. Hay is the principal crop in the St. Joseph valley also. The elevation of the slack-water portion of the valley, 650 to 670 meters (2,100 to 2,200 feet), gives it to some extent immunity from summer frosts. More grain and garden vegetables are raised here than on the St. Mary; also large quantities of small fruits, especially strawberries and raspberries. The production of these is more than sufficient for home consumption, and a ready market is found for the surplus in the South Fork mining districts. Several orchards were seen, none of the trees fruiting very freely, but I was informed that in some years apples, pears, plums, and cherries bear abundantly. Owing to the fact that the slack-water portions of the St. Mary and St. Joseph valleys are elevated above the summer stage of the river only 2 to 3.5 meters (6.6 to 11.5 feet), and that the spring rise of the rivers, or rather the back water of Lake Cœur d'Alene, often amounts to 5 meters (16.4 feet) and upward, they are frequently overflowed for weeks at a time. This entails a severe loss to the owners of timothy fields, as such a prolonged submersion kills this grass. For this reason a large part of the rich meadow lands produces nothing better than coarse sedges and such plants as sweet flag (*Acorus calamus*), tule (*Scirpus lacustris occidentalis*), bur reed (*Sparganium eurycarpum*), water cinquefoil (*Potentilla palustris*), and cat-tail (*Typha latifolia*). The reclamation of these overflowed bottom lands would make them very valuable. It can be accomplished only by lowering the water in Lake Cœur d'Alene. This is possible by widening the channel of the Spokane River at Post Falls, a matter that could be done readily and cheaply. It would, however, destroy in large measure the water power at this point and very materially injure the one at Spokane. The interests that would suffer by a lowering of Lake Cœur d'Alene would be far greater than those that would benefit by the permanent drainage of the overflowed bottom lands of the St. Joseph and the St. Mary.

The neighborhood of Lake Cœur d'Alene insures a comparative freedom from summer frosts to the small quantity of arable land around its shores. Northeast from this lake lies a very undulating region, formed by a multitude of low spurs which in part proceed from the northern half of the western rim of the North Fork triangle and in part from the ridge which forms its base. It is about 25 kilometers (15.5 miles) long by 4.5 kilometers (2.8 miles) wide, is of low elevation, varying from

750 to 950 meters (2,500 to 3,100 feet), and affords a considerable quantity of arable land. This lies sometimes on the long and easy slopes of the spurs, and again on the bench lands which occur here and there. A growth of yellow pine (*Pinus ponderosa*), red fir (*Pseudotsuga taxifolia*), white fir (*Abies concolor*), and tamarack (*Larix occidentalis*) covers this area, which therefore requires clearing before it can be put under cultivation. The summer frosts are not severe over this tract, and in consequence large quantities of garden produce, as well as some fruit—apples, plums, and cherries—are raised.

The slack-water portion of the Cœur d'Alene valley is practically identical with the same part of the St. Joseph valley, though not nearly so extensive. The products are the same, and it is liable to summer frosts and to overflows in the spring, which latter of late years appear to be greater than formerly.

The South Fork of the Cœur d'Alene is closely occupied and cultivated in most of its available portions as far up as the town of Wallace. The timber in the bottom lands is nearly all gone, and the greater part of the land has been utilized for agricultural purposes. The products are hay, potatoes, and garden vegetables. Owing to its configuration, that of a rectangular area opening to the west, it enjoys a rather greater degree of freedom from summer frosts than do the other sections of the Cœur d'Alenes.

As already noted, the agricultural areas in the North Fork basin are very limited. The products are hay and garden vegetables in insufficient quantities to supply even the local demand.

The produce—hay, vegetables, fruit, etc.—of the farming districts of the Cœur d'Alene, the South Fork, and the St. Joseph valleys is mostly consumed at home, the mining camps when in operation furnishing a ready market. This local produce can not be shipped any considerable distance without coming in competition with the products of the plains region of Washington, which can furnish all sorts of farm produce in unlimited quantities and at much lower prices. As, therefore, the home demand will always be the principal outlet for the surplus of the Cœur d'Alene farms, and as this of necessity will be limited for a long time to come, additional farms opened in the timber and among the mountains at great labor and expense will simply add an undue amount of competition to an already fully stocked market.

GRAZING LANDS.

The grazing capacities of the Cœur d'Alenes are small. The forests at low elevations are singularly deficient in species of grasses, and those that occur are very limited in quantity and innutritious in quality. The thick layer of decaying pine needles which is present everywhere in the unburned portions of the timber seems to be inimical to a growth of grass. The dense canopy of interlacing branches that allows but a small amount of heat and light to filter through

them and keeps the ground in the heavy forest in a perpetual state of twilight is also among the causes that prevent grasses from obtaining a foothold.

The settlers everywhere keep a few head of stock—horses and cattle. The general range is the forest, and for reasons already stated it is circumscribed in extent and the quality is poor. The areas in the Cœur d'Alenes where stock raising becomes an important factor are the slack-water portions of the Cœur d'Alene, St. Joseph, and St. Mary valleys, the central and upper parts of the St. Mary valley, and the tracts along its tributary, the Santianne.

Except those on the central and upper St. Mary, these lands are bordered by low hills, the ends of the spurs that reach down from the high divides. A great deal of the forest which grows on them is composed of the yellow pine, and is open and park-like in character. There is always a sparse growth of grass in those localities. Much of the low hilly country along the lower St. Mary and St. Joseph is composed of basaltic outflows. The timber here in many places is thin and scattered and a heavier stand of grass is found. The slopes facing the south are more open than those with any other exposure and have more grass land. They are also rockier and with a much thinner soil, generally steeper as well. In the spring and early summer the grass on these slopes furnishes a fair pasturage; in the middle of the summer and later the herbage dries up and stock refuse to eat it unless pressed by extreme hunger. Owing to the limited extent of the range and the absolute necessity of keeping the meadows free from grazing that they may furnish hay for winter feed, each settler can at the best have but a small amount of stock. All the grasses that furnish pasturage on these hillsides and in the forest are easily eaten out, even more so than is the case on the plains areas of Washington and Oregon. The grazing grounds at low elevations are everywhere showing the effects of overpasturage, notwithstanding the number of animals ranging on them is small and they have been utilized but a comparatively short time. During the past ten years thousands of acres of these hillsides, which I once saw covered with a good stand of grass, have been so thoroughly eaten out that now they produce nothing but a few coarse weeds.

The tracts mentioned above are all within the limits of the yellow-pine forest. As we proceed up the valleys we come into regions covered with the white pine (*Pinus monticola*). The pasturage now becomes exceedingly scanty. The range is the forest, as before, but no more open hillsides are to be found. Stock must resort to the densely timbered areas, and the pasturage becomes everything that grows excepting the conifers and the bear grass (*Xerophyllum douglasii*). A common undershrub in these white pine forests, which is often eaten by stock under stress of hunger, is the holly-leaved buck brush (*Pachystima myrsinites*), an evergreen plant belonging to the staff-tree family.

Sharp, broken pieces of the woody portion of this species are often found embedded in the rumen of cattle that have fed in the forest.

The settlers in the Cœur d'Alenes must have access to the forest as a range for their stock, or, except in a few cases, they could not keep any cattle. A quarter section is rarely composed entirely of bottom land except in some portions of the valleys along the slack water. Usually a quantity of forest, some steep ravines, and rocky hillsides form a considerable portion of the farm. The small amount of bottom land must be rigorously preserved for purposes of hay and garden or field products. Sometimes the farm is all forest and there is no natural hay land whatever. When, as is the case in the central and upper St. Mary valley, we find the settlers depending almost wholly upon cattle raising for their support, and observe the small and poor range they have for their stock, and that it is rapidly growing less by over pasturing, the question is forcibly presented, Would it not be to the ultimate advantage of them, as well as to the country at large, if all forest lands were absolutely withdrawn from entry and set apart as timber reserves?

I have not found that the free range of the cattle through the forests is at all detrimental to the conservation of it. They do not eat the conifers, and the deciduous trees and shrubs which are eaten by them in the young stage, or browsed off when they grow older, are of no consequence in any way. Young conifers are, as a matter of course, broken down by their trails, but the damage due to this cause is on the whole insignificant. They prefer to range through the more open portions where saplings and young trees are not so abundant, leaving the denser parts untouched. If agricultural settlements are to be permitted to go on in the timbered regions of the Cœur d'Alenes, there is no reason why the unlimited use of the forest as a stock range should not be permitted, so far as the possible damage done by the cattle is concerned.

There is, however, another aspect to this question which puts the matter of stock raising in a forested region in another light. It has been found that by burning off the timber the grass growth is greatly increased. New species come in, those that were there before grow more robust and acquire a much denser stand, and seeds of various kinds of cultivated grasses will take root and grow if sown at the proper time upon the loose soil which results from the burning process. When a settler lives in the white pine region, or in any other where the timber is heavy, the temptation to burn the forest and make larger and better range for his stock is very great, and it is morally certain many will yield to it. For proof of this it is but necessary to observe the numerous instances in which fires have spread "by accident" from clearings into the adjoining forest. Stock raising and farming in the heavy forest regions of the Cœur d'Alenes is not profitable, and does not furnish a living to those engaged in it. Many have to supplement the income from these sources by the wages they can earn in the harvest fields of eastern Washington or in the mines of the home region.

One would suppose that in a country where natural pasturage areas are so limited and so much in demand all available portions would be utilized. This is far from being the case here, however; outside the slack-water portions of the valleys the best and most extensive grazing grounds of the Cœur d'Alenes are totally neglected. I refer to the great grassy, park-like forests which are found on the high divides that rise above 1,500 meters (5,000 feet) altitude. In the North Fork basin, which has but few natural pastures at any elevation, these parks are of small extent or wholly wanting even on the highest ridges, but on the divides which separate the waters of the North Fork of the Clearwater from the Cœur d'Alene basins, on those which lie between the South Fork of the Cœur d'Alene and the St. Joseph, on those which divide the principal forks of this latter stream, and on the slopes of the peaks near and along the main range of the Bitter Roots are many thousand acres of grass land which yield a most luxuriant growth and are in their prime at a time when the summer pasturage at low elevations is thoroughly dried up. With the exception of small tracts on the Clearwater divide, to which bands of horses are occasionally driven, none of these grazing lands are utilized. The reason for this is in part the difficulty of access to the high summits and in part the lack of water during the summer. To reach the parks on the crests it is necessary to travel through miles of heavy timber or dense brush without roads or trails of any sort. The summer water line is always below these grass lands. Rarely is it found at a higher altitude than 280 meters (900 feet) below the crest line of the ridges; usually it is much lower. The summer water level of the great grass-covered slopes which are situated between the St. Joseph and the Cœur d'Alene rivers varies from 320 to 950 meters (1,000 to 3,100 feet) below the crest line. Above this not a drop of water is obtainable after the snow is gone. Without paths through the dense timber which always succeeds the grassy expanses it often requires several hours to reach water and as long to climb back to the summits. Notwithstanding the drawback of the lack of water, these grassy expanses would furnish good sheep pasture were it not for the presence of bears and cougars, which doubtless would cause havoc in any flock that ventured into these solitudes. The difficulties in the way of utilizing these grazing areas are not insuperable; on the contrary, they can readily be overcome. The only requirements are trails through the timber to the foot of the parks and from them to the highest permanent water levels in the canyons below.

During the past nine years sheep have been driven annually from the Snake River country into some part of the Cœur d'Alenes for summer pasturage. They are driven in by way of Santianne Creek and reach the valley of the St. Mary in the middle of June. Their range is as yet confined to the low, rolling basaltic, yellow-pine forest which lies between the middle portion of the St. Mary and the St. Joseph. As elsewhere, these bands of sheep are very destructive to the pasturage and leave but little along their route for the stock of the resident

farmers. In consequence there is a great deal of hostility between the sheepmen and the ranchers. Attempts have been made by the former at various times to drive their flocks up the St. Mary valley, so as to reach the rich pasture grounds on the Clearwater divide, but the threats of the farmers have so far prevented them. The sheep do no more damage to the coniferous trees than do the cattle and horses, and there is no reason, except local hostility, why the sheep herders should not be permitted to utilize the grass lands on the high divides. Small flocks of sheep are owned here and there by the resident farmers. They are not allowed to range through the forest at will, but are pastured in the near vicinity of home. Their number is insignificant.

The cultivated grasses which furnish hay are limited almost exclusively to one species, timothy. Bottom lands high enough to be above the reach of freshets are sown to this kind of grass, but the cleared bench lands are, or rather become, too dry, and they are therefore devoted to wheat or rye.

The small number of the species of grasses found in the Cœur d'Alenes has already been referred to. Not only are the timbered tracts noticeable in this respect, but many of the meadows as well. In the lands adjacent to the slack-water courses of the rivers where the elevation is insufficient to place them above high-water mark there are hundreds of acres in solid bodies upon which not one species of grass is to be found. They are covered with various kinds of sedges, poor and innutritious in quality, but nevertheless commonly cut for hay for want of anything better.

The species of grasses which furnish the bulk of the natural pasturage in the bottom lands are the following:

Graphephorum wolffii, Vasey. A beautiful species in the low meadows throughout the St. Mary basin.

Phleum alpinum L. Found very sparingly along the St. Mary River and extending up into the subalpine heights. (No. 447 from Stevens Peak, altitude 1,650 meters, or 5,400 feet.)

Alopecurus geniculatus L. A grass usually growing in still or running water, but occasionally met with in low places that dry up in the summer and then covering considerable areas with a close matted growth. (No. 1329.) It is called "wild timothy" by the farmers. Cattle do not seem to eat it except when forced by hunger.

Alopecurus occidentalis Scribner. A rare grass in the meadows along the St. Mary River in the central and upper portions.

Agrostis tenuis Vasey. Very plentiful in all the meadows in the central portions of the St. Joseph and St. Mary valleys.

Agrostis scabra Willd. With the preceding, but not so plentiful.

Eatonia obtusata Gray, *Poa serotina* Ehrh., *Deschampsia elongata* Munro, and *Deschampsia caespitosa* (L.) Beauv. These four species occur now in the open meadows, now in the forest, and again in the thickets bordering swamps.

Elymus condensatus Presl, and *Elymus glaucus* Buckl. Two grasses almost exclusively confined to the slack-water portions of the valleys.

Festuca rubra L., *Melica spectabilis* Scribner, *Trisetum canescens* Buckl., and *Stipa viridula* Trin. Common in the middle and central portions of the St. Joseph and St. Mary valleys.

Danthonia californica Boland., *Poa buckleyana* Nash, *Poa pratensis* L., *Agrostis alba* L., and *Calamagrostis canadensis dubia* Vasey, are species generally disseminated throughout the drier meadows.

Bromus breviaristatus (Hook.) Thurb. A grass which is found accompanying the settlements everywhere throughout the region. It does not seem to be indigenous here; possibly it has been introduced from the plains region of Washington, where it is plentiful. It grows luxuriantly wherever it obtains a foothold, and is esteemed a good pasture grass.

Phalaris arundinacea L., *Beckmannia erucaciformis* Host, *Glyceria fluitans* R. Br., and *Glyceria nervata* Trin. are species which grow in the wet, swampy portions of the meadows and furnish, especially the last, a fair amount of coarse, watery forage.

Agropyron tenerum Vasey. Probably the best of the native grasses of this region. It is not plentiful in any locality.

The species which form the pasturage on the uplands in the yellow pine belt and at low elevations in the white pine forests are as follows:

Calamagrostis suksdorfii Scribner. A grass which springs up in extreme abundance wherever the forest has been burned. It is a coarse species, not much relished by stock.

Poa sp. Common everywhere on the rocky hillsides.

Melica acuminata Boland. and *Festuca scabrella* L. Throughout the open yellow pine forest.

Danthonia intermedia Vasey. In the edge of the forest and on the adjoining meadows.

Agropyron divergens Nees. The most valuable of the uplands grasses at low elevations and furnishing more forage on these areas than any other species. It constitutes the greater portion of the "bunch grass" of the Cœur d'Alenes below altitudes of 1,200 meters (3,900 feet).

The grasses of the parks on the high ridges above 1,500 meters (5,000 feet) elevation are:

Oryzopsis exigua Thurb. A local species not observed elsewhere than on the ridges along the main divide of the Bitter Roots in the North Fork basin.

Deschampsia atropurpurea Hook., *Calamagrostis suksdorfii* Scribner, *Calamagrostis purpurascens* R. Br., *Poa purpurascens* Vasey, *Poa pulchella* Vasey, *Trisetum subspicatum* Beauv., *Agropyron divergens* Nees, *Festuca rubra* L. The last-mentioned species forms at least four-fifths of the total grass growth on the ridges between elevations of 1,500 and 2,100 meters (5,000 to 6,900 feet). It is the "bunch grass" of the high ridges in the Cœur d'Alenes.

Cinna pendula Trin. A plentiful species in the canyons at the altitudes given above. It is an especially characteristic species in wet grounds where the forest has been burned off.

None of the native grasses of the Cœur d'Alenes are worthy of cultivation in that region. No one species is found in sufficient quantities by itself to furnish hay. The wild hay is in consequence composed of a mixture of all the species enumerated above as growing in the meadow lands. The species that grow on the ridges and slopes yield no hay.

Timothy has proved itself thoroughly well adapted to the soil and climate, and wherever the bottom lands are secure from inundation it is generally cultivated.

In some sections that are annually submerged, especially on the areas bordering on the St. Joseph and Cœur d'Alene rivers, sedges become

important hay material. The kinds which are most commonly utilized for this purpose are:

Carex utriculata minor Boott, *Carex nudata* W. Boott, *Carex stipata* Muhl., *Carex canescens oregana* Bailey, all of which are very abundant. Others not so common are: *Carex festiva stricta* Bailey, *Carex straminea* Willd., *Carex festiva* Dewey, *Carex pratensis* Drejer.

Carex geyeri Boott. Furnishes more forage in its fresh state than any other of the sedges. It is extremely plentiful everywhere in dry soil. It has an extensive altitudinal range, being found in the yellow pine forest at 650 meters (2,100 feet) altitude and on the summit of the highest ridges at 2,100 meters (6,900 feet). It is of general occurrence throughout the region and is readily eaten by all kinds of stock.

NATIVE FOOD PLANTS.

The native food plants are few. The paucity of plants suitable for human food is one of the most remarkable circumstances in a region which supports such vast quantities of vegetation as does this in its forest covering. Probably, for this reason mainly, it contained only a small aboriginal population, and the only localities in which there appear to have been permanent settlements of the Indians were in the slack-water portion of the Cœur d'Alene—possibly some existed in the lower valley of the St. Joseph. The rest of the country was visited by them only in their migratory summer and fall excursions in pursuit of game and fish, with which the St. Mary and St. Joseph valleys formerly abounded.

The most valuable food plant in the dietary of the Cœur d'Alene Indians was undoubtedly the camass (*Camassia esculenta*), a plant belonging to the lily family, therefore related to the onion, but lacking all trace of alliaceous flavor and smell. The esculent part of the plant is the bulb, which in the fresh state is of an oblong shape, seldom more than 2.5 cm. (1 inch) in diameter and 4 cm. (1½ inches) long. It is mucilaginous and possesses very little, if any, definite flavor. The flowers are bright or deep blue, and a camass meadow in full bloom, seen from an elevation, gives the impression that one is looking at a body of very clear water reflecting a cloudless sky. The lower portion of the valley of the St. Joseph, and in particular that of the St. Mary and its tributaries, were, before the advent of settlements, among the classic camass grounds of the Cœur d'Alenes. Here the tribe came in large numbers each summer to dig the root and to hunt the deer and elk, which roamed by the thousand in the surrounding forest, and to catch the trout, with which the streams teemed. Every meadow was a camass field. The plant was so plentiful in many places that it is no exaggeration to say that in the upper St. Mary basin more than one-half of the total herbaceous vegetation in the lowlands was composed of this one species. With the advance of settlements came the utilization of the camass fields as hay meadows. This ended the existence of the plant, except as a weed in the farmers' fields, and the camass digging in

the Cœur d'Alene basins, like the game, is now a thing of the past. Strangely enough, the plant seems to have been entirely absent from the North Fork areas, at least I do not know of a single locality where it occurs.

Two species of lichens, *Alectoria fremontii* and *Alectoria ochroleuca*, principally the form *sarmentosa* of the latter species, were eaten by the Cœur d'Alene tribe. Both are extremely plentiful at all elevations. Boiled, or rather baked, in which latter condition they were mainly used, together with venison, they become somewhat gelatinous in their consistency and lose the bitter taste which they possess in a fresh state.

Of fruits, they had huckleberries (*Vaccinium myrtilloides* principally), raspberries (*Rubus leucodermis* and *R. strigosus*), blackberries (*Rubus ursinus* or *vitifolius*), and service berries (*Amelanchier alnifolia*). These fruits are gathered and used at the present time by the white settlers, but none are abundant in the region except the huckleberries and service berries, and these not every year. The Cœur d'Alene Indians draw no more native plant foods from these mountains. They are now mostly farmers, have large and fairly well cultivated ranches, and find in the raising of the cereals and vegetables of civilization a far more bountiful supply of food, and much more palatable withal, than they ever obtained from the laboriously gathered camass of their mountain meadows.

UTILIZATION OF WATER SUPPLY.

Owing to the large annual precipitation, the region is abundantly watered. The lateral ravines which supply the main streams carry water throughout the year with but few exceptions. The annual freshets are usually at their height in the latter part of May or early part of June, and the volume of water then depends upon the winter's snowfall, the amount of rain which has fallen and been absorbed by the snow in the high elevations during the chinook storms of spring, and the suddenness with which the whole mass melts. It is a noticeable fact that more severe freshets are recorded in later years than was the case at an earlier date. In the report of Capt. John Mullan upon the building of the military road it is stated¹ that "the highest water mark seen was only 3 feet above its usual level." This was in 1861 and in the South Fork valley. There are water marks now in the central part of the valley at the old mission which show a rise of over 6 meters (19.6 feet) above the usual level, and in the upper or canyon part of the South Fork, 2.5 meters (8.2 feet). Per contra, the streams are decidedly lower in their fall and winter stage than formerly. The cause lies probably in the removal of the timber. When the builders

¹Capt. John Mullan, Report on the Construction of a Military Road from Fort Walla Walla to Fort Benton, page 121, 1863.

of the Mullan road first came into the country the forest was in the main intact. The extreme rise in the St. Mary and the North Fork seldom exceeds 2 or 2.5 meters (6.5 to 8.2 feet).

The principal applications of the water in the streams, not considering the item of navigation, are in the mining and lumbering industries, such as furnishing motive power for ore-concentrating plants and sawmills, and means for logging, placer mining, and irrigation. The principal streams whose waters are used by the concentrating plants are the South Fork and Canyon Creek, one of its feeders. Part of the water appropriated by them furnishes motive power; part of it is employed to effect the separation of the metallic part of the ores from the lighter gangue. After it is used the water is of course returned to its channel. It is then heavily charged with the siliceous slimes derived from the crushed gangue of the ore, and more or less of the metallic elements which the concentrating machinery failed to save, such as the sulphides of lead, iron, antimony, zinc, and arsenic in various combinations. The color of the slime-laden water is a dirty gray, and the particles held in suspension are deposited along its course. Undoubtedly some of the metallic elements enter into the water in a state of solution after exposure to the action of moisture and air. After passing through these establishments the water is unfit for either drinking or irrigation purposes. Most of the matter held in suspension is deposited in the calm slack-water portion and little, if any, reaches Lake Cœur d'Alene. So far as I know, no deleterious substance attributable to the concentrators has been detected in the Spokane River. As the water supply of the city of Spokane is taken from this river, the question whether any of the slimes suspended or dissolved pass through Lake Cœur d'Alene into the Spokane is of some importance.

MILLING AND LOGGING.

The water is little, if at all, used as motive power for the sawmills at the present time. Steam is now very generally employed for this purpose.

For logging, the North Fork, Cœur d'Alene, St. Joseph, and Lake Cœur d'Alene are utilized. The stage of water does not permit general driving in the North Fork and upper and middle St. Joseph above the head of navigation except during and for a short time after the annual freshets. The St. Mary would afford water high enough in the spring for this purpose were it not for the obstruction of rocks and its tortuous channel in the canyon where it breaks through the basaltic outflows. This is about 6 or 8 kilometers ($3\frac{1}{2}$ to 5 miles) in length. Attempts have been made to pass logs through this canyon, but they have always failed. Logs can be floated down the North Fork for a distance of at least 80 kilometers (50 miles) above its mouth by taking advantage of its highest stage of water. Two of its tributaries, the Little North Fork and another unnamed stream of equal volume, have water deep

enough for three or four weeks each year to serve the same purpose. These waterways furnish a means to reach most of the heavily timbered districts of the North Fork areas, as they head near Lake Pend Oreille and drain a large part of the basin.

MINING.

The area devoted to placer mining lies in the southeastern part of the North Fork basin, and it is therefore only here that the waters are utilized for this purpose. Owing to the fact that the channel of this stream lies so much nearer the eastern rim of the basin than the western, it follows that the tributaries putting in from the main range of the Bitter Roots are all short and carry only a small volume of water. Added to this is the circumstance that the bottoms of many are filled above the bed rock to a very considerable depth with masses of gravel and boulders, which permit the stream of water, small in the fall, to sink beneath the surface. The quantity of water is therefore in many places insufficient for the placer miners in the autumn, and compels them to suspend operations earlier in the season than they otherwise would.

IRRIGATION.

Very little of the water is used for irrigation. The insignificant area of irrigated lands lies almost wholly in the South Fork valley. Water is obtained from the small laterals which are not used for mining purposes and are therefore clear and uncontaminated. So long as the bottom lands furnish most of the agricultural areas, irrigation will be dispensed with whenever possible. When the forest is cleared away from the bench lands and they are put under the plow, the necessity of irrigation will be felt. Lands in the Cœur d'Alenes from which the forest has been cleared become very dry notwithstanding the large annual precipitation. This happens even in case of swampy ground, if it lies above the level of a running stream. The soil does not retain moisture long owing to its largely siliceous nature. The small side ravines will furnish an easy means of irrigating the bench lands so long as the forest at their sources is not cut off. When that is done, the streams will be dry during the growing season, when most needed, and water must then be elevated from the main streams or brought in ditches or flumes from their higher levels.

One problem connected with the water supply of the Cœur d'Alenes may be considered here. It is the possibility of utilizing the streams or the stored-up water in Lake Cœur d'Alene for irrigation purposes on the semiarid lands of the plains of the Columbia. In a general way it may be said that this is feasible to some extent. The physical difficulties, however, are so many and so great and the financial success of an undertaking of this sort so problematical that neither private individuals nor the General Government are likely to engage in any scheme of this kind for a long time to come, if ever.

In the remarks presented in this report upon the configuration of the Cœur d'Alenes it has been seen that the whole area is contained in an inclosed triangle, with an opening that permits the drainage to flow into one of the direct tributaries of the Columbia, and that Lake Cœur d'Alene, into which all the waters of the Cœur d'Alene basins are poured, is situated in this opening or gap. Now, if we desire to take the waters of this region and conduct them upon the plains for irrigation purposes we are limited to two courses. One is to divert the rivers, before they enter into Lake Cœur d'Alene, through artificial channels into the plains areas, the other is to take the water directly from the lake. In either case the ultimate outlet must be through the natural gap in the Cœur d'Alene triangle, for there is no place where an excavation through the inclosing ridges can be made at the proper level.

At the outset we are confronted by the prime difficulty of the undertaking. The surface level of the water in Lake Cœur d'Alene in its medium stage is given by various authorities at 655 meters (2,148 feet) above the sea. Now, the plains region of the Columbia River basin is very far from being a level expanse. On the contrary, it is a very undulating region, with a sort of crest line that stretches from the northwest to the southeast. The course of this is tortuous and lies nearer to the verge of the eastern slope than the western, making that by so much the shorter. Both the eastern and western slopes are intersected by a great number of rocky canyons, the Coulees. The crest line exceeds in many places 910 meters (3,000 feet), and a great deal of the eastern slope will average not less than 720 meters (2,350 feet), excluding the stream valleys. To bring the water of Lake Cœur d'Alene to this plateau at the necessary height to irrigate the uplands, which have most need of it, would necessitate a dam sufficiently high to raise the water level in the lake more than 56 meters (184 feet) above where it stands now. Even then it would not suffice to reach the highest and most arid lands of the plateau. Nor would the difficulties of the work end here. The contour line which joined the raised level of Lake Cœur d'Alene and the plains would be exceedingly tortuous. To conduct the water along this level, miles of rock cutting or high aqueducts would be required.

Another plan is presented, that of taking the water from one of the rivers which empty into Lake Cœur d'Alene. Each of these has a long slack-water portion nearly at lake level. To obtain sufficient head we should be compelled to go far above this portion of the rivers. Omitting all considerations regarding the riparian rights of owners of property below the point from which the water was taken, we will confine ourselves to the physical features. To obtain the elevation of 720 meters (2,362 feet) without a dam would necessitate going up the valley of the South Fork a distance of 20 kilometers (13 miles) above the slack water. The configuration of the country is such that it would

be necessary to carry the flume or channel conveying the water along the valley of the South Fork and around the east shore of Lake Cœur d'Alene. This would involve the construction of hundreds of miles of conduits if the contour line was followed. At this point in the river we should have the slimy water delivered from the concentrators, which is wholly unfit for irrigation purposes while charged with siliceous and metallic elements. The waters of the North Fork would not be open to this objection, but the conduits necessary would not be shorter. The same difficulty applies with added force to the St. Joseph, as the length of the necessary water channels would be even greater.

The waters of Lake Cœur d'Alene can be utilized in a limited way for irrigation purposes. It is within a reasonable range of possibilities to dam the lake at Post Falls, and raise its waters sufficiently to irrigate a large portion of the immediate valley of the Spokane River. But a dam high enough to hold back a sufficiency of the surplus water of the spring freshets that the summer stage in the river below would be high enough to maintain the water power at Spokane would submerge permanently all the land which adjoins the slack-water portion of the Cœur d'Alene, St. Joseph, and St. Mary rivers, besides a large quantity abutting upon the shores of Lake Cœur d'Alene. The quantity of land which could be irrigated from this source would be relatively small. Only the lower benches along the Spokane could be reached; the upper are from 30 to 150 meters (98 to 490 feet) above the lake. For the same reason any scheme to take water directly from any of the Cœur d'Alene streams to irrigate the lands of the Spokane valley would not be a financial success.

FOREST RESOURCES.

The Cœur d'Alene basins are or, perhaps more properly, have been a densely forest-covered region. The humidity of the climate and the great depth to which the zone of decomposition of the rocks has extended have combined to favor a surprisingly great development of the forest part of the flora. The growth of timber is by no means uniform throughout the region. Many agencies have operated and are still active to produce present conditions, which will be considered under the head of "Forest destruction."

At the present time the areas which have the heaviest stand of living timber are the central portions of the St. Mary and St. Joseph valleys, the valleys of the various forks of the St. Joseph, and the western region of the North Fork basin. The density of the forest varies with its position as regards elevation and exposure. It is far heavier in the bottom lands and on the mountain sides where the angle of the slopes does not exceed 35° nor the elevation 1,250 meters (4,100 feet) than elsewhere. The northern faces of the ridges have also invariably a thicker stand of trees than any of the others, provided the slope is not too great. The sides fronting the west come next, then those that face the east,

lastly the southern exposures, which are very often grassy and have only scattered trees, especially at high altitudes.

Of the two great classes of trees which make up our northern forests on the Pacific Slope the conifers are by far the most abundantly represented in point of individuals. They are also of the greater economic importance. The deciduous trees are the most numerous as to species, but form only an inconsiderable quantity in the forest growth, and their commercial importance is as yet practically none.

There are of the conifers 15 well-defined species. They are distributed among the various genera as follows: pines, 4 or possibly 5; spruces, 1; firs, 2; larches, 1; hemlock spruces, 1; arbor vitæ, 1; hemlocks, 2; yews, 1; junipers, 2. Thirteen among the 15 always attain the stature of trees. One, the yew, is sometimes a tree, sometimes a trailing shrub. Another, the alpine juniper, is always a low, spreading shrub. One, the Western tamarack, is deciduous, shedding the leaves of the season in late autumn, October and November. The others are evergreen.

All the species are of wide range, occurring generally throughout the forests of the Pacific Slope above the northern boundary of California. It is uncertain how many of them range far enough east to enter the Rocky Mountain region proper. I am inclined to think that they all do, with the possible exception of the yew.

The conifers are as follows:

Pines.—Yellow or bull pine (*Pinus ponderosa*), white pine (*Pinus monticola*), black pine (*Pinus murrayana*), white-barked pine (*Pinus albicaulis*).

Spruces.—Engelmann spruce (*Picea engelmanni*).

Firs.—White fir (*Abies concolor*), subalpine fir (*Abies lasiocarpa*).

Larches.—Tamarack or Western larch (*Larix occidentalis*).

Hemlock spruces.—Hemlock spruce, Douglas spruce, Oregon fir, red fir, etc. (*Pseudotsuga taxifolia*).

Arbor vitæ.—Cedar (*Thuja plicata*).

Hemlocks.—Patton hemlock (*Tsuga pattoniana*), Mertens hemlock (*Tsuga mertensiana*).

Yews.—Short-leaved yew (*Taxus brevifolia*).

Junipers.—Red cedar (*Juniperus virginiana*), mountain juniper (*Juniperus nana*).

YELLOW PINE.

Pinus ponderosa Dougl.

The yellow or bull pine stands at the head of the list of the Cœur d'Alene trees as the most generally useful. It furnishes probably not less than four-fifths of all the sawed lumber of the region. It is found in all the larger valleys, in the bottoms and on the bench lands and the slopes of the abutting spurs. The mean elevation of its extreme altitudinal range is 1,250 meters (4,100 feet). In some localities a few trees will be found as high as 1,500 meters (4,900 feet), and in some places it falls far short of its mean range. This is apparently due to difference in precipitation, for the capacity of the yellow pine to endure great atmospheric humidity is decidedly limited. The zone of its

greatest density lies between 650 and 850 meters (2,100 and 2,800 feet) elevation. Although of wide distribution, it is far from equally abundant in all localities. In the St. Mary valley it is especially plentiful in the basaltic region, both along the main stream and its tributaries. Above these areas it thins out rapidly, and ceases almost entirely at a distance of about 52 kilometers (32 miles) from the confluence of this river with the St. Joseph. The line of demarkation is quite sharply drawn, and is clearly due to a greater humidity than is compatible with the proper growth of the tree. In the St. Joseph valley the species extends a distance of above 80 kilometers (50 miles) from its outlet into Lake Cœur d'Alene. Around this lake and on the low, broken country which extends from this point to the northeast and southeast until it joins the valley of the Cœur d'Alene the tree is more plentiful than elsewhere. It follows up the valley of the South Fork to the foot of the main divide of the Bitter Roots, but in the upper or canyon part of the valley it is almost wholly confined to the mountain slopes which have a southern exposure.

In the North Fork basin the tree occurs on all the more rocky and open hillsides in the eastern part which face the south. In the large interior and western portions of this area the species is nearly absent. Now and then a few individuals of mature age are seen on some bare, rocky point of a projecting spur, but their numbers are very small and I have never known any of them to produce cones.

The yellow pine in the Cœur d'Alenes varies in height from 30 to 65 meters (98 to 213 feet), ranging in diameter up to 1.5 meters (4.9 feet). The largest diameter which has come under my observation was 2.3 meters (7.5 feet); a fair average is 1 meter (3.3 feet). The species may be considered as mature at 150 years of age. At a certain period in its existence the tree ceases to grow in height. This is marked by the loss of the leader, which begins to fork and branch out in a horizontal manner. Thenceforth it only increases its diameter, and the process is a slow one. In trees 200 years old and upward the annual rings for a distance of 7 cm. (2.5 inches) or more from the periphery will often not average more than 1 mm. ($\frac{1}{25}$ inch) apart. The age at which the species ceases to grow in height varies with the individuals and the conditions under which they are placed as regards soil, humidity, and elevation. I should consider 150 years an average age. The sapwood of the tree is white, almost free from resin, and constitutes from one-third in young trees to one-sixth or one-eighth in old of the total diameter. It is not durable if subjected to alternate wet and dry conditions. In sawing, the larger part of this is slabbed. The heartwood is of a yellowish color, and is always more or less resinous, sometimes exceedingly so. It is very durable, but objectionable and not fit to use for many purposes on account of the quantity of resin with which it is charged. The tree would doubtless furnish a superior article of tar, especially the roots, many of which in dry soils are so highly

resiniferous that the woody structure is almost obliterated and they resemble lumps of resin. The tree furnishes a fair fuel and is largely utilized for this purpose. The specific gravity of the wood is only a little less than that of water, but unless the logs are heavily charged with resin they always float. None of the other Cœur d'Alene lumber trees grow in as accessible places as this, and it is therefore a conspicuous mark for the woodman's ax.

WHITE PINE.

Pinus monticola Dougl.

The white pine, as it is commonly called, comes next on the list of the useful pines of the region. It is very much more abundant than the yellow pine, but as it grows in places more difficult of access is not so generally converted into lumber.

When obtainable, the tree is sawed into lumber which is used for all purposes. Owing to its freedom from resin it is suitable in many places where the yellow pine is not. For this reason it is rarely employed as rough lumber. It commands a very much higher price than the lumber from the yellow pine, the difference being as much as three to one, and even more, according to distance. It is often made into shingles which are of a superior quality. The sapwood is white and moderately durable. It varies from one-third to one-fifth (according to age) of the total diameter. The heartwood is white, with a tinge of yellowish brown, and when it seasons it acquires a somewhat satiny feel and luster. Neither the sapwood nor the heartwood is resinous except sometimes a narrow zone of wood around the very core. The green logs are very liable to the attack of a longicorn beetle, which begins to bore holes in the sapwood as soon as the tree is felled, except in winter, and deposits its eggs, which soon hatch out into burrowing larvæ. The tree is also very susceptible to the attack of various fungi, which often destroy every individual over large areas.

The range of the species is universal throughout the Cœur d'Alenes, but it only becomes of a sufficient size to be made into saw logs on areas where there is a plentiful supply of moisture. It will grow on tolerably well-drained slopes, but does not acquire any considerable size. The largest and best bodies of timber of the species are found on the area which lies between the St. Joseph and the St. Mary rivers, from the junction of the two streams to the northern slopes of the Elk Range; along the central portions of the forks of the St. Joseph; in the region which lies directly to the south of the Santianne valley, and in that which is situated between the head waters of the St. Mary and the Potlatch. The greatest, however, is found in the unburned region along the North Fork and in the western and central areas of this basin. The mean extreme altitudinal range of the species is about 1,500 meters (4,900 feet). The zone of greatest density lies between 750 and 1,200 meters (2,500 and 3,900 feet). The height of the approximately mature tree is from 60 to 90 meters (190 to 290 feet), with a

diameter of 1 to 2 meters (3.3 to 6.5 feet), which is only rarely exceeded. The average is about 1.2 meters (4.9 feet) for individuals of above height. The crown is about two-thirds the total length of the tree, sometimes not more than one-third or one-fourth, with remarkably short and few branches. The tree is of indefinite growth—at least I have never seen one without a leader, no matter how old, unless it had accidentally become broken. When young the tree is a rapid grower. After 100 to 150 years the annual growth becomes slow. It begins to furnish prime lumber when about 180 years of age. Like the yellow pine, it sets cones in abundance, and there are always a multitude of young trees with the old ones. The fuel from it is of indifferent quality.

BLACK PINE.

Pinus murrayana Balfour.

The black pine is found throughout the whole region of the Cœur d'Alenes. It is unfit for lumber, and is therefore mainly utilized as fuel. It grows tall and slender, and is converted into fence rails, etc., in many localities. There are two varieties of it. One is the prevailing form at low elevations, the other grows mainly at the higher altitudes. The lowlands variety is marked by its dwarfed stature, which seldom exceeds 15 meters (50 feet), low and widely branched crown, and coarsely fissured black bark. This form approaches the black pine of the Washington coast, *Pinus contorta*, of which it may possibly be a variety rather than of *Pinus murrayana*. The typical form of the present species is strictly limited in its range to the mountain slopes and wet meadows in the upper river basins. It has a comparatively narrow crown and a smoothish, brownish bark, and grows from 20 to 40 meters (65 to 130 feet) in height, and up to 50 cm. (1.6 feet) in diameter in favorable situations. Its range extends to elevations of 1,600 meters (5,200 feet). The character of the wood is similar in both forms.

WHITE-BARKED PINE.

Pinus albicaulis Engelm.

This is a species strictly limited both in its altitudinal and regional range, and is but little known or noticed by the people of the Cœur d'Alenes. Within our limits it was more or less abundant on all ridges having a greater elevation than 1,650 meters (5,400 feet), with the exception of the central and western areas of the North Fork basin, where it was not seen. It is especially plentiful on the divide between the Clearwater and the St. Joseph, on the high ridges which separate the latter stream from the Cœur d'Alene River, and along the main range of the Bitter Roots south from Stevens Peak. Its extreme altitudinal range is not known. It is found as large and robust at the highest elevations, 2,160 meters (7,100 feet), as it is at points 500 meters (1,600 feet) lower. The tree attains a height of 20 meters (65

feet) and a diameter of 1.2 meters (4.9 feet), more commonly 40 to 55 cm. (1.3 to 1.8 feet). The crown is very large and spreading, and occupies about two-thirds of the entire height. Very frequently the tree begins to branch immediately at the ground. The crown is rarely symmetrical. The branches are crooked and gnarled and bent in all directions. The wood is white, moderately dense, and resinous. No use is made of the species.

The impression one receives from the general appearance of the tree in this region is that the species is in the process of extinction. Cone-bearing individuals are very rare. Among thousands of trees which I examined for the purpose of obtaining cones I found but a single one, and the remains of old cones at the base of the trees were found but rarely. Few saplings were seen; nearly all the trees were old ones, upward of 100 and 150 years of age.

Possibly climatic changes are going on which are tending toward the obliteration of the tree in the Cœur d'Alenes. These would be less humidity and a general lowering of the mean temperature, in the spring especially, when the young cones are forming. It is a very noticeable fact that the male catkins were present in abundance in the majority of instances, giving the tree the appearance of a diœcious species.

ENGELMANN SPRUCE.

Picea engelmanni (Parry) Engelm.

This is the only representative of the genus *Picea* known to occur in the Cœur d'Alenes. It is of general range throughout, at elevations from 700 to 1,550 meters (2,300 to 5,100 feet); the latter is rarely exceeded. Its principal habitat is in the low, wet bottoms of the streams, which it follows to their source in the ridges. The localities in which it reaches its greatest abundance and its largest development are in the basin of the North Fork. It never forms pure growths, but is always scattered among the other conifers. In favorable localities it grows to a height of 40 to 60 meters (130 to 190 feet), with a diameter of 2 meters (6.6 feet); the sizes one most frequently sees are 0.75 to 1 meter (2.5 to 3.3 feet). In places where other trees do not crowd it, the outlines are exceedingly symmetrical, and with the deep bluish green of the leaves it is by far the most beautiful of the forest trees of the Cœur d'Alenes. In such places the shape of the young individuals, up to the age of 50 years or thereabouts, is a perfect cone from base to summit, the branches commencing immediately at the ground. As the tree grows older the lower limbs die off and the symmetry of the whole is lost in the formation of the thick bole. The crown is seldom less than two-thirds of the height, more frequently as much as three-fourths. The branches are long and pendulous in old trees, but not especially so in the young. It is a rather fast and regular grower and appears to mature at 180 to 200 years of age.

The wood, which is soft, white, free from resin, and quite durable, has a great number of small black knots embedded in it. It is occasionally sawed into lumber, and would be used much more extensively were it easier of access. There is less sap in the tree than in most of the other conifers of the Cœur d'Alene forest, and for this reason it is fit for lumber at an earlier period. No especial distinction exists in color or durability between the sap and heartwood. The species is often confounded with the firs. It may be readily known and distinguished from any of the firs of this region by the thin, scaly, reddish bark of the mature tree, pungently pointed leaves, long, sloping branches, and pendulous cones. Our firs all have upright cones. The hemlocks, which have the mature cones pendulous, differ so much in general appearance that they are not apt to be mistaken for this spruce by anybody.

WHITE FIR.

Abies concolor (Gordon) Parry.

A tree found pretty much everywhere in the Cœur d'Alenes. It ranges from the lowest levels, where it is always associated with the yellow and black pines and the red fir, to elevations of 1,500 meters (5,000 feet), and on the southern slopes of the ridges may go considerably higher. It is equally at home in the wet bottoms of the valleys or on the well-drained slopes of the ridges. On the northern faces of the mountains the young growth frequently forms the densest of thickets, not to be penetrated except by a liberal use of the ax. There are two varieties of the species, but not at all distinct botanically. One of these forms is of low stature, seldom exceeding 15 to 20 meters (50 to 70 feet) in height, and 30 to 35 cm. (12 to 14 inches) in diameter. The branches are long and sloping, and begin from near the base. The wood is soft, spongy, and worthless. It soon decays at the root, and, outside the burned-over areas, furnishes the largest percentage of the woody débris that litters the Cœur d'Alene forests. The other form grows very large. Trees with a height of 60 to 70 meters (190 to 220 feet) and a diameter of 1.4 meters (4.6 feet) are often found. The proper crown is about one-half of the total length of the tree, and the branches are very short and few, diverging at right angles. This form is much less common than the one previously mentioned. It inhabits localities more plentifully supplied with moisture, and ranges to quite as high an elevation as the other. It is sometimes sawed into lumber, and is said to produce a fair article. The smaller form is not utilized for any purpose. It is probable that it would make excellent paper stock. Both forms produce cones rarely and but few at a time. I have never seen more than two cone-bearing individuals of the larger variety.

SUBALPINE FIR.

Abies lasiocarpa (Hook.) Nutt.

A tree of wide range in the Cœur d'Alenes. It is never wholly absent from any portion of the wet valleys of the interior basins and extends up the slopes of the ridges to the highest elevations. As there is no land higher than 2,160 meters (7,080 feet), it can not be determined what the ultimate altitudinal limits of the tree may be in this latitude, but it seems probable that the species would be the last at timber line. In the valleys the tree grows to a height of 20 to 30 meters (66 to 98 feet), with a diameter up to 50 cm. (20 inches), which it rarely exceeds. At elevations of 1,500 meters (4,900 feet) and upward it seldom goes above 18 meters (60 feet) in height and 30 cm. (1 foot) in diameter. On the summit of the loftiest ridges it often occurs very much dwarfed. Trees which do not reach a stature above 2 to 3 meters (6.7 to 9.8 feet) bear cones and show an age of 50 to 60 years. This is more due, however, to a rocky and unproductive soil than to nearness of altitudinal limits. The tree requires an abundance of moisture and at low elevations a northern or eastern exposure. Given this, the lower limit of its range will be the lowest levels of the Cœur d'Alenes, about 650 meters (2,100 feet). In the basaltic areas of the St. Mary and St. Joseph valleys it is frequently found associated with a dense yellow-pine forest. In the valleys the tree never forms a forest of pure growth. It is always scattered among the other conifers. But on the mountain slopes and summits, at 1,500 meters (4,900 feet) elevation and upward, there are often large tracts where the species forms fully 90 per cent of the forest. This is especially the case on the ridges of the North Fork basin. The tree has always a large crown, with rarely a clear trunk, though the branches for a distance of 5 to 6 meters (16 to 20 feet) from the ground may be small and dead. More often they are green quite to the ground. It is of short-lived growth, and the large individuals are mostly rotten in the center. The wood of the tree when it grows in the valleys is very soft and sappy and of no value, even for fuel. On the ridges, owing to slower growth, the wood is denser and contains less sap. If cut and allowed to season, it shrinks and becomes so dense that only with difficulty can a nail be driven into it. It can then be used for various purposes, such as timbering mining tunnels and shafts, and is fully as durable as wood from the yellow pine. The bark of these two species of fir is abundantly supplied with resin vesicles, and they are therefore commonly known as balsam firs. They are frequently confounded with each other, but, aside from other characters, they may be readily separated by the position the vesicles occupy in the bark. On the white fir these are quite superficial and appear as raised blisters, while on the subalpine fir they are sunken, and rarely appear elevated above the surface of the bark.

TAMARACK.

Larix occidentalis Nutt.

The only species of deciduous conifer in the Cœur d'Alenes. It is plentiful everywhere—in the canyons, on the mountain slopes and summits, and even among portions of the low-lying yellow-pine forest. It is a noble tree when seen in its favorite haunts, which are the wet, gloomy canyons of the interior basins, where it often vies in size with the white pine. It grows here to a height of 30 to 60 meters (100 to 200 feet), frequently with a diameter of 2.4 meters (8 feet). The crown is composed of short, straight branches, and is about three-fifths the total height of the mature tree. The individuals that are found on lower levels, especially in the yellow-pine forest, have a much larger crown; often five-sixths of the entire length of the tree is composed of this, and the branches are long, slender, and slope downward at a high angle. Its altitudinal range is between 650 and 1,900 meters (2,100 to 6,200 feet), reaching its greatest size between 850 and 1,000 meters (2,800 and 3,300 feet). In its youth it is a rapid grower. During the first 30 to 40 years the spaces between the annual rings will average 5 mm. ($\frac{1}{5}$ inch) in favorable localities. As it advances in age the annual increase in its diameter becomes very much less, until at 180 to 200 years and upward there is often not more than 0.5 mm. ($\frac{1}{50}$ inch) between the yearly layers. The sapwood is white and forms but a narrow zone a few centimeters wide. The heartwood is of a yellowish or reddish tint, and is very heavy, full of sap, and frequently seamed with long, wide gum cracks. The specific gravity of the wood is slightly higher than that of the yellow pine, and the logs often sink when put in water. To obviate this the butt end is sawed off a few meters above the cut, or holes are drilled in the logs and tightly plugged. It is largely sawed into lumber, which, however, is apt to wear very rough unless care is taken in sawing. It makes excellent fuel and is one of the two trees in this region which supply most of the cross-ties used by the railroads. The fiber is short and the tensile strength low; it is therefore, so far as I know, never sawed into square timber for bridges, beams, etc.

HEMLOCK SPRUCE.

Pseudotsuga taxifolia (Poir.) Britton.

The hemlock spruce is, next to the yellow pine, the most generally useful of the Cœur d'Alene conifers. Both its regional and altitudinal range are very much greater than those of the yellow pine. It is found in all portions of the Cœur d'Alenes, from the lowest level to elevations of 2,160 meters (7,100 feet). It is equally at home in the humid valleys or on the well-drained mountain slopes. In the lowlands it reaches a height of 50 to 70 meters (160 to 230 feet), with a diameter which seldom exceeds 1.3 meters (4.2 feet); on the dry hillsides it is of slow growth,

and the crown constitutes about two-thirds of the total length of the tree. In the valleys it grows more rapidly and the boles form long, straight, cylindrical columns. In such cases the crown may occupy less than one-fourth of the total length of the tree and is made up of short, straight branches. The sapwood is white and varies from the one-tenth to the one-sixth of the diameter, according to age. The heartwood is sometimes yellow and sometimes pink or reddish. The yellow variety is soft, easily worked, and much preferred; the red is very tough, considerably harder, and less esteemed for general purposes. The wood contains but little sap, and is therefore comparatively light. It is sawed into lumber for all purposes, and owing to the small quantities of sap will furnish a fair quality at an earlier age than the other conifers of the region. It is much cut for railroad cross-ties, and, together with the tamarack, furnishes fully 85 per cent of all this sort of timber drawn from the Cœur d'Alenes.

CEDAR.

Thuja plicata Don.

A beautiful and valuable tree occurring plentifully in many localities throughout the Cœur d'Alenes. It is popularly designated as cedar, but a more proper name is arbor vitæ. It is not equally distributed, but thrives best in low, swampy localities, at the outlet of streams, around and on the former sites of beaver ponds, and in the neighborhood of wet, springy places generally. At the same time it is not entirely absent from the dry mountain slopes. The areas upon which it is found most abundantly and of greatest size are the central portions of the St. Joseph and St. Mary valleys and along the North Fork for a distance of 80 or 90 kilometers (50 to 55 miles) above its junction with the South Fork. There are also many localities of minor extent scattered here and there throughout the inaccessible parts of the upper tributaries of the streams, where it is found in small groves and occasionally of large size. In the upper part of the valley of the South Fork the tree formerly existed in large numbers and of gigantic size, as is attested by the old stumps one sees everywhere in that locality, but it is now nearly destroyed by forest fires and the ax. It is absent from over the major portion of the western half of the North Fork basin, an inexplicable circumstance when it is considered that the climatic conditions and the elevations are not essentially different from those that prevail over other areas where the species is plentiful.

The tendency of the tree is to form groves of pure growth. The interlacing branches, cutting off the sunlight from the ground beneath them, produce a condition inimical to the growth of other kinds of conifers. Owing to its habitat in places where the soil is continually saturated with water and to the exceedingly firm hold the roots have on the earth, it often stands a fair chance of escaping the forest fires and of successfully resisting the fierce gusts of wind that sweep the canyons

occasionally and uproot thousands of trees of other species. We therefore find among the groves individuals which far surpass in age and diameter any of the other trees of the region. Specimens have been seen 4 meters (13.5 feet) in diameter. If the growth of such an individual was approximately in the same ratio as is that of trees 1 to 1.5 meters (3.2 to 4.9 feet) in diameter, it would have been not less than 1,200 years of age. Probably it was far older, for with advancing age comes slowness of growth.

The altitudinal range of the species is between 650 and 1,500 meters (2,100 to 4,900 feet). The tree grows from 20 to 50 meters (65 to 164 feet) in height, with a diameter which varies from 1.5 to 2.5 meters (4.9 to 8.3 feet). The length of crown is commonly three-fourths of the total length of the tree, but is subject to considerable variation in this respect. Where it grows in very close and pure groves it may not be above one-half the whole length.

The bark of the tree is tough and stringy, and is used by the Indian tribes of the Northwest in making mats, baskets, etc. The sapwood is white, and forms a mere narrow zone 1 to 3 cm. (0.4 to 1.2 inches) broad. The heartwood is reddish, pleasantly odorous, light, entirely free from resin, and does not contain much sap. In large trees it is more or less rotten, and sometimes the whole trunk of the tree is only a thin shell, the balance having decayed.

Probably not less than 80 per cent of the trees 1 meter (3.3 feet) and upward in diameter are rotten at the core. As the center of the tree is not much used in any case, a moderate quantity of rot does not materially lessen its value. The grain of the wood is rather coarse, it splits easily, and is brittle. It is a moderately rapid grower, and is more uniform in this respect than any other of the Cœur d'Alene conifers. The principal use of the tree is in the manufacture of shingles. It is also occasionally sawed into lumber for inside finishings. This is said to take a fine polish and to acquire a deeper color with age. As the wood is very durable when in contact with the soil, it is largely employed for fence posts, telegraph poles, bridge piles, and the like. It makes very inferior fuel, and is rarely used as such in the region where it grows. Owing to the knotty character of the wood, the waste of material in shingle making is enormous. The shingles are sawed out of the wood between the knots and the balance thrown away. When a shingle mill is located near a stream its presence is always made known by the great quantities of knotty rejected shingle bolts and blocks that litter the banks of the stream.

Owing to the rapid growth of the tree, it is early fit for various uses. At 20 to 50 years it will furnish rails, fence posts, and telegraph poles. At 150 to 350 years the tree is in prime condition for shingle bolts and lumber. Above this age the rot at the core is apt to extend so far toward the periphery that the value of the tree is small.

PATTON'S HEMLOCK,

Tsuga pattoniana (Jeff.) Engelm.

This species of conifer is comparatively unknown to the majority of the people of the Cœur d'Alenes, and when seen is frequently confounded with Mertens's hemlock (*Tsuga mertensiana*). It is a tree which in the Cœur d'Alenes is pretty closely confined to the higher divides. Its range is from the Clearwater divide in the south, where it forms more than 75 per cent of the forest, through the canyons and on the divides of the upper St. Joseph, on all the divides between the St. Joseph and the Cœur d'Alene River, throughout the main range of the Bitter Roots, on the divides between the North and South forks east of Nine-mile Creek, and sparingly on the higher peaks in the eastern part of the North Fork basin. It is absent from all the ridges, except the Clearwater divide, which form the basin of the St. Mary River, from all the mountains around Lake Cœur d'Alene, and from the whole western portion of the North Fork basin. The tree is essentially an inhabitant of the high ridges above an elevation of 1,500 meters (4,900 feet). It forms here a very large proportion of the forest growth. It is much more abundant on the Clearwater divide and on the upper St. Joseph than elsewhere, diminishing very rapidly in numbers as we go northward.

The species is well adapted to stand the severe winter blasts of these high, exposed ridges. Large trees are seen only in protected saddles or sheltered ravines; on the open part of the mountains, where the tree stands alone or in scattered groves, the species is low and squatty and the branches are short and stiff, to retain as little snow as possible and to present a small surface to the storms. It is of slow growth. A tree 15 cm. (6 inches) in diameter showed 75 annual rings. This was in an exposed rocky place, where the growth was perhaps slower than in more favorable localities. In sheltered places, in the saddles of the ridges, and in the upper portions of the canyons which head in the Clearwater divide the tree is seen to best advantage. It reaches here a height of 30 to 40 meters (100 to 130 feet), with an extreme diameter of 70 cm. (28 inches), commonly from 35 to 50 cm. (14 to 19 inches). The crown on such well-developed individuals is about three-fifths the total length of the tree. Its growth is slow, even with the most favorable surroundings. Trees with a diameter of 50 cm. (19 inches) will give 200 to 250 annual rings. The wood is very dense, close grained, and hard, utterly unlike the wood of any other conifer of the Cœur d'Alenes. It resembles, in a degree, as to its qualities, the wood of the white ash of the eastern United States. If the species grew in accessible places it would be a valuable tree and be extensively used. As it is, the tree is not utilized in any way. The bark contains but little tannin. It is one of the few species inhabiting the high ridges of the Cœur d'Alenes which bear cones abundantly

each year. This and the white-barked pine (*Pinus albicaulis*) are the only trees in these mountains which have a strictly limited lower range.

MERTENS'S HEMLOCK.

Tsuga mertensiana (Bong.) Carr.

A common species and with a regional distribution practically throughout the Cœur d'Alenes. The area upon which it grows most plentifully and attains its largest development is the western portion of the North Fork basin. About 30 per cent of the forest is here composed of this one species.

Unlike Patton's hemlock, it is a tree which belongs to the low, wet valleys, and is rarely seen above 1,400 meters (4,600 feet) elevation. It is of extremely slow growth in most localities. Trees 12 to 15 cm. (4.7 to 6 inches) in diameter, which will count 120 annual rings, are very common. This slow growth is especially marked where the trees are set close. When a larger space intervenes, the trees grow faster and attain greater size. An average height, rarely exceeded, is 40 to 55 meters (130 to 180 feet), with diameters up to 70 cm. (28 inches), but sometimes groves are found which contain individuals with a diameter of 1.8 meters (5.9 feet). It is usually a very branching tree, with excessively long laterals. The crown is about two-thirds the total length. As the tree is often plentiful in accessible localities, it is frequently sawed into lumber. This is of fair quality, and when seasoned it becomes dense and hard, so that a nail can be driven into it only with difficulty. The bark appears to carry a considerable quantity of tannin, and the tree could probably be used as a source of tan bark.

YEW.

Taxus brevifolia Nutt.

This species of tree, while classed among the cone bearers, does not produce a cone as its fruit. In the month of August there will be seen in the forests where the species grows a tree, or long, straggling shrub, with evergreen leaves in appearance like those of a fir, and bearing bright red berries. This is the yew. The tree ranges throughout the Cœur d'Alenes, with an extreme altitudinal limit of at least 1,600 meters (5,300 feet). It is nowhere abundant; perhaps more nearly so in the North Fork basin than elsewhere. It rarely attains the stature of a tree; more commonly it is a shrub, with long, irregular branches, which sometimes reach a length of 10 meters (33 feet). Near Lake Pend Oreille and in the upper part of the North Fork basin I have seen trees having a height of 20 meters (66 feet) and a diameter of 35 cm. (14 inches). Such trees exhibit the characteristics of the species more fully than the shrubby forms. From a specimen of this sort I draw the following description: Height, 20 meters (66 feet); diameter,

35 cm. (14 inches); branches beginning 3 meters (10 feet) above the base; crown very wide, with a great number of long laterals drooping at an angle of about 45° ; bark reddish, close, thin, of a leathery consistency; wood reddish, hard, fine grained, full of knots, but very readily fissile between them, apparently capable of taking a bright polish; wood of the trunk breaking with a short fracture, that of the limbs very flexible; sapwood, 1 cm. (0.4 inch) thick, white; heartwood, 34 cm. (13.4 inches); annual rings, 185. In this region the tree is too rare, small, and knotty to be of any commercial value.

RED CEDAR.

Juniperus virginiana Linn.

A low tree rarely exceeding 6 meters in height (20 feet) and 20 cm. (8 inches) in diameter. Its habitat is on rocky banks, principally around lakes Cœur d'Alene and Pend Oreille. Its altitudinal range lies below 700 meters (2,300 feet). The wood is fragrant and reddish in color, hence the popular name "red cedar." The tree is too small and scarce to be of any commercial value. Mountain juniper (*Juniperus nana* Willd.) is a mere shrub, prostrate or trailing over the rocks at elevations of 1,800 meters (5,900 feet) and upward; of no value.

A summary of the conifers as to their principal economic uses will stand as follows:

Lumber.—Yellow pine, white pine, Engelmann spruce, tamarack, hemlock spruce, cedar, Mertens's hemlock.

Shingles.—White pine, cedar.

Railroad cross-ties.—Tamarack, hemlock spruce.

Telegraph poles.—Cedar.

Fence posts and rails, fuel.—Any and all of the species.

The deciduous trees of the Cœur d'Alenes are as follows:

Cottonwood, balm of Gilead (<i>Populus angustifolia</i>).	Cherry (<i>Prunus demissa</i> , <i>Prunus emarginata</i>).
Aspen (<i>Populus tremuloides</i>).	Chittim wood (<i>Rhamnus purshiana</i>).
Birch (<i>Betula occidentalis</i> , <i>Betula papyrifera</i>).	Thorn (<i>Crataegus douglasii</i> , <i>Crataegus tomentosa</i>).
Mountain maple (<i>Acer glabrum</i>).	Service berry (<i>Amelanchier alnifolia</i>).
Alder (<i>Alnus rhombifolia</i> , <i>Alnus viridis</i> , <i>Alnus tenuifolia</i>).	Mountain-ash (<i>Sorbus sambucifolia</i> , <i>Sorbus occidentalis</i>).
Willow (<i>Salix lasiandra</i>).	

With three exceptions, all these species occur throughout every portion of the Cœur d'Alenes. Those of local distribution are: *Alnus rhombifolia*, *Crataegus tomentosa*, and *Sorbus occidentalis*. Such of them as reach high elevations often become mere shrubs. None are of any economic importance. It has been stated that the wood of the poplar works up well into a fair article of paper stock, and that it can not be excelled for purposes of match making. None of the native trees are transplanted or cultivated.

FOREST ZONES.

To obtain an accurate conception of the Cœur d'Alene forests as we find them now, and to enable us to treat the subject comprehensively, it is necessary that a division into *zones* or districts be made. There are various advantages in such a partition. It will enable us to treat each part specifically, and when we come to consider the problems connected with the destruction and preservation of the growing timber we can the more readily refer to any of the various sections comprising the same. I propose to make two classifications of the coniferous forests of the Cœur d'Alenes, basing them upon (1) the vertical range of the species; (2) upon the age of the trees which predominate over any given area. The former of these is the plan generally used in mountainous regions to define the presence or absence of species within certain limits. The latter has, so far as I am aware, never been employed in the West to characterize the condition of the general forest growths over large areas. It is, however, by far the best and most reliable from an economic point of view, and, as it is applicable to all our Western timber regions alike, should be employed in all cases where an accurate knowledge of the condition of the forest is desired. Both classifications will apply to any of the forests of the Pacific Slope. But there is this to be observed, that the limitations of the former will always vary with the species which compose the forests and the latitude of the region where they grow, while the latter can be applied alike to all areas, no matter where situated. For this reason, if we wish to know the actual state of the forest growth of any region of the West on a basis of these divisions, we must have a table of the vertical limitations of the forest zones of such locality. Given this, with the data of age demanded by the second division, we should be able to form a very accurate conception of the true condition of the forest anywhere.

According to the first principle of classification, namely, the species of conifer which is most abundant or characteristic in each section, the forests may be divided into four parts. They will be designated thus: The Lower, or Zone of Yellow Pine (*Pinus ponderosa*); the Intermediate, or Zone of White Pine (*Pinus monticola*); the Upper, or Zone of Subalpine Fir (*Abies lasiocarpa*); and the Crest Line, or Zone of White-barked Pine (*Pinus albicaulis*).

The second classification will give us four categories: Old Growth, Second Growth, Young Growth, and Recent Burns.

It must not be understood that these sections are absolute in their limitations. Innumerable variations and modifications are found to occur when each is taken up specifically. But in general they will stand, and are infinitely preferable to the customary "lumping" of the forest region into one very heterogeneous mass.

In attempting to limit the vertical extension of the coniferous forest zones of the Cœur d'Alenes we meet at once with a serious difficulty.

This arises from the fact that the lower boundaries of most of the species are ill defined. We shall find that the cause of this is the infinite variety of climatic conditions, which is such a marked feature of the western extensions of the Bitter Root Range.

The tortuous courses of the mountain ridges and the canyons are the main causes of the innumerable local variations of climate. The mean annual temperature of any given portion of a ridge or canyon varies with its direction of exposure, and this does not simply refer to the cardinal points of the compass. Almost every degree of inclination to any of these directions involves a corresponding change in the prevailing temperature conditions. This occasions differences in the precipitation, and, though we have no data by which we can demonstrate the difference between a south and a north slope, yet it is a fact well established by observation that more rain and snow fall on the latter than on the former.

It must here be taken into consideration that the evaporation from the southern slopes is greater than from the northern, and that the visible effects upon the vegetation, from the same amount of rain and snow, would therefore be less on the meridional sections of the ridges than on any of the others. It is not temperature conditions alone which influence the precipitation. There is another very potent factor to be found—the mechanical impact of the wind. Let anyone who doubts this go to the summit of some of the high ridges, say from 1,500 to 2,100 meters (5,000 to 7,000 feet) altitude, and remain there during a rain or snow storm. It will be seen then that a large quantity of the air which is driven against the southern face is deflected upward with great force and velocity, carrying with it enormous quantities of clouds, which sink and are thickly massed as soon as the calmer and cooler north or lee side is reached. The rending asunder of the cloud masses by this upward current diminishes the amount of moisture precipitated from them. Part of the deflected air and clouds will, if the ridge is high enough, pass through the low gaps or saddles in the mountain. The heavier growth of timber in these saddles than elsewhere in the neighborhood is due to this rather than to the drainage from the higher parts of the ridges, which would not flow toward the depression unless the dip of the strata favored it. The phenomenon which I have designated the dominant precipitation point plays a part here; but however much this may vary from year to year the condition of the forest as a whole proves that there is a general mean in it, and that the variation is not sufficient to exert a permanent influence in the distribution of the species.

From a consideration of these climatic conditions we shall not be surprised to observe the poorly defined vertical limits of the Cœur d'Alene conifers, and as great humidity is the predominant climatic feature of the region, we may expect the species of the elevated portions, which can endure these very conditions, to descend to low levels. On the

contrary, the trees of the lowlands thriving only in drier air and soil would not extend far upward, and, in point of fact, we find that the upper limits of the coniferous zones are far better defined than the lower.

The Cœur d'Alenes possess no proper foothill region, unless the small area to the east of the north end of Lake Cœur d'Alene can be so called. If there were a central ridge whose slopes were continuous with a lower or plains region, the diversity of climatic conditions now experienced would not be met with inside the Cœur d'Alene triangle, and the forest zones would be far more readily defined.

I will now pass to the question of the limits of the forest zones and the features which give the distinguishing character to each.

ZONE OF YELLOW PINE.

There is first the Lower, or Zone of Yellow Pine. This is at the present time by far the most important from a lumberman's point of view, as, owing to its accessibility, it supplies the larger portion of the logs sawed into lumber. The principal upper and lower limits of its vertical range are between 650 and 850 meters (2,100 and 2,800 feet). It is marked by its open character. The trees stand far apart and there is but a sparse undergrowth, generally made up of species of *Opulaster* and *Rosa*, *Holodiscus discolor*, *Ceanothus sanguineus*, and an occasional *Philadelphus lewisii*. The ground is covered with a fair, sometimes a very luxuriant, growth of grass, principally species of *Festuca* and *Poa*, with occasionally an area of sedge—*Carex geyeri*. There is not much fallen timber. Where the growth is pure the forest is park-like and has a clean and open appearance.

Usually, however, the growth is mixed, and here and there among the yellow pines are more or less extensive groves of Douglas spruce, white fir, and the lowlands form of the black pine. In low or moist places will be found the tamarack. The Douglas spruce sometimes replaces the yellow pine to the extent of 75 to 80 per cent, and the black pine occasionally crowds it out altogether. In such cases the forest growth is dense. A heavy stand of these species is a sort of transition ground to the next section. The undergrowth will be the same as that of the typical yellow-pine forest, but in addition there will be a multitude of young trees of the white fir, so crowded that the larger number will never develop beyond mere shrubs.

The number of trees to the acre varies so greatly that it is almost impossible to give, even approximately, an accurate estimate. I should consider that in a yellow-pine forest untouched by the ax, 20 to 30 trees of *Pinus ponderosa* or of *Pseudotsuga*, 70 cm. (28 inches) and upward in diameter, would be a fair average. Where the timber is mixed the diameters of the trees will average much less and the number is greatly increased. Thus in a black-pine grove an estimate of 1,000 to 1,200 to the acre, 15 cm. (6 inches) and upward in diameter,

would not be at all excessive. The limits of the Zone of the Yellow Pine are influenced as much or more by the amount of the annual precipitation as by altitude. The ponderosa pine will not endure excessive humidity; therefore the area covered by this section is the one upon which less snow and rain falls than any other in the Cœur d'Alenes.

ZONE OF WHITE PINE.

The next section is that of the White Pine. In this zone occur the heaviest and densest forests of the Cœur d'Alenes. Its vertical range lies between 900 meters (3,000 feet) for the lower and 1,400 meters (4,600 feet) for the upper limit. As the mean of the extreme altitudinal limit of the yellow pine as a tree is about 1,200 meters (4,000 feet), we find more or less of an overlapping of the White Pine Zone by that of the yellow pine. The areas on which the White Pine Zone reaches its best development are all the wet stream valleys and the mountain slopes with a northern exposure. While as a whole the predominating species in this section is the white pine, we seldom find it forming pure growths. Accompanying it are the majority of the conifers of the Cœur d'Alenes, and some species find here their greatest development. These are the cedar, Engelmann's spruce, Douglas spruce, white fir, and Mertens's hemlock, Western larch in the lower parts of the zone, and the mountain form of the black pine in its upper.

The distinguishing feature of this zone in its vegetative aspect is the denseness of its growth and the great height of many of the trees. The stand of forest is very close; there is a vast amount of vegetable débris, decaying trees, fresh and old windfalls piled upon one another, broken-off tree tops, and young trees bent over by the snow and forming impenetrable thickets. Very little grass, more often none at all, grows on the ground, which is heavily covered with a humus reeking with moisture and topped off with a growth of mosses and liverworts. Multitudes of fungi are everywhere, representing numerous species and genera. In the fall of the year the ground is fairly carpeted with them.

Densely tangled masses of underbrush abound. The shrubs that form these are commonly various species of willows and alder, thorn, mountain maple, red cornel, the holly-leaved buck brush (*Pachystima myrsinites*), and species of elder.

The number of trees per acre is always considerable, but varies widely. A fair estimate per acre for the bottoms of the canyons would be 600 to 700 trees, with diameters from 25 cm. to 60 cm. (10 to 24 inches), and 2,000 to 3,000 trees, with diameters from 15 cm. to 25 cm. (6 to 10 inches); of saplings there are often tens of thousands on the same space in addition to the larger growth.

ZONE OF SUBALPINE FIR.

The third section is that of the Subalpine Fir. Its vertical range lies between 1,500 meters (4,900 feet) for the lower limit to 1,700 meters (5,600 feet) for the upper. The boundaries of this zone are intended to

include the area upon which the subalpine fir forms more or less extended forests of nearly pure growth. The altitudinal limits of the species are very much greater. This zone is always upon the high slopes and summits of the ridges where an abundance of snow falls and the drainage is good. It is marked by its open character. The undergrowth of shrubs is mostly confined to the saddles and northern slopes, and consists of huckleberry shrubs, mountain ash, alder, and menziesia. The trees stand widely apart, and when there is no undergrowth the ground is heavily carpeted by the bear grass. The appearance of the forest then is that of a park. Occasionally the undergrowth, especially in the saddles, is entirely made up of saplings of this fir. In such cases the young trees stand so close that it is impossible for a man, even on foot, to make his way through them without a liberal use of the ax. There is but little fallen timber in this zone. The trees are short and firmly rooted and do not topple over easily. Various species, whose range is mostly at lower elevations, extend into this section, but seldom grow to large size. Such are the Douglas spruce, Engelmann's spruce, and the white and black pines.

ZONE OF WHITE-BARKED PINE.

The Crest Line Zone is the uppermost of the forest divisions of the Cœur d'Alenes. It is composed to the extent of 85 per cent of two species. They are Patton's hemlock and the white-barked pine. The lower limit of its range is 1,700 meters (5,600 feet); the upper would doubtless be the timber line did any such exist in this region. The forest here is not continuous. It occurs in large or small groves separated by grassy tracts. Very often over large areas but scattered individuals occur. There is not much undergrowth. Some huckleberry shrubs and the two species of mountain ash (*Sorbus sambucifolia* and *S. occidentalis*) which occur in this region constitute the greater part of this. Very few windfalls are seen, and in general the forest is park-like, as in the zone below. By reason of its exposed position a great deal of the ground in the Crest Line Zone is rocky and the soil poor.

The second classification of the Cœur d'Alene forests is based upon the age of the majority of the trees, those which form the bulk of the timber growing upon any particular area. This is wholly dependent upon the time that has elapsed since the forest was burned, and while altitudinal limits have nothing to do with this we shall see farther on that by far the largest and most destructive fires occur in the Yellow and White Pine zones. The four subdivisions I will define thus:

Old Growth.—Areas on which no fires destructive to the forest growth have occurred within the past two hundred years.

Second Growth.—Areas which have been wholly or partially burned over inside of two hundred years, but on which no fires have occurred within the past seventy-five years.

Young Growth.—Areas on which the timber has been destroyed by

fires within seventy-five years, but where none have occurred during the past thirty-five years.

Recent Burns.—Areas burned over within the last thirty-five years, and on which the destruction of the timber has been from 65 per cent to total.

The Old Growth covers the smallest areas in the Cœur d'Alenes. It is most common in the Crest Line and Yellow Pine zones and least in the White Pine, for reasons to be stated farther on.

The Second Growth comprises the major portion of the growing timber fit for lumbering purposes. It is most abundant in the White Pine Zone.

The Young Growth and Recent Burns are more plentiful and of larger extent in the White Pine Zone than elsewhere.

FOREST DESTRUCTION.

Under this head we will consider the agencies which are now operating to destroy the forests of this region and the remedies which, if applied, would have a tendency to check them.

The remarks to follow will in a large measure fit the conditions which prevail throughout the forest regions of Idaho, Washington, and Oregon, and if the remedies to be proposed would secure the desired result here they would do the same elsewhere where like circumstances exist.

The Cœur d'Alene forests are in process of rapid and total extinction. The slow agencies of nature which are constantly destroying but as constantly replacing are augmented by the efforts of man, who, with all the means of destruction at hand, tears down the work of centuries, but gives no thought toward the rebuilding of the fabric.

The forests of the Cœur d'Alenes in all the accessible portions are becoming mere skeletons of their former state, and soon the last vestiges will be swept away and nothing remain but blackened logs and stumps to mark the former site of the densest forest between the Cascades and the Mississippi.

The popular mind, fostered by the newspapers of the West, refuses to believe that the forest region of the Pacific Slope is other than inexhaustible. It is a most pernicious idea, and one which is largely responsible for the apathy of popular opinion upon forest preservation in the West. Journals and newspapers in every section, in attempting to exhibit the natural advantages of their several localities, will, if in a forest region, invariably lay stress upon the inexhaustible supply of timber fit for lumbering and other purposes, absolutely ignoring the fact, patent to every careful observer, that in a country so rugged and difficult of access as that formed by the ranges west of the Continental Divide only a very small proportion of the forest covering can be reached economically, and that the accessible localities are being denuded as rapidly as the ingenuity and carelessness of the inhabitants

can accomplish it. So far as the Cœur d'Alenes are concerned, the forest is fast disappearing, a small percentage into lumber, but most of it into smoke and ashes, and generations will pass before what has been and is being destroyed can be replaced, even with the most fostering care, upon the denuded areas by the General Government or by individuals.

It is about thirty-four years since the Cœur d'Alenes became at all accessible, by the construction of the Mullan road. The age of the Young Growth upon hundreds of thousands of acres proves that the forest, at least in the Yellow and White Pine zones, was practically intact before that time. Upon the completion of the road a constant stream of immigration poured into Oregon and Washington by this route. The heavy and dense timber through which the road led for so many miles gave a gloomy aspect to the region, and the torch was freely applied "to let in more air and sunshine." The dry season was the time of year when the immigration was the heaviest; that was also the time of year when the forest was in prime condition for burning, and that advantage was taken of this circumstance the large tracts of young growth attest.

The next well-marked epoch in the annihilation process came with the building of the Northern Pacific Railroad. The right of way was cleared by fire whenever the timber was in a condition to burn. I passed over this road in September, 1883, and there were then two almost continuous lines of fire along the track throughout Idaho. It is true the road did not run through the Cœur d'Alenes. The fires were in the valley of the Clark Fork, but they extended from that region into the basin of the North Fork of the Cœur d'Alene and wrought immense destruction there.

The next and last stage, which is still in active operation, came when the great ore deposits in the Cœur d'Alenes were discovered. Thousands of prospectors flocked into the country then, and the forest fires raged in hundreds of localities to clear away the dense growth of timber and shrubs, which very materially interfered with the work of the prospectors seeking the mineral-bearing lodes. As the mines began to develop, fuel and lumber were needed. The choice parts of the forest were cut into, débris took the place of the green tree, and fire, coming later, finished what the ax had spared. In 1884 I passed through the Cœur d'Alenes into Montana. In spite of the many previous fires, there were miles upon miles of primeval forest. In this year (1895) along the same route there was not a single foot that the fire and ax had not run through and the larger quantity had been uselessly and totally destroyed. The site of the former flourishing forest was now occupied in part by a mass of blackened stumps and overthrown trees, in part by the débris left behind by the sawmills, long since departed, for there were no more logs to saw, and in part by coarse weeds or a struggling young growth endeavoring to gain a foothold along the steep mountain sides, but invariably fired as often as a sufficiency of undergrowth accumulated.

In the sections where no settlements exist the ax and the railroad as destructive factors are eliminated, but the most powerful of them all, the forest fire, remains and rages unchecked.

It is true that the needs of the people living in and developing the region demand fuel, lumber, etc. There would be an abundance to furnish all necessary supplies of this sort for ages to come if the forest was properly used. But in place of putting in practice an intelligent and careful system that would guard against waste and permit the growing timber to recuperate, methods are in vogue such as would have been especially devised for the purpose of laying waste as great an area of forest as possible in the shortest time.

From an intimate knowledge of the Cœur d'Alenes, obtained during a residence of ten years in the immediate neighborhood, I do not hesitate to affirm that 50 per cent of the accessible merchantable timber of the Cœur d'Alenes is absolutely destroyed; that of the remainder 20 per cent has been more or less culled, leaving only 30 per cent in good condition. All this within a period of thirty-four years, and of these only twelve years represent settlement and development.

Judging from these data, how long will the remainder last, without some system of protection?

Few persons consider the time required to replace a forest of the sort that covered this region upon the advent of settlements. Those who are especially active in destroying it clearly never do. Let us take the most commonly utilized trees for examples. To produce mature lumber—that is, logs that will saw economically and furnish a product reasonably durable in character—requires for the yellow pine an average of 175 years, for the white pine a period ranging from 200 to 300 years, for Mertens's hemlock an average of 275 years, for the cedar 200 to 250 years, for the Western tamarack 150 years for rough lumber, 300 to 350 years for the clearer and more valuable product, and for the Douglas spruce an average of 200 years. The tamarack and the Douglas spruce are cut for railroad ties while young. Few trees are fit for this purpose under 50 years of age. A glance at these figures will show that no denuded area will again produce valuable timber for generations to come. It may be said that there is a young growth in various stages, which is continually producing mature trees. Accepting this, the question arises, Is this source of supply sufficient to meet the constantly growing demands? It is perfectly clear that it is not. Sawmills are continually exhausting the forests in their localities and laying new areas under contribution. Small lumbering plants and tie-choppers' camps are being moved from place to place to find fresh and untouched regions; and, so far as we know, not one of the areas denuded since the advent of the sawmill has as yet recuperated sufficiently to yield a further supply of merchantable logs.

However rapid the destruction may be from the ax and the saw, it would still require a very long time to create any appreciable want of suitable lumbering material on the Pacific Slope if only these two means

were employed, but added to them are the fires, and they spare neither old nor young growth.

There are two principal agencies by which growing timber is destroyed—the operations of nature and those of man.

The natural agencies operating in the Cœur d'Alenes are in part those of the meteorological order and in part those which act as diseases of the trees. Of the former there are four, rain, snow, lightning, wind; of the latter, one, fungi.

The action of rain, snow, and wind is more or less synchronous, according to season, and operates throughout the year. The lightning is more local, and limited to a few months during late spring and summer. The destruction from the first three climatic agencies, resulting from the enormous precipitation, is immense. The vast quantities of débris in the shape of fallen or broken trees, which litter the forest in all directions, prove this. The storms that bring the rain or snow are nearly always accompanied by strong south or southwesterly gales. Owing to the broken character of the mountains, the valleys are sheltered from the direct force of the wind, which is only felt in all its strength on the high summits of the ridges. In the valleys the wind comes in series of severe gusts of longer or shorter duration. The heavy rains loosen the soil and humus about the roots of the trees, and their great height affords a leverage by which the largest tree is easily overthrown by a comparatively small exertion of force. The ease with which a tree is thrown down depends, also, largely upon the depth to which the roots penetrate. There are but two species of conifers of general occurrence in this section which strike root deep enough to offer a fair degree of resistance to the wind. They are the cedar and Western tamarack. The cedar is short in stature and does not offer much leverage; the tamarack grows tall and, as it does not readily yield at the root, is frequently broken off in the trunk. We therefore find the greatest destruction due to these agencies in the Intermediate or White Pine Zone.

The operation of the phenomenon that I have named the dominant precipitation point (see page 15) is shown here. It has already been mentioned that the winds which accompany the storms are felt throughout the valleys as powerful intermittent gusts. The greater number of these are observed to have a certain determinate direction for each season, breaking down the forest persistently and repeatedly in the same locality during successive storms and leaving other portions untouched. As the ridges by their trend determine in the deflection of the air currents the angle of impact of the wind in the valleys, it will be readily seen that a change in the general direction from which the storms come will involve a corresponding change in the deflection of the air into the valleys, which, in turn, will spend its force upon another part of the forest. If the storms came always unalterably from the same point, we should have long, tortuous passages cut through the forest in certain

directions, but owing to the oscillating movement of the point from which the storms come we find areas which have been partially denuded in all stages of repair and others which show all degrees of destruction.

The agency of snow in destroying the Cœur d'Alene forests is seen in the great number of broken trees, both young and old, which one meets constantly in traveling through the timber. To successfully resist the snow, it is necessary the tree should have a vertical stand. Even a slight degree of inclination is pretty sure to end in the uprooting of the individual by the weight of the snow which will accumulate on the crown during the storms of early winter.

Snow slides occur at various places, especially around the high, bare peaks—such as Stevens, Wiessner, and Sunset—but they are insignificant and not at all dangerous, except where the timber has been destroyed. The occurrence of destructive snow slides in the settled portions of the Cœur d'Alenes is a direct consequence of forest destruction in those localities. On the areas where it is untouched no slides can occur. The snow is firmly held, melts slowly, and there are no bare spots on the slopes or on the summits where a loosened mass can acquire momentum.

The lightning operates by following the trees to the earth and firing the humus, or, in cases where they are dead and standing, the trunks or limbs are set on fire. Many of the fires which rage in the Cœur d'Alenes are ascribed to this cause. The supposition, however, is in the main fallacious. There are occasionally during summer high winds accompanied by electrical phenomena, lightning and sometimes thunder without rain. If lightning strikes a tree during such a storm and fires the humus, there is a probability of a forest fire. The largest number of electrical storms, however, are accompanied by downpours of rain which drench the humus and the foliage of the conifers so thoroughly that they can not burn.

Diseases of the trees come last among the more prominent of the natural influences which destroy the forests in the Cœur d'Alenes. They are the results of the attacks of various kinds of fungi. Every species is subject to them, but some more than others. Of the varieties that are particularly useful the white pine is, perhaps, more liable to such attacks than any other. Great bodies of this pine are often attacked simultaneously over considerable areas by some obscure fungous disease and invariably succumb.

We come now to the cause of the most extensive depredations on the growing forest—man. He employs two potent weapons, the ax and saw and fire. The methods and the motives of and for his work on the timber are infinitely varied. Among the former, sawmills and logging operations stand preeminent. There is not now as much activity in these industries throughout the Cœur d'Alenes as there formerly was. The reason for this is partly to be found in the diminishing supply near the centers of consumption and partly in the failure of

various parties to obtain the timber-cutting permits they have sought, which, if granted, would have opened up to them the best portions of what yet remains comparatively untouched. There are now no very large sawmill or logging concerns in operation in the Cœur d'Alenes. The largest and most numerous are at Harrison, at the outlet of the Cœur d'Alene River into Lake Cœur d'Alene. They obtain their logs partly from the St. Joseph region, partly from the Cœur d'Alene and North Fork valleys. At Cataldo, 3 kilometers (1.7 miles) above the old Cœur d'Alene Mission, there was until three months since a mill for the manufacture of shingles. They obtained their logs wholly from cuts along the valley of the North Fork. This plant burned down and is not yet rebuilt. There are, or were recently, a few small mills in the valley of the North Fork sawing lumber for local demands, also a few in the South Fork, all mere portable concerns. There are no sawmills in the St. Mary basin and none in that of the St. Joseph. In the former no logs are cut above the point where the river enters the canyon; on the St. Joseph logs are cut wherever opportunity is afforded. The large sawmill lately built at Spokane, Wash., will in the near future make itself felt as a consumer of the Cœur d'Alene forests.

Among other demands which make serious inroads into the timber are those for railroad ties and telegraph poles. None but young trees are used for these purposes, and none of larger diameter than can be used in their full diametral growth. The telegraph poles are cut altogether from the cedar, the railroad ties from Douglas spruce and tamarack. None are sawed except bridge and switch ties; the others are hewed from the tree. This makes the employment of large trunks for this purpose impossible. As ties made from the soft timber of the Pacific Coast conifers are not durable when placed in contact with the soil, they soon decay and require frequent renewal. Vast quantities of young timber are continually cut to meet this never-ceasing demand.

In logging, or cutting timber for any purpose, no attempt is made to spare the forest. A tree is felled in the direction which will be most convenient, without regard to the number it will crush in falling. The best parts only are used—tops, etc., are left to rot where they fall. The tie-chopping camps are the worst in this respect. As they can utilize more of the trees in a given space than the loggers, they also leave more tops and litter behind. This furnishes an excellent nidus for the coming forest fire to work in. Wood choppers, if in a region where trees are plentiful, pursue the same method. The straight, clear parts of the tree only are utilized; the crown is rejected, because it splits harder and requires time to trim up.

The clearings made for agricultural purposes really are the least destructive of timber, though one would suppose it would be the reverse. That is because it is an impossibility for one man to clear a farm in the White Pine Zone of sufficient size to support a family within the time of one generation. The clearings are mainly confined to the Yellow

Pine belt, and when settlements are made within the White Pine Zone the open meadow lands are universally chosen.

We come now to the most destructive of all the means used in exterminating the forests not alone of the Cœur d'Alene region, but of the Pacific Slope in general—the element of fire. The forest fires of the far West are very different affairs from those that ravage the upper Mississippi Valley or the Eastern States. Did they carry with them the same menace to life, we should soon see concerted efforts to abate the evil. Forest fires have always raged in the Cœur d'Alenes. The oldest growth of forest shows blackened stumps buried under the accumulated débris of centuries. When one digs down in the soil charred wood is often turned up from the depth of 1 meter (40 inches) or more. The forests of the past were doubtless fired in the main by the Indians, accidentally or purposely, or both. The areas, however, which were burned over each season were insignificant; in most sections fires manifestly did not occur during centuries.

The action of the fires in each of the forest zones is in a manner peculiar to each section, depending upon the means whereby it spreads. Its destructiveness, always considerable, is proportional to the amount of humus which covers the ground and to the free or interrupted access of a draft or wind. The fires of the White Pine belt are by far the most destructive from every point of view and very much more numerous. Owing to its sheltered situation, the progress of fire is here slow. It is not difficult to walk away from a fire as it advances. One can ride through a burning forest, as I have done many times, and suffer no other inconvenience than a covering of ashes and dust. A slight amount of clearing around a cabin or house is ample protection. It only becomes dangerous in the rare instances when a high wind fans the flames, or when the fire runs through an area previously burned over on which the dead timber is down. It then sometimes creates a strong draft or suction of its own, which sends the flames through the forest at great speed and annihilates everything in its way. Such instances are rare, and the fury of the sea of flame is soon over. The quiet and slow burning is the rule, and but for the volumes of ascending smoke an observer at a distance would not suspect the perhaps near presence of a great forest fire.

The fire in the White Pine belt spreads principally by burning the humus. There is a covering of this material ranging from 4 cm. (1.6 inches) in depth to 50 cm. (20 inches) or more. This rarely burns with a flame. It is a process of slow incineration of the mass at a red heat. If the fires ran through the forest with the same speed as in the East, every vestige of timber would have been swept off long since. After the fire has once obtained a firm lodgment in the humus it becomes an exceedingly difficult matter to extinguish it. I have known it to burn continuously for two months under the snow. As the line of incineration spreads through the forest, it encounters the roots of the trees.

In the majority of instances these are not burned, they are simply cooked, and the lower portion of the trunk, which is always more or less buried in a mass of dead and decaying pine needles, suffers the same fate. Only when a tree is reached having pitchy roots or gum cracks does it burn up, and then seldom completely.

The fire-resisting power of the trees, both in species and individuals, varies greatly. The factors of safety lie in a thick, nonresinous bark and in roots which penetrate deeper than the lower limit of the humus. Among the trees that occur in the White Pine belt the Douglas spruce resists fire the longest and Mertens's hemlock the least.

The fires in the Yellow Pine Zone spread with greater rapidity than in any of the other sections. The country is open and the ground more or less covered with grass, through which the fire runs. As the growth of grass is thin, the duration of the fire in any locality is short, and neither the yellow pine nor the Douglas spruce suffers very much the first few times. Where dense groves of black pine and tamarack exist there is a thick layer of pine needles, and the effects of the fires on them are much the same as in the White Pine belt. When the fires occur among the subalpine firs or along the crest line of the ridges, there is commonly a strong breeze accompanying them and fanning the flames. A clean sweep is pretty apt to be made in such cases. The subalpine fir does not well resist the fire, as the resin vesicles in the bark burn readily and cook the wood.

The after results of a fire on the timber are various. In the White Pine belt every tree that has been exposed to a fair contact with the smoldering, redhot humus dies. In the Yellow Pine section the tamarack and Douglas spruce trees that survive are almost certain to develop gum cracks, which unfit large portions of the tree, if not the whole, for use. The yellow pine develops pitch streaks and spots where the fire has touched the bark most severely, but in general this tree, owing to its very thick and nonresinous bark, suffers less than any other species. The gum cracks and pitch streaks which come as the after effects of the fires, even if the tree is not killed, pave the way for a burning of the individuals so affected at the next conflagration.

The trees in the White Pine belt soon begin to decay after the fire has passed through. The hemlocks always rot first at or closely below the lower portion of the crown of the mature trees, the others at the root. Two or three years after a fire the tops of the hemlocks begin to drop off and the tall, dead spires of white pine, spruce, fir, etc., begin to fall down. In six or seven years from the time the fire first swept through there is a sufficiency of débris on the ground to furnish material for a fresh conflagration. In the meantime a growth of saplings has sprung up, and the forest has become so dense with the mass of uprooted trees and vigorously growing saplings as to be quite impassable. For the second time fire is applied. There is now no humus, only woody litter. The fire, fanned by the free access of

the air over the denuded area, burns fiercely, and windfalls, standing dead trees, and young growth are all swept away together, leaving nothing but a light covering of ashes and a few blackened stumps.

In the Yellow Pine section, as before explained, the trees are not fire-killed as extensively as in the other sections, but the action on the young growth is the same. The second fire therefore frustrates any attempt of nature to replace the cut off or burned up older growth by a new one.

The forest is replaced by nature abundantly and surely if not interfered with. Within a few months after a "first burn" of a forest area in the White Pine Zone, there will be seen young plants of various species of willow and ceanothus springing up in great numbers from the denuded soil. In places where the humus was not totally destroyed seedlings of different kinds of conifers which grew nearest the burned area begin to show themselves. After three or four years the shed and decaying leaves of the willows, ceanothi, and the annuals that are coming in have formed a very thin humus, which appears to be essential to the germination of the seeds of the conifers, which now increase rapidly, and in a few years the shrubby vegetation has given place to a thriving young growth of trees. At the same time most of the dead timber killed by the previous fire has fallen down.

When the timber is removed by a second burning, the barren soil parts more readily with its moisture. Owing to this cause many places, especially those with a southern exposure, become too dry after a fire to again allow the growth of conifers. We find such places everywhere along the valley of the South Fork, the upper St. Mary, and in the zones of the Subalpine Fir and the Crest Line. The wide expanses of grassy slopes at high elevations are probably due to the exsiccated nature of the soil during the summer months. One sees old burned stumps in many localities at these elevations, and their presence proves incontrovertibly the existence of a heavier forest growth in past times.

It would be practically impossible for human efforts to replant successfully any considerable portion of the burned forest tracts in the Cœur d'Alenes. In the first place, the ground must be sheltered from the direct rays of the sun, not only to permit the germination of the seed, but also to retain a sufficiency of moisture during the dry season. Next, the seedlings or saplings must stand close enough to resist the crushing effects of the great quantities of snow piled on them during the winter. Observation proves that a dense growth does not suffer in the aggregate from this cause as much as one that is open.

On an acre of ground in one of the sections where the forest is in process of restoration a half million seedlings 15 cm. to 20 cm. (6 to 8 inches) high is a common occurrence. On shady slopes with a northern exposure I have seen them set so closely that every acre bore millions. Young trees 4 to 5 meters (13 to 16 feet) high form such dense groves in many places that it is impossible to force one's way through them

without chopping. It is only by growing in such masses that the species in their early stage stand a chance to survive the destructive forces of wind and snow.

In the belt of Yellow Pine there is always more or less of a grassy covering, which is replaced very soon after being burned. This acts the part of the humus in the White Pine Zone and favors the germination of seeds.

The species of conifers that come up over the burned areas are the same as those which grew there before, the only variation being in the relative number of individuals of the various kinds upon a certain measure of ground. Thus, upon a piece of bottom land previously covered to the extent of 70 per cent by the white pine and hemlock the black pine may come in and form perhaps 90 per cent of the total stand, or hemlock may crowd everything else out on the slopes, or the white fir do the same. This, however, is not lasting, for eventually the same balance which existed before the fire is restored.

The principal causes of forest fires in the Cœur d'Alenes are prospectors, railroads, timber cutters, farmers, camping parties, and maliciousness.

First come the prospectors, as the originators of the larger number of fires. The dense forest and the deep humus covering the soil are great hindrances to prospecting. To clear away these and expose croppings or "float" from the mineral-bearing veins which may exist in the neighborhood the forest is fired. When a mineral claim is located, it is customary to employ fire to help in stripping the ground, if heavily timbered; that it spreads does not matter, in fact no attention whatever is given to it. When it is considered that the Cœur d'Alenes are seamed with mineral-bearing lodes, that many men are engaged throughout the summer in searching out these veins, and that they never hesitate to fire the forest to expedite their work, it need surprise no one that every season hundreds of forest fires are started in every section where mineral is known to exist. While each of these may not cover an extensive space, collectively they form a very large area. The first burning, however, does not suffice for prospecting purposes. The fallen trees soon render the country more difficult of access than ever. It is only when a region is given a second burning that the ground is well cleared for years to come, and the prospectors know this only too well.

Railroads come next as the originators of fires. No line is ever constructed through the timber that is not flanked by two strips of forest fires so long as the timber lasts in proximity to the road. During the time of construction the right of way is cleared by fire whenever practicable; it spreads from the construction camps, and no efforts are made to check it, except so far as relates to the safety of that particular camp. When the line is in operation, sparks from engines—never provided with efficient spark arresters—start extensive conflagrations. Both sides of an embankment a few years old, and the partially or wholly

cleared right of way always support large quantities of herbage in the shape of annual and perennial plants. In late summer all this is like a mass of tinder, ready to burst into flame upon the application of a spark. The railroads themselves often suffer severely from the fire, kindled through their own carelessness or negligence. Bridges are burned, ties and wood destroyed; still, little effort is put forth to check the evil.

Timber cutters come next as factors in the destructive processes. If they do not absolutely kindle as many fires as do those we have already noticed, they certainly contribute more toward the effective preparation of the forests for the coming conflagrations than do the others. The forests are filled by them with litter from the cut trees, the upper portions of the trunk and the crown, which are never utilized; broken and splintered trees of all ages and sizes, destroyed by the careless felling of the trees that were used; large trees cut down and sawed into logs, but rejected for various reasons; in short, all the *débris* a large dense forest will furnish. Such a mass of inflammable substances gives an excellent opportunity for a hot, destructive fire, and it is sure to come sooner or later. Occasionally fires are set to cover up plunderings of trespassers upon the public timber, and they are common enough in all localities where large quantities of lumber are cut from public lands.

Settlers upon agricultural lands within the forest areas do their share toward needlessly destroying the timber. We will exclude all fires set for the purpose of clearing the land to render it tillable. It never stops here, however, except by accident. If the conflagration spreads from the clearing to the neighboring forest, no one tries to stop it or cares in the least how far it extends so long as it does not endanger the individual's property. The greatest danger from this cause lies in the sections where the settlers endeavor to depend upon stock raising for their support. Their summer range here is the forest, where the grass growth, at least in the White Pine Zone, is exceedingly scanty. By burning the forest they reason that a larger supply of grass will be obtained. This is true, at least partially. Many fires are started with this object in view.

Camping parties often carelessly neglect to extinguish their fires in breaking camp. There is a local law applicable to this in the Cœur d'Alenes, which, however, nobody ever dreams of enforcing.

Maliciousness adds in a slight degree to the causes of forest fires. Instances are known where parties have fired the timber out of morbid curiosity to see it burn and to see the flames run to the top of the tall, lichen-draped trees.

BURNED AREAS.

The forests in the Cœur d'Alenes are honeycombed with burns in all directions and of all sizes. It is impossible to travel anywhere without meeting with these dead and blackened remnants of what was once a vigorously growing forest. The saw and the ax have been as nothing compared with the fires. I do not hesitate to assert that for every

foot of lumber, board measure, put to proper uses in this region 100 cubic feet of timber have been destroyed by the fiery element or needlessly wasted in the tree. The burns of largest extent have been in the Yellow Pine districts. It would be a difficult matter to find a body of 500 acres in the whole of this zone which has not been visited by fire within the past thirty-five years. If the damage done here was as great and complete as elsewhere, there would now be nothing left of this but charred logs. Luckily, however, this, the most accessible portion, suffers the least. It is in the White Pine belt that we find the destruction in its widest sweep. I would here call attention to the map accompanying this report. I have endeavored to mark on it all the large areas where more than 50 per cent of the growing timber is destroyed by fire. Commencing in the southern part with the St. Mary basin, we find in the upper portion of its valley an area, approximately 25 kilometers (15.5 miles) north and south and 35 kilometers (22 miles) east and west, upon which the destruction of the old growth has been from 70 per cent to total. The bulk of this was burned about sixteen or seventeen years ago. A young growth has covered the oldest burns, and this has in turn been destroyed over about one-fourth of the area.

Coming down the valley, we find minor burns everywhere. They range in size from an acre or two to tracts of 300 or 400 acres. An exception to this is a large tract of mostly Old Growth, situated between the Santianne and a line drawn east and west through a point about 4 kilometers (2.5 miles) south from Emerald Creek from the west divide to the St. Mary. Burned spots occur over this area also, but they are not large in the aggregate. When the canyon portion of the St. Mary is reached, most of the burns are on the west bank in the Yellow Pine belt. They are, as before, of varying size, dotting the country here and there and separated from each other by bands of living forest. On the east bank the open Yellow Pine belt, which follows the immediate vicinity of the stream, soon gives way to a section of the White Pine Zone, remarkable for its excellent state of preservation. This tract occupies the triangular space which is inclosed between the St. Joseph and the St. Mary on the east and west, the point of junction of these two rivers on the north, and the Elk range for the base in the south. The best and most valuable timber, as well as the easiest of access of all in the St. Mary basin, is situated here and on the previously mentioned area north from the Santianne.

Coming to the St. Joseph basins, we find that the burns are of the scattered kind. Small tracts, from a few acres to 3 or 4 square miles, separated by larger areas of green timber, are found throughout. On the whole, the St. Joseph region has suffered very much less than any other portion of the Cœur d'Alenes. This is entirely due to its general inaccessibility and remoteness from the highways of travel and centers of population. In the low country around Lake Cœur d'Alene and its

easterly extensions up the valley of the Cœur d'Alene River we enter upon the classic grounds of the great burns of this region. Through this low, broken, undulating country came the two routes of the military road constructed by Capt. John Mullan in 1859 and 1862 and in later years a branch line of the Union Pacific Railroad. There has been in consequence no lack of opportunity for the spread of fires, and the region has always been and is yet a grand starting point for the conflagrations which are sure to occur each summer.

This broken region consists, topographically, of the foothills of the basal ridge of the North Fork basin, the only area of its kind in the Cœur d'Alenes. A line drawn from Rathdrum, Idaho, to the Old Mission, on the South Fork of the Cœur d'Alene River, would very nearly bisect it. We find here a mingling of the zones of the Yellow and the White Pine—an interlacing of long lobes which extend from the one into the other. Originally the forest was exceedingly dense over the greater portion of this area, and being easy of access it was one of the most valuable parts of the region for lumbering purposes. Hundreds of fires have sadly decimated it during the past twelve or fourteen years. The Yellow Pine has not suffered so extensively, owing to causes already explained, but the abutting and interlacing portions of the White Pine Zone have been frightfully ravaged. From this tract as a central point the fires have spread many kilometers north and south into the adjoining mountains. Excluding all portions to the east of the Old Mission for the present, there is in this tract an area of about 50 kilometers (31 miles) from east to west and as much from north to south upon which 65 per cent of the forest has been destroyed by fire. The remaining 35 per cent represents yellow pine principally. As this foothill region is especially liable to conflagrations, the inroads of sawmills, and the clearings of settlers, a few years longer will solve the forestry problem here.

Proceeding up the valley of the South Fork, we come into the center of population of the Cœur d'Alenes. Between the fires and the sawmills the valley is pretty well cleared of its forest. From the Old Mission to the summit of the Bitter Roots, a distance of 60 kilometers (37 miles), and extending north and south, with an average width of 18 kilometers (11 miles), fully 90 per cent of the timber is gone. Comparatively little of it was utilized; most of it burned up. Much the larger part of the valley is now entirely destitute of sizable timber. What is left we find in the wet canyons, where the abundance of water in the humus has acted as a bar against the spread of the flames. The young growth stands no chance here. As soon as large enough and dense enough to burn it is certain to be fired.

Coming into the North Fork basin, we go away from the highways of travel and would expect to find a less amount of destruction. It would be so were this tract not surrounded by a series of points whence conflagrations are sure to come each year, everyone eating a little deeper into the forest than did its predecessor.

In the southeastern part of the basin, where the gold-bearing areas are situated, we find about 80 per cent of the forest destroyed. These burns date partially to the time of the old ones of the South Fork valley, with which they connect in many places, and in part to the conflagrations started by the army of gold seekers which overran the country when it first became generally known as a mineral-bearing region in 1883 and 1884.

Going north into the basin, one encounters interrupted burns at frequent intervals until the northern portion is reached. Here are found those which had their origin in the fires kindled in the valley of the Clark Fork at the time the Northern Pacific Railroad was built. The area covered is not known to me, but it is large, for the burns follow the valley of the Clark Fork from Thompson to Lake Pend Oreille, a distance of 115 kilometers (69 miles), and the fire has eaten into the timber of the North Fork basin in thousands of places, extending in some localities as much as 30 kilometers (19 miles) southwest from the river.

Changing to the western side of the North Fork basin, we come to the burns which have had their origin in the mining camps on the east shore of Lake Pend Oreille. A strip of country 45 kilometers (30 miles) from north to south, and averaging in width from 8 to 16 kilometers (5 to 10 miles), has been laid waste here to the extent of about 75 per cent.

Going farther south, we reach the northern limit of the burns which have come from the region of the Cœur d'Alene valley. They have not penetrated very far into this part of the North Fork basin. Owing to the slow progress of forest fires, the spread of one having its origin in the South Fork valley, or along the Mullan road, would only, except in unusually dry seasons, reach this part before the quenching fall rains commenced. The most valuable portions of the growing timber are found here upon an area which extends eastward to the main river and northward to the central sections of the basin. I estimate that upon a tract of about 400,000 acres 10 per cent of the forest is destroyed by local burns, an insignificant amount when compared with the condition of the timber in other localities.

In estimating the percentage of timber destroyed and standing it is pertinent to consider what amount of merchantable timber of the different species of conifers grows upon an acre. This varies so greatly that it is difficult to give even an approximately correct estimate. I would consider for the best class of bottom lands in the White Pine belt an average of 30,000 feet, board measure, to the acre a low estimate. It might be divided thus:

	Feet.
White pine	17,000
Douglas spruce	4,000
Tamarack	3,000
Cedar, spruce, etc	6,000

Where cedar predominates it might rise to three or four times this amount. This estimate includes only trees fit for saw logs.

In the Yellow Pine Zone a fair acreage would be 7,000 feet, board measure, divided about equally between yellow pine and Douglas spruce to the extent of 75 per cent, the remainder tamarack. However, as before remarked, the conditions of the forests are so unequal, owing to climate, etc., that no just estimate as to the total amount any particular area carries can be made from a general average.

The accessible portions of the Cœur d'Alene forests theoretically include the whole; practically they do not. The amount that can be reached will always depend upon the urgency of the demand and the prices of the forest products in the particular region. There are no physical difficulties in the way of gaining access to all parts which can not be readily overcome; the cost is the main factor. The total of the bottom lands in the valleys and canyons is probably not the one-hundredth part of the superficial area of the region.

The future of the forests of the Cœur D'Alenes can be easily predicted unless a successful system of adequate protection against wanton destruction is afforded. If in the short space of thirty-five years 50 per cent of the accessible timber has been totally destroyed, it requires no great calculation to figure out the destiny of the other half. It must be recollected that only twelve or thirteen years of this period have been marked by industrial development in the region.

FOREST PRESERVATION.

Putting aside wholly the question of sentiment and looking at the matter from an economic standpoint, there is not the slightest question that the forests of the Cœur d'Alenes should be preserved.

The forest should be preserved because it is a source of lumber and fuel. The greatest wealth of the Cœur d'Alenes is in its mines. To exploit the mineral treasures of these mountains successfully requires an adequate amount of lumber and fuel.

When the home supply gives out it must be imported. That means a very long haul, for the forests of Montana, never extensive, are fast drifting toward the same condition in which the Cœur d'Alenes are found. We have seen that a very long time is required before a forest once destroyed will arrive at sufficient age to yield marketable logs. The young growth of the Cœur d'Alenes will not reach this state, even with the best of care, within the next three generations. There is all the more reason, then, why that which remains of the Old and Second growths should be used legitimately—that is, with all needlessly wasteful methods rigorously eliminated.

The forest should be preserved for climatic reasons. The clearing away of the forests subjects all the agricultural lands in the valleys to much greater temperature variations than they previously experienced. The days will be warmer, the nights colder. The increased diurnal temperature is no compensation whatever for the lower nocturnal. It means a freer evaporation from the soil and consequent desiccation, and a greater radiation into space of the heat that the earth has

absorbed during the day, and therefore more frosty nights. Not only are the valleys within the mountains affected, but the phenomena of frosty nights during the summer will make itself felt more severely in the valleys of the plains which have their head in the adjacent mountains. The living forest warms the cold night air that filters through it during the night. As the sun nears the western horizon on a clear afternoon an interchange of air between the crests of the ridges and the bottoms of the valleys takes place. The cold air being the heavier descends, and sinks into the lowest depressions in the ravines and canyons. The heated air of the valleys ascends by the slopes. In a dense forest where free radiation is prevented the mean temperature of the several seasons varies but little either during the day or night. Let us suppose the mean summer temperature in a section of normal forest in the valley bottoms to be 6° C. (43° F.) at water level in the soil a meter or two beneath the surface. I think this temperature approximately correct for elevations of 700 to 900 meters (2,300 to 3,000 feet). During the night the air temperature to a height of 50 to 90 meters (160 to 300 feet) above the surface will not be more than 2° C. lower. The cold air from the crests filtering through such a forest is warmed near the earth and emerges upon the open meadow lands at a considerably higher temperature than it otherwise would. Frosty nights are doubtless averted in many instances through this means and the severity of others much mitigated.

The timber should be conserved for the part it plays in regulating the drainage of the annual precipitation. Vast quantities of snow fall every winter in the western ranges. Rain storms occur frequently during the late fall and early spring and load the mountain snows with water. The amount thus held by the snow is sometimes immense. I have melted the snow on the mountain summits in the month of March and have found it in some seasons so heavy with absorbed water that from a layer 18 cm. (7 inches) in depth 10 cm. (3.8 inches) of water would be obtained. In the spring the snow disappears much faster and more suddenly on the open and exposed places than it does where afforded protection by the shady forest. This precipitates a great volume of water into the streams and destructive freshets occur. During the summer the streams become abnormally low and the supply is insufficient to serve the purposes for which it is needed. Alternate freshets and scarcity of water in the streams are the universal results of the cutting away of the forests in all portions of the world, and are too well known to be dilated upon here. In the Cœur d'Alenes and indeed every where throughout the Pacific Slope an element not so universally experienced comes in, namely, fire.

The streams are supplied in two ways, by springs and by slow percolation of the water held back in the moss and humus and in the top soil among the multitude of roots that ramify throughout it. The springs issue forth from the rocks, their water representing the drainage of the precipitation that has fallen upon the crests and rockier

portions of the ridges and which has sunk into the cracks and crevices of the strata to become visible again at lower levels. A very large proportion of this water comes from the snow which falls in the zones of the Subalpine Fir and the Crest Line. The slower the snow melts here, and by far the larger part of the precipitation these zones receive comes in the shape of snow, the higher will be the upper level of the water line and the more will the annual amount discharged by the springs be equalized.

The amount of water held back in the humus and top soil is immense. In the two zones above mentioned there is but a small depth of this, but in the White Pine Zone it is very thick. This section is the great water reservoir of the Coeur d'Alenes. Not only does it hold back great quantities of water by its absorbtive power, but the denseness of the forest growths prevents direct evaporation from the surface, and the widely spreading rootlets, together with the other multitudes of obstacles it interposes to the free flow of water in its heavily wooded canyons and bottoms, hold back great volumes. When a fire devastates a region here, these conditions are changed. The sponge of humus is destroyed; the mold in the top soil is burned off, leaving behind the siliceous portions which do not long retain water, and the shade is gone, exposing the ground to the direct rays of the sun with their baking and desiccating power. When spring comes, the snow that has fallen upon the burned-over areas in any of the forest zones melts with great rapidity. As there is nothing to hold back the water until its absorption into the soil has taken place, it rushes off on the surface in torrents to the plains below. The small quantities that sank into the soil have drained away when summer comes, and a scarcity is the consequence. It will therefore readily be seen that if the mountain streams or lakes are ever to be utilized as reservoirs for water to irrigate the plains areas it will be necessary rigorously to preserve the primary reservoirs—that is, the forests.

It is probable that but for one circumstance connected with the climatic conditions of the Coeur d'Alene forest areas there would long since have been felt a very severe scarcity of water in the summer season throughout the regions where fires have exterminated any considerable portions of the growing timber. The feature referred to is the absence of frosts in the ground during the winter months—a condition which prevails even at elevations above 2,400 meters (7,900 feet). Owing to this the lower surface of the snow melts slowly all winter, and the weight of the heavy superincumbent mass pressing down firmly on the soil holds back the water and compels its absorption.

Manifold other evils arise from the destruction of the forests. There are the snow slides that imperil life and property with every recurring spring; avalanches of rock and dirt that are loosened and slide down the steep hillsides to the bottoms of the valleys; inundations in the mountain regions and along the courses of the rivers through the plains; sand, gravel, and bowlders washed down the valleys and spread out

over the fields; new and wider stream channels, cut by the spring torrents, which in narrow valleys with much alluvium becomes a serious matter, especially along the portions of the streams which meander through the plains, and pretty certainly a lessened amount of rainfall over the plains area. It is a matter of popular experience that the longer the snow remains on the mountains the more abundant and copious are the spring and summer showers on the open and timberless regions.

The following clipping from the *Spokesman-Review*, a newspaper published at Spokane, Wash., is so pertinent to the subject of the water supply of the Cœur d'Alenes as affected by the destruction of the forests that it is here appended, with the necessary comment for a proper understanding of the same:

The water problem is a serious one in the Cœur d'Alenes at present. The mills depending upon a water supply have in many cases been compelled to close down. A number of reservoirs are being built this fall, and this will greatly augment the supply.

The lack of water is seriously interfering with the working of the Hunter mill. As a consequence, 50 men were laid off last week, as the stopes and chutes were full of ore and the mill could not keep pace with the mine.

The mills to which these paragraphs refer are concentrating plants, and are situated partly in Canyon Creek, a tributary of the South Fork, and partly in the upper portion of the valley of the South Fork. They are nearly in the central areas of the great burns that have spread from the Mullan road and from the placer fields in the southeastern parts of the North Fork basin. The streams they utilize head and have their tributaries almost wholly in and from mountain slopes on which the destruction of the forest varies from 80 per cent to total. Each of the streams carries a very much greater volume of water in the spring now than was the case in the past. This is shown conclusively by the cutting of the channels, the height of the lodged drift-wood, and the greater amount of sand, gravel, and rock washed down to lower levels each spring. Even were there present none of these physical signs, a moment's reflection would convince us that such must be the case. The hills, once forested, are now bare; the winter's accumulation of snow, unprotected from the direct rays of the sun, melts rapidly in the spring; the rain and snow water, not now held back by the deep humus and the other multitudinous obstacles which were there when the forest covered the slopes, runs off swiftly. In the summer the evaporation is enormously increased from the denuded areas. A scarcity of water during a portion of the year is the inevitable result. Recourse will now be had to the reservoir system, with a fair prospect of much trouble in controlling the spring floods. The Hunter property, referred to above, is the most easterly of the concentrating works in the South Fork valley, and as a consequence has the least amount of available water from this stream.

A NEW SYSTEM OF TIMBER PROTECTION.

It is not my purpose to attempt here a review of the various acts and laws which have been framed during the last two decades for the purpose of regulating the sale and protection of the timber on the forested areas of the western United States. That the timber laws now in force are evaded, circumvented, or absolutely ignored is a patent fact. Two means are depended on chiefly to prevent the deforesting of the public lands on the Pacific Slope; they are the detection of timber trespassers by a corps of special agents acting under the authority of the Department of the Interior and the reserving of certain tracts against entry—the so-called timber reserve.

The detection and punishment of trespassers upon the public forest domain by the system of special agents is totally inadequate in practice, however good the intention of the framers and executors of the law. It is impossible for any one individual to patrol even a limited district in regions so difficult as are most of the Western ranges, and when timber trespassers are apprehended a conviction is by no means certain, for the weight of popular opinion is almost invariably on the side of the accused.

By establishing forest reserves we may be able to control all logging operations on the areas covered by the reserve. We, however, can not prevent fires from outside spreading beyond the boundaries. In a single season they may deforest a much larger tract than logging or lumbering operations would have done in several decades. The single factor of forest fires demonstrates amply that a timber reserve only protects against one class of timber depredators, who stand far from the head of the list.

That none of the present arrangements for protecting the forests are even moderately successful is a fact painfully evident to every observer. There are so many loopholes and the acts and regulations, dating back through many years, are so diverse that some plan can nearly always be contrived for trespassing without punishment upon the public timber lands.

The most common and the simplest method is that of the squatter. The portable sawmill is set up, first here and then there; with it follows a crew of employees and professional squatters. Land in the vicinity of the mill is covered by squatters' rights, a slight pretense is made at agriculture, the valuable timber is cut off and converted into lumber, and the concern moves on. Or the programme is varied by the squatter going into some mountain valley along a stream where logs can be floated to market. As before, a claim is staked off, notices posted announcing that the claim is taken under such and such an act, a mere pretense at improvement is made, often in a region where it would be impossible to carry on agricultural operations of any kind, the logs are cut and floated, and the claim is abandoned. Perhaps a number of

these trespassers are apprehended; but it is one thing to apprehend and another to convict.

The railroads act indirectly as trespassers through their tie and fuel contractors. Little regard is paid by the latter to public ownership of land. The contractor cuts his ties where the timber is the choicest.

The miner becomes a depredator under various pretexts. An old ruling or law which permits him to cut timber from the public domain for mining purposes is interpreted with the utmost latitude. If the miner happens to be a mine owner as well, his views as to his rights under this old law are extremely elastic.

The farmer living in the timber becomes a trespasser by cutting fuel on the public lands and disposing of it. Sometimes he squats on a piece of land from which the timber fit for lumbering purposes has already been removed. When all that is readily converted into fuel is gone, he goes too. That a farmer living upon forest-covered lands entered under the homestead laws can not legally sell the timber from such lands until patented to him is a matter which is not generally known.

In the case of *Shiver v. U. S.*, 159 U. S. R., 491, the United States Supreme Court decided, in an opinion handed down by Justice Brown, that lands entered under the homestead laws are not by the mere act of entry so segregated from the public domain as to give the homesteader a right to sell timber from his entry. The decision is in part as follows:

Where a citizen of the United States has made an entry upon the public lands of the United States under and in accordance with the homestead laws of the United States, which entry is in all respects regular, he may cut such timber as is necessary to clear the land for cultivation, or to build him a house, outbuildings, and fences, and perhaps may exchange such timber for lumber to be devoted to the same purposes; but he can not sell the timber for money, except so far as it may have been cut for the purpose of cultivation; and in case he exceeds his rights in this respect, he may be held liable in a criminal prosecution under section 2461 or section 5388 of the Revised Statutes of the United States, or either of said sections, for cutting and removing, after such homestead entry, and while the same is in full force, the standing trees and timber found and being on the land so entered as a homestead.

A vigorous application of this decision would have a twofold result. It would very materially diminish the number of farms taken up in the heavy forest and the fires that spread from the efforts of the settlers to clear up the land. While it is fairly well known that a squatter can not legally remove the growing timber on the land he occupies for purposes of sale, it is not at all understood and believed that this provision applies to land upon which a homestead filing has been accepted at the local United States land office. A great many with limited means settle on forest lands expecting to be able to dispose of fuel and timber from their claim in sufficient quantities to enable them to tide over the time that must pass before it can be made fit for tillage. While the enforcement of this decision will work hardships to many individuals, it can not but be to the advantage of the public at large eventually, inasmuch

as it takes away a great incentive to settling on forest lands and in so much assists in preserving the timbered areas.

The method of special agents, which is relied upon to detect trespassers and keep the evils of forest depredations in check, is held in utmost contempt by those who are guilty of infringing the timber laws or contemplate doing so. Not only is the system despised, but the men who work under it as well; for, right or wrong, in the minds of the people of the West there is a firm conviction that a true charge of venality would lie in connection with any of these offices.

We have seen that the forests of the West stand in need of protection, and that if this is not afforded their entire destruction is merely a matter of a comparatively short time. It is not sufficient that a tract be set aside here and there as a forest reserve. A wider application of a protective system is needed. It should cover alike all areas of the public timber lands in their uttermost extensions, even those which now are simply burned and blackened tracts and those which, situated on remote mountain slopes, are at present too difficult of access to be utilized.

Below is presented the outlines of a plan entirely feasible and practical, that will furnish a substantial foundation for the erection of a system which, if properly and faithfully carried out, can not fail to prevent the depredations that now lay waste the forests. It will not only protect the tracts now belonging to the public domain, but also, to some extent, those which have already passed outside the immediate ownership of the General Government.

The plan to be proposed may be called the resident district commissioner system. The primary feature of this plan is the division of all the forest areas throughout the Western States where the Government still controls the major portion into districts with definite boundaries and the absolute prohibition within these limits of removing or converting to any private use timber, growing or dead, without the issuance of a license by the official in charge of such district.

The supervision of each district should be confided to a resident district commissioner, who should act under the immediate direction of a general commission or commissioner of forestry. The district commissioner should reside at some generally accessible point within his district and should be a bonded officer. His jurisdiction should extend to all cases arising within the district except certain ones hereinafter specified, which should be referred to the general forestry commissioner for his action, with the necessary information and the district commissioner's recommendation appended.

To enable the district commissioner to exercise a perfect control over all portions of the tract within his jurisdiction a comprehensive system of licenses should be made effective. It should cover all cases of every nature where the removal of the timber from the public domain is concerned. The district commissioner should issue licenses to all applicants, except as hereinafter specified, and should keep accurate copies

and files. Monthly reports setting forth the particulars, with copy of each license issued, should be made to the general commissioner of forestry, who would thereby be enabled to judge as to the actual amount of timber removed from each district monthly.

Let us examine in detail the different classes and purposes to whom and for which licenses should issue, beginning with the prospector for mineral deposits. This class of timber depredators is by far the most difficult to control. They are very numerous, and each summer they scatter over a great area of country, very often the most difficult of access, where it is impossible to subject them to direct supervision even were the forest areas patrolled.

To fit their case the mining laws should be so amended as to require each one of them to secure a yearly license before being allowed to prospect for mineral lodes upon any part of the public domain. These licenses should hold good in any locality for the time issued (one year), but before any prospector could legally enter within the boundaries of a district different from the one in which his original license was issued for the purposes of discovering mineral deposits he should be required to have his license duly indorsed by the commissioner for that district. There should be as an aid a law framed defining the act of firing the public forest domain as a crime, and fixing punishments both by fine and imprisonment, with a reward for the detection of the criminal. Copies of this law should be supplied to every prospector applying for a license. The system of licensing the prospectors would result in keeping an accurate tally of all persons in a district employed in this work. I am of the opinion that the knowledge of this fact, together with the certainty of severe punishment if detected, would very materially reduce the number of forest fires due to this cause if it did not entirely prevent them.

Wood choppers, tie choppers, charcoal burners, sawmill and logging concerns should be required to obtain yearly licenses upon their applications, setting forth where they intend to operate, for what purposes, and the estimated value of the yearly product. If this exceeded a certain sum, say \$1,000, the application should be referred to the general forestry commissioner, with the facts of the case as indorsed by the district commissioner. If the yearly output was less than \$1,000 in value, the authority of the district commissioner to issue the license should be sufficient. A stumpage should be charged in connection with the removal of any portion of the timber for purposes of profit. Each of these licensed occupations should be required to file monthly or quarterly with the district commissioner sworn statements as to the quantity of timber taken, and upon the basis of this the stumpage should be collected, penalties being provided for false returns, and the scaling books of logging and lumbering concerns to be open for inspection by the commissioner at any time, as also the accounts of tie and wood choppers. When the value of the yearly cut by any lumbering

concern exceeded a certain amount, say \$1,000, a bond in a sum sufficiently large to cover the value of the product above this sum should be exacted. Miners should be placed upon the same footing as the foregoing classes. The law or ruling which permits them to fell timber on the public domain for mining purposes should be repealed. As it now stands, mining companies take timber not only adjacent to their claims, but miles away when it happens to be easier of access or choicer in quality. There should be no exception. The timber standing on an unpatented mining claim should require a license for its removal just as much as though it were miles away. This should also apply to mill sites located in connection with lode claims. The licenses issued to any of the foregoing classes should be valid only in the district where issued. The law permitting parties to buy timber lands valuable chiefly for their timber and stone and unfit for agricultural purposes ought to be repealed. It is now to a great extent a cloak made use of by the big lumber concerns in the regions where it applies to acquire cheap timber lands for their sawmill operations. Private ownership of forest lands is a certain way to destroy the timber. The owners rarely look for anything beyond some way to make it profitable as quickly as possible. The conservation of the forest upon any such tract is never considered.

A strong and persistent effort should be made to discourage agricultural settlements in the heavy forest region. The value of the product on many tracts of agricultural lands won from the forest will not equal the value of the timber the tract could produce. More attention should be directed to the capabilities of the arid regions, where the same amount of labor bestowed upon irrigation as is now wasted in clearing the heavy forest would result in far larger returns than can ever be had from any tracts in the frosty mountain regions. No one should be permitted to settle upon lands covered with a forest which requires to be cleared away to fit it for agriculture without first submitting an application to the district commissioner, who should examine the tract in question, and if, in his opinion, the land was more valuable for agricultural purposes than for its timber he should so indorse it upon the application; and no filing at any land office upon lands covered with a forest should be accepted unless indorsed in the affirmative by the district commissioner.

No person living upon unpatented lands, agricultural or other, should be permitted to burn for clearing or remove for sale any timber growing on the claim without a permit from the district commissioner.

Parties desiring to open roads or trails through the forest which would involve the cutting of timber should be required to make written applications to the commissioner, setting forth the point of beginning and ending and for what purpose.

Railroad companies operating lines which traverse the forest areas should be compelled to provide thoroughly efficient spark arresters for

the smokestacks of their locomotives, or, failing to do this, the right of way through the forest should be kept permanently clear of all débris that would enable a fire originating on their premises to spread into the adjoining timber, and the cost of such work, if done by the district commissioner, should be a lien upon the property of the company until paid.

It is customary around many saw and shingle mills since the law prohibiting the throwing of sawdust into streams became effective to burn the refuse. This is sometimes carried away to a distance from the mill and there consumed. Fires occasionally spread from such places into the forest. Regulations should be made effective that would obviate all danger from this source.

Any person to whom the foregoing provisions of licenses apply, if found pursuing his avocation in the forest regions without the proper permits, should be treated as a trespasser and punished as such. Simple ejection as a penalty would be insufficient. Fine or imprisonment, or both, should be imposed, and in the case of prospectors no mineral-claim location should be recorded unless the discoverer possessed the proper license.

Around many of the larger mining camps in the forest areas are found a class of squatters holding small parcels of land outside the town limits. They are mostly miners by occupation, live there with their families, and cultivate small patches of land for gardens. As these holdings are within the areas where the land would be considered more valuable for forest purposes than for agriculture, no filings upon these lands, unindorsed by the commissioner, should be accepted at the land office. A provision should be made for this class by permitting the occupancy of small tracts within the forest limits—say 10 or 15 acres—at the discretion of the commissioner, the title to be merely possessory, but to be transferable to other parties in the manner of a mining claim, with this exception, that no patent from the United States should ever issue for the same to anybody, it being only regarded as a lease from the United States to the party actually in occupancy.

In dividing the forest areas it would be best to follow political boundaries for the present, as, for example, county lines, although by such a plan many districts would include considerable areas destitute of forests. To limit the districts to the tracts actually covered by timber would be preferable, but would require much time and cost.

The system would be to a great extent, if not wholly, self-supporting. In addition to the stumpage income a certain fee should be required for each license. In addition to this the mining laws should be so amended as to require all filings upon mineral claims to be made with the district commissioner instead of the county clerk, as is now the case. This would in the mining districts add to the revenues and serve as an additional check upon the prospectors. Deputy district commissioners should be permissible where necessary, as should also

district mining recorders for the convenience of miners in remote places.

That a system of this sort could not be put in force without encountering a great deal of opposition may be taken for granted at the outset. Its application would so materially circumscribe the freedom now enjoyed by the various classes of timber depredators that strong efforts to frustrate any plan that aimed at curtailing it would certainly be made. However, it is reasonably sure that the majority of the people would cheerfully obey such a system. It would extend the protection of the Government to all classes engaged in timber production, and enable them to pursue their vocations unmolested. Timber and fuel are needed to develop the West. The people must have them. For want of a proper system of licenses easily obtained they resort to all manner of trespasses. The system of timber reserves, even with the bill presented last winter permitting the sale of timber at the discretion of the Secretary of the Interior, does not and would not protect sufficiently, and renders the purchase of timber by the smaller concerns a very difficult matter. Whatever plan or system may be finally adopted, let this be taken as an assured fact, that the strong hand of the General Government, without delay, fear, or favor, is urgently needed to put in effective force regulations that shall thoroughly protect the forests of the West and restrain the waste that now runs rampant throughout their entire extent.

