

BULLETIN UNIVERSITY OF MONTANA,

No. 10.

BIOLOGICAL SERIES No. 3.

A Biological Reconnoissance

IN THE VICINITY OF

FLATHEAD LAKE

BY

MORTON J. ELROD.

Professor of Biology, University of Montana, Director University of Montana Biological Station,
President Montana Academy of Sciences, Arts and Letters.

Prepared at the
UNIVERSITY OF MONTANA BIOLOGICAL STATION,
BIGFORK, MONT.

University of Montana, Missoula, Mont., U. S. A.

1902.





Site of the University of Montana Biological Station, from the bluff on Swan River. The Laboratory is on the right beyond the bridge. The river turns to the left in the distance and flows into Flathead Lake. On the left are the Helena Club grounds. The view is west.

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Introduction.

The material presented in this bulletin represents the work of four seasons in the region under discussion. The bulletin is not intended as a dissertation on a technical subject. The notes presented are given with the idea (1) of describing a region in which considerable work has been done, and in which more will be done; and (2) to indicate to future collectors in the state regions where collecting may be carried on to advantage, and some of the finds to be expected.

The material collected is being worked over as rapidly as time will permit, and in due time technical papers will be presented. Nearly 1,500 shells of the species *Pyramidula strigosa* have been gathered, from altitudes ranging from 2,300 feet to 8,900 feet. This gives an excellent series for studying variation. This work is being conducted in the laboratory at the University. A series of about 1,300 butterflies has been taken, most of which have been expanded. Many moths have also been secured. Large collections of Odonata have been secured, and as soon as the eastern part of the state is more fully covered this group of insects will be taken up, a treatise on those in the western part being now in manuscript. The botanical collections number thousands of specimens, and when the work of identification and labelling is completed the University will have a very creditable collection of the plants of the state. The collection embraces specimens from varying altitudes up to 10,000 feet, and from localities heretofore unexplored. Included among these is a large series of lichens.

A large collection of entomostraca has been made, during the several seasons, and from many bodies of water. A portion of the material has been worked over and the remainder is now being examined.

The accompanying illustrations were all taken by members of the station staff or those attending the station. Due credit is given for each. Some of the cuts have appeared elsewhere, for which acknowledgement has been made in the proper place.

The bulletin will place on permanent record much information which is important, and which in a few years would be lost or very difficult to secure.

Bulletin No. 1 of this series, "Summer Birds of Flathead Lake," by P. M. Silloway, is out of print; the large edition having been exhausted a short time after its publication.

The author takes this public manner of expressing his high appreciation of the very cordial support given by those who have accompanied him on collecting trips and assisted in the work at the Station at Flathead lake. The recollection of smoldering campfires in many wild places, with sleeping bags containing tired but happy naturalists, working

without compensation for the sake of knowing, is a fond memory. It is on such occasions that enduring friendships are formed, the ties of brotherly love firmly bound, and the great and unknown field in a new country opened to view. The cheerful and happy dispositions manifested on trying occasions, when rain, or snow, or hunger, or fatigue was most severe, are characteristic of that great body of men who care neither for labor nor fatigue if there is added something to the sum total of human knowledge.

It is a pleasure to note that much of the work represented by this publication has been accomplished through funds contributed by friends. To the many who have aided in the work by contributions sincere thanks are tendered. We are under special obligation to Senator Wm. A. Clark, who has rendered great service by generous contributions on many occasions.

THE AUTHOR.

University of Montana, Missoula, Montana, September 14, 1902.

Establishment of the University of Montana Biological Station.

The organization of the University of Montana Biological Station was effected in the spring of 1899. The State of Montana contains several lakes of larger size, and many smaller ones. Very little work has been done on any of these lakes, that of Forbes on Flathead and Swan, as given later, being all that is known. Little systematic study of birds, flowers, insects, shells, or kindred topics, has been made save the collections from expeditions which have been taken to the institutions of the east for study. While there have been many expeditions to Montana and the Northwest Territory, and while large quantities of material have been taken from the state and incorporated in reports, there nevertheless has been little systematic study of particular groups by residents of the state.

Early in the spring of 1899 a trip was made to Flathead lake for the purpose of selecting a site for the station which would meet the demands for work. Through the kindness of Mr. E. L. Sliter the launch "Undine" was placed at the disposal of the writer, and almost the entire shore of the lake was examined.

The site chosen is on the main road to Kalispell, which is 18 miles distant by wagon road, and nearly double that by water. The steamboat running between Kalispell and the foot of the lake will stop to let off and take on passengers. The launch "Undine," the property of the Kalispell Club, is also moored here. It is a pleasure resort of considerable prominence. The hotel at Bigfork gives accommodations to those who do not wish to live in tents. The mouth of the river makes an excellent harbor for small boats, which is a very important item on so peculiar a body of water as Flathead lake, where the waves may rise high in a few minutes.

A small field laboratory was erected on the banks of Swan river, a short distance from the lake. A few rods from the laboratory a bridge gives communication with the opposite side of the river. Immediately above the bridge a series of rapids offers excellent sport for the fisherman, as well as exceptional field for the photographer. The country in the immediate neighborhood is well timbered. To the north the country is well tilled, fine fields of grain and good orchards making a splendid showing in the fertile valley. Two and a half miles to the west the Flathead river enters the lake, its mouth being marked by a well defined delta with sand banks and shoals, a great shelter for birds during the migrating season.

The laboratory is a wooden structure with suitable accommodations for summer outdoor work. There is table room for twelve students. The site is excellent for camping. A large spring enters the river from the bank immediately below the laboratory.

A mile and a half from the laboratory along the road south is Daphnia pond, covering some fifteen or twenty acres. A description of this pond is given later. About the same distance farther is Estey's pond, covering a little less space, but fully as interesting. It is eight miles by the nearest road to Swan lake. This lake is the expansion of Swan river, and lies in the glaciated valley between the Swan and Mission ranges. The lake is about 12 miles long, perhaps a half mile to a mile wide. A few miles to the northeast is Echo lake. Near it is Rost lake. Along the banks of Flathead lake on either side may be found numerous ponds and small lakes; others are reported to be in existence, but have not yet been studied or examined. The northern part of the state is well dotted with lakes which await study.

The Lewis and Clarke Forest Reserve extends to within a few miles of the station, and offers exceptional opportunities to study forest influences and subjects relating to forestry.

A few miles eastward and the Swan range of the Kootenais is reached. This range has several peaks nearly 10,000 feet in high, with dozens of alpine lakes, rock ridges, snow slopes, and other collecting places. The Mission range is immediately south of the station, ending as a range at Swan river. The range makes the eastern bank of Flathead lake, is well timbered, and rises higher toward the southern end, where the peaks reach nearly 10,000 feet.

The preliminary work of the Station naturally falls within the country immediately near the laboratory, and in the Mission mountains and the Mission valley. This territory lies between Missoula, where the University is located, and the laboratory. In the fall of 1897 a collecting trip of three weeks was taken to the Flathead Reservation. This was the first collecting expedition from the University, and resulted in a large supply of material in various lines.

In 1899, during the month of August, the first work of the Station was begun. During this month considerable time was spent on the lake, making soundings and gathering microscopic forms from the water. These are incorporated in a paper presented to the American Microscopical Society.

In 1900 two months were devoted to the work of the Station. The month of July was spent in the Mission mountains and in the Mission valley gathering material, the month of August being spent at the Station.

In 1901 a party outfitted at Missoula, and started for the field June 13, continuing the work of collecting and studying either in the field or at the laboratory until August 21, when the party returned to Missoula.

The party consisted of Dr. D. T. MacDougal, of the New York Botanical Garden, making collections in botany; Wilson P. Harris, of Brooklyn, N. Y., collecting lichens; Maurice Ricker, Burlington, Iowa, High School, collecting entomotraca; P. M. Silloway, Fergus County, Mont., High School, studying birds, and the writer.

Collections were made in the Mission mountains. Several peaks were ascended, and McDonald and Sinyaleamin lakes, which had been visited the previous year, were again visited for comparison of records. The party moved slowly up the east side of Flathead Lake, making occasional excursions into the Mission range.

After reaching the station and depositing a large proportion of the luggage a trip was taken to the foot of the Swan Range eastward. Rost lake and Echo lake were partially studied. Several excursions were made into the range, with packs on backs, and many peaks ascended.

In August, Dr. H. C. Cowles, from the University of Chicago, with a party of nineteen students, spent ten days at the laboratory. The entire party, with many others, made the ascent of the Swan range in safety, returning laden with specimens. More detailed information relative to these mountains and their lakes is given later.

During the summers of 1900 and 1901, Prin. P. M. Silloway, of the Fergus County High School, spent the months of June, July, and August in the study of the birds. The nesting birds near the laboratory were made a special study, and a good series of nests and eggs secured, notwithstanding the weather was very bad most of the time. The results of the work are embodied in the bulletin from the Station (21). He also made extensive studies of the birds in the Mission range and in the Mission valley on the west of the range. During this time a large series of skins was secured, now deposited in the museum of the University, and a large amount of data collected relative to the birds of the state. This gave excellent opportunity for studying those birds which make the state their summer residence. As a matter of fact there were less than a half dozen birds noted which apparently came from the north on their autumnal migration.

L. A. Youtz, of Columbia, devoted two months of the summer of 1900 exclusively to the study of the entomostraca of the lakes and rivers in the western part of the state, so far as the travels during the summer permitted. His observations extend to the waters of Sinyaleamin lake, McDonald lake, the ponds and creeks in the Mission valley, Flathead lake from one end to the other, Flathead river, Swan river, Daphnia and Estey's ponds, and to this was added the material from Swan lake after he left the party.

During the following summer the work was continued by the writer, assisted by Maurice Ricker, of the Burlington, Iowa, High School. The same lakes and rivers were visited, as also Echo lake, Rost lake, Silloway lake, Placid lake, Trail lake, and other smaller bodies and streams of water.

In 1902 work at the Station was continued during July and August. Mr. Harry N. Whitford, with a party of botanists from the University of Chicago, carried on studies in forestry. Large collections of plants were made, forestry conditions carefully considered, and a large series of photographic negatives made. Prin. P. M. Silloway spent the month of June at Swan lake, and July at the Station. He secured much information additional to that given in his bulletin "Summer Birds of Flathead Lake," which will be incorporated in a supplementary report. The work of collecting entomostraca from the lake was continued by Mr. Maurice Ricker, of Burlington, Iowa, and the writer.

Special Studies.

Among the other groups special study was made on shells and dragonflies. Shells in the State of Montana are relatively scarce. Few reports have been made on shells taken from this region. The only list so far available is the one given in *Nautilus*, Vol. VIII, p. 63, giving a list of 42 species from the Missouri river. The material from the western side of the range lists 21 species. The conditions in the State of Montana are not favorable to the growth of shells. The rivers are rapid, with scarcity of food, and with little lime. The lakes contain clear cold water, are usually deep, with few swampy places, and with rocky shores and bottoms. The marshy stagnant portions of the lakes are usually small, and liable to dry up in summer. The mountain sides in summer become dry and parched, except in protected portions and along streams. Great stretches of plain are without moisture for a portion of the year, and almost every living thing that cannot move to the water courses is killed. The days in summer are hot, the nights cool. The air is dry and evaporation is rapid. As a result of the above conditions we may expect great variation of species in adjacent regions, where the barriers may be sufficient to cut off all communication between the regions. It is hoped by making extensive collections of land and fresh water shells to secure sufficient material to throw some light on the geology of the region, which now offers many difficult and complex questions. One new species has been discovered, and the first living specimens secured. Another has been found at an altitude of 9,000 feet. In the report of the work on the lakes following information is given regarding the limited number of species found in each.

The work on Odonata has been prosecuted with more or less vigor during the past four years, besides material taken at different portions previous to that time. The result is the discovery of about fifty species in the state, which is not a large showing. The same conditions making it difficult for shells to grow in the waters of the state will apply to dragonflies. The young live in water, which must not be swift nor too clear, but must offer sufficient animal food to keep the larvae alive, must be stagnant enough to support life of such slow and uncouth water dwellers and must offer them suitable hiding places to keep out of the sight and reach of enemies. Such places are not common. In Illinois the writer was accustomed to visiting the ponds around town, taking as many as 25 species in a single afternoon. In Montana a hard and long day's work has resulted in but six species, and not many specimens of these. From this it will be seen that dragonfly collecting in the state is not only difficult, and the results meager in amount of material, but from what has been said there is a possibility of securing many new and interesting things.

During the three seasons of collecting in the western part of the state large numbers of botanical specimens have been secured, which are deposited in the herbarium of the University, and await study.

It will now be helpful to the reader to give some information concerning the region under discussion, which will convey a better idea of the country than has heretofore been given.

The Mission Mountains.

The Mission range is familiar to all old-timers of the State of Montana. Its snow-clad peaks appear suddenly before the eye as the traveler reaches the crest of the hill above Selish, the railroad station on the Northern Pacific where the traveler leaves the train and takes the stage for the mountains, Flathead lake, or Kalispell. The first view is one of grand comparisons, with the broad and beautiful valley in the foreground, the majestic peaks of the Mission range behind, while in the direction opposite rise the rugged Cabinets, the abrupt and pointed Squaw peak being the most conspicuous.

No one can see the Mission range without bursting into exclamations of surprise and admiration. A view is given in Plate XIX. The high, snow-capped, jagged peaks, rising abruptly from the valley, usually shadowed by clouds whose lower strata obscure the higher peaks, offer such decided contrast to the level valley that the comparison is very noticeable.

The range is about 75 miles long, the higher peaks being on the southern end. The range slopes gradually down to a lower altitude northward, finally ending as a range at the Swan or Bigfork river.

Very few of the peaks in the range have received names, though most of them are large enough and of sufficient importance to be named. McDonald peak is the only one with a name recognized as belonging to a definite height. McLeod peak is a well established peak on the southern end of the range, and has been one of the points used in triangulation by the United States Geological Survey for many years. McLeod peak is south of the Jocko river. Big peak is another name given to one of the heights opposite the peninsula at Flathead lake. But the particular height to which the name is applicable is not definitely established. Aside from these three, and a fourth on the map a little north of McDonald and called Teton, none of the peaks in the range have names. Since the work in this region was undertaken the necessity for naming many of the peaks, lakes, and points of interest has become apparent, and some suggestions have been made.

Mention was made of the fact that the Mission range was cut in twain by the Jocko river. Immediately north of the river is a high point, very conspicuous, and without a name. The name suggested for this is Sinyaleamin, an Indian name meaning "surrounded." Years ago the Flathead and Blackfeet Indians had a fight on the banks of the creek having its source in this mountain, with the result that the Blackfeet were surrounded and exterminated. The Indians made reference to this in naming the creek "Sinyaleamin," afterwards changed to Mission. As the mountain mentioned had up to this time no name the name Sinyaleamin has been given to it. Plate XX gives a view of this mountain. It is also seen on the right in Plate XIX. East of Sinyaleamin, and ap-

parently a part of the same range, are the well known Jocko peaks, shown in the illustration from the mountain summit, Plate XXI.

The range extends almost due north and south, the meridian 37 passing along the western base of the range. The 46th and 47 parallel degrees approximately mark the southern and northern ends, though a large bend extends toward the east in the southern end of the range.

The drainage from the western side is across the Flathead Reservation, through several creeks, into the Pend d'Oreille river, and into Clarke's Fork of the Columbia. The drainage from the eastern side is into the Swan river, north around the range into Flathead lake, and out through the Pend d'Oreille river as before. From the southern end the waters are carried by the Jocko river into the Pend d'Oreille river. A portion of the eastern slope of Sinyaleamin mountain, as also the eastern slopes of the Jocko peaks, drains into the Clearwater river, thence into the Big Blackfoot; from this into the Missoula, and finally into Clarke's Fork of the Columbia. It is thus seen that the entire drainage of the range is into the same stream, though by very different routes, and over distances of varying lengths.

SINYALEAMIN LAKE.

The first place in the range at which work of consequence was undertaken was at Sinyaleamin lake. See plates XXII and XXIII. As has been stated, this little alpine lake is at the southern base of Sinyaleamin mountain. From the nature of the location of the lake the name is very appropriate. Locally the lake is called St. Mary lake. As there is another larger and more widely known St. Mary lake in the northern part of the state in the Blackfeet reservation, the name Sinyaleamin lake is most appropriate for this beautiful little sheet of water, and should be retained.

St. Ignatius is about six miles from Selish, on the Northern Pacific railroad. From St. Ignatius to Sinyaleamin lake the distance is given as nine miles. The distance to the mouth of the canyon is nearly six miles and the road up the winding canyon is about three miles. The road across the valley is excellent. A mountain road has been constructed up the canyon to the lake. This is passable in summer, is no doubt good in winter, and with a little work could be made very good indeed, save for a couple of steep hills. The road follows up the canyon carrying the waters from Sinyaleamin lake. This stream joins the main stream before it reaches the Mission. The waters from the branch stream are derived almost wholly from Sinyaleamin lake. The waters from the main stream of the Mission creek come from the mountain peaks to the north of Sinyaleamin mountain, tumbling over a high fall which may be seen miles away on the plain.

The lake is hemmed in on all sides by mountains, only a small flat near the water affording a camping site. This camping site is on the top of an old moraine which is well covered with small timber. If the timber was cleared away there would be a good-sized camping site in an admirable location for scenery. Campers are continually widening the small space by cutting down small trees for fuel and it is now a delightful place for a camp for either outing or study.

Our camp at this lake was from July 7 to July 18, 1900. The party numbered 15 most of the time, and for a couple of days there were 23, including a number of distinguished visitors. The weather was perfect, not a thing to stop work for the entire time.

A second visit was made in June, 1901, a month earlier than in the preceding year. A large collection of plants was made and further notes and collections of shells were taken. Dredgings were made for Entomostraca in the lake and in the ponds to the south of the lake. As the season was early there was much moisture. This made the material collections more abundant but made the work more laborious.

On the north side of the lake the mountain rises abruptly to a height recorded by our aneroid as 9,200 feet, probably 200 in excess of the true height. On the summit abundance of snow could be seen. The lower slopes are moderately wooded with small red fir, while the upper heights are bare jagged rocks. On these a few white-bark pine have a foothold. See Plate XXIV. On the east and south of the lake the summits are lower, sloping gradually to the south and then to the west where the ridge descends almost to the level of the waters of the lake. The mountain sides in this direction are densely wooded with small trees. The western end of the lake is the only part with what might be termed open country. Here the lake is dammed by a moraine which is now covered with small trees and other vegetation. This moraine extends across the ravine, which is here about a quarter of a mile in width, and down stream for nearly a mile, as nearly as could be determined. The present outlet is at the southern end of the moraine. There are indications that the outlet was formerly at the other end of the moraine, next the mountain side proper. From indications it would appear that the lake was formerly larger than at present, when the waters were dammed up, overflowing what is now the good camping place, and for some distance beyond. On the moraine the vegetation is different from that at other places, indicating that the period when the waters covered this part of the moraine is not so very far back in time. The time that has elapsed since the outbreak at the present outlet has not been great. When the lake occupied this addition it was larger, and perhaps forty or fifty feet deeper. When the water first started at the present outlet the cutting was rapid, as shown by the abrupt and narrow declivity at the outlet, and resulted in the present lake level.

By damming up the present outlet the level of the lake could be raised about fifty feet without overflowing the moraine.

The lake is about 7,500 feet long and 2,500 feet wide. The shape and outline are readily seen from the accompanying sketch. See Fig 1. The length lies east and west. The lake is clear, cold, and deep. At 8 P.M., July 9, 1900, the temperature was 15 degrees Centigrade. By trials it was found that the white net used for collecting entomostraca could just be seen at a depth of 30 feet. The dark rocks on the bottom could be seen only at much less depth than this.

The banks of the lake are precipitous, no shoals or rocks being found. The largest shallow place is on the western end of the southern side where a small shallow place some 300 feet long by 50 feet wide slopes

Sin-yale-a-min Lake

Cedar Forest

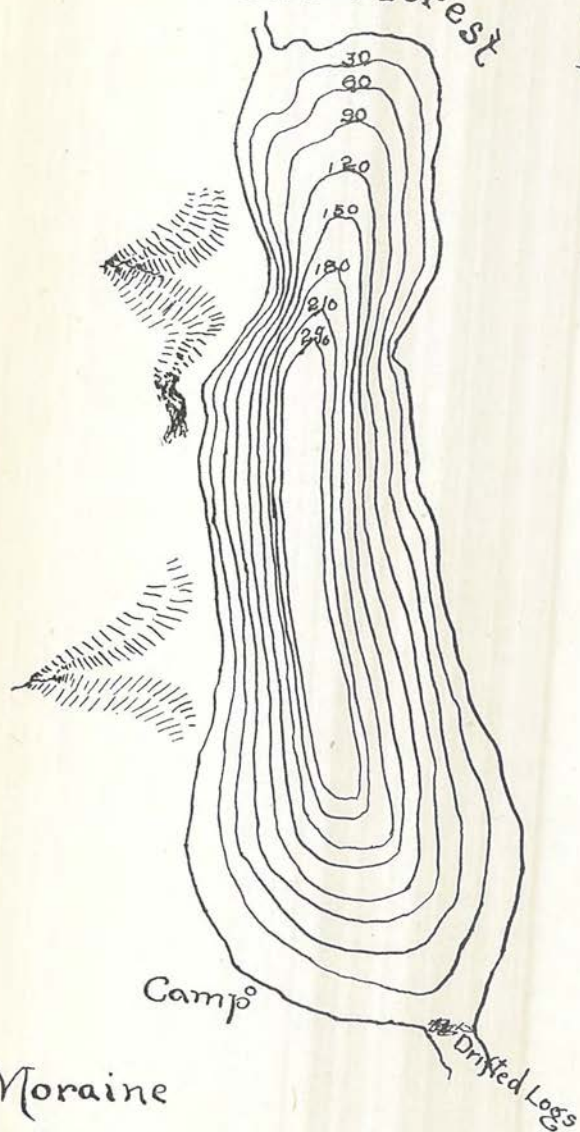


Fig. 1.

Diagram, showing shape of Sinyaleamin Lake.

down from shore. At the upper end, around the inlet, there has been some filling, but it has been slow. The depth a few hundred feet from the inlet was 30 feet, but it shot down rapidly to 115 feet, and finally to 250 feet, the deepest recorded. This depth was taken opposite the rocky cliff toward the upper end, but a glance at the map of the lake will show it is everywhere deep. But a few feet off shore near camp at the southern end the depth taken was 165 feet.

There is but one inlet, at the upper end, draining the eastern slopes of Sinyaleamin mountain and the Jocko peaks where there is abundance of snow the year through. There are no small inlets save when the snow is melting off the hills in the spring, but there must be a little underground seepage, as there is considerable water on the mountain sides high up that disappears before the stream reaches the lake.

The stream forming the inlet comes through a canyon from the north, Sinyaleamin mountain forming the western wall, one of the Jocko peaks the eastern. Along this creek for a quarter of a mile or so there is a rank growth of beautiful arbor-vitae trees, as shown in the illustration. See Plate XXV. These continue until the canyon becomes so narrow there is room only for the stream, which tumbles over a cascade several hundred feet high, a portion of which is shown in Plate XXVI. This cascade was followed for some distance and as far as could be seen or heard the cascade continued. Later, from the summit of the mountain, the direction and source of the stream was determined.

On account of the land locked position of the lake it is seldom disturbed by storms, although some strong gusts blow in from the west. The surface is usually calm and smooth, timber growing to the water's edge, making a beautiful reflection. It appeared from indications along the shore that the surface of the water in the lake varied some three or four feet, at the time of our visit being at its lowest. There is very little drift in the lake. At the outlet there is quite a pile of old logs that have come down, but they show evidences of long submergence in the water, and are not in great quantity considering the timber around the lake. The shores are free from drift.

Three ridges lead up from the base to the summit of the mountain, all of comparatively easy ascent. The ascent of the mountain from the lake, whose altitude is 3,800 feet, was made in a day, returning very late at night. We almost failed making it though within sight and hearing of the camp. This summit is really a long ridge, extending southeast and northwest, culminating in two peaks, and joined to the remainder of the range to the north by a low spur at the easternmost of the two peaks. On the north the drainage is into the main branch of Mission creek. The western peak drains into the stream below Sinyaleamin lake. The drainage from the country to the eastward and southward, as shown in the illustration, see Plate XXIII, is into Sinyaleamin lake.

On the 12th of July, 1900, the ascent of Sinyaleamin mountain was made. The start was made before seven in the morning, three of us preparing our loads for the ascent. The outfit consisted of a camera with 15 plates loaded, a rifle, a shotgun, a botany can, provisions for a day, and

necessary ammunition and material for saving specimens. Although it was the middle of July the morning was quite cool. By keeping behind the hill on the western ridge of the three we were in shadow for a good portion of the distance. It was not until nearly at the limit of trees that the sun's rays began to be felt. The ascent to the timber line was devoid of interest, save that at about 7,000 feet a mother bird with a brood of chicks about three days old was flushed among the *Xerophyllum* through which the ascent led. This grouse, known as Richardson's grouse, seems to be common to this range of mountains, and was taken on several different occasions. It was a surprise to find the chicks so young. This proves either that the bird had misfortune the first sitting and made a second nest, or that the altitude retarded the nesting time. The size of the birds discovered and their ability to escape at the age of a few days may easily be conjectured. Two of these little fellows were captured by hand, and proved to be the only birds secured on the trip.

Lunch was eaten at 7,800 feet, and the summit looked near, but the ridge looked steep and rocky. We were ascending a "hog back," a ridge leading to the summit. It was narrow, in places no more than wide enough to travel in single file, occasionally widening with small grassy plots, in which flowers were growing in great profusion. On the summit of the ridge, and occasionally in the crevices on the sides, a few white-bark pines had a foothold. See Plate XXIV. Their trunks were gnarled and twisted, with broken limbs and stunted branches, showing plainly the great struggle they were enduring. The dead trees are light and dry, burning with a great amount of smoke and much pitch, blackening everything used about the fire for cooking to an unusual degree. The picture given shows plainly the condition of the trees.

Insects are always scarce in high altitudes and flowers are always brilliant. The slopes of Sinyaleamin mountain were no exception. The zoologist may find some food for reflection in this. If insects have been instrumental in developing color in flowers, as is concluded from modern theories, this condition is to be expected. The few insects seen were very busy, and had a wide field to work over and an abundance of flowers to select from.

Luncheon over, and a supply of typical flowers having been gathered and a few insects taken, the ascent was resumed.

Mountain climbing to some people is a pleasure, to others a drudgery. Certain it is that few people enjoy climbing up among the timber and over slippery grass, with nothing to see but the limbs of trees immediately ahead, the grass or rocks under foot, and occasionally a patch of blue sky or a glimpse of a peak or a canyon. But when one finally ascends to the rocks, where grass does not grow, where trees are few and stunted, and where solid rocks are piled in stratified layers or tumbled in confusion as the case may be, mountain climbing becomes to most people a pleasure and a reality. When one can rest on solid rock for a moment and before him see the peak in all its grandeur, to the right a mass of snow with a stream of silver leading away, to the left a wall of rock 3,000 feet high, it is worth the effort needed to get to the position.

The interesting part of this climb was that one of the party was being

initiated, never having climbed before to such a height or been in such a trying place. The result was interesting both to himself and the others. The sight was too much, and his nerves refused to stay under control. All his will power was not sufficient to hold his muscles in control, and he shook as with a palsy. Places that could be passed with a step were trying and difficult, and often required minutes to get over. He reported it seemed as though all the rocks were loose and ready to tumble down, and to see him pick and try at rocks to see if they were stable was under most circumstances really amusing. Under present conditions it was trying. Needless to say the rocks were solid. It is sufficient to say that in such attempts either all reach the summit together, or all return together without reaching it. The higher we ascended on the peak the sharper the ridge became, and the steeper, and with this there was greater trepidation on the part of the shaking member of our party. Constant encouragement was necessary, and repeated lifts and boosts were given. Although a man of mature years and of careful habits, ordinarily calm and deliberate, he reached a point where he had no confidence in himself, and even refused to stand erect on places that were perfectly safe and with abundant room. All this was the result of the effect of the crags, cliffs, waterfalls, and peaks on such an immense scale that it was too much for the nervous makeup to stand, and there was a collapse. When the collapse came it was quite complete, and lasted until the foot of the mountain and camp were reached. Needless to say the result was to make the individual exceedingly weary. Long before the others were tired he was almost overcome, though this was most noticeable after the last cliff and crag were out of sight behind.

The last thousand feet of rocks were almost completely bare. But at the altitude of about 8,500 feet, as indicated by the aneroid, we came across a small shell among the rocks, on the summit of the ridge. This little shell belongs to the *Pyramidula*, and is known as *P. strigosa* var. *alpina*, and was found in considerable abundance. While the others went on the conchologist devoted a quarter of an hour to the search, resulting in securing some two or three dozen and several live ones. No doubt many could have been found if search had been made, as they were picked up occasionally almost to the summit. There was very little vegetation on which these shells could live, an occasional plant with a few leaves and a stunted stem being seen here and there on the rocks. Aside from this there was nothing to decay. The trees had long since been left behind and there was nothing else alive visible, save the lichens.

These shells reveal a very interesting point in adaptation. A near relative has been found on the high mountains in various portions of the State of Montana. *Pyramidula strigosa* Gld., small variety, has been taken on the sides of nearly all the high mountains in the western part of the state. They have been collected at an altitude of from 8,000 to 9,000 feet in the Tobacco Root mountains in the eastern part of the state. *Pyramidula strigosa* Gld., var. *cooperi* W. G. B., is found along the shores of the lakes and along the damp banks of the streams. Apparently some of the lower forms have ascended, becoming accustomed to altitudes above

the lakes and rivers, and being able to live on the mountain sides during the damp spring months, in summer disappearing from sight until the following spring. As the ascent was made and the struggle became fiercer the size of the shells became reduced, this form being much smaller than the variety *cooperi*. But still others ascended to higher realms and are now found on the highest and bleakest of rocky slopes. This *P. strigosa* var. *alpina* is no doubt the result of this gradual ascent. In size it is small, being really diminutive. The struggle is great. Food is scarce. To support so large a body as the small form lower down, or the ordinary specimen at the lake or creek, is impossible. Consequently, there has been a change in structure to accommodate the changed conditions, and the shell is much reduced in size. The form, *cooperi*, has not been found by the writer above 4,000 feet. The small variety is found from 5,000 feet to 7,000 feet in the west, and higher in the east. The diminutive variety has been taken on this occasion at an altitude of 8,500 feet and from that nearly to the top. The same diminutive shell was later taken on McDonald peak at an altitude of 8,000 feet to 9,000 feet.

Plate XXVII will give the reader a better idea of the size and relationships of the shells before mentioned than can be obtained from a description.

The summit was reached at 4:15 in the afternoon. It was completely bare of vegetation save for one little straggling specimen on the western edge, catching the rays of the sun, and not sufficiently far along in growth to make a determination. The aneroid registered 9,150 feet. Although the sky was cloudless a few pellets of snow came from some place and struck us in the face. At our feet was an immense snow drift on which the camera was planted and which was covered with goat tracks.

The sight was fine. No one can tell the glories, beauties, or depict the awfulness of the view from one of the heights of the Mission range. To the west is the twin peak of the one we have ascended, showing beautifully the stratification, and the formation of the mountain. Beyond this peak the mountain drops almost abruptly to the plain. To the north the range appears as one vast jumble of peaks and ridges, though of course there is order in it all. Reference is made to the impression. To the east the Jocko peaks rise abruptly from the snow fields, old snags that appear incapable of being ascended. A view of these is given in Plate XXI. Between Sinyaleamin and the Jocko peaks is a large glaciated region, no doubt the former ice region supplying the material for the moraine at Sinyaleamin lake, or the lakes toward the east. At the foot of the old Jocko crag is a small lake, filled with slush snow and ice, as viewed from our distance, and which has been christened Snow lake in consequence. This Snow lake is in the drainage of Sinyaleamin lake, the waters entering Snow lake, overflowing, passing down over the rapids into Sinyaleamin lake, and on to Mission creek. To the south Mount Lo Lo, in the Bitter Root range, may be seen 75 miles away. The Bitter Root range, Cabinet and Swan ranges, the Mission range in the foreground, the Kootenais and the Rockies, make a grand and beautiful panorama. Thirty miles to the north may be seen Flathead lake, blue as the

sky above. The Mission range shows up grandly. It is a magnificent sight.

The descent was made along the ridge to the southeast, so as to descend the middle ridge of the mountain instead of the western one. The descent was begun at 5:35, and was devoid of interest save that the trip was exceedingly difficult and tiresome. In an evil moment a ravine was selected, which was followed for some time. In one respect this was fortunate, as late in the evening a movement was seen in the bushes ahead indicating a bear. The head man immediately dropped to his knees. A black patch about the size of a man's hand was all that could be seen, and instantly it was fired at. The surprise of the mountain climbers was great to behold a monster porcupine roll over into the ravine. He was big and heavy, and it was nearly 4,000 feet of a descent to camp, and already getting dusk, owing to the fact that we were in the ravine. Tying his legs together the beast was slung across the back of one of the men, and the descent in earnest began. This was the largest porcupine ever seen in the region. Indeed, porcupines in this section of the state are scarce, and many an old timer has no recollection of ever having seen one. When 2,500 above camp a scheme was resorted to in an effort to arouse the camp which is worthy of mention, as it may be used by any one in any locality. The idea belongs to Prin. Silloway, though it may be commonly known. Taking a double-barrelled gun, opening the breech, and blowing in the breech end as in a conch shell a noise is made that is deep, heavy, and resonant, and may be heard a long distance. The noise made on this occasion was clearly heard in camp a half mile below, and much farther by the road we had to travel. Also, we could hear their reply, though told afterwards that all had called together at the top of their voices in order to make us hear. This blowing on the gun barrel is the cheapest whistle a hunter can buy, and will carry the sound farther than any on the market. Late that night, about ten o'clock, the party arrived, tired and hungry, as is usual in the mountains, but well paid for the trip.

ORNITHOLOGY AT SINYALEAMIN LAKE.

Animal life around the lake is interesting, but not abundant. The ornithologists followed the birds from daylight until dark, which is most of the time when the days are so long. The nesting season had apparently closed, and not a single set of eggs was taken or seen.

While the list of birds seen at this lake includes 39 species which is a fair number, there was no abundance of any species. Owing to the character of the banks traveling was difficult. The waters of the lake harbored little food, and aquatic life was relatively scarce. In the dense arbor-vitae woods at the head of the lake the carol of the winter wren was frequently heard, while in the cascade the American dipper boldly dashed back and forth in the spray. A pair of wandering loons once rested over night on the lake. The American golden eye now and then made appearance on the lake. Along the shores the spotted sandpiper was not uncommon. In the woods Richardson's grouse and ruffed grouse were frequently flushed. A desert sparrow hawk, pursued by pine siskins, was seen when high up on the mountain. The belted kingfisher

was common around the shores of the lake, and in the woods might be seen woodpeckers of several species. Cabanis's woodpecker was not uncommon, Batchelder's woodpecker was occasionally seen and heard, one pair of red-naped sapsuckers was seen for a day, the lordly pileated woodpecker made announcement of his presence by his loud call and hard and slow pounding on the trees, while the red-shafted flicker was seen and heard daily. At dusk the western night hawk occasionally was seen in the air, while during the day, strange as it may seem, an occasional humming bird was seeking food from the various flowers about the lake. The sharp and far-away sounding call of the western wood pewee was frequently heard on the hillside. Wright's flycatcher was common in the timber south of the lake. The black-headed jay was not uncommon, and a single curious Rocky Mountain jay was one day seen lurking around camp. Higher up on the mountain, above 4,700 feet, Clarke's nutcracker was found. In the woods adjacent to the lake the American crossbill was common, and pine siskins were frequently noted in the air overhead or occasionally were seen in camp having come for crumbs. Everywhere on the reservation where observations were made the western chipping sparrow was found. Around the lake Shufeldt's junco is abundant. Black-headed grosbeaks were not seen about the lake, but at the ponds a mile to the south they were abundant. The brilliant Louisiana tanager was everywhere to be seen, while the handsome cedar waxwing was frequently noticed at the pond with the grosbeaks. The red-eyed vireo, warbling vireo, Audubon's warbler, Townsend's warbler, and Macgillivray's warbler were the insect feeders noted in the trees. The Rocky Mountain creeper was only occasionally seen, though the slender-billed nuthatch is common. Every walk brought to view the long-tailed chickadee. The notes of the olive-backed thrush were regular features of the woods. A single pair of western robins were feeding the young on the nest during the stay at the lake.

The region seems to be a place of resort for birds, where they come for a time and disappear, as is the case with the region as far as man is concerned. Later investigations may reveal more.

CONCHOLOGY OF SINYALEAMIN LAKE.

One would expect to find an abundance of shells in and around such a body of water as this lake. In this, as in many other points, there is disappointment. These clear cold lakes do not offer a large supply of food for such dainty feeders as shells and the supply is not abundant. The small alpine form, *Pyramidula strigosa*, var. *alpina*, has been previously referred to as having been found near the summit of the mountain. In the woods along the borders of the lake the larger *Pyramidula strigosa* Gld., var. *cooperi* W. G. B., was taken rather abundantly. With the preceding *P. solitaria* was found in less abundance. Only a few *Polygyra townsendiana* Lea, var. *ptychophora* A. D. Br., were taken. These two have so far been found together, the former most abundantly, the latter much less so. These four land species were all that could be found. In the water three more species were taken, all sparingly. *Physa heterostropha* Say was not abundant, but several large and very fine specimens were taken. Now and then *Planorbis trivolis* was seen.

Nearly an entire afternoon was spent at the outlet attempting to secure a few of these two species, and the result was not very flattering. An Illinois bog would produce a thousand for one. The most noticeable snail, and the most difficult to secure, was *Limnaea emarginata*, a small variety. The same species was found very abundantly in McDonald lake fifteen miles further to the north, and is also in Swan lake across the range east. In Sinyaleamin lake the shells are for the most part singly on stones in the bottom where the water is shallow, or along the bank. They are very light in color and very conspicuous. To secure them it is necessary to take a boat, row slowly where the water is shallow, and when one can be seen wait until the water becomes smooth and either pick it off by hand if not too deep, or by some other method. As there is much trouble to determine the depth of the water on such occasions the task becomes quite difficult, and the result is often a wetting. Our best success was to take an insect net, and with this gently pull the shell off the rock by inserting the net under the snail, thus letting the animal fall into the net. Even this is slow work. The snails have the peculiar habit of letting all holds go when anything touches them, falling to the bottom among the pebbles, where it is very difficult to see them. An entire afternoon was spent fishing for these specimens, a couple of dozen being the number secured, and many getting away. It is readily seen from this that a small bottle may hold the entire catch of an afternoon. Notwithstanding the difficulties, the snails present many interesting points, and are well worth the effort. No bivalves were seen anywhere.

By comparing these notes with the record of McDonald lake it will be seen that the snail life of the two regions is very similar.

The butterflies noticed were not numerous. Those seen were *Colias eurytheme*, *Basilarchia lorquina*, *Vanessa milberti*, and a species of *Lycaena*. These latter were collected in small places where the butterflies seemed as close together as they could get, as many as 75 or 100 being collected in one small space. No effort was made to make a collection of moths or butterflies, attention being diverted in other directions, but on account of the cold water and the limited vegetation it is not likely the best place to seek such insects in quantity.

ENTOMOSTRACA.

Dredgings and surface catches were made during each day of the ten spent at the lake. Altogether 39 vials were filled, each representing a catch. Usually the catch represented fifty strokes of the pump. It was our custom to take a surface pumping, then attach ten or fifteen feet of hose, afterwards 25 feet, then 50 or 75, then 100, afterwards all that could be put together, 140 feet. It was soon discovered that during the day very few entomostraca were at or near the surface, though they were always to be found late at night or early in the morning near the surface. To seek a solution of the problem pumpings were made late at night, before daylight in the morning, and during the day. It was observed that light was not suited to these animals, and that as soon as day dawned they sank to a depth of 25 or 30 feet, remaining until dusk, when they again returned. These observations were verified later in McDonald lake, in Flathead lake, and Swan lake. It was found that to

secure specimens in day time the hose must go to a depth of 25 or 30 feet, while at night they were as numerous at the surface as any place else. These diurnal movements are very interesting. It does not appear that the movements are in schools, but that the movements are everywhere uniform.

These observations are not in accord with those made on Flathead lake on July 6. At that time *Cyclops pulchellus* Koch was exceedingly abundant on the surface of Flathead lake, in great numbers, on a bright sunshiny day.

Observations showed that life at night was most abundant at the surface, the quantity decreasing toward the bottom, until at the lowest point reached by the apparatus, 140 feet, but few forms and relatively few of each species, were found. Life in the lake is scanty as compared with that in the shallow ponds near the lake, and small ponds found at other places. Yet considering that the water is so clear and cold and contains so little food the life appears abundant.

The most abundant species, which had practically entire control of the lake was what appears to be a new species of *Diaptomus*. The next was *Daphnia thorata* Forbes, a species allied to *Daphnia hyalina* Leydig. *Cyclops Americana* Marsh was rather abundant. No amphipod crustacea were observed in any place.

The work in this lake was made possible only by the use of a canvas boat which was secured on purpose for the work, and which served its purpose admirably. See Plate XXVIII. This boat was 14 feet long, and carried about 800 pounds as the largest load given it, carrying this in perfect safety. The only boat on the lake was an Indian scow found near the upper end on the shore, which the boys towed to camp and fixed up so as to be serviceable, but which was very unwieldy and could not be used to any advantage. It was jocularly termed the Oregon, but was not used to any extent, and would never have been found save with the canvas boat. The canvas boat, *Daphnia*, was used constantly to transport the collectors to different parts of the field at the lake, and to go across and from end to end. It was in use most of the time by some one, was light and easy to handle, and was a general favorite. The boat was a source of much examination on the part of the Indian visitors both here and at other portions of the reservation. They seemed to think it was good for any kind of a trip, and an invitation was extended later to take a badly wounded Indian with a well friend a distance of 20 miles on Flathead lake, and the same distance returning. Needless to say the offer was not accepted. It was with much hesitancy a canvas boat was taken, fearing it would be unserviceable, but it was a complete success. In a short time after landing at the lake the boat was in use and was readily packed up when camp was broken.

By following the canyon leading south toward the Jocko for a distance of two miles there are to be found several ponds. The first one is small, and at the time of our observations contained little water, though much life in proportion. In fact the first pond was not much more than a puddle. This was in the canyon before it had widened much. But a little farther the canyon widens considerably, making a pond cover-

ing several acres, and still further widens into a beautiful park with fine timber of yellow pine and tamarack, with a pond much larger than the preceding. How many more may be beyond is not known. Reference has been made to these ponds under the remarks on ornithology. They proved to be very interesting from the entomostracan standpoint.

As the boat was not taken to these lakes the hauls were made by throwing the net out from shore with a long line and pulling it in. It was difficult to secure a haul more than thirty or forty feet from shore. On one occasion the pump was taken and pumpings made.

The entomostraca differ radically from those found in Sinyaleamin lake, some two miles distant. The species identified are *Diaptomus leptopus* Forbes, *Cyclops serratulus* Fisher, *Moindaphina*, probably *alabamensis*, and *Cyclops signatus*. Not a single one of these species was found in Sinyaleamin lake, and not a single species found in the lake was taken in these ponds. As the ponds are shallow and the water warmer, besides having different food conditions, it is probable there would be a difference in the two lakes, but no such striking difference was expected. From a casual observance the idea was gained that the lake possibly had an outlet through this canyon, but the life in these ponds does not confirm the idea, but opposes it.

One surprising thing at these ponds was the scarcity of dragonflies. It would appear that this would be an admirable place for these insects to breed in, yet very few were seen. From this it will be inferred that the ponds freeze to the bottom in winter, thus killing the most of the larvae, but this is only conjecture. It is also possible that the numbers of birds in the region may keep them pretty well killed off. At any rate, they were scarce. *Aeschna constricta*, *Sympetrum obtrusum*, and *Enallagma calverti* were the only species observed. Not an *Ischnura* was seen.

The presence or absence of fish in these ponds was not determined, but all the evidence was negative. The ponds gave the impression from appearances that they would go dry in some seasons. If so the absence of fish would be accounted for, as also the absence of much other life one would expect to find.

One of the conspicuous features at the lake from a botanical standpoint was the abundance and beauty of the lichens. This is noticed in many places in the state, and in some places even more conspicuously than here. The lichens cover the trees in many places. Several species were taken in great abundance at camp. In breaking off dead limbs for firewood the choice specimens covering the small limbs were saved, thus procuring in abundance some fine specimens. At the upper end of the lake a beautiful species of *Lycopodium* was discovered, with long green trailing vinelike stem, several yards in length. In the woods a species of mushroom belonging to the *Polypori* was found growing quite luxuriantly, but mushrooms appeared very scarce.

From Sinyaleamin lake camp was moved to McDonald lake, fifteen miles north, in the Mission range. But the distance necessarily traversed to reach the latter lake is much more than the distance by crow's flight.

MCDONALD LAKE IN THE MISSION RANGE.

The road to McDonald lake from St. Ignatius Mission is good. The distance is about 11 miles. Most of the distance is across the level valley, the last two miles being a very stiff up grade, causing a hard pull when there is a load.

Camping sites at the lake are scarce, owing to the nature of the lake. There is but one portion of the lake, the western end, free from cliffs or rocks. Most of this is densely wooded with timber and heavy underbrush. By fording the outlet, possible in summer when the water is low, a camping site sufficient for the party was found, on the bank of the lake, in plain view of the peak, free from underbrush, and above all, in a place where the cool breeze from the mountains after sundown drove away the mosquitoes, which are much of an annoyance in the region in early summer. The camping site was a delightful place, and a stay of ten days in 1900 was made in order to make collections, and search for living species of the shell *Pyramidula elrodi* Pils., as well as to study the entomostraca of the lake. A camp of a week in June, 1901, was made for the same general purposes. Plate XXIX gives a good view of the lake from the outlet.

McDonald lake of the Mission mountains lies at the foot of McDonald peak on the northwest. Like Sinyaleamin lake, it is hemmed in on all sides except the west by mountains, save that they are much higher, more picturesque, and steeper. The lake was named McDonald back in the sixties, and according to priority the name should easily displace that given to Terry lake, also called McDonald, which lies northeast of Kalispell.

The valley enclosed by the peaks, in which the lake now is, has been carved out by a glacier, or more properly by glaciers, as there were undoubtedly several uniting to form the main glacier which flowed down the valley. Remnants of these glaciers are yet seen on the mountains, there being three on McDonald peak, one in plain sight from almost any point on the lake. The rocks along the lake have been ground smooth, and show plainly the marks of the ice. At the outlet of the canyon a large moraine has been made, though not so advantageously situated for damming the water as at Sinyaleamin lake. But the water has in time past evidently been much deeper than it now is. The rock on the north is fast disintegrating, and is filling up the lake with red mud and ooze. At the upper end is a wooded valley which formerly must have been a part of the lake. The filling in has drained this part of the lake, the remainder of the lake not yet being filled up. The present lake is therefore but a part of what it was formerly.

The lake is smaller than Sinyaleamin lake and not nearly so deep. It is a mile to a mile and a quarter long, the average width being less than a quarter of a mile. On either side the mountains come abruptly to the water, as may be seen in the illustration given, Plate XXIX. As has been stated, there is a valley at the upper end, so far unexplored, and densely wooded with arbor-vitae, several species of fir, white and red birch, and other smaller shrubs. The inlet divides above the lake, one branch receiving water from the glacier visible, the other bringing

the water from the amphitheater toward the east, which has for drainage not only the peaks visible, but also the eastern slopes of McDonald peak. A general view of the upper end is shown in Plate XXX.

The bottom of the lake is comparatively level and from the mud on the bottom the impression is gained that the lake is either older than Sinyaleamin or has filled up much faster. The depth from end to end is nearly uniform, the deepest being eighty-four feet. The lower end is shallow, the outlet being crossed by a ford, hub deep in July. There is considerable shallow water. The mud at the bottom is of a reddish color, apparently from the decomposition of the rock on the north shore. At a point near the middle a ledge of rocks projects from either side, making the lake at this point quite narrow. The ledge is precipitous, and the water a few feet from the rocks is deep. These stones are worn smooth by glaciation, and show deep and numerous glacial scratches.

On the north, to the left in the illustration, Plate XXIX, the rocks are very steep for about 2,000 feet. Shale and cliffs alternate. By much hard work one can reach the top of the talus. Above is a mass of precipitous rock, not to be ascended from this side. Four waterfalls, with small streams, tumble over the rocks. The waters disappears in the loose talus at the base long before it reaches the lake. The southern slope is not so abrupt. Large masses of loose talus, with large boulders, line the water's edge, making a loose and spongy surface for the retention of moisture.

Life in and around the lake is not abundant. There are few frogs, and probably no snakes, as but one of the former was seen during the ten days and none of the latter. On the rocks at the water's edge, altitude 3,300 feet, several pika, *Lagomys princeps*, were killed. This is the lowest altitude known to the writer at which these peculiar animals have been taken. They are abundant on the peak at 8,000 feet and over, but none were taken, owing to the difficulties in getting them when killed among the crags at these high altitudes. The banks of the lake are so steep and rough that it is all but impossible to climb along. Almost an entire afternoon was spent in going the length of the lake a few hundred feet from the water's edge. An exploration will probably show great possibility of increasing the size of the lake by overflowing the valley at the upper end, if it shall ever become a necessity to use this lake as a reservoir site.

On the northern side the timber is not so dense, owing to the nature of the rocks. The banks are steep, and the cliffs afford poor hold for the roots of trees which have not gained much headway. On the mountain above the precipitous rocks the timber is quite heavy, being largely of yellow pine and fir. The southern bank is well wooded. The canyon at the head of the lake is densely wooded, through which there does not appear to be an entrance made by road or trail. At the outlet and along the moraine near the lake there is fine timber, some of which has been cut for rails and lumber. Everywhere there is much underbrush, making progress difficult.

The road to the lake is good, considering it is a mountain road. There is some travel over it. The lake is a great resort for the Indians and those who visit the reservation, on account of the excellent

fishing and beautiful scenery. There is no drift around the shores, most of the drift having lodged in the outlet. Here there is a quite a jam.

CONCHOLOGY OF McDONALD LAKE.

Search was made daily for shells. In the waters there were large numbers of a new variety of *Limnaea emarginata* Say, described in *Nautilus*, Vol. XV,* as var. *montana*. This is the same shell that was previously taken in Sinyaleamin lake with so much labor, and was much more abundant in McDonald lake than in Sinyaleamin. Along the rocks in the middle of the lake they were taken in considerable numbers, and at the outlet others were taken among the grass and weeds in the shallow water. This species seems to relate *emarginata* to *stagnalis*, some of the shells showing the malleations of *stagnalis* quite plainly. Placed side by side they have many points in common, but are very much smaller than the variety *appressa* of *stagnalis* taken in western Montana.

Physa ampullacea Gld. was found sparingly, not so abundant as in Sinyaleamin lake. Strange to say, not a single specimen of *Planorbis* was seen. *Planorbis* seems to be a warm water species, and while a few were taken at Sinyaleamin lake, they were very scarce, and the few taken were small and badly broken. In the small ponds and lakes in the valley to the west of the Mission range *Planorbis trivolvis* is exceedingly abundant, and in the small lakes or ponds of glacial origin along Flathead lake these shells are found in great numbers.

Among the underbrush at the lower end of the lake *Pyramidula strigosa* var. *Cooperi* was found in large numbers, as also *P. solitaria* Say. These two species have been considered distinct heretofore. A large series of several hundred was assorted with the attempt to make two species. The most widely different were easily separated, but by this process of elimination those remaining were more and more difficult to place in one species or the other, and the last remaining could apparently go as easily in one pile as the other. From external appearances it seems difficult to distinguish some of those found at this lake as belonging to either the one or the other species. The two were found in the same locality, were picked up together, and were placed in the same receptacle. It was impossible to do anything toward working out life histories, and internal anatomy may reveal differences that external anatomy does not disclose. But as descriptions of shells are largely based on external anatomy it is doubtful if these two species are distinct. It may be well to note here that all the shells taken so far at the upper end of Flathead lake are var. *cooperi*, none having been taken that could be called *solitaria*.

Having found a very small variety of the shell *Pyramidula strigosa*, called *alpina*, at high altitude on Sinyaleamin mountain, it was thought the same shell might be found on the heights of McDonald peak. A short description of the trip in search for this shell is given in the succeeding pages. Sinyaleamin mountain is almost due south of McDonald peak, in the same range, the distance between the two peaks in air line being

* *Nautilus*, Vol. XV., p. 111.

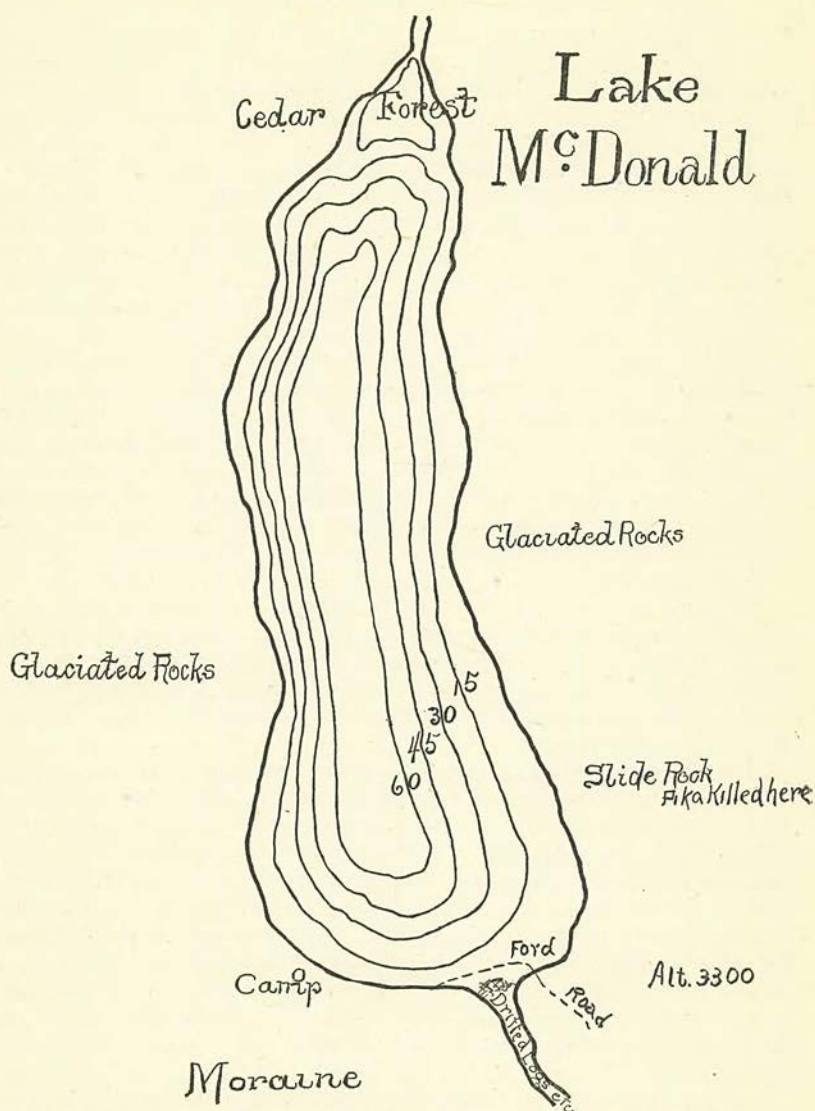


Fig. 2. Diagram of McDonald Lake, showing contour, depth and shore characteristics.

something like twelve or fifteen miles. On the assumption that the shells would start from the water course, and possibly follow the ridge on the shady and damp side, they must have taken entirely different routes in ascending the two peaks. They were found abundantly on McDonald peak at the altitude 7,800 feet to about 8,500 feet. It is worthy of note that the shells seem to begin and end rather abruptly. When first found, on either mountain, they were found in considerable numbers. The high summits of McDonald are so steep, and the broken rocks so large in size, that there seems a limit to the range of the shell on McDonald. From our observations it appears that on the south side of Lake McDonald there is a break from the slopes immediately above the lake, with altitude about 3,400 feet, to 7,800 feet, in which no *strigosa* have been found. They are probably there, but sparingly, since diligent search was made during the ascent. On the other bank, however, the northern slope, *strigosa* has been taken from the lake to altitude 7,500 feet, and continuously. Moreover, the shells taken at the high altitude on the north slope are many times the size of those taken on the opposite mountain. The locality in which the shells were taken on McDonald is on a ridge facing the west, bare of trees and other shelter, wind-swept, and storm-swept. On the north, on Teton mountain, the ridge faces the west, but is well wooded and protected, and apparently retains moisture much longer. To conchologists and others the wanderings of this shell will be of much interest, and the description has been given in some detail because of that interest.

A good series of *Polygyra townsendiana*, var. *ptycophora* was secured. The underbrush was so dense that it was necessary to crawl on hands and knees most of the time among the shrubs and small trees. By digging in dead logs, overturning decayed stumps and branches and pulling apart dead leaves a good series was obtained, but at the sacrifice of clothing and flesh.

Of these three species many were found eaten by squirrels. These were carefully preserved, and examination made of the method of procedure. The usual method was to break the shell at the apex of the spire, making a good sized opening. Through this the animal was drawn and no doubt afterwards devoured. A few openings were made at other places, and sometimes at very unfavorable places, due no doubt to lack of experience on the part of the enemy. Of the species *P. strigosa*, var. *cooperi* fifty were found thus broken into. Of *P. solitaria* four or five more than of *cooperi*, while *P. townsendiana*, var. *ptycophora* had but two thus eaten. As these latter much more resemble the surroundings than do the striped *Pyramidulas* this is not surprising, and is a good illustration of protection.

On the talus north of the lake the bleached remains of a hitherto new shell were lying abundantly on the rocks. During the short stay at the lake in July, 1899, some forty specimens of this shell were secured, Pillsbury described it as a new species in *Nautilus*, Vol. XIV., P. 40. The species is shown in Plate XXXII. It certainly is a species as distinct as many other described species, and certainly is unlike any other shell so far described in many respects. Whether or not intermediate

forms will be found which will destroy the identity of the species is to be determined. During our stay of ten days at McDonald lake several days were spent almost entirely in searching for both living and dead specimens. More minute descriptions of the results of this search have been given elsewhere, and need not here be repeated. It is sufficient to say the living shells were found. The first were taken high up, on a small space on the top of a crag where there was a little decaying rock, while trying to get a good position for a photograph of the peak opposite. The success on this occasion spurred to greater effort, resulting in finding other living shells nearer the water's edge, by going deep among the talus toward moisture. But none living were found among the rocks close to the lake. The net results of this search were several quarts of shells, with several dozen preserved animals, some of them beautifully expanded.

This shell, *Pyramidula elrodi* Pils., appears to have a very limited range. It is found abundantly on the northern shores of the lake westward to the last stream of water trickling over the rocks, when it ceases abruptly. On the southern shore of the lake it is found very sparingly, but a few being found as the result of an afternoon's search, among them a single live one. There is good reason for believing they occur along the slopes of the mountains that form the amphitheater above the lake, bordering the valley mentioned, as otherwise their presence on the south side of the lake is not accounted for. They have been found up on the side of the mountain as far as explorations have been made, up to 7,500 feet, and still seem to continue. How far up the mountain they are to be found is problematic, and should be determined. Diligent search has so far not revealed the species at any other part of the Mission range. It is expected later to make collections on the east side of the range, when search will be made for the shell there. Search for shells during succeeding years has failed to produce a single specimen from other localities than the one here described. The distribution therefore seems to be extremely limited. The amphitheater may better understood by consulting Plate XXIX.

The shell is not only a land form, but is a rock form. It seems to have a preference for nooks and crevices on the summit of some cliff. In searching for them it was discovered they were most abundant along the water courses, where vegetation had not yet gained a foothold. It was unnecessary to search among the debris collected at the roots of a clump of bushes, but if there was an open space where the talus was loose and open they were likely to be found. In the spring time they evidently crawl over the brown lichen covered rocks in search of the lichen food, crawling beneath when the warm days come on and the moisture on the rocks dries up. The few remaining too long are killed, their shells bleaching from a dark flesh brown to a beautiful pearly white. It is described by an admiring friend as the queen of the *Pyramidulas*. By digging among the damp talus a few live ones may be found. Higher up, where there are small springs from the mountain side, they may also be found.

During the season of 1901 a week was spent again at McDonald lake

in the last of June. It was the rainy season. In three weeks there were but three or four days of sunshine. While this bad weather was hard on those living out, as we were obliged to do, it was the best time of the year for collecting. One day while at this lake the rain came down almost the entire day. It was just such a day as would be good for land shell collecting, and rigged out in gum boots and a slicker the writer spent the greater part of the day crawling through the wet underbrush in search of shells. They were found in great abundance. *P. strigosa* and *P. solitaria* were out in great numbers. It is no exaggerations to say that if one had desired to do so he could have secured a peck of these two species. With them was now and then found a *Polygyra townsendiana*, var. *ptycophora*, but they were in no great abundance. Considering the small territory examined the number of shells to be had of these two species in the region of McDonald lake is very great. As it is the collection taken and brought to the University of Montana was more than a thousand specimens from this field alone.

The camp was made primarily to secure further information relative to *P. elrodi* Pils. Immediately after a rain the rock talus on the north bank of the lake was examined. The rocks were very slippery, the grade steep, and the bushes dripping with moisture. Rain fell a portion of the time. But *P. elrodi* was at home. Large and small, they were everywhere in abundance. In 1899 but a few bleached shells were found on the exposed rocks. In 1900 a much larger number of bleached shells was found, together with a few live ones. They were also followed up the mountain slope about two thousand feet. But during the camp of 1901 large numbers, of all sizes and apparently all ages, were taken. They were crawling over the rocks in plain sight, though almost invisible save by close scrutiny, owing to their resemblance in color to the rocks, and were traced up the mountain to an altitude of over 7,500 feet. At this altitude the dead shells with occasional live ones, were still abundant. As we had started up the mountain in the afternoon it was impossible to go farther that day, and the return was made to camp, with plans for ascent to the end of the shell region. That night a storm prevailed, and we concluded from indications we would fare better out of the hills, and got out, none too soon. The next morning the hills were white with new snow, remaining so for a long time.

In making this search up the mountain a shell was found which is undoubtedly a hybrid between *P. elrodi* and *P. solitaria* or *P. strigosa*. It has the form and sculpturing of the former, and the characteristic band markings of one or the other of the latter. Which of the latter it is difficult to determine. But as *strigosa* was much more abundant along the ridge than *solitaria* the hybrid is probably *elrodi* and *strigosa*. The shell is of a young specimen, less than half grown.

P. elrodi is not the only shell that made the ascent of the mountain. Associated with it, even to the highest point, *P. strigosa*, and *P. solitaria*, in varying numbers, were taken. The result, is a fine series, from altitudes from 3,300 feet to 7,500, which will afford material for working out the results of altitude.

It is not inappropriate to quote the following paragraph in reference to *P. elrodi* and its home.

"It is a shell of the rocks. It lives among the crags of the Mission mountains, where there is scant vegetation, preferring the crannies at the top of some cliff, where large colonies have been found. Among the loose rocks it finds a home, hides from its enemies, thrives during the springtime when snows are melting, and, later, when the rocks are dry and hot, crawls beneath where there is a little moisture, throws a transparent film across the opening of the shell to prevent evaporation, and awaits the coming of the next season. Those animals which have not sought the damp and cool crevices early enough are prostrated by the heat. They soon die, and their bleached and empty shells may later be found by the collector who is so fortunate as to be in their locality. They do not like the bushes. It was found unnecessary to search the rocks about clumps of bushes, for none were there. But on exposed places, where the rocks were bare and clean, dead shells were found, and by digging below an occasional live one was secured. I envy this shell its home. It is one of the most beautiful spots of the beautiful Mission range. The grand old peak, McDonald, is constantly in view, its rocky crest most of the time covered with snow. Below, smooth and placid, McDonald lake invites attention. To the west a little water fall tumbles over a rocky cliff, and the water disappears in the loose talus below. Anon an eagle circles in the heavens, and the American raven casts a silent shadow as the bird passes over. The wild laugh of the loon rings in the air at midnight, and mountain goats browse on the vegetation above. Clouds gather at the summit of the peak, and fierce lightning on a moonless night illumines the sky with vivid and lurid light. The thunder-peals roll from crag to crag, and with deafening crash startle every living thing. Again the day is clear and the sun is bright, sunshine such as only a mountain region can give, and all is quiet, serene, and beautiful. Perhaps for countless years these varied scenes have been enacted. The home of this beautiful shell is as beautiful as the shell itself, and the carving and sculpturing which have been given by Nature as an adornment to the shell are but a miniature of the immense ridges and ravines everywhere abounding."

The shell life of McDonald lake is therefore seen to be very interesting. While there is no large list of species, those to be found are in good numbers, and the collection of shells made at this camp was very satisfactory.

ORNITHOLOGY OF McDONALD LAKE.

Bird life at McDonald lake is similar to that at Sinyaleamin lake, as was to be expected. The rugged condition of the country prevented extensive collecting. The woods and brush at the outlet of the lake were the most prolific places examined, and notwithstanding the dense brush and the attending difficulties, were the only places where much collecting was done. A two days' trip to the summit of the peak brought in several specimens, but the bare ridge ascended was comparatively free from bird life above the forest belt, and below that most of the time was employed in hunting a way for ascent. Around the lake the effort to take birds was exceedingly laborious. The ornithologists made strenuous efforts to search the shores of the lake, but it was almost impossible

to get around. More collecting was done at camp than at any other place. Once Prin. Silloway shot a Townsend's solitaire, a very interesting catch. It fell five hundred feet down a cliff, entailing a half hour's work to find it and recover the ground lost. Unidentified raptors circled above him in perfect disregard of futile efforts to secure them, as he describes in his report.

As usual at our camping places, the spotted sandpiper, *Actitis macularia* L., was common along the shores of the lake. On the slopes toward McDonald and elsewhere on the hills Richardson's grouse, *Dendagapus obscurus richardsoni* Dougl., was not infrequent. Franklin's grouse, the fool hen of popular reputation, was common in the vicinity, *Dendragapus franklini* Dougl. The gray ruffed grouse or pheasant, *Bonasa umbellus umbelloides* Dougl., was common in the thickets along the water courses. The sharp-shinned hawk, *Accipiter velox* Wils., was found regularly near the lake. *Accipiter cooperi* Bonap., Cooper's hawk, was common along the cliffs of the lake, but were on such inaccessible pinnacles that they could not be taken. The western red-tail, *Buteo borealis calurus* Cass., the American rough-legged hawk, *Archibuteo lagopus sancti-johannis* Gmel., and the desert sparrow hawk, *Falco sparverius deserticolus* Mearns, were all seen about the lake. The only owl observed was the western horned owl, *Bubo virginianus subarcticus* Hoy, which is common in all the woodlands of the region. Its mournful note was not infrequently heard in the evening or at night.

A single pair of kingfishers, *Ceryle alcyon* Linn., seemed to have charge of the lake, and worked industriously at the inlet at the upper end of the lake, where the diverging streams from the main source made the fishing excellent.

Five woodpeckers in all were taken at McDonald lake. One specimen of the alpine woodpecker, *Picoides americanus dorsalis* Baird, was taken near camp. The rednaped sapsucker, *Sphyrapicus varius nuchalis* Baird, is a common resident near the lake. The pileated woodpecker, *Ceophloeus pileatus* Linn., was heard several times near camp, and notwithstanding much shooting two were taken almost from the tent door. This large and beautiful bird is reputed to be shy of man. It has been taken throughout the Mission range, and nowhere does it appear as shy as is reputed. Lewis's woodpecker is common in the valley below the lake, and in the tall pines is one of the most common and conspicuous birds. Every where the red-shafted flicker, *Colaptes cafer* Gmel., is common.

Occasionally at nightfall the western night-hawk, *Chordeiles virginianus henryi* Cass., was seen flying about. The rufous hummingbird, *Selasphorus rufus* Gmel., was a frequent visitor to the flowers near camp, and was a delightful bird to see. Along the rocky wall of the mountain the calliope hummingbird was several times observed, without doubt, among the flowers growing along the small water courses dashing over the side of the mountain.

The western wood pewee, *Contopus richardsoni* Swains., and Traill's flycatcher, *Empidonax trailii* Aud., were the insect catching birds other than warblers taken at this camp.

The American magpie, *Pica pica hudsonica* Sab., the black-headed jay, *Cyanocitta stelleri annectens* Baird, and the American raven, *Corvus*

corax sinuatus Wagl., were all seen around the lake, though in no great numbers. The raven was often noted, and repeated efforts were made to secure specimens, but without success. The only method of approach was by the canvas boat, and by this means the ornithologist was always visible. To enter the timber and get among the rocks was to get out of sight of the prey, and progress was almost impossible. The American crow and Clarke's nutcracker, *Nucifraga columbiana* Wils., were also seen around the lake, the former sparingly, the latter common at elevation of 7,500 feet and above.

The fringillidae, while not numerous in species, were abundant around camp at all times. Most abundant among the seed eating birds was the pine siskin, *Spinus pinus* Wils., which was everywhere about camp, usually high overhead in the tallest trees. The western chipping sparrow was almost as abundant, *Spizella socialis arizonae* Coues. High up on the mountain, at an altitude of 7,500 feet or more, Shufeldt's junco, *Junco hiemalis shufeldti* Coale, was taken, the range extending from this altitude down to the lake, 3,300 feet. Among the bushes along the mountain sides the call of the spurred towhee *Pipilo maculatus megalonyx* Baird, was heard, and several were added to the collection. The Black-headed grosbeak, *Habia melanocephala* Swains., the lazuli bunting, *Passerina amoena* Say, and the Louisiana tanager *Piranga ludoviciana* Wils., were frequently seen and specimens were added to the list.

On the eastern side of the lake a colony of cliff swallows, *Petrochelidon lunifrons* Say, had made their habitations in the rocks. The song of the red eyed vireo, *Vireo olivaceus* Linn., was frequently heard and the bird was not uncommon. In common with the warbling vireo *Vireo gilvus* Vieill. was heard, and now and then a specimen was added to the collection. Audubon's warbler, *Dendroica auduboni* Towns., was common in the woods, the most abundant of birds, perhaps, while not infrequently Macgillivray's warbler, *Geothlypis macgillivrayi* Aud., was noted.

In the rapids above the lake, and in the waters adjacent, might be seen the American dipper, *Cinclus mexicanus* Swain. The delightful carol of the winter wren, *Troglodytes hiemalis* Vieill., was often heard at the upper end of the lake, but so secretive was the bird that it was but seldom a sight of it was obtained, and then but a passing glimpse as the bird flitted to a new location, to again begin its song. The Rocky mountain creeper, *Certhia familiaris montana* Ridgw., was noted almost daily. Also the slender-billed nuthatch, *Sitta carolinensis aculeata* Cass., and the long-tailed chickadee, *Parus atricapillus septentrionalis* Harris, were seen.

A single young Townsend's solitaire, *Myadestes townsendii* Aud., was captured, and the adult was seen. These were the only specimens of this species seen on the trip. It seems to be very rare to the region.

The thrushes include the Olive-backed thrush, *Turdus ustulatus swainsonii* Cab., which was common, the western robin, *Merula migratoria propinqua* Ridgw., also common, and the mountain blubird, taken at altitude of 7,500 feet, but seen at the lake.

The bird life of the lake as here given proves very interesting. The camp of ten days produced forty-seven species, all of this being the re-

sult of the work of Prin, P. M. Silloway, who devoted his entire time to the study of the ornithological fauna, the results being given in detail elsewhere.

ASCENT OF McDONALD PEAK.

A party of six made the ascent of McDonald peak, taking two days for the trip, with the intention of gathering material from high altitudes. The start was made early in the morning, going as far that day as could be gone with a horse, which was taken to carry provisions, material, and blankets. The ascent for the greater portion of the distance from camp was through dense timber, where it was impossible to see out. The first steep slope, however, was open timber, full of ripe huckleberries, and where there was considerable evidence of bear. Soon, however, a dense growth of small yellow pines and fir, so thick a man could not enter them unencumbered, was encountered, barring the way. This small timber had been seen from below, and appeared to extend for a mile and a half or more, but from a distance the timber did not appear so dense as was found on closer inspection. It became necessary to either go around or return, and the former was decided upon; but even this was very difficult, owing to the growth right up to cliffs, making it difficult to get the horse through. After much toil and fatigue the ridge leading up to the main peak from the northwest was reached, when ascent became less difficult, and finally comparatively easy.

It is well to remark here that there is a well made trail to the highest point to which a horse may be taken, the trail leading up from a ridge near St. Ignatius, from which point many of the ascents are made. This trail was made in the early days, and over it many persons of note have travelled. By this trail it is possible to ride on horseback from St. Ignatius to snow. It is utterly impossible to take a horse to the summit. The nearest point to which a horse can be taken is about twelve hundred feet from the summit. The last twelve hundred feet require about four hours of hard climbing.

Camp for the night was made at an altitude of 7,800 feet, as shown by the aneroid. There was not much place for camp, the ridge being narrow, and the rocks rough. But by vigorous efforts each of the party hollowed out a place large enough to lie in. Rocks were piled up on the down hill side so as to prevent rolling over the cliff, which was but a few feet away. Rolled in a blanket, the night was spent here. The locality may be better understood by referring to Plate XXXIV.

The timber at this place shows the ravages of fire. The south side of the mountain in past years has been covered with a good growth of white-bark pine. These extended a little above our camping site, and for a long distance below. Fire had passed over the mountain in years gone by, killing the trees, but leaving them standing. The result may be seen by an examination of Plate XXXIV. At present the timber has not made a new start, and the ground is comparatively bare, and in the summer, from its southern exposure, becomes dry and parched. The opposite side of the mountain is a cliff on which nothing can grow.

At the time of our ascent a forest fire was raging below, filling the air with smoke, making it difficult to see in some directions, and materi-

ally interfering with the work we wished to do in photography. Over the range, in the Swan river country, another fire was raging. These fires were started by the Indians, if reports are true. A few days before as we were on our way to McDonald lake, the first signs of fire were seen by us when still miles away. It was remarked that the fire would reach alarming proportions if not attended to, and such was the case. It is difficult to care for fires started in this way, owing to the lack of transportation facilities, and also owing to the difficulty in getting help sufficient to extinguish them. The fire raged for several weeks, ascending the mountain higher and higher, until a fortunate rain extinguished it.

Immediately on making camp the work of collecting was begun. The botanist went energetically to work, and flowers were abundant wherever there was sufficient space and soil for a foothold. The rocks above camp were searched in the hope of finding more of the small shells, *Pyramidula strigosa* var. *montana*, which had been found for the first time on Sinyaleamin mountain ten days before. Sinyaleamin mountain could be plainly seen by us to the south, its snow covered peak being easily distinguished from the others. The shells had aroused so much interest among the party that all were interested in the search. Nor was there disappointment. A careful search of the rocks a few hundred feet above camp brought to light a couple of hundred specimens, among them several live ones. A careful search among the smaller stones, overturning them and examining the crevices, produced a collection that caused exclamations of delight from all.

McDonald peak is double, the western summit, the one ascended, being about a thousand feet lower than the eastern. The two are connected by a ridge, with a saddle or depression between them. To pass from the western summit to the eastern requires a descent of perhaps a thousand feet, then an ascent of perhaps two thousand. The western summit is easy of ascent, although the last 1,200 feet requires about four hours. But to ascend the main peak from the western summit seems difficult, though by taking the snow it is no doubt possible. Up to the present the main peak has not been ascended by the route from the west, with the exception of a rumor that the trip was formerly made by Indians. This statement has not been verified.

The main peak has three or four spurs projecting in different directions, behind or between which the snow lies in masses, glaciers apparently, remaining the year through. There is little snow on the western peak in summer, and its importance as a snow holder lies in the fact that it permits the snow blowing from the valley on the west to pile up between it and the main peak, thus making the glacier, visible from almost every part of the valley. These spurs make such protection that on three different places on the heights of this mountain the snow piles in drifts which never melt, making three large glaciers. One of these, the one seen from the lake, is shown in the illustration. The others lie behind the spurs. The waters from these three snow masses all flow into McDonald lake. The supply is therefore abundant and never failing. Moreover, the peaks to the north of McDonald peak, and which are also north of the lake, give much of their water to this lake.

The snow mass behind the spur to the left in Plate XXXV. flows into a small and beautiful lake, Leash lake. This lake is said by those who have seen it to be of surpassing beauty, usually full of snow, and visible only when almost upon it, so well is it hidden in the cliffs. The water entering the lake flows down the side of McDonald northward. After leaving Leash lake the water flows west, coming down and joining the stream from Teton on the north and the stream from the west glacier of McDonald.

Post creek, the outlet of McDonald lake, on the 30th of June, 1900, carried 473 second feet of water. The place at which the water was measured was some miles down creek from the lake, at a lower elevation than the lake by a thousand feet, and with considerable loss between place of measurement and lake through irrigation.

The Mission Valley.

This beautiful valley is bordered by the Mission mountains on the east, the Jocko river on the south, the Pend d'Oreille river on the west, Flathead lake on the north. The extreme length is about 35 miles, the extreme width about 15 miles. A terminal moraine separates the lake from the valley, bordering the lake on the southern end. The country immediately south of the moraine for a distance of ten miles is beautiful. It is level land, rich, capable of making good farms, easily irrigated. A large sand dune stretches across the valley about 15 miles from the lake, extending east and west. The eastern end is free sand, is not yet held in place by vegetation, and is slowly creeping eastward. The free and movable sand is 12 to 15 feet high, clean looking and white. Some eight or ten miles from this free sand westward one comes to the Pend d'Oreille river. The country abounds with depressions and coulees, with several large buttes from 100 to 200 feet high. It is in this region that the buffalo herd ranges.

The valley is crossed by four large creeks, as follows: Mission creek is the most southern. It takes its source in two canons, one the outlet of Sinyaleamin lake, the other Mission creek proper, with its high falls, visible for miles on the plain. Sinyaleamin lake receives its water from the eastern slopes of the mountains, principally from Snow lake, which is full of slush snow even in July. The stream leaving Snow lake tumbles over a beautiful cascade just before it enters the lake. The lake is described elsewhere. The stream from this lake joins Mission creek proper a short distance from St. Ignatius Mission. A third and smaller branch emerges from the canon between Mission canon and McDonald lake. This branch takes its rise in two small and beautiful alpine lakes, Twin lakes, lying high up in the mountains, fed by melting snows. Except in early spring this water is consumed in irrigation. Mission creek flows a little to the north of west, receiving Post creek a few miles west of the Mission, finally flowing into the Pend d'Oreille river, Mission creek may be located by examination of Plate XIX. Post creek is the outlet of McDonald lake, which receives most of its waters from the slopes of McDonald peak. The creek forming the inlet of the lake has two forks, one taking the waters from McDonald peak, the other from the peaks immediately to the north. This northern branch flows through two small lakes, and has some beautiful cascades, seen plainly from McDonald peak. Neither of these branches is known save for a very short distance from the lake. Post creek flows southwest into Mission creek as previously mentioned. Crow creek takes its rise in the mountains still farther to the north, in the canon through which runs the Crow creek trail. This trail is the Indian route across the range to the Swan river and Big Blackfoot river country. As it crosses the range at a high altitude it is passable only in summer, and is the only passageway between the Jocko river and the northern end of the Mission range. The creek flows a little south of west, receiving Mud creek near the sand dune previously mentioned, and flowing into the Pend d'Oreille river. It is a large creek,

clear of brush, a famous fishing resort. Mud creek rises in the canons near the southern arm of the lake, flows south of west, receives the waters from Ronan Springs, passes the edge of the sand dune, and enters Crow creek a couple of miles from the dune. It is not a large creek, but irrigates several farms. A fair sized stream reaches Crow creek. From the sand dune to the lake is 15 miles. The land is level, and no streams cross it.

ORNITHOLOGY OF MISSION VALLEY.

The country between Crow creek and Post creek is full of pot holes, of varying sizes and depths, containing water all summer. Hundreds of these small ponds may be seen from elevation on the mountains, the larger ones lying near the mountains. These pot holes abound in entomostracan and insect life, prolific in quantity rather than species. Thousands of frogs line the banks all summer, and garter snakes, feeding on the frogs, are numerous, large and fat. In the grass and reed bordered ponds water fowls breed and rear their young. In the fall large numbers of migrant water birds stop at these ponds, making an ideal field for the hunter and sportsman. In July the most abundant water fowl found with young was the American Golden-Eye, *Glaucionetta clangula*, var. *Americana*, taken at several places. A camp of several days was made at Crow creek in July, 1900. Three years previously a camp of several days was made near the same place. In the creek three species of case worms were found. A quart of bivalve shells, *Margaritana margaritifera* were taken in the sandy shoals. Several other species of shells were found, *Planorbis trivolvis*, *Limnaea palustris*, a *Physa*, *Polygyra townsendiana*, var. *Ptycophora*, *Pyramidula solitaria*, and *P. strigosa*, var. *Cooperi*. Dragonflies were not numerous. *Aeschna contsricta* was seen everywhere. *Sympetrum obtrusa* was abundant; indeed, it is the most common dragonfly in western Montana, and is easily captured. Around one of the ponds near the creek *Sympetrum* (*Diplax*) *madida* was common. They were wary, shy, and hard to catch. Two hours of hard work resulted in only about two dozen. *Lestes unquiculata* was the most abundant. Hundreds could easily have been captured had they been wanted. A few *Amphiagrion saucium* and *Ischnura* were taken, making a total list of Odonata captured on the plain. In the stagnant water many Ostracoda were secured. Butterflies were not abundant. One catch of nearly a hundred *Brenthids* was very satisfactory. These were nearly always taken on a blue aster. *Colias eurytheme*, brilliant orange, were found in the grassy flats. *Pieris protodice* was not uncommon. A *Grapta* was occasionally seen. Among the shrubbery *Satyrus alope*, var. *olympus* was often seen. A single male *Argynnis leto* was captured. Several *Argynnis aphrodite* were among the captured. A single *Lycaena*, a few skippers, a *Thecla* and a *Chrysophanus*, made the remainder of the list. Except along the creek and around the ponds there is no collecting.

Birds in the valley are interesting, and around the water are abundant. The list of the ornithologist shows 43 species. Many of these are quite abundant. The few days spent here were fully occupied by the ornithologists, and over 60 skins was the result of their earnest work.

These were all prepared in rolled zinc holders to keep their shape until they could dry. In the few wheat fields several flocks of sharp-tailed grouse were flushed. Western meadow larks were everywhere abundant. A few mourning doves, *Zenaida macroura*, were found around the grain fields. Solitary sandpipers, *Totanus solitarius*, were along the streams. In the bushes catbirds, *Galeoscoptes carolinensis*, blackbirds, *Scolecophagus cyanocephalus*, yellow warblers, *Dendroica aestiva*, Audubon's warbler *D. auduboni*, flycatchers and others were always to be seen. In the trees were black-headed grosbeaks, *Habia melanocephala*, and woodpeckers, Lewis', *Melanerpes torquatus*, and Harris', *Dryobates villosus harrisi*. It was a pleasure to sit in camp and listen to the notes of the numerous species of birds. Over twenty were counted the first forenoon in camp, either by sight or by note. The total number seen during the few days at Crow creek is 43. Remembering that the creek forms but a narrow belt of vegetation in the valley, with dry plain and little vegetation on either side, this number is quite large.

GLACIAL ACTION.

Mission valley is undoubtedly glaciated. Between Crow creek and Post creek the valley contains many potholes, depressions in the surface which catch and hold water during the rainy season. At the lower end of the valley, near St. Ignatius Mission, large boulders lie high on the hills, while there are ridges and valleys plainly morainal. The valley and mountain range are worthy of careful study, and will repay the person who makes the study.

The southern end of Mission valley has a much larger moraine than that at the foot of Flathead lake, mentioned in succeeding pages. It extends from the mountains on the east westward as far as Plains on the Northern Pacific. It may extend farther as the writer has not been over the ground. The morainal matter in the vicinity of St. Ignatius makes hills several hundred feet high.* The height of these above this plain has not been determined, but it is certainly more than 500 feet. High up on these hills large boulders have been left stranded. The morainal matter here is badly broken and cut. The hills show plainly the presence of water in former times, beach marks being plainly visible from a long distance.

The entire Mission valley is made from glacial material, with high morainal deposit at both the northern and southern ends. The glacial drift extends many miles westward. It has not been followed, and the character of the soil cannot be given. The Pend d'Oreille river has cut a new channel through this valley, removing the glacial drift to bed rock. Whether this river drained the lake formerly covering Mission valley is for geologists to determine.

No doubt some of this material came from the Mission range. The mass of it could not have done so. The Mission range extends north and south. The canyons opening into the valley open westward. In front of each of the larger canyons is a small morainal dam, extending generally from north to south, or parallel with the range. The large moraines pre-

* It is possible the morainal deposit may be on a foothill, covering the rock.

viously mentioned extend from east to west, at right angles to the range. They are many miles in extent, much larger than any drift from canyons. A careful examination of the region north and west of Flathead lake will no doubt reveal glacial material on a large scale. From the trend of the mountain chains in that section of the state it will be interesting to trace this drift to its source. It is quite probable that this will be in the Kootenai mountains in the northern part of the state, with additions from the Swan and Mission ranges.

BOTANY OF MISSION VALLEY.

Collecting in the Mission valley is confined to the spring of the year. When the June rains fall almost daily the valley is a bed of flowers from end to end and from mountains on the east to mountains on the west. The vegetation is very characteristic. A few species of conspicuous flowers hold sway, and an examination of any spot after hours of walk will reveal almost identically the same flora over the entire distance. During the wet spring months the valley is a fairy land of flowers. But later when the rains cease the vegetation withers. The lupines are visible only by the stumps of stems. *Balsamorhiza sagittata*, with its big and thick leaves, is a conspicuous feature. The leaves dry on the stem, and stand so thick in places that to pass through makes noise enough to be heard a long distance. *Achillea* holds its green color well, but it succumbs to the heat, and withers on the ground. Wild Cranesbill is another abundant flower, and it with the others dies. The thousands of heads of cattle and horses nip the grass to the roots, and the former beautiful valley looks brown, bleak and bare.

The ride across Mission valley in early June, 1901, was delightful. Everything was at its best. Copious rains caused the vegetation to be profuse. While the number of species was not large the abundance of plants of a species was very great. Comment was frequently made on the beauty and abundance of the flora. Two months later the valley presented a brown, sun-scorched, and bleak appearance.

In 1902 the trip across the valley was made early in July. The vegetation was waning, but was still very beautiful. Most conspicuous were the large areas covered with *Clarkia*, *Clarkia pulchella*, Pursh. This beautiful flower will forever keep in memory of botanical students the name of its illustrious discoverer. The flower is a beautiful and delicate purple. The plant grows from six inches to two feet high, often spreading widely, though usually small, slender stalked, with a profusion of nodding flowers. It grows on the high and dry slopes, rarely appearing above 4,000 feet. It is a conspicuous feature of the landscape in western Montana during the summer. Often it is so abundant that the purple patches may be seen for miles. On the trip mentioned the *Clarkia* was just at its best. Everywhere in the valley it could be seen in greater or less abundance and profusion. Here was a beautiful stretch covering several acres, growing on a gentle southern slope. Yonder were smaller straggling patches, lending a delicacy of color to the mass of white *Achillea*, blue *Lupinus* and yellow *Balsamorhiza*. In whichever direction the eye was turned the *Clarkia* might instantly be distinguished from the other vegetation. In this open valley it is at its best. It is a flower

of the prairie or open hillside, rarely taken in woods, and then only in open places.

The western milfoil, *Achillea millefolium*, L., is also a conspicuous flower of the landscape. Everywhere in open prairies it grows in great abundance, although not in such great masses as the *Clarkia*. It is everywhere common, but grows among the other vegetation without apparently monopolizing the soil. In the Mission valley the milfoil thrives luxuriantly. In the early spring its clusters of dissected leaves lends a charm of color. Later the stem ascends, in midsummer reaching maturity. Its abundance of white composite flowers, scattered among the blue *Lupinus*, purple *Clarkia*, red *Geranium* and yellow *Balsamorhiza*, is easily recognized and is very conspicuous. Later, in August and September, the plant withers and dries on the stem; the leaves dry and become a dull brown; the flower stalks and flowers have fulfilled their mission, and the whole plant is dead and withered.

Another flower of the plain and open hillside is the composite *Balsamorhiza sagittata*, Nutt. This plant has large, thick, auriculated leaves, growing in clusters from thick rootstalks. The flower heads grow singly on branchless stalks a foot or two high. The plants do not grow tall. The large leaves spread out in every direction, casting shade over the smaller vegetation. Not only does the shade retard the growth of competitors, but the large rootstalks monopolize the soil. The flowerstalks are numerous, each with a large, yellow, and conspicuous head. The plant grows in masses. Its best season is in June. It begins to blossom in early May, continuing until late in July. In August the leaves wither on their stems, rattling more with the movement of an animal than dried corn stalks. *Balsamorhiza* grows abundantly on the dry and level plains. It is a xerophytic plant. It ascends the dry and open hillsides, and the large areas of yellow flowers may be detected miles away. Occasionally it seems to get into low and swampy meadows, where it struggles for an existence. It is sometimes seen in dense timber, often in open timber, but thrives best on open plain or hillside. It grows abundantly at all altitudes in the western part of the state up to 6,000, more sparingly for perhaps another thousand. In the Mission valley it has its best growth on the slopes nearer the mountains, and in the open woods and treeless hillsides. In the Mission range a species of *Lupinus* is as conspicuous as any of the flowers previously mentioned, and fully as abundant. Early in the spring its palmately compound leaves make their appearance, easily recognized. In May it has begun to bloom, the flowers continuing until late in July, when the last unfold. At the time of our passage, July 11, the plants had passed their best, save an occasional stalk which was covered with deep blue flowers, causing exclamations of pleasure and delight from the botanists of the party. Like the plants previously mentioned, this lupine thrives in the open plains or hillsides, but is almost as abundant on partially wooded slopes. Mountains from 2,000 to 3,000 feet high are in spring time clothed from foot to summit with its luxuriant growth, its deep blue making a charming mixture with the sombre green of the yellow pine, red fir, or the brighter green of the tamarack and balsam. Unlike the *Clarkia*,

and like *Achillea*, it is scattered everywhere, seldom occupying ground to the exclusion of other plants.

Here and there among the vegetation the traveler sees another composite, taller than the *Balsamorhiza*, with yellow center and dark brown ligulate border, much like the "bright-eyed Susan" of the east. This is *Rudbekia hirta*, a flower well worth cultivation for ornament. It is not so abundant as the others mentioned, but is strikingly conspicuous because of the decided contrast it makes with the remainder of the vegetation. Like the others it is xerophytic, selecting soil high and dry, lending a special charm by its beautiful flowers. Montana horticulturists should not forget it in selecting native flowers for ornament.

Less noticeable, but equally abundant along the way is a small composite resembling the eastern daisy or white weed. The flowers vary from a delicate pink to pure white. The plant is very abundant.

Less abundant than those before mentioned, but growing profusely wherever the soil is damp, along the edges of the glacial pot holes, on the banks of streams, around springs, in wet places on the mountain side or in the valley, the wild cranesbill, probably *Geranium caespitosum*, James, may always be found. Its general appearance and color are not so pronounced as those just discussed, but it is a well known plant, abundant, with luxuriant growth when it occurs.

Occasionally a thistle was to be seen, its flowers dull white or faint cream colored, its leaves presenting a bleached appearance, entirely unlike the delicate colors of the eastern pasture thistle. Its long and numerous spines give it good protection, and when it is seen the plant appears thrifty. But it is nowhere abundant. Here and there an occasional stem may be seen, but great patches of thistles such as are common in the middle and eastern states are unknown.

In the damp places along the road, of infrequent occurrence in the Mission valley, an occasional tall mallow, probably *Malvastrum nummorum* Gray, with delicate rose colored flowers crowding its upright stem, towers above the other foliage of the valley. These are stragglers. The plant thrives in the wet thickets and open banks of streams, where it is often very abundant. Flowers are often as conspicuous because of rare occurrence as of abundance. The traveler cannot fail to see the *Clarkia*. Its attention is forced because of its abundance. The same may be said of *Balsamorhiza*, *Lupinus* and *Rudbekia*. But in the Mission valley, where the vegetation is low, where the eye may see for miles, a tall stem covered with large delicate rose colored flowers is at once observed and noticed.

Wild dandelions thrive luxuriantly at places in the valley. Cinquefoil or five-finger is everywhere. Yellow composites with small heads show here and there. These, with the plants previously discussed, make up the greater portion of the vegetation over the valley. But the botanist who seeks the smaller and rarer forms will be able in a short time to fill his vasculum, each watered pot hole containing a large number which must be sought to be seen and which only the collector is likely to find.

About half way across the valley the traveller passes the sand dune

where free sand shifts from year to year, slowly moving eastward. On the sandy ridge but one plant has a foothold, i. e., *Symphoricarpus racemosus*, Michx., the snowberry. The sand buries this deeper and deeper each year, but it grows new shoots above, while the roots below are deep enough to obtain sufficient moisture.

In the early spring hundreds of small ponds in glacial potholes are filled with water. Around these collect various forms of animal life. Later these all dry up but a few of the larger ones, around which life is fairly abundant. A few rods from the creeks, on either side, and collecting in summer or autumn ceases. A few forms of life may be found, however. Hiding in the withered clumps of *Balsamorhiza*, *Lupine* or *Cranesbill* are hundreds of the big, black, and rapacious Rocky Mountain crickets. Over the dry duffalo range they hold sway with the departing king of the plains. When startled from their hiding place they give a series of loud, shrill, and startling noises, accompanied by vigorous bodily movements, which invariably startle the collector. A few grasshoppers live in the same region. Now and then a battered and frazzled butterfly, *Pieris protodice* or an *Argynnis*, flutters feebly past. In the buffalo range and over most of the valley there are no trees save along the water courses. The sparrow hawk is frequently seen on the wing or perched upon a rock. Other and larger raptorial birds circle in the air or are busy at the dead carcasses on the plain. Not infrequently a coyote is observed skulking near the herds of cattle, and even bears come down from the mountain sides into the timber along the creeks.

Collecting has been done at various places in the reservation and along the shore of the lake, in spring, summer and late fall. The reservation and the lake are crossed annually in going to and from the Station. Plate XLVI shows the most of the lower end of the lake, viewed from the moraine. The absence of timber will be specially noted. The swamp area, in which is the greatest amount of life, is to the right, extending to the mountains, not shown in the plate. On the left may be seen the outlet, the Pend d'Oreille river, which is about a mile wide, crossed by an old fashioned ferry, propelled by oars made from pine poles. The chain of islands which almost cuts the lake in two is plainly visible, the main lake lying beyond the islands. During summer the water in the visible part varies from 20 feet in depth to a shallow swamp. The postoffice, Polson, on the lake-river bank, may be located by following the road. Boats plying across the lake land at this place. The river is not navigable.

The Buffalo Herd.

So much scientific interest centers in the fast disappearing and almost extinct buffalo that a few words on the herd now roaming the plains in the Mission valley may not be out of place.

The buffalo herd ranges in the Mission valley, west of the main travelled road. They may be on either side or both sides of the Pend d'Oreille river. West from Stinger's ranch, twelve miles from the lake, is a large butte, rising from the plain. Near this some of the buffalo are quite likely to be found. Leaving the road at or near Stinger's the visitor may see the herd with a couple of hours travel. It is not likely the entire herd may be seen in one place.

Eighteen years ago, in 1884, Charles Allard and Michel Pablo bought of an Indian named Samuel ten head of buffalo, which the Indian brought from east of the Rocky Mountains. From "Buffalo" Jones, in Nebraska, they purchased 44 head, 18 of which were graded stock. From this beginning of 36 full blooded and 18 graded animals the present herd has descended.

At the present writing, February, 1902, there are on the reserve 220 full blooded and 65 graded animals. During the past year there have been sold nearly one hundred animals. In the years past others have been sold, but the number is not determined.

Twenty-seven head were sold to Conrad of Kalispell, and are now cared for on Conrad's ranch. Between 40 and 50 are said to have been sold to a company, the majority to stay on the Reservation, the others to be used in the show business. Several were sold to Iowa parties.*

In 1901, 65 calves were added to the herd. About half are reported to be males. Many of the males are castrated. About half the cows are said to have calves each year. The cows do not have calves until they are four or five years of age. It is claimed that the fertility of the herd is not decreasing. A portion of the calves die or are killed, about the same proportion as for ordinary cattle on the range.

A calf not over 30 seconds born was upon its feet, and not over 20 minutes old showed fight, as stated by Joseph Allard, who owned it.

Half-breed cows are fertile, either with buffalo or cattle. Half-breed bulls have not been tried and are not reported.

The stags show many differences in build from bulls. The principal difference to be noticed is in the horns, which are longer, probably larger, standing out farther from the head.

Twenty-seven of these animals were recently taken to Plains in order that two might be selected from the number. Five men were driving the animals, and even then a half dozen got away. They would not follow

* 25 were sold in the fall of 1902 for use in the Yellowstone Park. In October the guardian of the minor children requested permission of the court to sell 60.

the road, but went up and down hills as they pleased. They are sure footed, quick and nimble. The cows are always on the alert to see an opportunity to escape, and move very quickly. After escaping they immediately return to the herd.

The animals paid little attention to barb-wire fences, and went through on many occasions. After they were put into the high fenced corral at the stockyards they mashed down the gate, several escaping.

In crossing a river with ice it is necessary to make a good trail with horses, so the tracks may be visible, otherwise they will not cross. They look first at the near side, then at the far side, then dash across. An old bull will probably lead, when all will follow. They are sure footed, and take ice as easily as a shod horse. They plunge into water without hesitation when separated from the herd and are returning and swim easily and rapidly. The cows are much harder to handle than the bulls.

They usually range in two main herds, but in the winter of 1901, they were in three herds. These are further split up into small bands of from a few to several dozen.

The range of the buffalo herd is along the Pend d'Oreille river, in the Flathead Indian reserve. Occasionally they wander into the cultivated fields of the Indians and squaw men. They range over a territory 8 to 10 miles long and about as wide. With them are many herds of cattle and horses. It takes a practiced eye to determine whether a speck on the horizon is a herd of buffalo, of cattle or of horses.

A herder is kept with the animals continually. He knows where they are, keeps note of the increase, looks after the calves and the herd generally, much more closely than for domestic cattle.

Every Christmas season a few of the largest and finest bulls are sold to the butchers of the adjacent large towns, Kalispell, Missoula, Butte and Helena. These are sold over the counter as meat, while the heads are retained as mounts. Considering the few remaining animals in the world this seems a public calamity. But as the herd is owned by private individuals to whom appeals for the public interest and for science are of no avail, and who by law may do as they please with their own, the business is likely to continue. The price put upon the animals when sought by eastern people for parks and zoological gardens is so high that sales are almost out of the question, since the freight haul is long, the tariff high, and danger of death before the end of the trip not improbable. It is too bad some means cannot be devised to save the lives of the large fine bulls slain annually. It is claimed, however, that most of the animals thus killed are stags.

The steps one must take to see the herd are about as follows: One may either ride on horseback or take a rig, preferably a buggy. If he is wise he will also secure the services of an Indian as guide, to locate the herd and "round up" the smaller herds into one large bunch. There is no telling where the herd will be on the range. As a consequence the Indian starts out toward the high butte near which they are most frequently found. When a herd is sighted the guide will ride toward it until he can determine whether they are buffaloes or some other animals. In the latter case he takes another direction until another herd is sighted. It not infrequently happens that one travels for hours before seeing the

herd in the distance. In one instance the writer with a party was in the immediate vicinity, and it required most of the day to see the herd and return to camp. Usually one can see the herd with little difficulty, and it is well worth a day's work and the slight expense.

The animals go in small squads of from two or three to fifty. The Indian guide races his cayuse after a squad, coming up in the direction he wishes them to go. He will ride leisurely until he reaches the position that suits him, will then turn toward the squad, spur his cayuse to full speed, shriek like a demon, and fire his six shooter again and again. The squad is run in the direction of a larger squad. When they are joined he goes in search of others and repeats the same performance, until his cayuse will be panting and reeking with perspiration. Occasionally he will approach the visitor and stop at a respectful distance, sitting idly in his saddle. If the visitor says nothing no more will be brought up. If the visitor points to others or asks for more they are likely to be brought.

One may go within 20 to 30 yards of the animals. If closer approach is made they will slowly move off. If the pursuit is continued they will hasten the gait to a trot, then to a gallop, and finally run at full speed with lowered head and straight tail, bellowing every few jumps.

The guides are very positive the beasts will do harm to one on foot. There are several bad animals in the herd, and most of them will "stand pat," as expressed by one of the owners.

The writer has tried to go among them on foot, for photographic purposes, but they have invariably decamped. The first time they were viewed there were over 200 in the herd brought together. They were continually bellowing in their low, deep and rumbling gurgle. They would keep pawing the earth and stirring clouds of dust with their hoofs. The large masses of unshed hair in spots was a decided contrast to the sleek places where the hair was new. It is well known they shed in masses of hair. The young calves in color resembled Jerseys. The old bulls were noble looking fellows and looked large. Not a tree is on their range, save a few scraggy pines on the rocky buttes or along the river. The entire herd may be in a coulee but a few rods away and be invisible. It certainly is an unusual sight to see such a large herd on such a range; while the guide with his wide sombrero and leather chaps, his heels adorned with long clanking spurs, lends a charm that is more than passing. He eyes them constantly, answering questions with one of three answers, "yes," "no," "I don't know." Diligent inquiry may bring information, but it will not be volunteered by the guide.

The inspection over the guide gives a whoop, fires his six shooter, spurs his horse at them, follows for thirty or forty rods, shrieking, shooting and spurring his horse on, when it is over. They soon scatter, and are mostly out of sight. They always appear restless, and are seldom standing quietly, as cattle or horses often stand.

To make a visit to the herd is not difficult, and any number of photographs may be secured.

The country over which they roam is near the Pend d'Oreille river. The soil is sandy, held from blowing by vegetation. There are numerous

coulees and a few high buttes. To the east the Mission range, snow-capped in winter and clothed in dark green during summer, makes an imposing view. Occasionally in winter, when the river freezes, the herd crosses the river and give much trouble.

In the large bay of Flathead lake extending west from the main body of water is a large island, named Wild Horse Island. Its location may be seen by consulting Plate XXXVI. Several years ago about 75 half-breed buffaloes and four full blooded bulls were placed on this island and left to roam. The island is several miles long and not quite as great in width. It is well timbered, and rises several hundred feet above the lake. The writer has not been on the island, but has been around it on the water. No one lives on it. Rarely is it visited, even by Indians. It is entirely within the Flathead Indian Reservation.

The buffaloes staid on the island for a couple of years, but did not like it. They began swimming to the mainland, a mile and half away, continuing thus until but a few were left on the island, when they were removed.

This short record shows what can be done by private enterprises, and that the work of the Indian. In twenty years a herd of 36 has increased to more than 350, or ten times the original number, with no record of the many sales that have been made during most of the time. In 20 years the number of calves is given per year at 65, more than double the original number. The range on which the herd is kept certainly does not exceed 70 to 100 square miles, and they could no doubt be kept on a much smaller range than this.

There is this noticeable difference between the Allard-Pablo herd on the Flathead Indian reservation and the herd in Yellowstone Park, to which so much attention has been directed, and which has done so much toward forming an opinion in the minds of men adversely to further attempts to save to the world a herd of these noble animals. The Allard-Pablo herd has a man with it constantly. The animals are therefore accustomed to man, and are not alarmed at his approach. The Park herd were rarely seen by man, and were not carefully looked after. The Park herd were placed at a high altitude, over 7,000 feet, where snows were deep, winters long and severe, and where it was very difficult, perhaps impossible, to give them aid in case of scarcity of food. The Allard-Pablo herd has a range at altitude below 3,000 feet, where deep snows do not occur, and where poachers cannot molest without fear of discovery. Moreover, hay or grain may be taken to the herd in a few hours in case of necessity. While they range in a treeless valley, they have in the range coulees, morainal depressions, river and creek banks, which offer shelter. Several high buttes offer protection from the wind, while the river, creeks and ponds supply abundance of water.

From a careful study of the facts it will become apparent that Congress should not cease in its efforts to save the buffalo from extinction. An appropriation of \$8,000 will purchase 25 cows and a dozen bulls. If purchased from several different herds there is little danger from inbreeding. This is as large a herd as Allard and Pablo had in the beginning. With the same care exercised over this herd in 20 years the increase from 25 cows and 12 bulls should make the herd number between 400 and

500. Now, there are large tracts of land leased annually for small sums to large cattle dealers. There are large tracts in Indian reservations which can be utilized for some such purpose more legitimately than to lease to cattle men for stock. If a tract of land containing from 50 to 100 square miles were set apart for this particular use, with an appropriation at the beginning of \$15,000, and an annual appropriation of \$5,000, there certainly should be no difficulty whatever in developing a herd from a small beginning to one that would be a credit to the nation.

The government and care of the herd should be placed under the jurisdiction of the Biological Survey of the Department of Agriculture. The men in the Survey are keenly alive to the importance of an attempt to save the buffalo from extinction, and may be relied on to look after the animals as carefully as they are looked after in any zoological park.

It is hardly to be expected that the animals will thrive in the Yellowstone Park, where the winters are long and severe, the summers short and concentrated, and where protection is likewise afforded to the wild animals which prey upon the calves. The buffalo, unlike the deer and elk, seems to remain in a limited territory. If they are to thrive and multiply, they must be looked after and cared for. With a range in Montana, Idaho, Arizona or New Mexico as mentioned above, with a small herd under care of the Biological Survey of the Government, a small appropriation will, with proper handling, produce a large herd in fifteen or twenty years.

It is to be hoped that the recent small appropriation made by congress for the preservation of the buffalo will be sufficient to protect it from extinction. It is doubtful, however, whether they will ever thrive in the Yellowstone Park without much care in the winter. A lower altitude, with less snow and longer summer, similar to that of the Flathead Indian Reservation, will insure the safety of the herd with small amount of attention and expense.

Flathead Lake.

The following report of the lake was prepared by Fred. D. Smith, formerly Professor of Chemistry and Geology at the University of Montana, now mining engineer at Sumpter, Oregon. The paper was prepared while he was connected with the University, after he had made an extended trip around the lake and over a large portion of the country adjacent.

"The lake occupies the lower portions of an immense valley that reaches from a low range of hills along the Jocko river northward across the British Columbia line, and which has a total length of over 100 miles. Tobacco Plains on the north are a part of this valley though separated from Mission valley by a low range of hills. This larger valley may be considered made up of three smaller ones, viz: Mission, south of Flathead Lake; Flathead, north of the lake, and Tobacco Plains still farther north.

Mission valley has a general elevation of from 100 to 250 feet above the lake level and a length of about 35 miles north and south with a width of from 5 to 10 miles. Flathead valley has a slight elevation of from 20 to 50 feet above the lake and is much more regular in its surface contour and its width. Its length is about 40 miles and the width 8 to 10 miles. These two valleys are the more important in this discussion as each illustrates a geological process bearing on the history of the lake. (The lower portion of Flathead valley may be studied from Plate XXXVII.)

The present lake is the remnant of the much larger lake that occupied these valleys in Tertiary times, as shown by the lake beds in both valleys as well as in the valley through which the Jocko river flows. As yet little, if any, investigating for vertebrate fossils has been done in these beds though it is probable that they are of the same age as those of Flint creek and Madison valley studied by E. Douglass.

Mission valley and the lake are bordered on the eastern side by the Mission mountains, a range which rises abruptly from the plains to great heights. These mountains, with a very steep western slope, have their summit within relatively short distances from the valley and consequently the streams therefrom are neither large nor of great volume in discharge. On the other hand the eastern slopes of the mountains are long and gradual, thus furnishing a larger drainage area to the Swan river and Blackfoot tributaries which receive the waters. This range, as such, appears to terminate at a point near the upper end of the lake where the Swan river, changing its course from northward to west and south westward, flows into Flathead lake. Another range, the Swan range of the Kootenais, some 12 miles to the N. E. continues to be the border of Flathead valley in a manner similar to that of Mission range just explained.

The history of these valleys or of the one larger valley, when all are considered as one, is very interesting. The Mission mountain range was caused by a fault, having a general direction of north and south, with a