stronger throw on the southern end. This resulted in a much larger slip on the southern end of the range than on the northern. In fact the slight slip on the north together with the erosion by weathering and valley glaciers has resulted in a complete termination of this range, per se, near the University of Montana Biological Station as noted above. The slip must have been several thousand feet at the southern end as the peaks near the St. Ignatius mission are 7,000 feet higher than the plain below. The weathering following the elevation of this range has left the escarpment in jagged and precipitous cliffs making the range one marked by most picturesque scenery.

With the most superficial study only, it is suggested that the range noted above, the Kootenais, N. E. of the Mission range and forming the boundary of Flathead valley, was probably formed by a similar fault. The range of foothills which forms an irregular boundary of the Mission valley and of Flathead lake on the west, reaches westward to a considerable size and shows the strata once continuus with those of the Mission range. They were evidently depressed coincident with the tilting of the Mission which movements, together with the erosion in the trench like valley formed, [illegible] about the long valley extending 100 miles north and south.

Such a valley likewise is the Bitter Root valley, though the peculiar feature of this larger valley under discussion is that while the other valleys of similar history in the state show plainly by their drainage that erosion by streams and rivers has played an important part in the cutting and enlarging of the depression along the fault plane, this one by its peculiar termination at the Jocko hills on the south and by its entire lack of evidences of stream courses from Flathead lake to the south end gives indications of a different history. More detailed study may show that the valley was once occupied by a large stream, or that the drainage, unlike that of to-day, was to the northward instead of southward.

The Jocko hills may have been faulted or raised after the valley erosion had been finished. I have never been able to find any record of excavations in the valley bottoms by which could be learned the depth of the soil and gravel to the rock.

It has been noted above that the Mission valley has a general elevation of from 100 to 250 feet above the lake while the Flathead valley is much more regular in its surface and is but slightly elevated above the lake. These two valleys are of different history in so far as the bottoms are concerned.

Flathead valley plains show clearly that the soil is made almost entirely of sediments deposited in the still waters of the lake. This accounts for the level character of the plains. Little if any glacial deposit has been formed in this valley. Some is found in the rounded hills near the mouth of Swan river and along the eastern border of the valley below Kalispell. These are undoubtedly closely connected with the glacier deposits found nearer Swan river valley. The lake which filled the valley ecrtainly much higher than at present evidently receded rapidly as I have been unable to find any bench marks or terraces on the hillsides. However it apparently receded more slowly after it had reached the level of the Flathead valley sediments as several old stream courses are plainly discernible between the town of Kalispell and the lake.

The plains of the Mission valley have a much rougher and more irregular surface due to the moraines and other glacial debris deposited over much of the valley. The long hill extending diagonally across the valley directly at the foot of the lake is clearly glacial drift as shown by the irreguarly distributed clay, boulders, rounded pebbles, etc. The form of this suggests that it may be classed as a drumlin.

Along the eastern side of the valley are seen many rounded knolls enclosing small marshes and ponds which are all clearly of morainal origin. The small ponds found scattered over the entire valley which contain water most of the summer are probably formed by the depressions in the surface due to glacial deposits. These are plainly shown in Plate XXXIII. Small glaciers undoubtedly flowed from the Mission mountains along its entire length but these deposits must have come from a very much larger glacier, probably from one which came down from the north throughout the whole valley.

The lake in its higher elevations probably had its outlet in a western direction as shown by the old stream course to the westward of the large bay behind the large islands. A stream course near the town of Dayton leading southwestward down the valley of the Little Bitter Root is very plainly discernible.

When the lake reached its present level it found its outlet across the lake beds alluded to above, and through the moraines down its present course, the Pend d'Oreille river. This is plainly shown by the high cliffs of clay and other sediments that still retain their perpendicular sides along the canyon of this river. The increased head of the water in the lake above and the canyon cut below furnished the tools for the outflow to cut its canyon rapidly and the beautiful Pend d'Oreille rapids near the lake at Polson are the result. (These rapids are shown in Plate XLV.)

Flathead lake now forms but one element in the drainage system of the upper valley and the territory beyond the Mission and Kootenai ranges. The entire drainage from this section of the state flows into the lake through two rivers, viz., the Swan and Flathead rivers. The latter is made up of three large rivers known severally as the North, South and Middle Forks. These three streams by their confluence above Kalispell form the Flathead river. This river is very interesting in itself as from its fall and other characteristics it shows itself to be but an arm of the lake. When the lake receded to near its present level, the drainage from the north and northeast flowed across the sediments cutting an irregular channel, meandering across the plains until sufficient fall of the lake level was reached to allow it to cut enough channel to hold the stream. At present it winds its circuitous path across the plains and has a total length of about 35 miles while the distance as measured in a straight line from the forks above is but 15 miles. In general its width is from 300 to 800 feet, and its depth is in some places 75 feet. On account of the sluggish nature of the current of this river the erosion of the banks is slight except on the sharp curves, while the deposition in the bottom of the river and at its mouth is very rapid.

The northern end of the lake into which all of the drainage is poured

is apparently composed of sediments deposited in the manner mentioned as a large delta. The course of the river is plainly traced into the lake for some distance by the delta thus formed, which for a distance of from one-fourth to one-half mile from the shore is sufficiently high to be covered by vegetation and in some places by shrubbery. Beneath the surface of the water the formation is discernible for a long distance farther into the lake. Consult Plate XXXVII.

The opportunities for interesting and valuable geological study in connection with the Station are therefore apparent at first sight. Whether in connection with a study of the bottom of the present lake or as a separate study of the glacial deposits along the valley north to the boundary the study will be both of value and of interest. To students who have had some general work in geological study the field is a most promising one. A study of the valley from the upper end of the lake northward with particular reference to its relation to the older lake and river will certainly afford work for many students. This portion may be a delta itself or only the sediment of quieter waters. Beyond all of these questions a study of the territory within greater distances, especially north of Kalispell and around the divide between Swan river and the Big Blackfoot tributaries, may bring out information that will throw great light on the history of many other portions of old topography of the western slope of the Rocky mountains. The Mission mountains will prove to be an interesting study from the petrographical standpoint as will also the Kootenais. In view of the recent developments in the study of the Miocene Lake beds of Montana it would seem that Flathead lake offers a great field of study as both ancient and recent beds can be studied at once."

In addition to the above notes by Mr. Smith may be given the following:

The outlet is called by some Pend d'Oreille river, by others Flathead river. Some consider Flathead river to extend from its source to the lake, then from the lake to the Missoula river. Others give the name Pend d'Oreille to the stream from Flathead lake to the Missoula river. The river formed by the junction of the Missoula and Pend d'Oreille is called Clarke's Fork of the Columbia.

The present outlet of Flathead lake is of recent origin. The river for several miles near the lake is swift and rocky, a series of rapids alternating with more quiet water. About a mile from the lake there is a large bank of clay through which the river has cut. The clay is continuous with and apparently a part of the moraine mentioned. At the river bank it has been cut and eroded by the wind and rain. The bank is abrupt and steep, the clay clinging together so as to form cliffs, some ending in sharp pinnacles. Below the clay is the bed rock, similar to that found at different places around the lake. The river has done some cutting through the solid rock bed, but not much. At one place the channel is partially dammed by a large rock in the center of the river. Above and below this place the river is a beautiful sheet of foam, with several small falls. It is as beautiful a rapid as one usually sees. In my estimation it is superior to the rapid above the first falls in the Yellowstone. Plate XLV shows the rapids as seen from the hillside some two hun-

dred feet above the water. This is a great fishing resort for the Indians on the reservation, and one seldom visits the place without seeing several tepees on the bank some place near. The osprey is as industrious as the Indian, and is seldom absent from the scene when one visits the rapids.

The moraine at the lower end of the lake is worthy of more extended notice. Between it and the lake is a level plain. At the western end, where the plain is widest, it separates the moraine from the lake by a distance of about two miles. Eastward the hills come almost to the water's edge, separated only by a narrow strip of level land.

This level plain shows clearly two terraces, with evidences of a third higher upon the hillside. The terraces correspond with similar terraces at the northern end. Here one is beautifully shown at Sliter's, near the Station.

The lake has therefore had two, possibly three levels other than that at present.

The moraine is 450 feet above the level of the lake, at the piace where the wagon road crosses near Polson. There are probably several places higher than this. The railroad survey crosses the moraine about midway between the Pend d'Oreille river and the mountains. Their readings show the height at the river to be 84 feet less than that at the place selected for passage. The engineers preferred the higher passage because the lower necessitatd doubling back in order to get down on the southern side.

The wagon road winds back and forth in its passage over. The lake is invisible until the traveler reaches the crest of the hill, when it comes suddenly before him in all its beauty. The view of the lake proper is obscured by the islands and peninsula, which practically cut the lake in two. The view of the lake from any other point is better than that from the lower end.

The banks of the lake do not afford as much shelter for invertebrate life as would at first seem apparent. The southern third, cut off by the islands, is shallow, nowhere of greater depth than twenty feet. The eastern part of this bay, formed by the peninsula projecting from the Mission mountains, is very marshy, with muddy bottom. Rushes and weeds grow abundantly, offering an excellent harbor for smaller life. This is the largest marshy region around the lake. Between the mouth of Flathead river and the mouth of Swan river, along the northern shore, is another marsh in the spring, of peculiar nature. At the water's edge is an embankment of a more or less rocky nature. North of this embankment is a shallow marsh, about two miles long and a quarter to a half mile wide. When the lake rises, as it does in the spring, from ten to twelve feet, the water flows over the embankment, and into the low land. As the lake recedes the imprisoned waters cannot escape, and offer a fine breeding place for mosquitoes for some time, until the waters evaporate or filter through the soil to the lake region. Most of the remaining banks are rocky, precipitous at the water's edge, with or without a gravelly beach. The bottom generally is reported to be rocky, with little mud. This report comes from the captain of the boat Klon-

dyke, who has anchored all over the lake; his experience on the lake extends over a period of many years. Compared with the size of the lake the swampy country is small. From this it would appear that the breeding grounds for most of the fish must be in regions distant from the lake, causing long migration periods. This is made more apparent from the fact that fish are rarely caught any place in the lake except at or near the streams entering the lake, or at the outlet.

Flathead lake is popularly supposed to be very deep. I was told it was 1,500 feet deep in places. During the summer of 1899 some twenty soundings were made in the lake and rivers. The greatest depth obtained was 280 feet. The location of this may be found by referring to the map. Eugene Hodge, captain of the Klondyke, states that nowhere is the water deeper than this sounding.

McGovern Bay, on the northern end of the lake, is about seventy feet at the deepest. Flathead river has filled in a large amount of sediment. East of the mouth of Flathead river the drop in depth is sudden from the river bar. The deepest portion of the lake is off shore on the east side, next the Mission mountains. In high water a great deal of land at both ends of the lake is covered. If the depth of the lake should be lessened by ten feet, thousands of acres at the lower end would be uncovered. The annual rise and fall of the lake is from ten to fourteen feet, but it has risen as much as nineteen feet in a season. The lake acts as a huge reservoir for water storage, but overflows much land almost every year when it is at the highest. The amount of water flowing into the lake and out of the lake annually has not as yet been determined.

Life in Flathead is scarce. Although some species are taken in great abundance, the cold clear waters, with rocky bottom and banks and with few marshes, make life scarce as compared with similar bodies of water located in warmer climates at lower altitudes.

It is impossible to present the results on Entomostracan work in this paper. These results will be prepared separately. The work of collecting has extended over four seasons, and many data have accumulated.

During the summer of 1899 collections were made on various portions of the lake. Report of this work has been made. In 1900, collcollections were made by Prof. L. A. Youtz, then of Montana Wes. University, now at Lawrence University. In 1901, Maurice Ricker, of Burlington, Iowa, carried on the investigations. These studies have been made in but two months of the year, July and August. It is important that collections be made during other months of the year, in order that seasonal changes may be studied.

In 1902, collections were made during the months of July and August by Maurice Ricker and the writer. Pumpings were made almost daily, as the weather would permit. Specimens were taken at depths from surface to 130 feet.

Collecting around shore is confined to the country adjacent to either end of the lake. On the eastern bank the Mission mountains come down to the water's edge, with a few benches at different places. There are no large streams entering the lake from the mountains on the east. In the 30 or 35 miles of bank there are only four or five small streams of

water, any one of which one might step across. These lead down through deep and steep canyons, with dense underbrush, fallen logs and boulders. Botanical collecting is good. Insects are not abundant. The birds have been noted. The shells have been pretty well worked up, as far as species are concerned.

On the west side there are two large creeks, Dayton creek and Big creek. The former enters the large arm of the bay. Lake Ronan, which it drains, has not yet been visited. Indeed, no collecting has been done on the west bank of the lake. Big creek is near the northern end of the lake, flowing into McGovern Bay. At the mouth of the creek there is some low and marshy land, small in extent. The lake a few feet off shore is deep. The bay near its center is seventy feet deep.

On the west the mountains come down to the water's edge as they do on the east, though they are not so abrupt nor so high. The reservation line passes north of the wide bay at the lower end, thus placing much of the Dayton creek low land within the reservation. Settlers have taken up land along the lake, on both sides without the reservation lines, and the proximity to the lake makes this land very desirable for fruit raising. The region about Big creek has not been examined. No explorations have been made in the mountains west of the lake.

As has been stated, the water of the lake is received through the Flathead and Swan rivers. The annual rise of the lake in 1900 was 8.3 feet. That year was one of low water. It is claimed by those in a position to know that the water has risen as much as seventeen feet during a season. Since the lake has an estimated length of about 30 miles, which will for convenience be made 25 miles, and an average width of from 8 to 10 miles, no doubt more than this, it will be seen that the water held back by this lake in storage is sufficient to cover an area of from 200 to 300 square miles to a depth of from 8 to 17 feet. Swan lake, a few miles from Flathead lake holds the waters of Swan river in similar manner from passing to Flathead lake.

The amount of water flowing into Flathead lake, or out of it, has not been determined. In 1899, two gauges were established on the lake by the U. S. Government, one at the upper and one at the lower end. These were continued for a little over a year and were discontinued for lack of funds. But one measurement has been made of Swan river, none of Flathead.

The air currents of the lake are numerous, and worthy of extended study. Rarely is the water perfectly calm. It has been seen, however, so still that shore objects were beautifully mirrored. The mountains on such occasions show up grandly in the reflection. A ride across the lake at such time is rare, but it is one never to be forgotten. In the evening when much of the pumping was made for entomostraca there were many occasions when the water was comparatively quiet. Usually, however, a breeze was blowing.

During the summer the wind on the lake is from the south or southwest, the prevailing direction of the region. The general or prevailing winds in the summer are as follows: In the morning there is a gentle breeze down the lake from the north. Soon this dies away, and the wind

springs up from the south, increasing until early in the afternoon. Toward evening the lake becomes quiet. About dusk a light breeze blows out on the lake from the mountains. At the laboratory the evening lake breeze is from the east. We have often watched the ripples moving across the water toward our boat, coming from the land, as we were at work with the pump. The mountains cool quickly, the cool air flowing down the sides and across both the valley and lake. Similar phenomena have been noticed on all the lakes of the region.

Opposite Wild Horse Island the lake is widest, here having a total extent across of 18 or 19 miles. This island rises several hundred feet out of the lake, and is almost entirely in the western arm, projecting out from the main body of the lake. From the contour of the mainland it is possible for winds to blow up the lake from the lower end, and across the lake from the western arm. These air curents often meet in the open lake east of Wild Horse. Here the wind is most uncertain and the lake roughest. Winds blowing either up or down the lake may meet other winds from the bay. South of the islands the lake is rarely rough.

But when the lake gets real bad it seems as though Neptune was in a rage and had stirred up the waters to the bottom. In ten minutes the lake may change from a perfect calm to a sea on which small boats will hesitate to go, and which may even keep the larger boats in harbor. The surf beats as in larger lakes. One morning we started home in a 32-foot steamer. A mile out large waves were met coming up the lake which caused us to turn back to keep from getting our valuable material and specimens wet. Three days after a second start was made. We hugged shore for six miles, when the strong wind piled the waters so high we sought the shelter of Wood's Bay. Before we could get to shelter the wind died down so the journey could be resumed. When half way down and we were congratulating ourselves on crossing the widest part without trouble, a wind sprang up which increased in a few minutes to such proportions that the pilot was wet from head to foot, and we were obliged to seek shelter behind the nearest land, an island. In about three hours the journey was resumed. In the evening the lake was quiet.

During the summer, June, July and August, the lake is comparatively quiet, and the winds as given above generally prevail. In spring and fall they are uncertain, and may come up strongly from any quarter in a short time. On the occasion mentioned when waves turned us back after starting homeward the waters were driven by a strong south wind. On entering the harbor, the mouth of Swan river, a little over a mile of travel, a light breeze blew from the north east, apparently from the mountains. All day the waves rolled, but subsided toward evening.

As a result of these conditions small boats work close in shore. Row boats seldom go far out in the lake. To attempt to cross the lake in one would be very unwise. Fatalities do not occur because people are careful. As most of the residents are unfamiliar with boats in rough water and necessity does not drive them on the lake there are not likely to be reckless or foolish trips in rough water.

In the summer of 1902 a dam was constructed across the river at the outlet of the lake. This dam was made as follows. Piles were driven

by machinery into the river bed eight feet apart. The row of piling extended across the river from side to side. Two inch plank were nailed together side by side in threes, fastened by strips. Each set of three planks was then pushed down into the water, held by the current against two posts or piles. The ends were therefore between the piling, and could not be fastened. The idea was to hold back the lake water, prevent the surface from getting low in winter, and thus have depth of water sufficient to float logs at the new mill at the north end of the lake. In low water it is difficult to get logs to the tramway. What the result may be is in the future. The farmers at the upper end of the lake want the water to run out faster, so as not to flood the land. If the scheme of holding back the water succeeds in winter it is likely to succeed in spring when the waters are high. In that event the flooding of land above will be worse than ever. It is probable, however, that the dam will be taken out in the spring by ice.

Daphnia Pond.

Daphnia pond, so-called on account of the great numbers of **Daphnia pulex** found in it, is a small pond of some ten to fifteen acres. It is about a mile and a half from the Station, alongside the regular wagon road, and only about a half mile from the lake, but at a little higher altitude. This pond is no doubt of glacial origin. In the center the water is about twenty feet deep, but for the most part the pond is shallow and overgrown with rank vegetation, offering an excellent harbor for smaller forms of life. No fish have as yet gotten into this water, and consequently the invertebrate fauna is not affected by them, and has few enemies. It is a typical place to study some of the forms of life found therein, living as they do under very favorable conditions. The varied and abundant life in this small pond is in strange and striking contrast to the limited quantity and paucity of species in the large lake, so short a distance away.

Being in such close proximity to the laboratory it has received considerable attention, and is a favorite resort for those seeking material. In or near Daphnia pond may be found the following specimens:

SHELLS.

Planorbis trivolvis Say; abundant.

Sphaerium partumeium Say; abundant.

Physa ampullacea Gld.; rather common.

Pyramidula strigosa cooperi W. G. B.; in damp places along banks of Flathead lake.

ENTOMOSTRACA.

Daphnia pulex; exceedingly abundant, making the color of the water dirty red. May be taken by the spoonful or pint.

Diaptomus lintoni Forbes; common, but much less abundant.

Cyclops pulchellus Koch; not uncommon.

Gammarus, probably two species, one large, an inch in length, swimming among the water lilies.

ODONATA.

Aeschna constricta, Say; abundant; exuviae to be had in quantity on the rushes and cattails. The adults are on the wing in large numbers in late July and early August. During the first week in August, 1901, an American bittern, **Botaurus lentiginosus** Montag., was shot whose stomach was crammed with dragonflies of this species.

Libellula pulchella Drury; next in size to the preceding. Emerges before August.

Libellula quadrimaculata; on the wing as early as July 8 in 1901.

Lestes unginculata; Hag.; in 1899 this species was emerging in large numbers during the last two weeks in July. In 1901 they were just emerging July 8.

Lestes disjuncta; in smaller numbers than preceding, emerging at the same time.

Enallagma calverti Morse; on the wing early in July; the most abundant of dragonflies at the pond.

Enallagma praevarum Hag.; a few specimens captured.

Sympetrum scotica Donov.; rather abundant in 1899. Scarce in 1901.

Sympetrum obtrusa, var. assimilata Uhler; perhaps the most abundant dragonfly in Western Montana.

Ischnura is not uncommon in the vegetation near the water's edge.

The above list is not large, but is about as many as one usually finds in any one locality in the state.

Other material to be found in the pond in abundance may be mentioned; many beetles, dipterous larvae, two leeches, several case worms, many water bugs and worms.

The vicinity of this pond is a great breeding place for birds. It is here that the ornithologist may do some good work. To give a list of those choosing this for a nesting place is unnecessary repetition, as this has been given elsewhere. No fewer than forty-five to fifty migrants build their nests and rear their young within a hundred yards of the water's edge. For so small a pond this is certainly a remarkable showing. On all sides the timber has been destroyed by fire. Thus most of the shelter formerly afforded has been removed. The nesting sites are confind to the low bushes along the water's edge, to those which have sprung up on the burnt area, to the dead boles left by the fire, and to the grass and reeds of the pond. Rails are heard daily as they move around among the weeds. Golden-eyes and grebes usually rear their young in the grass. Catbirds, western yellow-throats, flycatchers, chackadees, sparrows, juncos and woodpeckers all are found. The tree dwelling warblers find a few trees near by. Kingbirds may always be noticed, noisily chattering as they leave their perches in pursuit of insects. In this open country the ornithologists of the shotgun or of the opera glass may alike find suitable field for work. It is but fair to our workers to say that very few birds have been killed around this pond.

Frogs, garter snakes, a single species of turtle, and an occasional muskrat, may be found on the banks or in the water. The white tailed deer has often been seen close to the pond, and annually black bears are known to frequent the bushes adjacent in search of berries. Not only is there an excellent field near this pond for study and for gathering material, but the study is frequently intensified by the sudden appearance of a frightened deer or the hasty and noisy departure of a black bear as the collector wanders over the hills.

No attempt will here be made to give the names of species of plants.

The vegetation is abundant, and offers splendid opportunity for studying plant communities.

A short distance below Daphnia pond, along the wagon road, is a second glacial pond, named Estey pond. This is larger than Daphnia, deeper, and like Daphnia teems with life. It has no outlet, and like Echo lake suddenly rose in height a few years ago, remaining to the present at the higher level.

ROST LAKE. (MUD LAKE.)

This is a small lake, elliptical in outline, lying between Echo lake and Swan river. It is but a few miles from either of the preceding, and about three miles from the base of the Swan range. This range rises abruptly from the plain, as does the Mission mountains, and was elevated in a similar manner. It may be seen by reference to Plate XXXVII, the small lake in the center of the illustration. Plate XLIV shows a general view of the lake from the outlet.

The lake is a little over a mile in length from north to south, its width being about two-thirds its length. It is densely timbered with fir, spruce, white and yellow pine, birch, cottonwood, and alder on all sides, with small meadows here and there. Between the lake and the mountains is a gradually sloping plain, with dense forest, crossed by a few small streams whose sources are in the gulches on the mountain sides. The upper end of the lake is very marshy, much of it swampy, with sphagnum bogs and many small rivulets whose waters reach the lake through tortuous channels. West of the lake the forest extends with gradual slope to the low hills along Flathead lake and river. The forest near Rost lake is damp and swampy for the greater portion of the year. So soft is the soil that the few settlers have been obliged to corduroy the winding road cut through the lodge poles for a distance of nearly a mile. Most of the country about this and Echo lake supports a dense undergrowth of thimble berry bushes.

The lake itself is shallow, with deep mud bottom. In most places the water is but a few feet deep, in no place was it discovered to be more than eight or ten feet. In the shallow water a long oar could be pushed down full length in the mud. As a result of this surface of shallow water the sun's rays in summer warm up the waters more than in any river or pond of the region, and the animal life and vegetation is correspondingly rich and varied.

In early September, 1902, the waters of the lake were remarkably shallow. The passage up and down the lake was made several times in the canvas boat, carrying two men. With this load the boat was usually stirring up the mud in the bottom, although the water was perfectly clear. In many places it was almost impossible to row. A few spots were found where the water was three or four feet deep. In landing at the upper end the boat was dragged by the oars through mud to a hummock of grass. We were then obliged to carefully pick the way out by stepping from hummock to hummock. A misstep on one occasion resulted in a sudden drop to the waist before the hands could be thrown out. It was only by quick and active movement that I regained the solid? ground.

Immediately around the waters of the lake the growth of native grass is rank. Where it is possible the residents cut this for winter hay.

In 1902, a row boat could land only in a few places, so gradually does the water deepen, and so deep is the mud. The vegetation is encroaching on the lake very fast. Rushes, water lilies, potamogetons, and other hydrophytic forms grow even in the middle of the lake. As a consequence, although there are several small creeks bringing water into the lake there is no perceptible current across it.

It would not require much work to lower the outlet so as to practically drain the lake. There is talk of damming the outlet for logging purposes. The idea is to make the water deep enough to float logs in early spring. It is only a little over a mile by section lines to the river. The creek could easily be cleared to float logs in the spring. By this plan it is hoped to get at the marketable timber with moderate cost of removal.

The timber in the vicinity of the lake is as follows: Yellow pine, **Pinus scopulorum** Engl., is quite abundant. The young trees of this species are by lumberman termed "bull pine," and are considered very inferior to what they term "Yellow pine."* There can be no doubt that the "bull pine" is but the early growth of the yellow pine. This is one of the most common trees in the western part of the state. In the wet and swampy land about the lake it is not abundant, being displaced or perhaps replaced by others. It is not uncommon to find trees from three to five feet in diameter. The tree is usually tall, free from limbs, making excellent timber.

Red fir, or Douglas' Spruce, **Pseudotsuga mucronata,** Raf., is the "oak" of Montana. It is the fir (false fir) of the Puget sound region in a higher, drier, and more unfavorable climate. In the Rost lake region it is not so abundant as some other species, but along the mountain slopes it becomes more common. Westward toward the dry and open prairie it attains considerable size. Between Rost and Swan lakes, a distance of some eight or ten miles, the red fir is very abundant, much of it young growth.

The cottonwood, **Populus angustifolia** James, is found around the borders of the lake and in wet places. Many of the trees are large. In this region there are no cottonwood belts as elsewhere, and the tree may be spoken of as "not uncommon."

Englemann's spruce **Picea englemanni** Engl., is the most abundant tree about the lake, save perhaps the lodgepole pine. It is a beautiful tree, tall and stately. North of the lake is a wet and swampy region with many meadows. Here this spruce is dwarfed, stunted and reduced in size. The trees are not marketable. In other places it becomes a large tree. It does not seem to be so well known among lumbermen as the yellow pine, fir or tamarack. As there are great quantities of this spruce in Western Montana it will no doubt be better known later.

The lodge pole pine, **Pinus murrayana,** Eng., is very abundant in the region of Rost lake, as also Echo lake. In many places it completely occupies the land, apparently to the exclusion of all other timber. In some sections the trees are small, a few inches in diameter and a thick stand. In other places they have attained large size for lodge pole, a foot or more in diametter. The lodge pole is not used for marketable timber, perhaps because the trees are too small. It seems to make good "shakes" and to be serviceable where it may stay dry, as in houses, stables and fences. It is reported to be not good for posts. Corduroy roads are made of it.

* I am informed that lumbermen at Missoula and Hamilton consider the bull pine or young yellow pine superior to the older trees, yellow pine proper.

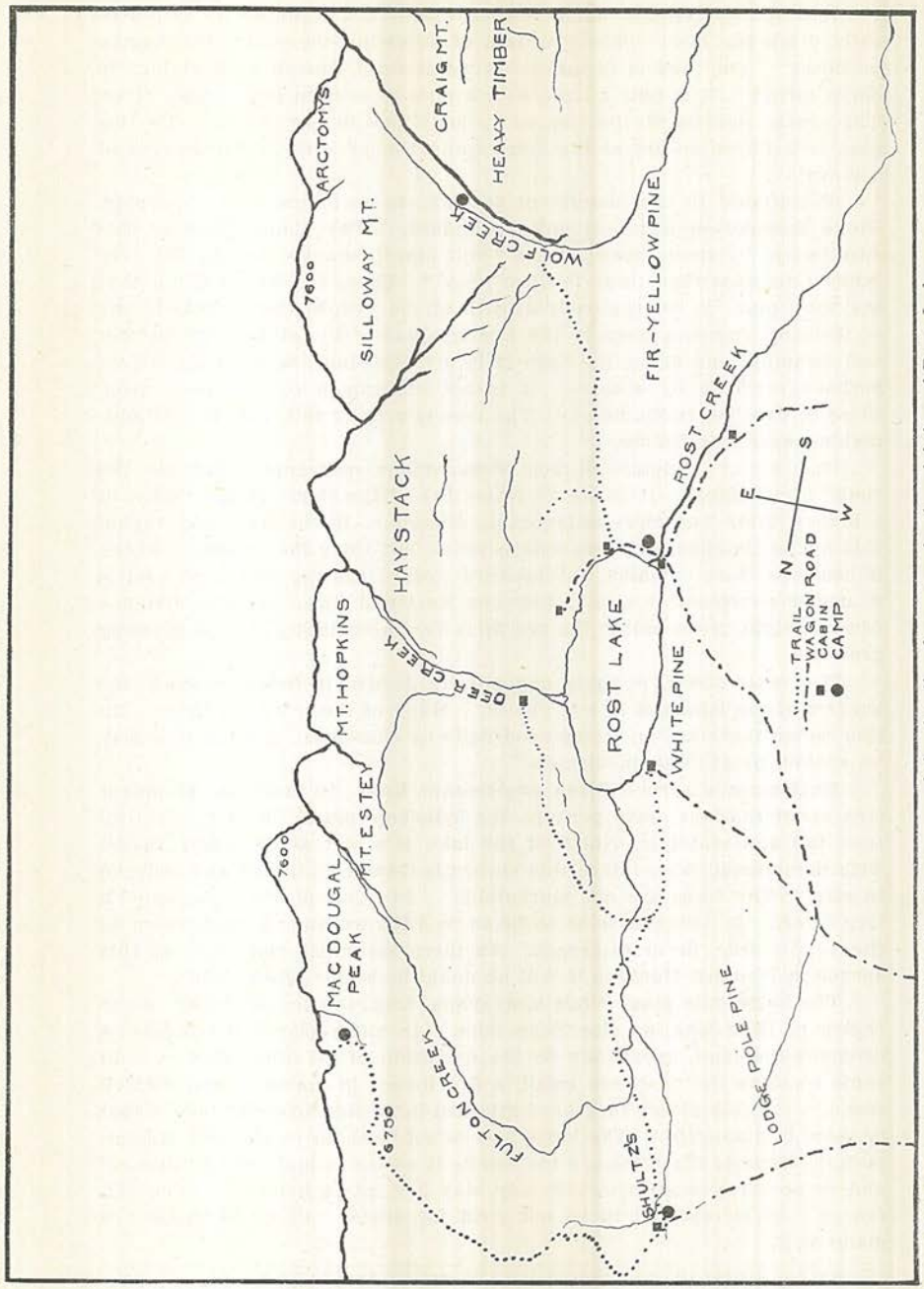

Fig. 3. Sketch showing some of the details of country in the vicinity of Rost Lake.

The white pine, **Pinus monticola,** Dougl., is not infrequent about the lake. Toward the Swan range it becomes more abundant. It seems to be more or less common along the western slope of the Swan range from Swan lake north to Flathead river. Large trees from 7 to 10 feet in circumference are not uncommon, and trees with diameter of 18 inches to 2 feet may be called abundant. This tree has not been lumbered much, and its true worth is not appreciated. However, compared with other lumber white pine is not common.

The western larch or tamarack **Larix occidentalis,** Nutt., is one of the best known trees of the state. There is considerable large timber near Rost lake. The trees are usually tall, clean, and free from knots. Much of the marketable timber of choice size and cutting will be of this species.

The balsam fir, **Abies grandis,** grows abundantly in this wet and shaded region, in some cases attaining the dignity of a tree of from 12 to 15 inches in diameter.

Here, also, the white birch thrives. Many trees large enough for logs are growing near the lake and along the mountain side in the wet region. Many a "curly birch" knot has been seen which from its size would make fine cuttings. The birch of this section will probably be utilized later. **Betula payrifera** makes a beautiful tree, conspicuous by its white bark. As is perhaps well known, in its early stages the bark is red. It may then be taken for the red birch, **Betula nigra,** L., which is not common in the region. The swamp birch, **Betula glandulosa,** Michx., is everywhere abundant around the border of the lake, growing in large clusters from a common starting place like a rose bush. It even attains to the dignity of a tree, four or five inches in diameter and fifteen or twenty feet high.

The white cedar or arbor-vitae, **Thuja plicata,** Don., grows in considerable quantity in many places in the region. Its value is well known, though little timber has been used except for "shakes" and posts. The cedar timber is practically untouched around Rost lake.

The hemlock, **Tsuga,** grows sparingly, but has not been seen within several miles of the lake. How abundant it may be along the mountains is at present not known to the writer.

Among the shrubs may be mentioned the ever present alder, and the yew. The former occurs along the banks of all the streams. The latter occurs on the mountain slopes, where it is a matted underbrush, spreading over the ground, an impediment to travel, but less difficult by far to penetrate than **Ceanothus** or **Menziesii,** both or either of which may be encountered. It was a rare pleasure to find in late August the ripe berries of the yew. I had never seen them before. The little red cup, the size of a pea, surrounding a central seed, the whole surmounting a slender branch of the evergreen, was very beautiful. They were sweet and pleasant to the taste. As we flushed several fool hens among the bushes the berries are no doubt eaten by these game birds.

It is unnecessary to mention the willows, three species of which were noticed, as they are ever present in the damper places in the valleys as also high up, even to the alpine regions. As Harry N. Whitford, of the University of Chicago, is making a careful study of the forests of the region adjacent to the Biological Station it would be unwise to

forestall any of his work or enter the field he has chosen by generalizations as to the influences which have caused the present distribution of the different species of forest trees. All this will be given in his final report, which will be published later, no doubt.

Rost lake is a typical example of a body of water being filled in by sediment and having its inlets, outlet, and sides choked by hydrophytic vegetation. This vegetation is encroaching on the lake in every direction. The annual rise and fall of the lake is several feet, and for a hundred feet or more in every direction from the lake the vegetation was profuse and abundant, at the time of our stay, early July. In the spring the surface of the lake is considerably larger.

The outlet of the lake, Rost creek, carries the water into Swan river. The lake has no driftwood. The inlets are too small to carry drift, and the edge is too swampy to permit forest vegetation close enough to the water to have fallen timber in the water.

This is locally known as Mud lake. It figures on most of the maps as Rost lake, improperly spelled Ross. The name was given because of the early residence at the lake of a Swede named Rost.

The lake is apparently of glacial origin. In a short time it will be filled up. The grassy meadows in the immediate vicinity, all of them wet and swampy, are no doubt smaller lakes or portions of this lake that have been filled up by sediment and hydrophytic vegetation.

As was stated, the animal and vegetable life is quite varied. Clustered about the dead stumps of the rushes were large masses of a fresh water sponge, Spongilla, green in color, with long fingerlike arms waving in the water. Very few shells were found. In the creek below the outlet a few young **Margaritana margaritifera** were taken. A single dead **Physa heterostropha** was picked up in the mud bottom, while a few **Pyramidula strigosa** var. **Cooperi** were found in the adjacent woods.

In Odonata the lake showed greater numbers and abundance than any similar region studied in the state. Many species were just emerging from the water. A **Calopteryx**, the first seen in the state and the first reported, was found rather abundantly. **Sympetrum rubincundula** was emerging, July 14, in large numbers, the specimens being fresh and uncolored. **Aeschna constricta** was on the wing, the exuviae being found on the rushes in numbers. **Ischnura** was common. **Libellula pulchella** was just emerging, in considerable numbers. **Libellula quadrimaculata** was on the wing, and captured specimens showed that they had been out for some time. Two species of **Lestes** were on the wing in considerable numbers, the larger number just emerging. A dark colored **Sympetrum** was sparingly distributed, difficult to catch, a single one being taken. **Enallagma calverti** Morse, was quite abundant, some on the wing, others emerging. A **Mesothemis, M. simplicicollis,** was occasionally seen, and one was captured on the mountain eastward at an altitude of over 7,000 feet.

Calopteryx yakima Hag. See Psyche, 1889, pp. 248-9.

Hagen described this species from specimens collected at Lone Tree, near the Yakima river, Wash. He says the discovery of a species of **Calopteryx** west of the Rocky mountains was very unexpected and rather

startling, the more as the species seemed to be different from all known to occur in North America. He also says: "I cannot but believe that some of the northwestern species pass east by the passage above Missoula, where the principal range of the Rocky mountains ends, and perhaps by the upper parts of the Columbia river. As far as I know, such species are, until now, not to be found in eastern Canada or in Maine. Of course when species can come east in such a way it is possible that some could go west in the same way, and would be, perhaps, modified by the climate. So I found it necessary to compare carefully with **C. yakima** the **C. hudsonica** from Michipicoten and **C. aequabilis.**"

From July 7 to 14, 1901, specimens were captured. The insects were taken from the log bridge at the outlet of the lake, on which they congregated. The collection was made gradually. Perhaps a half dozen would be seen on the bridge or in the rushes. When these were captured or driven off it would be some time before others would assemble. During the week's stay at the lake 26 males and 24 females were taken. They were all well colored, showing that they had been out for some time. They were not seen at Echo lake, a few miles further to the northwest, nor have they been seen anywhere else in western Montana. But dragonfly collecting in Montana has not been carried on very extensively.

Calvert considers **C. yakima** the same as **C. aequabilis,** the eastern insect.

Taking **C. yakima** at Rost lake indicates that this eastern dragonfly has effected passage across the Rockies in Montana, and above Missoula, as suspected by Hagen. Later investigations may show the exact place in the mountains where the species crossed over. It is quite probable that the species has crossed at Lewis and Clarke Pass, whose altitude is 6,323, from P. R. R. reports. The waters of the Missouri and of the Columbia are but a short distance apart, and the pass is low. Since the species has not been seen around Missoula it is likely, if the above pass was the passage, that the species has followed the Big Blackfoot through the upper part of its course and then passed over to the Swan river, and down that to Swan lake, from which opens up the large wooded valley in which Rost lake lies.

It will be apparent to the reader that the dragonfly in question has crossed the Rocky mountains, but that the passage has been from the east side westward, and not as Hagen supposed, from west side eastward. Further, the passage has been recent, since **C. yakima** and **C. aequabilis,** although on opposite sides of the range, have not sufficient marks of distinction to be considered even as separate races.

Since capturing these specimens I now recall an occasion when a single specimen was thought to be seen at the Biological Station. As I was passing through a barn lot on my way to lunch I was sure I saw a Calopteryx in the weeds some distance off. I had no net, but grabbed my hat and made chase. I was sure I had seen one glimpse of a Calopteryx but was unable to find it.

It is hardly likely the species crossed at the Marias Pass, whose altitude is 8,500 feet. Nor is it at all likely the species crossed over north of this, as the mountains are abrupt, high, and the streams very cold. If the passage has been any place in the range south of Lewis and Clarke

Pass it would be to a stream leading into Clarke's Fork through Missoula, where it has not been seen.

It is hoped soon to make an expedition to the headwaters of the Big Blackfoot and Swan rivers, when the question may be settled.

Few water birds were seen on the lake. It does not seem to be a favorite resort for them. Although there are several species of fish they do not seem to thrive in the warm waters of the lake. It is possible later investigations may show this to be a good breeding place, as Entomostraca are quite abundant. Other forms of animal life, such as larval Diptera and Odonata, leeches and worms have not been determined except in case of adult dragonflies.

Plate XLIV is a good view of this very interesting lake. The photograph was made from the bridge at the outlet. The view is northeast, up the lake. In the foreground is a bed of pond lilies. Rushes almost choke the stream. The dense vegetation along the shore line is plainly discernible. The wooded valley is a great shelter for white-tailed deer. During ten days stay in the region not a day passed without some one of the party either seeing or hearing an animal. Bear are abundant in the hills.

In the hills east of the lake mountain goats are reported. In former years an occasional moose is said to have reached this region, though none are now seen. Their spoor is found in the mountains shown in the background. Elk and black-tailed or mule deer were also formerly taken in this region. The former are no longer seen, and the latter only occasionally. But the white-tailed or Virginia deer roams the forests in the summer from the settlements to the summits of the range, altiude 7,500 feet. They have been seen on the snow banks almost at the summits. They are fond of lying in the open places on the high ridges in summer. Here they escape in part from their worst enemies, the flies. Food is abundant. They bask in the sun, rarely disturbed by man.

It was stated that the borders of Rost lake contained many sphagnum bogs, mud holes and swamps. In July we traveled miles of meadows and bogs with scarcely a dry knoll during the entire distance. In these marshes, which are no doubt deep in early spring, there must be an abundance of smaller life.

Among the interesting features presented by a brief stay at this lake was the information that all the deer were badly infested by a liver fluke. Numerous reports came regarding the "bloodsuckers" that were in the liver of every deer, etc. Coming from reliable sources these stories could not be denied. The first specimen examined after hearing these reports had two large flukes encysted in the liver. Old residents make the statement that "when you kill a big old buck in the fall, take out his liver and shake it, it is so rotten with blooksuckers it falls to pieces." The life hisory of this fluke will be an interesting study for some one. From the shells thus far found the early stages are likely to be in a **Physa**, although **Planorbis trivolvis** should be present in the region.

Next to Daphnia pond Rost lake has greatest interest for students at the Biological Station.

Echo Lake.

This interesting lake lies close to the Swan range of the Kootenai mountains, between the Swan range and Flathead river. It is but eight or nine miles from the Biological Station.

The outline of the lake is very irregular. From the mountain tops the outline very much resembles the letter H, with small projections in different directions. This may be studied from examination of Plate XXXVII. The total shore line of the lake, including all the arms, is said to be from 12 to 14 miles. The width varies from a half mile to a narrow neck.

Its depth is said to be great at the eastern arm, the head of the lake, but the soundings showed less than 20 feet.

The lake has no surface outlet. The waters are held in by glacial deposit, evidently a portion of a moraine. The waters escape through an underground outlet, finally reaching Flathead river, though just where the outlet is or how far it extends underground is not yet known.

Very recent, or present connection with some large body of water is indicated by the presence of at least four species of fish, the squawfish, **Ptychocheilus oregonensis,** Rich., whitefish, **Corregonus williamsoni,** Girard, minnow, **Leuciscus,** probably **gilli,** and trout, **Salmo mykiss.** It is said to have suckers, **Catostomus,** also. A very large spring is reported a short distance from the lake on the west, but it has not yet been examined.

The lake has an annual rise of from five to seven feet, the waters filling up with the melting of snow in the spring and summer, reaching the low stage again late in the fall or early in the winter. The drainage is from a small portion of the west slope of the Swan range, and a small portion of the timbered valley adjacent to the waters of the lake.

The lake lies in a trough or depression in the wooded valley. Its banks are steep slopes, leading up to the valley plain, densely wooded with fir, tamarack, lodgepole pine, yellow pine, and an occasional white pine. Maple, alder, cottonwood and birch are present, but less numerous.

In the year 1894 the surface of the lake rose during the freshet to a point some ten or twelve feet above its usual height, and has remained so ever since. This elevation of water surface, and consequent submergence of land, appears to be due not to the submergence by sinking of land surface, but to filling up the underground outlet, preventing the water from escaping. This additional depth of water has drowned considerable vegetation, and in one case has submerged a meadow of several acres, including house, barn, and fences, the lake water covering to a depth of several feet what was formerly a meadow and garden. The old house at present has the water half way up the door, whereas previous to the rise it was on the bank of a creek emptying into the lake. What was formerly the mouth of the creek, and for a quarter of a mile back, is now a part of the lake. This is plainly shown in Plate XLII. The bridge in the illustration formerly spanned the creek. The water is new lake.

This photograph was taken during the summer of 1901. In 1902 a

visit to the lake at the same place shows that the water has risen several feet higher in the lake, to the eaves of the log house in Plate XLII.

This seems to prove the statement made relative to the closure of the underground channel. If the lake continues to rise from year to year the results may be disastrous, as it may overflow the bank at some point, doing much damage.

Echo lake has not received extensive study, and offers a very promising field for a summer's work for some one who wishes to undertake it.

There are morainal hills a hundred feet or more in height between the lake and Flathead river. Ranchers, in digging wells, pass through alternate layers of sand and gravel containing water. The indications point to the existence of this sand and gravel from Echo lake to or near to Flathead river.

The canyons in the mountain sides to the east of Echo lake show distinct evidences of glaciation, leading from the slopes down into the valley. These various smaller glaciers from the west side of the Swan range and from the east side of the Mission range merged into one large glacier, which must have pushed down (northward) the Swan river valley. In Plate XXXVII the movement would be from left to right. At the same time a much larger ice mass was moving down the valley of the Flathead river and across Flathead lake. Evidences of this ice mass exist about Kalispell, along the shores of Flathead lake, and in the Mission valley to the south of Flathead lake. At the foot of Flathead lake the large and distinct moraine stretches from the Mission mountains on the east across the end of the lake to the Cabinents on the west, decreasing toward the west, and cut by the outlet of Flathead lake. As the ice river from Swan river valley moved northward it was met, almost at right angles, by the larger ice sheet covering the Flathead valley. The place of meeting should be the valley shown in the middle of Plate XXXVII.

The Mission range ends as such in the low hills south and west of Echo lake, in the immediate vicinity of the Biological laboratory. These hills may be seen in Plate XXXVII to the left and immediately in front of Flathead lake. This northern end shows distinct evidences of glacial tion. Large boulders, with abundant and deep striations lie at or near the summits.

The contour of the land indicates that Swan river formely had its course northward, instead of turning to the west as is now the case. When the river and valley were filled with ice, meeting the larger ice mass, the larger mass caused a deflection of the smaller (Swan river valley) mass causing it to pile upon and flow over the lower slopes of the Mission range. This deflection probably aided in carving the present channel of Swan river, where it makes an abrupt turn and passes through a short and steep descent to the lake.

The retreat of the main ice sheet was probably more rapid than that of the Swan river valley mass, owing to the close proximity of mountain ranges feeding the latter. The result was a morainal deposit at what should be the surface outlet and what is the underground outlet, of Echo lake. Echo lake therefore appears to be either a portion of the old river bed, or a depression left in the morainal mass by the retreat of the ice.

It seems very probable that the Swan river formerly flowed north along the base of the Swan range on the west, emptying into Flathead river north of Columbia Falls. The evidence for this is as follows. Between Rost lake and Swan river, a distance of but a little over a mile, the surface is low, level, boggy, and swampy. The impression is that the soil is the recently uncovered bottom of a quiet lake. Rost lake has been described. North of this lake for several miles the surface alternates with open and wet meadows, boggy woods, and swamps that partially dry in summer. This condition seems to prevail north to the end of the Swan range. Pasing from the mountains westward at Rost lake the surface is as follows: First are the timbered slopes immediately west of the range; next is the mud bottomed lake with its swampy border; then come the open woods on higher and drier morainal sandy soil; further west is the low end of the Mission range, rounded by ice; beyond is the valley of the Flathead river.

North of this line just drawn the swamp region takes the place of Rost lake, widening so as to include Echo lake and territory east of it. Further north the end of the Mission range disappears, blending with the morainal drift, which lies continuous with the Mission and parallel with the Swan range. The low and wet belt, narrowing to a small strip, lies between the morainal ridges and the mountains. The only explanation to be offered for this conspicuously low and swampy region is that it is the remnant of the old stream.

Adopting this view as a basis for argument it would appear that the river formerly flowed north as previously indicated. In the Rost lake region it probably widened into a lake with swampy bottom.

I have no opinion as yet concerning the manner of closing the channel so as to turn the river westward. The great bend made by the water as it flows north from Swan lake, then west, south and again west seems to indicate a dam by ice, possibly an unusual ice flow from the region of MacDougal peak, where remnants of glaciers still remain. In event of such an ice dam, which may have occurred farther north than the point suggested, even to Flathead river, the waters from the west side of the Swan and east side of the Mission ranges would be imprisoned, damming up far beyond the present head of Swan lake. The elevation necessary in order to overflow westward across the end of the Mission range is not determined, but it is not great. The water began cutting through the low gap. The cutting was rapid. The water meandered over the wide level valley left comparatively dry, seeking escape, finally making the present tortouous channel.

The lake is a place of great interest to a biologist. Having no surface outlet its animal life presents many striking peculiarities. In its waters was found a new hydra, **Hydra corala** Elrod and Ricker, elsewhere described. In the same locality where the hydra was collected was found a species of Polygonum which has been growing in shallow water since the rise of the lake, before that being undoubtedly on dry meadow banks. This plant has accommodated itself to its new surroundings, and adapted its structure to the new conditions. The joints are swollen to considerable proportions, conspicuously noticeable. The lake contains an abundance of entomostracan life.

Swan Lake.

From Swan lake to the Mission mountains westward the distance is perhaps not more than six miles. It lies in a direction north and south, parallel with Flathead lake. It was evidently formed by the same geological method, faulting, the western half of the uplift of the Swan range falling after the upheaval, thus making the valley between the Swan and mission ranges, in which Swan lake lies.

From the laboratory at the outlet of Swan river to Swan lake is perhaps eight miles. The road winds through the forests and along the river, mostly through unfenced country, scarcely touched by the hand of man. There are a few houses along the road, several more between the road and the mountains to the west. The timber close to the road is mostly lodge pole pine, **Pinus Murrayana**, Engl., and Douglas spruce, **Pseudotsuga mucronata**, Raf. Occasionally in the smaller timber there rises the tall trunk of a monster tamarack or yellow pine, showing that in days gone by a different forest growth covered the country. Towards the Mission range there is considerable low and swampy land, apparently the remains of a portion of the old lake before mentioned, where is to be found an abundant growth of arbor-vitae, or white cedar, **Thuja plicata**, Don. Some of the mountain spurs have a dense growth of young timber of this species, so thick that the sun scarcely strikes the ground through the foliage, and where underbrush and other vegetation are entirely wanting. In passing through such timber one is continually squeezing between small trunks, often no thicker than one's arm, breaking limbs to make a passage, with nothing but dead leaves underfoot. It is impossible to see out in any direction. One must follow the compass, not knowing whether before there is a lake, a swamp, a steep slope, or open woods.

While exploring a portion of this region we came upon some blazes on the trees. At first these were supposed to be the marks of the surveyors. The compass showed them to be out of line with the directions which surveyors would take, and the question then was as to what the blazes would mean. It was decided to follow them up the mountain side, through the dense timber. The way wandered much through the woods, apparently taking an uncertain direction. They were certainly made by some one who was undecided as to his bearings. They fianally led up the mountain side to a tree well cut, barked almost around the trunk. From indications it was decided that some hunter a few years before had killed an animal at this spot, and had blazed his way out in order to be able to return for his game.

On this same trip, leaving the blazed trail before mentioned, we took the direction of the compass southeast, wishing to come out at a lake reported to lie between the river and the Mission mountains, a little north of Swan lake. The timber was very thick, and a view impossible. Following down a ridge which we had been ascending for some time, we came in sight of a small lake, covering but a few acres, lying in a pocket between two steep slopes. As we descended to the lake shore a pair of

golden-eye ducks started in affright. A kingfisher noisily resented our intrusion, perhaps the first for a long time. A flicker called from a near-by tree, and drummed loudly. Otherwise the woods seemed to be silent. The lake was almost choked by hydrophytic vegetation. The waters were of a beautiful blue color, causing exclamations of surprise and delight. We were not prepared to make examination of the water.

The ridge proved to be morainal, as shown by the rounded pebbles and stranded boulders on the surface. It continues to the lake, as we afterwards discovered, cutting the lake in twain, really making the lake double. This body of water is perhaps a mile or more across, somewhat elliptical in outline, timbered to the edge, and unexplored. The ridge cutting the lake in two meets the waters of the lake approximatly at the middle, extending from side to side of the lake. The morainal ridge extends almost due east and west, The ridge is sharp and steep, and at the same time narrow. On the summit the distance across is but a few feet. In height it is perhaps a hundred feet above the water. It is well wooded with small timber. On the north the trees are arbor-vitae, on the south Douglas spruce. It is a place where the sharpest line yet observed is drawn between forest growth of two different species, showing plainly how slight differences in location may make sufficient difference to give one species an advantage over the other. The southern side of the sharp ridge faces the sun, is dry, and supports Douglas spruce. The north slope holds more moisture, gets much less sun, better suited to the growth of cedar.

A portion of this lake to the north has receded so as to uncover the ground, leaving a marshy meadow on which native hay grows in abundance. This is cut by thrifty ranchers for winter use. The lake is not named, is little known, and biologically is unexplored. As our trip on this occasion was hasty and merely for preliminary purposes no attempt was made to collect material. Indeed, it was late when we returned home from this hasty reconoissance, much as we desired to make more careful examination. That must be left for future years.

On the ridge between the two portions of the lake a place was noticed where the grass and other vegetation was apparently trampled and mashed down as though a conflict had taken place. At first it was taken for the bed of a deer, but there was a marked difference in appearance between this and the ordinary deer bed. Examination disclosd the wasted skeleton of a porcupine, yet covered by portions of skin, and abundantly protected by long quills. The fight had taken place at the foot of a fir tree. Evidently the porcupine had just descended from the tree, when he was seized by an enemy, probably a wolf.

Along the bank of the old lake referred to as meadow was found the partly decayed skeleton of a fine white-tailed buck. He had a large pair of antlers, which were still covered with velvet. His death can only be conjectured, but must no doubt be referred to the hunter. Unfortunately his antlers were badly eaten by rodents, hence they were useless. On the border of the meadow a fine buck was rousd from his midday slumbers. The timber was dense, and the first bound put him behind such a mass of tree trunks as to make a shot impossible. Up in

the wods we came across the fresh spoor of a bear. An old beaver dam separated the meadow into two portions. On the return we flushed three flocks of ruffed grouse, each containing a half dozen or more birds. It is apparently a good game region.

Swan lake is a beautiful sheet of water. It is but the widening of the river, the remnants of much larger lake, both at the upper and lower ends. It is estimated to be twelve miles long, but this estimate is probably a mile or more in excess of the true length. It is narrow except at the upper end. Here it broadens, making a circular bay perhaps three miles wide. Soundings have been taken at the lower end, and to a point about half way up. The deepest sounding taken was about eighty feet. At the lower end it is narrow, shallow, and with considerable current.

Above the bay mentioned is a large swampy area, the home of water fowl and aquatic insects. This swamp covers several square miles. At the lake it is densely covered with hydrophytic vegetation, making a dense growth to the height of a man's head. To collect in this region is to wade in water waist deep. It is practically impossible to use a boat, and when a bird is shot it may be irretrievably lost though but a short distance away. As one moves farther south from the lake the swamp vegetation becomes less profuse, finally yielding to grassy meadows. Bordering this the forest makes a shelter for wild game. Through this swamp Spring creek winds its way to the lake. Its outlet is choked by masses of yellow water lilies, floating potamogetons, and great tufts of water crowfoot. It is a very suitable place for fresh water invertebrates. At the outlet of the creek fishing is usually good, and rarely does the visitor push up the creek in a boat at eventide without sight of a deer.

Swan river enters the lake along the slope of the Mission range to the west. It does not empty into the upper end of the lake, but follows parallel to it for a mile or more, meeting the lake far down the bay. The river is a great fishing resort, and is much visited by fishermen and hunters. Many interesting regions are reported along its shores which the writer has not visited.

The shores of the lake are densely wooded. This timber extends up the slopes of both ranges to the rocky nummits. The mountains are not high, not exceeding 7,500 feet, and support timber to the rock crests. The timber is that prevailing in the region, the same species as mentioned for the region adjacent to Rost lake, one species prevailing in one locality, another most abundant at some other place. Most of the timber is of younger growth. The mountain slopes on either side of the lake are well wooded. Indeed, we may say they are densely wooded. The summits on the west are rounded, with no sharp peaks. These begin further to the south. The slope of the Swan range to the west is the more abrupt, since it is the cliff side of the fault. Weathering has reduced the range very much. Ice has no doubt had a great effect in breaking down the sharp ridges. At the upper end there is a small valley between the lake and the base of the mountain. This is very wet, covered with dense forest. Toward the middle and lower portion the hills end at the water's edge, clothed with timber to the base.

The wagon road from the north ends at the outlet of the lake. If one wishes to go farther he must proceed by boat, on foot, or with pack horse. The trail follows the east shore. It is well travelled, and is the only passageway from this region south to the headwaters of Swan river. The trail is kept open by the forest rangers. One may follow it to the headwaters, when it meets a wagon road. This may be followed to the Big Blackfoot river, thence to Missoula.

The upper half of Swan lake, the swamp at the upper end, and the Swan river region mentioned above, lie in the Lewis and Clarke forest reserve. The large timbered area included is therefore under the care of the government, and very little cutting has been done. There are several cabins along the shore of the lake, occupied by hardy pioneers who occupied the land before the Forest Reserve act was made. As a consequence there is little traffic on the lake. The boats are confined to a few row boats owned by different individuals.

During the summer of 1902 a party of thirty-one was taken across the lake to the upper end. A stay of several days was made in scientific work. This party taxed the facilities of the region. All the available boats on the lake were in use, as well as the canvas boat.

On this occasion an ascent was made of Hall's peak. This is a small and rugged rock pile rising out of a wooded slope with three separate humps or shoulders. The altitude is about 7,250. The summit is a sharp ridge, in several places barely wide enough to set foot for passage. On either side it is precipitous. When the rocks are bare of snow the peak is neither difficult nor dangerous to climb. It is necessary to skirt several places where the slope is very steep. With snow there would be no footing. When the surface is bare there is little trouble. It would probably be impossible to ascend this summit when it is covered with snow. Those who have reached it at such times report that they would not attempt the feat. There were a few snow patches below the summit at the time of our ascent, the last week in July. The view was very fine. The air was comparatively clear. Clouds gathered and indicated a rainy descent, but happily there was no rain. Among the party was Miss Pearl Ricker, of DesMoines, who is the first and at this writing the only woman to ascend this mountain.

The mountain is wooded to the very summit, save where the rocks have not disintegrated sufficiently to permit trees to grow. The few stunted and gnarled alpine firs and white-bark pines were small, and showed the great struggle they were making for an existence. Near the summit there was great profusion of spring flowers.

This peak stands out alone from the others in the range. It is connected eastward by a ridge a thousand feet below the summit. Deep and precipitous canyons separates it from the mountains on the north and south.

The mountain is not difficult of ascent, and the climb is devoid of interest until the last 1,200 feet are reached. A trail leads from Bond's cabin to the foot of the mountain. The climb is through dense timber, up a wide mountain face where directions are difficult to follow without the use of compass. There is no view in any directions save an occa-

sional glimpse of the lake until the foot of the cliffs at the summit is reached. From this up the view is superb.

The most impressive feature of the panorama spread before the eye is the great stretch of timbered country visible. Westward to the summit of the Mission range there is nothing to be seen of the mountains, so well are they hidden by the forests of pine, fir, and tamarack. The lake with its swamp and meadow relieves the somewhat monotonous view of forest, and sparkles and glistens in comparison with the sombre green of the trees. It looks beautiful in the valley far below. To the south is the timber belt along the Swan river. Pathless save for the trail mentioned, unbroken by the woodman's ax save for the few trees cut by the early settlers along the lake shore, it stretches as far as the eye can reach, and dimly beyond may be seen the high snow crowned summits marking the valley yet almost unknown. On the right may be seen the high summits of the Mission range, McDonald being most conspicuous. To the left Swan peak rises high towards the clouds, and in late summer wears a crown of white. Eastward the lower summits hide the wooded valley of the South fork. Everywhere forests greet the eye. No one can comprehend the enormous quantities of marketable timber visible from the summit of this mountain, almost all of which is in the forest reserve.

While the ascent is largely devoid of interest it is certainly worth while to see this great stretch of timbered country, and few are likely to make the ascent and be disappointed with the view.

The ornithology of the lake has been partially studied by Mr. Silloway, who has a special report on the birds of the region. This will be issued separately later. Mr. Whitford has made a comprehensive study of the forest region about the lake. He has travelled through many miles of pathless woods guided by the compass. Several weeks have been spent in this work. The result will be of great value to students of the laboratory, and to students of forestry in general. His report will no doubt be published in full by the Bureau of Forestry.

It would be premature to make report of the entomostraca in the lake. The material consists of collections made during two different summers. In 1900 the writer spent several days at the lake. Pumpings were made from different depths, and a number of surface hauls made. In 1902 Mr. Silloway made almost daily collections during the month of June. The work of Forbes has been previously referred to.

Shell life in the lake seems to be scarce. No more than six species have been found in the water or along shore. They are as follows:

Planorbis trivolvis Say. At the lower end they seemed rather common. At the upper end, in the swamp, Mr. Silloway secured a good series, and reported them abundant.

Limnaea stgnalis, L. A few specimens of this large shell were picked up at the lower end. At the upper end they were common in the swampy bay, where Mr. Silloway gathered a moderate quantity.

Limnaea emarginata, Say. Specimens very closely related to those found at McDonald lake, described as variety montana, were taken sparingly.

Physa heterostropha, Say. A few were picked up along shore at the

lower end. They were all dead, and no doubt were washed in from the nearby marshes.

Sphaerium partumeium, Say. A single dead specimen was taken along shore at the lower end. The statement made for the preceding species will no doubt apply to this.

Pyramidula strigosa var. **cooperi**, W. G. B. This land species was taken abundantly by Mr. Silloway, who reported it in great quantities during the wet month of June. It is interesting to note that it does not seem to be mixed with **P. solitaria**, so abundant on the opposite side of the Mission range.

The annual rise and fall of the lake does not seem to be more than a few feet. The area drained is almost entirely wooded. The snow is therefore held back in spring by the timber, which prevents the sun from taking it off rapidly. The only water of any importance entering lake is the river, which enters the bay toward the upper end as previously mentioned. On the east one small creek and several rivulets carry a few second feet of water. There are no streams worth mentioning coming from the Mission range into the lake. The entire shore along the Swan range at the upper end is springy. A few inches below the surface at almost any point reveals cold water, seepage from the hills, no doubt. The amount of water brought to the lake from this source is not known. The river at the inlet and outlet have not as yet been measured, and the flow cannot therefore be given.

Air currents in the region of Swan lake are pronounced, and merit notice. Lying in a cradle between two mountain ranges, its surface must be stirred by every mountain breeze. As has been mentioned, the higher slopes of both ranges are south of the lake. In summer these higher summits contain the greater portion of snow, while the peaks nearer the lake are mostly bare, save on the north and east. During the day these rock summits become heated, the warm air rising as the rocks become more and more affected by the sun. A current of air is therefore put in motion up the lake. This is usually felt during the day in summer. At dusk, after the sun has set, the reverse takes place. The rocks along the mountain ranges which during the day have been warm now cool rapidly. The cool air is heavy, and flows down the mountain slopes toward the center of the valley. Down this it moves. As it crosses the lake from the upper to the lower end its movement may be followed by the ripples on the surface. Occasionally this is intensified by a breeze, which may be occasioned in the same manner by extremes of heat, but which probably has some other origin. The result is a strong wind, perhaps sufficient to be called a gale, which piles up the water at the narow outlet into waves of much force for so small a body of water.

The lake is free from driftwood. The currents just mentined no doubt carry all the drift down lake to the outlet. From this place it may easily pass down the river and on to Flathead lake.

From its beautiful location in the heart of the mountains Swan lake will no doubt become a resort for those who wish a rest from mental labors. It is primitively wild. Game abounds. The lake is large enough for extensive boating with small craft. The waters are clear

and cool. Fishing is good. Mountain climbing may be indulged in to almost any extent. The lower peaks near the lake may be scaled, or the mountaineer may go south a few miles and find summits reaching to 10,000 feet. The region is a bontanist's paradise. In the swamp the entomologist will find a rich field. No doubt many new species await the collector. Artists may find ample scope for the brush, and the weary brain may find a haven of almost complete rest if such is desired.

The Swan Range of the Kootenai Mountains.

Several excursions have been made into the Swan range in different years. In 1901, Dr. MacDougal, Mr. Harris, Mr. Ricker, Mr. Silloway and the writer shouldered packs and started over the trail to Haystack. We passed along the south face of this about third way up, and northeast to Silloway mountain. The second day Mr. Ricker and Mr. Silloway returned to camp. The remaining three passed entirely around the head of Wolf creek, ascended Craig mountain, followed its long ridge to the northern end, and descended through the woods to camp the third day without mishap.

The trail thinned out and disappeared early in the day. The slope was steep. The blazing July sun on the south side of the mountain was blistering hot. The way was almost barred by dense growth of rock maple, alder, mountain ash, New Jersey tea and Menziesii scrub. This growth was bent downward by many heavy and sliding snows. In its effort to straighten the shrubby vegetation had become a tangled mass, exceedingly difficult to penetrate.

From nine in the morning, when this scrub growth was first encountered, until six in the evening we worried through this dense and tangled shrubbery. Excessive thirst drove us to a descent to the creek at this time, as our canteens were long since empty. After a cool and refreshing draught the brush was again entered. It was worse than ever. It was impossible to see more than a few feet ahead, and it was often necessary to crawl on hands and knees to get through. Most of the time the head man was poking his gun between bent bushes with one hand and with the other trying to force the stems apart so as to slip through. Of course the others followed. The lead man was soon tired out with the threshing round he received and was relieved by another, and so on. It was the most trying, soul stirring, temper distracting and abominable place the writer has ever had the bad fortune to be in. Guns, packs, and other paraphernalia made progress so slow as to be very disheartening. Some of the boys wanted to stop and sleep on the brush. But we pushed on. About nine in the evening we stopped on a large flat rock, fifty feet above the stream, and 1,600 feet below the ridge we hoped to reach by night. So tired were we that we threw ourselves down to rest without removing the packs. After a meal remembered not by the abundance or variety of food, but by the fact that it was very good, we crawled into our sleeping bags around the campfire for a night's rest.

The next morning we were off before half past six. The slope was steep, and smoothed annually by spring avalanches. We reached the ridge summit at 9, prospected the three ridges to the mountain, as also the lake. As stated, two of the party returned from here to camp. The other three followed the ridge southward, skirted Actomys on the west, passed over some rocky cliffs into the pass of faulted rock between Arctomys and Craig, spending the night between huge snowbanks. Our

supper consisted of emergency rations only. It was very palatable and satisfying. After the meal I skinned a ground hog I had previously shot and buried the carcass in the sonw to try the meat for breakfast.

Breakfast consisted of emergency rations and ground hog. The latter was so tough we had to chew it as we went to save time, and little of it could be eaten. Old woodchuck from alpine regions is not recommended as a palatable diet.

Passage across the rock ribbed pass was interesting. It was up and down the faulted rock, with a tendency upward. Wearily the ascent of Craig mountain was made. After a rest the ridge was followed until the descent to camp began in earnest. After entering the dense timber nothing could be seen beyond the immediate foreground. During the afternoon our noise interrupted a bear at his feast of berries. Of course he immediately decamped. We arrived at camp tired and hungry, late in the evening.

A few weeks later, in the middle of August, Dr. MacDougal and the writer, accompanied by an old trapper, made an expedition into the Swan range over Aeneas trail. This time we took a pack horse to carry our luggage. A week was spent in gathering material. As we were not familiar with the region some time was lost in getting into localities desired. Ample collections of plants were made. The trip brings back only pleasant memories of beautiful moonlight nights, camps in delightful spots, and other reminiscences of similar nature. Of course there was rain, and hail, and sleet, and slippery trail with poor footing, long and hard tramps with good load to carry, but all these are forgotten.

Necessity demanded that many of the peaks and lakes be named. When collections are made they must be located. This will be apparent The following pages give some of the names applied and the reason for each. No excuse is offered for these. They are as appropriate as any, unless it be some local characteristic which would be especially noticeable.

From the laboratory to the base of the mountains eastward the distance is twelve to fourteen miles. There is a good wagon road to within three miles of the base of the range, but it is a few miles farther by this road than by the trail. Starting from the top of the hill at the bend of the river north of the laboratory one may take a well worn trail through the woods to Nigger Prairie, from there following the wagon road, going either to Shultz's cabin, the end of one road, or to Rost lake, the end of another road, or to Swan lake, where the road ends in that direction.

The ascent of MacDougal Peak is made from Shultz's cabin; the ascent of Silloway mountain, Craig mountain or Haystack is made from Rost lake. The mountains farther south in the range are reached from the Swan lake region.

From Shultz's cabin the old Aeneas trail leads to the summit of the ridge, passing through a notch in the ridge, then to the left along the east slope in a direction northeast, and on to the South Fork of Flathead river. The trail is well worn and easily followed. It is full of snow until July, and in the middle of August the trail is par-

tially buried by drifts. Camp may be made at the end of the wagon road at Schultz's where there is water and pasture.

From the lower end of Rost lake a trail leads through the timber to the mountain side, evidently a game and huckleberry trail. At the base of the mountain it thins out and finally disappears. The trail may be found by following the wagon road to the first house on the east side. Cross the little meadow toward the mountain and the trail may be seen leading off into the woods. When it forks take the right hand fork. The mountain slope has no trail. On the canyon side it is very bad going. The route up over the summit of Haystack is preferable to the trip up the canyon. Silloway peak is the bald mountain east of the first summit, which is Haystack. Craig mountain is across the canyon south from Haystack. Arctomys is next southeast of Silloway, connected with Silloway and Craig mountains by low passes.

By passing up the east side of the lake to the second cabin another trail may be found. This trail leads through the woods to the pass between the southern or pointed peak of Haystack and the next one north, Hopkins, and over or through this pass to Silloway peak.

At the upper end of Rost lake on the west is a cabin. From this center several trails lead out. The main trail leads into the timber north, and by blazes may be followed to Shultz's cabin, where the Aeneas or Blackfoot trail is to be taken. About fifteen minutes walk after leaving the cabin brings one to a fork with a branch trail leading to the right. This branch goes to a series of bear traps. Farther on a branch to the left takes one up to the very foot of Haystack to trapper's cabin. By consulting Fig. 3, page 148, the above details may be easily made out.

At the foot of Swan lake if one has a wagon and wishes to go farther he must leave it. A well worn trail for pack horses may be followed up the east side of the lake. Or one may take a boat up the lake about twelve miles and then take the trail. This trail is kept open by forest rangers, and leads up Swan river to the divide between it and the Big Blackfoot, and down this to any point along the river.

In winter when the snow is deep and snowshoes are used the passage to the South Fork country is up Fulton creek and through the low pass between MacDougal peak and Estey. This pass is shown in the foreground of Plate XXXI, and is known as the Snow Shoe pass and trail. It is impracticable in the summer time on account of the dense brush.

The trails mentioned above are from the writer's personal knowledge. By consulting the pages elsewhere trails into the Mission range may be located.

The trail from Shultz's cabin to the foot of the mountain is well worn, and shows much usage. Up the mountain side it is tortuous, winding, and very irregular. It winds back and forth in the timber, unnecessarily increasing the distance, in some cases actually losing ascent as one proceeds upward. As one traveler on the trail expressed it, the trail gives the impression of having been made by a drunken squaw, who had no idea of where she was going, and who wandered around in the woods. But it is no easy matter to find a way through a densely tim-

bered region, with no view out, and to strike the main slope without more or less wandering is practically impossible, except when the view is open, which is rarely the case. But when the trail reaches the mountain slope and takes the ridge it goes directly up. The ascent is easy, but in several places quite steep. The first summit is at an altitude of 6,750 feet, approximately. This summit is the end of a spur from the main peak, connected with it by a long ridge. Between this summit and the main ridge farther east is a large amphitheater, wood mostly with black pine, and filled with snow until middle July. The trail follows the spur ridge for some distance, then drops off into the amphitheater and across to the notch in the ridge to the east, passing over much large and loose talus. It may be of value to travelers over the pass to know that just before making the steep ascent to the notch, in middle or late summer when the snow is gone, water may be had in abundance by following the dry water course down a few rods, where a large spring affords abundance of water. As this is the only water between the foot of the mountain at starting and the first lake beyond the notch its location in late summer is very important to mountain climbers.

Passing through the notch the trail thins out, and for a short distance is not easy to follow. It turns to the left. By following the base of the summit ridge it is not difficult to find it a few hundred yards ahead.

In ascending MacDougal peak the mountaineer does not follow the trail when it leaves the ridge before mentioned, although he may do so and later follow up the ridge from the notch. Instead the ridge is followed, until late in summer over snow banks. When the main ridge is reached, it is followed to the summit. On the eastern face of the ridge is an immense snow and ice mass which remains all summer, and which seems to have a little glacial movement. At the foot of the glacier is a small lake which is named Blue lake on account of the color of the water, which appears deep blue.

On the summit, altitude 7,725 is a U. S. G. S. triangulation stone monument. The view from this summit is superb, and the geology of the region may be studied to good advantage. Without duplicating descriptions the reader is referred to Plate XXXVII, which gives the view west and southwest, with explanations; to Plate XXXVIII, showing the backbone of the continent, the view being to the northeast. The mountain in the foreground is Dodge mountain, named in honor of Wm. E. Dodge, who has made large contributions toward the study of Montana flora; Plate XXXI shows the view to the southeast. Silloway peak is the double peak. Craig mountain is on the right. Silloway lake lies behind the double peak. Wolf creek takes its source in the depression seen between Silloway peak and Craig mountain.

In Plate XXXI four lakes are visible. In the foreground the larger one is MacDougal lake. The outlet is to the right, through Fulton creek.

On the summit of MacDougal peak were found large numbers of ladybird beetles, Hippocampus 13-signata, found on most of the summits with loose rock from Washington far east into Montana.

Dodge mountain has been traversed from end to end, and many rare botanical specimens secured.

Between Dodge mountain and Silloway peak is a deep canyon with steep sides. This is recognized as Wilson creek. On the northeastern side of Dodge mountain, low down, is a beautiful lake, Dodge lake. Between Dodge mountain and the slope leading down from MacDougal peak, northwest of Dodge mountain, is another lake, Sylvan lake. Its banks are abrupt on all sides except the outlet. In the wooded bench to the northeast of Sylvan lake may be found many smaller lakes, to which no names have been given.

From the notch before mentioned and from the crest of the ridge leading up to MacDougal peak a bench slopes off eastward. This is a beautiful park like slope, with a carpet of alpine flowers and beautiful though dwarfed trees. This is called Sylvan slope. The trail before mentioned traverses it for some distance, hugging the base of the ridges.

Sylvan slope is wooded by the same trees that grow on the higher summits. The two most abundant trees are the white-bark pine, **Pinus albicaulis** Engl., and the Alpine fir, **Abies lasiocarpa** Hook. In protected places these trees grow to a beautiful shape. They are usually limbed to the ground, the larger and longer limbs at the base. Succeeding limbs taper gradually to the summit or tip of the tree. The limbs are bent downward with the weight of snow during many winters. In most cases they make an acute angle with the trunk of the tree.

On the exposed slopes and summits the trees are torn and twisted, stunted and gnarled, almost limbless, with tops broken off, and roots exposed. They are subject to extremes of heat and cold, moisture and drouth.

Strong gales from different directions sweep the summits and ridges. The winds blow with fury. They turn and twist the trunks until they are misshapen and unsightly. But still the trees survive. Their mangled limbs and broken trunks are silent witnesses to the fierce struggle through which they have passed.

The contrast between the exposed and protected trees is very great, as may be seen by consulting the plates. Sylvan slope is an ideal region. To spend a night there is to have the feeling of perfect rest and peace. No one can forget the beautiful trees, the marked contrast between flowers and snow, water and sky, lakes and cliffs, roaring water falls and murmuring pines, barren rocks and mossy banks, or can blot from memory the magnificence of a night when the moon is at is full and the sky is clear.

There are many of these benches, made by faulting in the uplift, between the crest and the South Fork river. They are long, steep, and heavily timbered, enclosing many lakes, and holding large masses of snow. Sylvan lake is reached by passing down the slope eastward immediately after passing through the notch in the main ridge. It is yet unexplored zoologically.

The trail follows Sylvan slope for some distance, a couple of hours walk. Even in July and August there are large snow banks in the ravines along the slope. An admirable oportunity for study of alpine flora is presented in this field. The trail then drops abruptly over the ridges and down a very steep bank for more than a thousand feet to another beautiful lake. This we called Placid lake.

Placid lake is hemmed in on all sides by abrupt slopes, save toward the southeast, in which direction the small stream leaving the lake flows toward the South Fork river. At the upper end of the lake is a small and densely wooded flat. The trees are beautifully formed, tapering to a point, tall and stately. It is a fine place for camping, and game appears to be abundant in all the timbered slopes and valleys. The trail is traveled very rarely, and the life of the lake and adjacent territory is unknown, save from the collections made at the time of our visit, and which will be reported later. It appears that the Indians have made this a halting place in earlier days.

From Placid lake the trail ascends a ridge to the northeast, the ascent being about 800 feet. The view in every direction is very fine, and for this reason the ridge was named View ridge. At the time of our visit the vegetation was very luxuriant. A storm was approaching from the east, across the main Rockies, the backbone of the continent. Heavy clouds were rolling over the peaks, enveloping them one by one. It was a rare sight to stand at a distance and see the ranges slowly wrapped in a mantle of mist. Behind, almost a thousand feet below, was to be seen Placid lake. Beyond it was the main ridge of the Swan range; to the left was Dodge mountain, bold and rugged. Between View ridge and Dodge mountain is a creek of considerable size, unnamed. This creek we called Trail creek, because the old trail is not far from it during its entire course, and crosses the creek again before it flows into the South Fork river. Let us again follow the trail, down View ridge; between it and the next ridge is another beautiful lake, larger than Placid lake, and more interesting. The trail passes close by the lake. The shores of the lake have no doubt been the camping place of Indians, as evidenced by the large number of tepee poles. The age of these poles shows that they were used many years ago. Game signs are abundant. Collecting is good, but owing to lack of facilities the life of the lake was not examined. From this region many rare botanical specimens were secured.

Again the trail makes the ascent of a ridge, to the northeast. It follows the summit of the ridge southeastward, and keeps on the ridge until it drops off to the South Fork river. For this reason the ridge was named Trail ridge. The lake is likewise named Trail lake. The names Trail creek, Trail lake, and Trail ridge seem very appropriate. The waters from Trail lake flow in the opposite direction from those of Placid lake, and reach the South Fork river by an unknown and unexplored creek. The waters of Placid lake flow into Trail creek. Trail creek originates in the snow banks and glacier on MacDougal peak.

The view from Trail ridge is excelled only by that from View ridge, and the territory one may inspect is considerable. The ridges and valleys are well wooded, and to leave the ridge is to plunge into timber where a view of the surrounding country is seldom had.

Table of Altitudes.

The altitudes below are from aneroid readings. The barometer is of English make, compensated, reading to 20,000 feet. It has been thoroughly tested, and the readings, although uncorrected for atmospheric variations, are not far from correct. The altitudes are given for the benefit of those who may be traveling in the regions mentioned.

Kalispell, correct	2,946
Flathead Lake	2,916
Biological Station (approximate)	2,935
Rost Lake	3,200
Summit of Ridge on Silloway Peak, immediately above and west of Silloway Lake	7,350
Wolf Creek at base of preceding ridge	5,450
Silloway Peak, highest	7,725
Silloway Peak, second summit	7,625
Saddle, between Silloway and Arctomys	6,800
Pass at head of Wolf Creek	6,550
Craig Mountain, highest	7,425
Shultz's cabin	3,225
Water, trail above Shultz's	4,000
First Summit, MacDougal Peak	6,750
MacDougal Peak	7,725
Notch, where trail passes	7,075
Dodge Mountain	7,425
Sylvan Lake	6,450
Peak between MacDougal and Dodge	7,400
Placid Lake	5,950
Trail strikes View Ridge at	6,850
View Ridge, highest,	7,450
Trail lake	6,200
Trail strikes Trail Ridge at	6,750
Trail Ridge, summit	6,950
Sin-yale-a-min Lake	3,800
Sin-yale-a-min Mountain	9,250
McDonald Lake	3,300
McDonald Peak, west summit	9,500
Post Creek at wagon road	2,300
Summit of Moraine at Flathead Lake	3,400

MONTANA SHELLS.

The following list comprises the land and fresh water shells reported from the state. The list contains 60 species and varieties, 25 of which have been collected west of the main range of the Rocky Mountains, 42 east of the range. This makes a list of seven found on both sides of the Rocky mountains.

The collection east of the range was made largely by Homer Squyer, of Wibaux, recorded in Nautilus, Vol. VIII, pp. 63-65. At the time the record was made the town was called Mingusville, since changed to Wibaux. The shells from Madison Lakes and Tobacco Root Mountains were collected by Earl Douglas and E. H. Murray. Those on the western slope were all collected by the writer.

The list certainly does not represent the entire mulluscan fauna of the state, and is given merely as a basis for work, so that those interested in these forms may be able to work intelligently. Residents of the state are invited to send to the writer shells from their localities, so as to aid in making a complete list.

Full information and notes regarding these shells are to be found in the articles mentioned in the appended Bibliography.

It will be observed that the shells collected are from extreme ends of the state, with a few only from the interior. As the state is about 600 miles long there is consequently an extensive area intervening between the two collecting fields which yet awaits study.

The writer is under many obligations to Dr. W. H. Dall, of the Smithsonian Institute, and Dr. H. A. Pilsbry, of the Philadelphia Academy of Science, for their valuable assistance, so freely and cheerfully given, in the determination of specimens.

PHYLUM MOLLUSCA.

Class LAMELLIBRANCHIATA.

Order Siphonata.

Family CYCLADIDAE.

Genus Sphaerium.

Sphaerium sulcatum Lam.; Wibaux.

Sphaerium partumeium Say; Daphnia Pond, Swan Lake.

Genus Pisidium.

Pisidium compressum Prime; Wibaux.

Order Asiphonata.

Family UNIONIDAE.

Genus Anodonta.

Anodonta plana Lea; young, Wibaux.

Anodonta ovata Lea; young, Wibaux.

Genus **Margaritana.**

Margaritana margaritifera Lea; Bitter Root River, Tributaries of Pend d'Oreille River.

Class GASTROPODA.

Subclass Euthyneura.

Order Pulmonata.

Suborder Stylommatophora.

(Superfamily **Holopoda.**)

Family HELICIDAE.

Subfamily **Helicinae** (vel Belogona.)

Genus **Vallonia,** Risso, 1826.

Vallonia gracilicosta Reinh.; Wibaux.

Vallonia gracilicosta Reinh., var. close to **costata** Say; Wibaux.

Vallonia perspectiva Sterki; Wibaux.

Vallonia pulchella Mull.; Wibaux.

Subfamily **Ploygyrinae** (vel Protogna.)

Genus **Polygrya** Say, 1818.

Polygyra albolabris Say. A single specimen, which I refer to this species, was sent from Lewistown by P. M. Silloway, while the proof was being read.

Polygyra devia, var. **hemphilli** W. G. B.; Missoula.

Polygyra townsendiana, var. **ptycophora** A. D. Br.; Flathead Indian Reservation, in Mission Valley and Mission Mountains.

Family PUPIDAE.

Genus **Pupa** Draparnand.

Pupa muscorum L.; Wibaux.

Pupa blandi Morse; Wibaux.

Pupa blandi Morse, var. **edentata;** one specimen, Wibaux.

Pupa syngenes Pilsbry; eight more or less perfect specimens, Wibaux.

Pupa holzingeri Sterki; Wibaux.

Pupa armifera Say; Wibaux.

Pupa pentodon Say; Wibaux.

Pupa decora Gld; Wibaux.

Genus **Vertigo** Draparnand.

Vertigo ovata Say; Wibaux.

Vertigo binneyana Sterki; Wibaux.

(Superfamily AULACAPODA Pilsbry.)

Family ZONITIDAE.

Subfamily **Zonitinae** Pilsbry.

Genus **Vitrea** Fitzinger.

Vitrea arborea Say; worn var., approaching **V. breweri** Newc. Wibaux.

Vitrea radiatula Alder; rare. Wibaux.

Genus **Conulus** Fitzinger, 1833.

Conulus fulvus Mull.; one specimen from Wibaux; a few from Missoula.

Subfamily **Ariophantinae** Pilsbry.

Genus **Zonitoides** Lehmann, 1862.

Zonitoides minusculus Binn.; Wibaux.

Zonitoides laeviusculus Sterki; close to vars. of **minuscula**; Wibaux.

Zonitoides conspectus Bland; Wibaux.

Zonitoides arboreus Say; sparingly along the Bitter Root River.

Family LIMACIDAE.

Genus **Agriolimax** Moerch, 1868.

Agriolimax campestris Binn., var. **montanus** Ing.; Missoula, Flathead Lake.

Family ENDODONTIDAE.

Subfamily **Endontinae** Pils.

Genus **Pyramidula** Fitzinger, 1833.

Subgenus **Patula** Held, 1837.

Pyramidula elrodi Pils.; Banks of McDonald Lake, Mission Mountains from 3,000 to 7,500 feet.

Pyramidula strigosa Gld.; Tobacco Root Mountains, Bitter Root Mountains.

Pyramidula strigosa Gld.; var. **cooperi** W. G. B.; Mission Mountains, banks of Flathead Lake, Swan range of the Kootenai Mountains.

Pyramidula strigosa Gld., var. **alpina**; Mission Mountains above 7,800 feet altitude.

Pyramidula solitaria Say.; Missoula; Mission Mountains from 2,300 to 7,500 feet.

Subgenus **Gonyodiscus** Fitz.

Pyramidula striatella Anth.; Wibaux; a few from Missoula.

(Superfamily ELASMOGNATHA.)

Family SUCCINEIDAE.

Genus **Succinea** Drap.

(Amphibinae.)

Succinea avara Say; Wibaux.

Succinea obliqua Say; Wibaux.

Succinea grosvenorii Lea; Wibaux.

Succinea nuttalliana Lea; Flathead Lake.

Family LIMNAEIDAE.

Genus **Limnaea.**

Limnaea palustris Mull.; Wibaux, Flathead Lake, Swan Lake, Madison Lakes, Missoula.

Limnaea bulimoides Lea; Wibaux.

Limnaea humilis Say; Wibaux.

Limnaea caperata Say; Wibaux.

Limnaea stagnalis L., var. **appressa** Say; Bitter Root River, Swan Lake.

Limnaea nuttalliana Lea; Missoula.

Limnaea emarginata Say, var. **montana** Elrod; Sinyaleamin Lake and McDonald Lake in the Mission Mountains, Swan Lake.

Genus **Planorbis.**

Planorbis bicarinatus Say; Wibaux.

Planorbis lentus? Say; young shells only, Wibaux.

Planorbis parvus Say; Wibaux, Flathead Lake.

Planorbis umbilicatellus Cockrell (**P. umbilicatus** Taylor); Wibaux.

Planorbis trivolvis L.; Daphnia Pond, Flathead Lake, Sinyaleamin Lake, Swan Lake.

Family ANCYLIDAE.

Ancylus rivularia Say; one specimen from Wibaux.

Family PHYSIDAE.

Genus **Physa.**

Physa gyrina Say; young only, Wibaux, Missoula.

Physa ancillaria Say; Wibaux.

Physa heterostropha Say; Wibaux, Missoula.

Physa lordi Baird; Wibaux.

Physa ampullacea Gld., lakes in the Mission Mountains, Flathead Lake, Swan Lake.

Genus **Aplexa.**

Aplexa hypnorum; ponds along the Missoula River near Missoula.

The five species following are referred to in Pilsbry and Johnson's Catalogue of the Land Shells of America as probably occurring in Montana. The notes accompanying are quoted from the catalogue. The addition of these to the preceding list makes the total number of species and varieties in the state 65.

Vallonia costata montana Sterki, Rocky Mountains.

Vallonia cyclophorella Ancey, Washington to Montana.

Polygyra devia mullani (Bld. and Coop.), near Coeur d'Alene Mission, Coeur d'Alene Mountains, Idaho; west side of Bitter Root Mountains, Washington.

Polygyrella polygyrella (Bld. and Coop.), Coeur d'Alene Mountains, Idha. A variety **montanensis** Ancey is described from Deer Lodge Valley, Montana.

Succinea retusa Lea. Canada to Montana, southward to Georgia.

Bibliography of Montana Shells.

Squyer, Homer; List of Shells from the vicinity of Mingusville, Mont. Nautilus, Vol. VIII, pp. 63-66, 1894.

Pilsbry, H. A., and Johnson, C. W. A classified catalogue, with localities, of the Land Shells of America, north of Mexico. Nautilus, Aug., 1897 to April, 1898.

Pilsbry, H. A. New American Lands Shells. Nautilus, Vol. XIV, p. 40, 1900.

Elrod, Morton J. Montana Shells. Rocky Mountain Magazine, Vol. 11, No. 3, pp. 692-697, 4 pl., 1901.

Elrod, Morton J. Collecting Shells in Montana. Nautilus, Vol. XV, pp. 86-89, 103-4, 110-112, 129--30, 1901.

Bibliography.

The following papers and publications were prepared at the Biological Station, or emanated from work carried on there.

Cowles, H. C. The Influence of Underlying Rocks in the Character of the Vegetation. Bulletin Am. Bureau of Geog., Vol. 2, Dec., 1901; makes reference to the rock vegetation of MacDougal's Peak.

Cowles, H. C. Ecological Problems Connected with Alpine Vegetation. Read at the meeting of the Botanists of the Central States, Chicago, December, 1901. Printed in abstract in Science.

Elrod, Morton J. The Beauties of the Mission range. Rocky Mountain Magazine, April, 1901, pp. 623-631, 4 pl.

Elrod, Morton J. The University of Montana Biological Station. Rocky Mountain Magazine, Vol. II, 1901, pp. 781-787, 4 pl.

Elrod Morton J. Montana Shells, Rocky Mountain Magazine, Vol. II, 1901, pp. 691-697, 4 pl.

Elrod, Morton J. Limnological Investigations at Flathead Lake, 1899. Trans. Amer. Mic. Soc., Vol. XXII, pp. 63-80, 9 pl.

Elrod, Morton J. The University of Montana Biological Station. Jnl. App. Mic., Vol. IV, No. 5. pp. 1269-1278, 13 fig.

Elrod, Morton J. The Value of the Telephoto Lens, Jnl. App. Mic., Vol. IV, No. 4, pp. 1241-1242, 2 ills.

Elrod Morton J. Variations in Dragonflies, read before Sec. F., Amer. Assn. for the Adv. of Science, Denver, Aug., 1901.

Elrod, Morton J. Further notes on the Use of the Telephoto Lens. Journal of Applied Microscopy, Vol. IV, No. 12, pp. 1568-1571, with 5 ills.

Elrod, Morton J., and Ricker, Maurice. An apparently New Hydra. Trans. Am. Mic. Soc., Vol. XXIV, 2 pp.

Elrod Morton J. Among the Kootenais. Rocky Mountain Magazine, Nov.-Dec. 1901, 14 pp., 10 ills.

Elrod, Morton J. Collecting Shells in Montana. Nautilus, Vol. XV, No. 8, pp. 86-89; No. 9, pp. 103-104, No. 10, pp. 110-112, No. 11, pp. 129-130.

Elrod, Morton J. The University of Montana Biological Station at Flathead Lake. Kaimin, Vol. V, Nos. 7 and 8, pp. 12-15, 3 ills.

Elrod, Morton J. Effects of Altitude on Snails of the Species Pyramidula strigosa Gould. Read before Section F, American Assocation for the Advancement of Science, Pittsburgh meeting. Abstract in Science for August 29, 1902, p. 349.

MacDougal, D. T. The University of Montana Biological Station. Journal of the N. Y. Bot. Garden, Vol. 11, p. 143.

MacDougal, D. T. Report of an Expedition in Montana in 1901. Jul. N. Y. Bot. Garden, Vol. III, No. 25, pp. 8-13, 4 ills.

Announcement of the session of the Univ. of Mont. Biol. Station for 1901, Science, Vol. XIV, N. S.

Pilsbry, H. A. **Pyramidula elrodi** and **Epiphragmophora circumcarinata.** Nautilus, Vol. XVI, pp. 62-63.

Ricker, Maurice. A Large Red Hydra. Read before Iowa Aacademy of Science, Dec. 1901, Des Moines.

Ricker, Maurice. The Univ. of Mont. Biological Station. Read at Iowa Academy of Science, Dec., 1901, Des Moines.

Silloway, P. M. Summer Birds of Flathead Lake. Bul. Univ. of Mont., No. 3, Biological Series No. 1, 84 pp., 16 plates.

Silloway, P. M. Among Our Summer Birds. Rocky Mountain Magazine, Vol. II., No. 5, pp. 863-867. (Popular descriptions of the Catbird, Warbling Vireo, Bleak-headed Grosbeak, Louisiana Tanager, Olive-backed Thrush, Lazuli Bunting, Yellow Warbler, and American Redstart. Illustrated.)

Silloway, P. M. Our Mountain Grouse. Rocky Mountain Magazine, Vol. III. ,No. 3, pp. 193-202. (Popular descriptions of the Sage Grouse, Columbian Sharp-tailed Grouse, White-tailed Ptarmigan, Gray Ruffed Grouse, Franklin's Grouse, and Richardson's Grouse. Ilustrated.)

Silloway, P. M. My Story of the Sharp-shinned Hawk. The Osprey, Vol. V., No. 5, pp. 70-71. (Record of a nest taken in the swamp adjacent to the University of Montana Biological Station grounds.)

Silloway, P. M. Flathead Lake Findings. The Condor, Vol. III., No. 1, pp. 4-7, with plates of nests of Audubon's Warbler and Wright's Flycatcher. (Description of nesting habits of Audubon's Warbler and Wright's Flycatcher.'

Silloway, P. M. Holboell Grebe in Montana. The Condor, Nov.-Dec., 1902.

Stearns, R. E. C. **Helix** var. **circumcarinata** and **Pyramidula elrodi.** Nautilus, Vol. XVI, pp. 61-62.

Stearns, R. E. C. **"Pyramidula" elrodi** and **Epiphragmophora circumcarinata,** Nautilus, Vol. XVI, No. 7, pp. 83-84.

ERRATA.

Page 119, fourth line from bottom, read bluebird for blubird.

Page 121, fifteenth line from top, read **alpina** for **montana.**

Page 149, twentieth line from top, read **Betula papyrifera** for Betula papyfera.

Page 163, twenty-first line from top, read Blackfeet for Blackfoot.

Page 122, second line from top, read Lace lake for Leash lake.

Page 147, ninth line from top, read **ponderosa** for **scopulorum.** At other places where reference is made to yellow pine **ponderosa** should be used instead of **scopulorum.**

Page 147, fourth paragraph from top, **Populus angustifolia** should read **Populus balsamifera** var. **candicans.** Dr. J. W. Blankinship of the Agricultural College expresses the opinion that this latter is the only species in the western part of the state.

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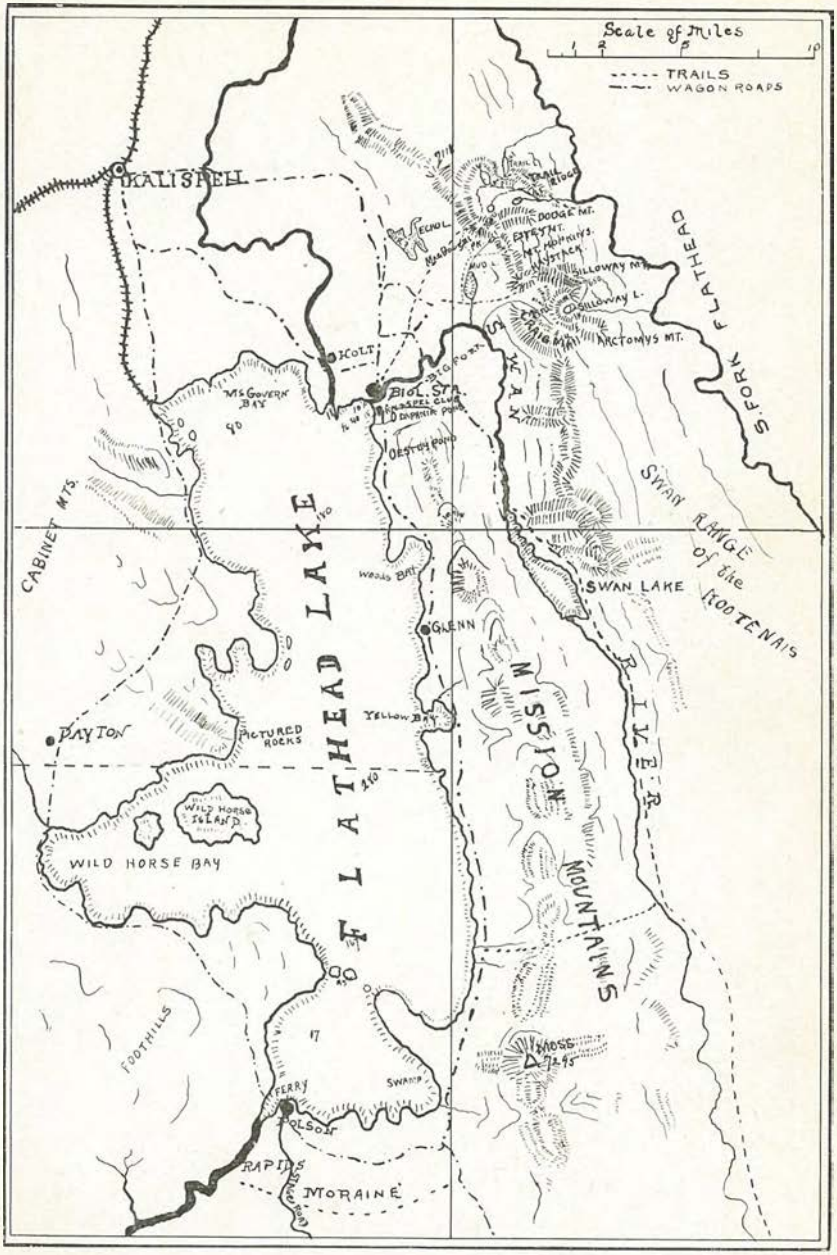

Map of Flathead Lake and adjacent region.