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CONTENTS:

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THE WATERWAYS OF THE MACKENZIE RIVER BASIN*

By Charles Camsell.

Introduction.

The Mackenzie is one of the great rivers of the earth, with a drainage basin covering about one-fifth of the total area of Canada, exclusive of the islands of the Arctic. The subject, therefore, is too big a one to discuss in all its details within the limits of a short paper such as this, and I will make no attempt to do so. I wish, however, to draw particular attention to what I consider one of the most important features of the region, and one on which, to a very large extent, its future development depends, namely, its navigable waterways. The importance of these waterways, first in the exploration of the region and later in its settlement and the development of its natural resources, cannot be overestimated, and these waterways can and will be used far beyond the limited extent to which they are used at present.

I have selected the Mackenzie river region for two reasons. In the first place, I am familiar with much of its geography, its natural resources and its inhabitants, and I am able to speak of them with some degree of knowledge gathered throughout many years of residence in the region. For many years I wandered over much of the northern part of the region, from the barren lands on the east to the Pacific coast on the west, travelling in summer by canoe and in winter on snowshoes. During these years I travelled over nearly all the main routes, besides some that had not previously been explored.

In the second place, the Mackenzie river region is at present beginning to attract a good deal of attention among men who are anxious to develop its natural resources in minerals

*Paper read at the meeting of the Ottawa Field-Naturalists' Club on March 10th, 1914.

and agriculture. The agricultural portion, namely, that within the basin of the Peace and Athabasca rivers, has been widely advertised as "The Last West," and is being gradually settled up. This portion of the Mackenzie basin, together with that immediately to the north of it as far as the Liard river, contains the greatest area of unoccupied agricultural country in Canada, and it is the direction in which Canadian expansion in agricultural pursuits is bound to take place.

The northern and eastern portion, however, is still largely unexplored and, while it is never likely to support a large agricultural population, offers a vast field of possibly great value to the prospector and the mining man.

To develop the Mackenzie basin, railway companies are building lines into it from the south, one going north-westward from Edmonton into the Peace river, and another down the Athabasca river, and still others are asking for charters to cross it from Hudson bay to the Pacific. Its magnificent system of waterways, with thousands of miles of river and lake navigation, combined with the transportation that will be afforded by the proposed railway lines, will make the development of the more accessible parts a quick and easy matter.

Although it is more than 100 years since the first explorer descended the Mackenzie river to its mouth, yet at the present time practically all we know of most of the region north of Athabasca lake is confined to the valleys of the main streams and the shores of the Great Lakes, and that knowledge is very imperfect. The vast extent of country lying between the river courses is still virtually unknown, except to the Indians. What those portions of the country contain in the way of mineral resources it is impossible to say and unsafe to hazard a guess, in view of the surprises we have already received in opening up similar country in northern Ontario.

Twenty-five years ago the basin of the Mackenzie was the subject of an investigation by a select committee of the Senate of Canada. The report of that committee summarizes the information that was available at that time on its climate, inhabitants and natural resources. That information is valuable to-day, but little new information has since been obtained on a great part of the region. The time is at hand, therefore, when we should endeavour to learn more about this region.

PHYSICAL FEATURES.

The Mackenzie river is on the Arctic watershed, draining an area of 682,000 square miles, a territory covering about one-fifth of the total area of Canada.

The basin of the Mackenzie comprises three main physical features: On the west is the great series of parallel mountain ranges known as the Rocky Mountain system, into which many of the stronger tributaries of the Mackenzie cut deeply. On the east is the low-lying, rocky, broken Laurentian plateau, which in its northern part is treeless and is known as the Barren Lands. Between these two strongly marked features lies the broad lowland, through which the Mackenzie flows northward to the Arctic. The Mackenzie lowland is the northward extension of our own Great Plains region. It is a country of numerous lakes and of rivers flowing in shallow valleys, and its general level is only broken by occasional low ranges of hills. It corresponds to a certain extent with the region to the south, through which the Mississippi flows southward to the Gulf of Mexico. In contrast to the Mississippi region, however, the Mackenzie lowland is forested northward to its mouth and it embraces also within its limits some of the largest lakes on the continent.

The physical features of the Mackenzie basin then are these: A mountainous highland on the west, a low-lying, rugged, rocky and partly treeless plain on the east, and in the middle a broad, almost level, forested lowland, with the trunk stream, like a great artery, flowing northward to the Arctic sea, fed on the one hand from the melting snows of the mountains and on the other hand from the numberless lakes of the plateau region on the east.

The Mackenzie ranks as one of the eight large rivers of the earth. It is exceeded in length, drainage area and volume by the Mississippi, but has a greater length and drainage area than the St. Lawrence. Its length is reckoned at 2,550 miles to the head of the Peace river and its volume at about half a million cubic feet per second, or nearly ten times as great as the mean volume of the Ottawa river.

It is navigated by river steamers for 1,300 miles without a break, from its mouth up, and above that again on the Peace, Athabasca and other tributaries for a total length of about 1,400 miles in three sections. If we include its great lakes and those tributary streams that have already been explored, it has an estimated length of navigable river and lake shore line of nearly 7,000 miles in length.

HISTORY.

The history of the Mackenzie river district is intimately bound up with that of the fur trade, and particularly with that of the Hudson Bay Company. Organized in 1670, under the name of "The Honourable Company of Merchant Adventurers

Trading into Hudson Bay," a charter was obtained from Charles the Second, which carried with it not only the right to trade, but the ownership of most of the region now included in northern and western Canada.

For 100 years after its formation, "The Company" as it is familiarly known all over this vast territory, confined its operations to the immediate shores of Hudson bay. In 1770, however, they were induced to send an explorer, Samuel Hearne, into the country west of the Bay for the purpose of finding the locality from which the Esquimaux obtained the native copper which they made into arrow heads and other implements. Hearne's first two attempts to reach the locality failed, because, as his Indians told him, he had no women on the party. "Women," they said, "were useful to draw the toboggans and carry the loads, while the men hunted; and, besides that, they could easily subsist on the bones from which the men had eaten the meat." On his last journey, Hearne discovered Great Slave lake, and explored the Coppermine river to the Arctic coast. His journey is one of the most remarkable that has ever been made in the history of northern inland travel, and for a year and a half he travelled with a band of Chipewyan Indians, living as one of themselves, under the conditions of the greatest hardship.

About this time other fur trading companies, financed from Montreal and Boston, began to enter the field in opposition to the Hudson Bay Company. Competition, however, soon became so keen that they had to unite under the name of the North-West Company. Between this and the Hudson Bay Company the rivalry was so fierce that it often led to bloodshed, but it greatly stimulated explorations in the Mackenzie basin.

The North-West Company was the more aggressive of the two and pushed their outposts far into the interior. In 1778 we find them establishing a post near Athabasca lake, and in 1785 they reached Great Slave lake, fifteen years after Hearne.

It was from Athabasca lake that in 1789 Alexander Mackenzie, an employee of the North-West Company, started on his voyage of exploration northward. On this journey he crossed Great Slave lake, and descended the Mackenzie to its mouth, the first white man to make the trip. He was six weeks in descending the river, and during this time he met with many discouragements. Meeting a party of Indians at the mouth of Great Bear river, he was told that it would still take years to reach the mouth, and they would be all old men before they returned.

Three years later Mackenzie explored the Peace river, and crossed over to the Pacific, being the first white man to cross the continent north of Mexico.

In 1821 the two fur trading companies, finding that their profits were being reduced by competition, amalgamated under the name of the older company, and thus was ended one of the most interesting chapters in the history of the Northern Interior of Canada.

In 1819 Franklin made his first journey into the Mackenzie basin, when he explored the Coppermine river and a part of the Arctic coast to the east, a journey which cost him the lives of many of his party. In 1825 he made a second and more successful trip to the mouth of the Mackenzie and along the coast to the east and west.

Franklin's journeys mark the beginning of much Arctic exploration, and in the succeeding years the Mackenzie was traversed by such men as Dease, Simpson, Rae, Richardson and many others. Many of these explorers were sent out to search for traces of Franklin's last expedition, from which neither he nor any of his party ever returned.

Much of the details of geographical work in the Mackenzie basin was filled in by the officers of the Hudson Bay Company, but few of them considered it worth while to record their observations in writing or were trained for that kind of work. In more recent times, Father Petitot did a great deal of unobstrusive exploratory work, and later still we have such men as Macoun, McConnell, Ogilvie, Russell, Bell, Preble and many others. The most important geographical and geological work in this field in the present generation is that of McConnell, whose expeditions in 1887-88 and later, added more to our knowledge of the geology and natural resources of the region than any other expeditions since.

There is still much exploratory work to be done, and there are many blank spaces on the map of the Mackenzie basin to be filled in.

UNEXPLORED AREA.

In 1890, Dr. George Dawson, in a paper before the Ottawa Field-Naturalists' Club, made an estimate of the area of unexplored territory in Canada, exclusive of the islands of the Arctic. His results were obtained in this way. All lines along which reasonably satisfactory explorations had been made, he gave a width of 50 miles, that is to say, he assumed that the explorer learned something of the country 25 miles on either

side of his route. The area between these lines was measured, and in this way he calculated that out of a total area of 3,729,665 square miles, there were about 1,000,000 square miles of unexplored territory in Canada. About 600,000 of this lay in western Canada, the rest being in what are now the provinces of Ontario and Quebec. No area less than 7,500 square miles was included.

Recently I had occasion to revise this estimate, but believing that the 50-mile strip was too wide, I took a strip 15 miles on either side of the explorers' route and reduced the explored lines to a width of 30 miles, which I think is quite enough. The result is that I find in western Canada there are areas aggregating 600,000 square miles in extent which must still be considered as unexplored. Of this area 240,000 square miles lie within the drainage basin of the Mackenzie river, an area which is almost equal to the area of the Province of Saskatchewan.

In commenting upon the area of unexplored territory that we have within the borders of the Dominion, Dawson remarked that it might be considered a reproach upon Canadians as indicating a lack of justifiable curiosity on what our country contains. That reproach still remains on us, and will continue so long as such a large proportion of our country remains unknown. Expeditions into the Arctic are useful in their way and add much to our knowledge of those little known regions, but it seems to me imperative that we should devote more of our attention to the more accessible parts of our unexplored region, on the chance of finding something on which to build productive industries and open fresh outlets for our national energy.

Every explorer, even at the present time, going into the north country, away from the regular lines of trail, takes a certain amount of risk, though that risk is not as great as it might appear to those who have no knowledge of that kind of work. Life, even for the natives, is a constant struggle, and the law of the survival of the fittest holds more rigidly in that region than in southern latitudes. It is not so much the severity of the climate and the intense cold of the winter season that take their toll of human life, but the uncertainty of the food supply. Game is very plentiful in certain parts and at certain seasons of the year, but the habits of some of the animals are migratory, especially the cariboo, on which such a large proportion of the inhabitants depend for food, and it is absolutely necessary to know those habits before one ventures without a sufficient food supply into regions distant from the few scattered trading posts.

A change in the course of the migration of the cariboo or the periodical failure of the rabbits has always been attended by starvation and hardship among the natives, and has, in the past, been the cause of occasional lapses towards cannibalism. If it were not for the food supply of fish, it would be exceedingly difficult for the natives to live at all, and it is safe to say that no country in the world has such a large quantity or excellent quality of food fishes as the lakes and streams of the Mackenzie basin.

INHABITANTS.

The population of the Mackenzie basin, at the present time, numbers only a few thousands, the larger proportion of which are Indians and half-breeds. Most of the white population is segregated on the southern fringe of the region. The widely separated posts in the central and northern parts of the basin average perhaps a dozen white people each, and these posts are usually about 150 miles apart. As far northward, however, as the Liard river and Great Slave lake, which might be considered the northern limit to which any considerable settlement of an agricultural population will take place, there is within the basin of the Mackenzie an area of about 200,000 square miles, which should be able to support a population of at least 2,000,000 people, or about ten persons to the square mile, and that mainly from agriculture.

WATERWAYS.

One of the most important features of the Mackenzie basin, and one on which to a very large extent the development of the region depends, is its system of waterways. These waterways are the main highways of the region, and except for the very southern fringe of the region, where railways and wagon roads are now being built, constitute the only routes of travel in winter as well as in summer. Until 25 or 30 years ago, the only craft plying on them were the York boats of the traders and the canoes of the natives. Since that time river steamers have been built and now run on all sections of the main waterway. At the present time steamers are running on the Athabasca, Peace, Slave and Mackenzie rivers.

The Mackenzie system of waterways, on which steamers can and do run, has a known length of river and lake shore line of 6,900 miles. This system is divided naturally into four sections, each section being separated from the adjoining one by natural obstructions of falls or heavy rapids which the steamers cannot surmount. These sections I have named for convenience:—(1) The Athabasca river section; (2) the Peace

river section; (3) Athabasca lake section, and (4) the Lower Mackenzie section. The navigable river and lake shore line of these sections have been arranged in tabular form in the subjoined table. The figures are given in round numbers.

NAVIGABLE WATERS OF MACKENZIE BASIN.

Lower Mackenzie river section:		
Mackenzie river, below Great Slave lake	1,000	miles
Peel river, to mouth of Wind river	250	"
Bear river	90	"
Shore line, Great Bear lake	1,360	"
Liard river	440	"
Shore line, Great Slave lake	1,440	"
Slave river, Fort Smith to Great Slave lake	200	"
Total	4,780	"
Athabasca lake section:		
Slave river, Athabasca lake to Graham landing	100	miles
Peace river, Slave river to Vermilion falls	220	"
Shore line, Athabasca lake	560	"
Athabasca river, Athabasca lake to McMurray	170	"
Clearwater river	80	"
Total	1,130	"
Peace river section:		
Peace river, Hudson's Hope to Vermilion falls	550	miles
Athabasca river section:		
Athabasca river, Grand Rapids to McLeod river	325	miles
Lesser Slave river and lake	115	"
Total	440	"
Total for whole Mackenzie basin	6,900	"

The Athabasca river section has a length of navigable river and lake of about 440 miles, on which steamers drawing two feet of water may run. This includes the distance from the mouth of McLeod river to the Grand rapids on the Athabasca and Lesser Slave lake and river.

This section is separated from the Athabasca lake section by 90 miles of rapids on the Athabasca river, extending from Grand rapids to Fort McMurray, which is navigable with difficulty for scows and canoes. Navigation of this section of waterways will soon be done away with on the completion of

the railways now being built to Fort McMurray and Peace River Crossing.

The Peace river section is 550 miles in length and extends from Hudson's Hope down to Vermilion falls, and is navigable for steamers with a 2½ foot draft. The Loon river, a tributary of the Peace, in this section is said by McConnell to be navigable for powerful river steamers for a distance of 150 miles, but is not included in the table.

This section is interrupted at its upper end by the Peace river canyon, where the river breaks through the Rocky Mountains, and is separated from the Athabasca lake section by the rapids known as Vermilion falls, where there is a fall in the river of about 25 feet. This obstruction could possibly be improved to such an extent as to allow steamers to pass from the Peace river section into the Athabasca lake section. The Peace river section will shortly be connected by railway with Edmonton on the completion of a line from that point to Peace River Crossing.

The Athabasca lake section has a length of navigable river of 570 miles for boats of 2½ foot draft, and a shore line on Athabasca lake of about 560 miles in length, making a total of 1,130 miles. This section includes the Athabasca river from Fort McMurray to Athabasca lake, 170 miles in length, 80 miles of the Clearwater river, the Slave river from Athabasca lake to Graham's landing, 100 miles, and the Peace river from its mouth up to Vermilion falls 220 miles. It is separated from the Lower Mackenzie section by a series of rapids on Slave river about 16 miles in length, where there is a total fall estimated at 250 feet. This break in navigation is now overcome by a wagon road of 16 miles from Graham's landing to Fort Smith, but scows and light craft are usually taken down through the rapids by making four short portages. On the completion of the Alberta and Great Waterways Railway from Edmonton to Fort McMurray, the Athabasca lake section will be directly connected with the main system of Canadian railways and there will not be the necessity for traversing the 90 miles of rapid, broken river which now separates it from the end of the railway at Athabasca Landing. Steamers are now running on this section throughout the summer season, which usually lasts about five months.

The Lower Mackenzie section is by far the most important of the whole system, covering as it does about 4,780 miles of known river and lake shore line, on which a depth of water, ranging from two feet to six feet, may be found. This section

embraces the trunk stream from Fort Smith down to the Arctic coast, a distance of 1,300 miles, over which a depth of five feet of water can be obtained. This, with the shore line of Great Slave lake, 1,440 miles in length, and the small part of Peel river, is the only part of the section that is now being used by steamers. The remainder of the navigable waters of the section are only available for light draft steamers and cannot be navigated by the deeper draft steamers that now ply on the portion previously mentioned. The Liard river is obstructed on its lower part by a strong rapid which, however, could be ascended by powerful light draft steamers with the aid of a line, making the navigable water on this stream 440 miles in length. Great Bear river, 90 miles in length, also has a shallow rapid about half way up its course which could be ascended in the same way. With this obstruction removed or overcome, the whole of Great Bear lake, with a shore line of about 1,360 miles, becomes connected with the Mackenzie system. Peel river is navigable for shallow draft steamers from the Mackenzie to the mouth of Wind river.

The Mackenzie has a number of other tributaries about which little or nothing is known, but which, on exploration, might prove to be navigable for certain distances. Among these are Little Buffalo river, Willow river, Hareskin river, Arctic Red river and some others.

The Lower Mackenzie section is navigated at present by a few small steamers that are operated solely for the benefit of the fur traders and the missions. In spite of its greater length and the depth of its channel, it is, however, used less than any of the other three sections. This, because of its remoteness.

Taking the Lower Mackenzie section and the Athabasca lake section together, it will readily be understood how important they become in connection with the exploration and development of the whole Lower Mackenzie region and a great part of the region to the east, which cannot easily be reached from Hudson bay. These two sections of the waterways are to-day suffering from the handicap of being separated from railway connection by obstructions which are not easily surmounted. This handicap will, however, be removed when the promised railway to Fort McMurray is built. It would greatly increase the value of these waterways if the obstruction of 16 miles at Fort Smith could be overcome, either by a tramway or a system of locks, and it is probable that one or the other of these projects will one day be carried out.

It is difficult to over-estimate the value of the waterways of the Mackenzie basin, not only to the region itself but to Canada as a whole. They constitute an asset of the first importance in the development of the natural resources of the region. Not only have they been the channels of trade and exploration in the past, but they will continue to be in the future the means by which further exploration, settlement and development will be carried out. In the early history of the region the waterways formed the routes by which the explorers traversed the country, and while, at the present time, most of the main streams have been explored, yet there are vast areas between these main streams, aggregating 240,000 square miles in extent, that are still unknown and the smaller streams and watercourses constitute the easiest and only natural means by which these areas are to be explored. To-day, with hardly any exceptions, the settlements of the region are situated on the waterways, and for a long time to come these waterways will determine the location of the centres of population in the region. No doubt, in the future, mining camps may be opened up in the interstream areas and agricultural communities formed in sections where the land is suitable, as is now being done in the south-western portion of the region, but in the early stages of development and growth of either of these two classes of communities, the watercourses must be used before other routes of travel are opened up.

Railways will eventually be built into the region from the south, and this period is now beginning for the extreme southern fringe of the Mackenzie basin, but unless there is some extraordinary mineral development in the northern part of the basin, the limit northward, to which the future railways will extend, will be determined by the limit at which successful farming operations can be carried on, for, except in certain exceptional cases, the products of agriculture furnish the bulk of the traffic for the railway lines.

Until these railways are built, however, water transportation must be practically the only means by which the traffic of the region is handled, and, indeed, the building of railway lines will by no means do away with the navigation of the lakes and rivers, when there is such a magnificent system of waterways, because of the difference in the cost of the one method of transportation over the other.

Of course, on account of the climate, it is not possible to navigate the lakes and rivers of the region for a longer period than four to five months of the year. On the other hand, how-

ever, the winter routes, at the present time, all follow the river courses, either horses or dogs being used, in different parts. The winter mail that is sent down the Mackenzie valley by the Government to the various posts eventually reaches Herschel island, in the Arctic ocean, and for the whole of the distance from the end of the railway line at Athabasca landing—a distance of about 2,000 miles—the route is over the ice of the Athabasca, Slave and Mackenzie rivers, and the conveyance in toboggans drawn by dog teams.

Again the waterways are of importance, because the natural resources that are known to exist on them, and those which will in the natural course of events be developed first, are to be found along them. The best agricultural land, and that which will be first utilized, is situated along the banks of the streams where the drainage is good. There is undoubtedly much that lies back from the stream courses, but this will not be taken up and worked until the available area along the valleys is occupied. The best timber also is situated on the banks of the streams.

Not only are the waterways of the Mackenzie basin important from the point of view of navigation and transportation, but because of the quantity and variety of food fishes which they contain.

The fisheries of the Great Lakes of the Mackenzie basin—namely, those of Athabasca, Great Slave and Great Bear lakes—are among the most valuable of the assets of the region. Hundreds of thousands of excellent whitefish are caught in Athabasca and Great Slave lakes every year. A great many more were caught annually a few years ago, when the trading posts were more dependent on the native food supply than they are now, and McConnell's estimate of half a million pounds of whitefish being taken from Great Slave lake in the autumn fishery of 1887 is not too large. The fisheries of Athabasca lake are equally good in proportion to its size, but both of these lakes are outdone by Great Bear lake in the size, quality and variety of its fish. Whitefish there go up to 12 pounds in weight and trout to 50 pounds or more, besides which there is the herring, which is not found in either of the other lakes. Even at present, whitefish form a very important item in the diet of the natives, and it has been proved by long years of experience that a man can live and thrive on a diet of whitefish, and whitefish alone. He will tire of any other kind of fish, even of trout, but the whitefish never. In fact, the taste for whitefish increases with the use of it.

Other natural resources which will be developed by means of the water routes are the minerals, among which are oil and

gas, coal, iron ore, salt, gypsum, and gold, silver and copper ores. The best known of these, and possibly one of the most important, is the oil, which is known to occur as seepages at points from one end of the region to the other. With the exception of placer gold from the Omenica and Cassiar districts, however, no production has yet been made of any of these minerals.

Furs are the chief products of the region at present exported, and the Mackenzie river region is considered by the Hudson Bay Company to be the best fur-producing portion of Canada.

LICHENS FROM VANCOUVER ISLAND.

BY G. K. MERRILL.

The lichens here commented upon were collected by Prof. John Macoun in the vicinity of Sidney, Vancouver Island. With two exceptions, the plants are new to the Canadian flora, and several are recorded as hitherto unreported from the North American Continent. Other interesting discoveries of Prof. Macoun await future comment.

CLADONIA FURCATA var. CONSPERSA Wain. Mon. Clad. I., p. 335 (1887).

Thin earth over rocks, Beaver Lake and Fowl Bay.

Podetia erect, colored above is in the var. *palamaea*, below glaucescent, above more or less densely squamulose and isidio-squamaceous, cortex continuous below but above rimose-diffract. Unreported previously from America.

USNEA CAVERNOSA Tuck. in Agass, L. Superior. Appendix (1850).

Branches of trees, Sidney.

Remarkable because of the main branches showing articulations in the manner of *U. articulata*, and from the fact that the cortex here and there is papillose or papillose-scabrous.

LECANORA (ASPICILIA) GIBBOSA var. ZONATA Wain. Medd. Soc. pro F. at Fl. Fenn. t. VI (1881), p. 168.

Rocks, Sidney.

This is a remarkable condition of the species characterized by a sub-effigurate thallus, which is zonate toward the circumference.

New to America.

LECANORA (ASPICILIA) GLAUCOMELA Tuck. Gen., p. 118 (1872).

Alder trunks, Beaver Lake.

Spores rounded, short-ellipsoid or ovoid, serially disposed in cylindrical asci, hymenium and hypothecium without color, the paraphyses distinct and lax.

The thallus varies from greenish-ashy in the specimens from Prof. Macoun to sordid-greenish-brown in examples from Washington collected by Mr. A. S. Foster. Tuckerman was inclined to make the present a sub-species of *L. oculata*, an assumed relationship that no one but an arrant Sporologist may assent to.

BIATORA ATROFUSCA Flot. in Hepp. Exs. p. 268 (1857).

Bark of maples and Douglas fir, Sidney.

Spores oblong-ellipsoid 15–19 x 7–8 μ, hypothecium brown, paraphyses distinct but coherent, tips thickened and brown, hymenial gelatin with I + intense-blue.

Thallus less developed than in the muscicoline conditions collected in Maine, where it was found over rocks and about the base of trees. Without question, Tuckerman united the present with *B. sauguineoatra*, and the distribution cited for that species must, in some part, represent the plant of this note.

Biatora (Biatorina) lenticularis (Ach.) comb. nov. forma nigricans Arn. in Flora 1860, p. 14.

Rocks, Sidney.

Spores ellipsoid or variously difform, bilocular, the epispore distinct, 10–12 x 5–5.5 μ, hymenium and hypothecium hyaline, paraphyses distinct, more or less discrete, tips enlarged and black, asci inflated-clavate or oblong, hymenial gel. with I + sordid-blue.

Previously unrecorded from America.

LECIDEA LATYPEA Ach. Method. Suppl., p. 10 (1803).

Fragmental rocks, Sidney.

Spores ellipsoid 15–18 x 8 μ, hymenium colorless, hypothecium brown, paraphyses distinct, slightly discrete, tips blue-green, asci ventricose, hymenial gel. with I + intense-blue.

Thalline reaction K +, C + orange-red.

While resembling forms of *L. parasema* externally, the internal characters preserve specific distinctness.

Macoun's Canadian list cites the plant from Newfoundland, and it has since been collected in Alaska, California and Washington.

LECIDEA LATYPIZA Nyl. Obs. Pyr. Orient, Bull. Soc. Linne. de Norm. 2 serie VII, p. 201 (1872).

Rocks, Sidney.

Differing from *L. latypea* only in the absence of reaction with Ca Cl.

It has also been collected in California and Washington.

LECIDEA CONFLUENS forma OXYDATA Leight. Lich. Fl. G. Brit. Ed. III, p. 304 (1879).

Schistose rocks, Sidney.

Spores ellipsoid, 16–18 x 8–9 μ, hymenium hyaline, hypothecium dark-brown, paraphyses distinct, compacted, tips brown, hymenial gel, with I + deep-blue.

Hypothallus little visible in our specimens.

Unreported from America previously.

LECIDEA (RHIZOCARPON) DISTINCTA Stiz. in Lich. Hyperb., p. 47

Rocks by the roadside, Sidney.

Spores colorless, 4-loc. halonate 25–29 x 10–12 μ, eight, or fewer, in the ascus, hypothecium and tips of the paraphyses purplish-brown, hymenial gel, with I + blue or here and there violet.

This is one of the multifarious exhibits of the section *Rhizocarpon* of *Lecidea*. In thalline characters it is similar to many other species of the section and depends for its specific standing wholly upon the hymenial characters. Unreported previously from America.

XYLOGRAPHA HIANS Tuck. Syn. II, p. 113 (1888).

Dead wood, Sidney.

Hymenial gelatine with I + faint blue.

Also detected in material sent by Mr. A. S. Foster from Washington.

OPEGRAPHA BETULINA Sm. Engl. Bot. t. 2281 (1811).

Young trees, Sidney.

Spores 2–4 locular, typically 4, halonate, 22–28 x 8–10 μ, hypothecium brownish, paraphyses distinct, slender, not coherent, tips brown, asci oblong or inflated-clavate, hymenial gelatine with I + wine-red.

Under the synonym of *O. atrorimalis* Nyl., reported from California, but little is known of the species in America.

OPEGRAPHA VARIA forma DIAPHORA (Ach.) Nyl. Scand., p. 253 (1861).

Various rough barks, Sidney.

Occurs in Washington on both smooth and rough barks.

Arthonia (Arthothelium) Macounii sp. nov.

Thallus hypophloedes albus vel cinereo-albidus effusus; apothecia .10–.05mm. lata orbicularia et elliptica vel angulosa plana vel leviter emersa nigra; sporae hyalinae cylindrico-abovoideae 40–47 x 13–14 μ muriformi-multiloculares, loculus superior reliquis multo major; hypothecium hyalinum, asci saccato-abovoidei 8 spori; gelatina hymen. iodo vinose-rubens.

Est valde affinis *A. ampliatae* Kn. et Mitt.

Ad corticem Abietum juniorum. Sidney.

Young spores 4–loc., cells of those mature commonly once divided, but sometimes twice, the large cell at times irregularly septate. Proportion of the large cell to remainder of the spore 3-10 of its length.

VERRUCARIA AETHIOBOLA var. ACROTELLA (Ach.) A. L. Sm., Brit. Lich. II, p. 282 (1911).

Rocks, Sidney.

Thallus a filmy dark stain, spores 22 x 9 μ, agreeing well with the measurements given by Nylander. The relatively feeble development of the variation prevents its easy recognition.

Unrecorded from America.

LIST OF PLANTS IN FLOWER IN THE VICINITY OF SIDNEY, VANCOUVER ISLAND, MARCH, 1914.*

BY JOHN MACOUN, M.A., F.R.S.C.

The following is, I believe, the first list of Vancouver Island spring flowers that has been published, and as most of the genera and some of the species are also found in eastern Canada, it may prove of interest to readers of THE OTTAWA NATURALIST. Fifty-seven species of phanerogams were noted in bloom during the month. It may be said that a visit to Victoria during the last week in March would probably have added ten or more species to the list.

March 1—Alnus oregana, Nutt.
" 2—Stellaria media, (L.) Cyrill.
Brassica campestris, L.
Taraxacum officinale, Weber.

*Published by permission of the Director of the Geological Survey.

March 4—Claytonia spathulata, Dougl.
" sibirica, L.
Salix Scouleriana, Barratt.
" " var.
Senecio vulgaris, L.
Ulex Europaeus, L.
" 6—Shepherdia canadensis, (L.) Nutt.
Paspalum?
Spergula sativa, Boenn.
Lysichiton kamtschatcensis, Schott.
" 13—Sisyrinchium grandiflorum, Dougl.
Saxifraga integrifolia, Hook.
Mimulus alsinoides, Benth.
Collinsia parviflora, Dougl.
Erodium cicutarium, (L.) L'Her.
Draba verna, L.
Barbarea vulgaris, R. Br.
Brassica arvensis, (L.) BSP.
Ranunculus occidentalis, Nutt.
Pachystima Myrsinites, Raf.
" 16—Erythronium giganteum, Lindl.
" 17—Stellaria nitens, Nutt.
" 18 Berberis Aquifolium, Pursh.
" nervosa, Pursh.
" 21—Dodecatheon latifolium, (Hook.) Piper.
Lithophragma parviflora, (Hook.) Nutt.
Sanicula Menziesii, Hook. and Arn.
Arbutus Menziesii, Pursh.
Arctostaphylos Uva-Ursi, (L.) Spreng.
Arenaria macrophylla, Hook.
Fritillaria lanceolata, Pursh.
Collinsia grandiflora, Dougl. var. pusilla, Gray.
Aira praecox, L.
" 23—Fragaria cuneifolia, Nutt.
Acer macrophyllum, Pursh.
Pseudotsuga mucronata, (Raf.) Sudw.
" 24—Ribes Lobbii, Gray.
" 25—Cardamine oligosperma, Nutt.
Dentaria tenella, Pursh.
Cerastium viscosum, L.
" 26—Equisetum arvense, L.
" 27—Pedasites speciosa, (Nutt.) Piper.
Rubus spectabilis, Pursh.
Ribes divaricatum, Dougl.
Cytisus scoparius, (L.) Link.

March 28—Populus trichocarpa, T. and G.
" 30—Nemophila pustulata, Eastw.
Fragaria bracteosa, Heller.
" 31—Claytonia perfoliata, Don., var. depressa, Gray.
Acer Douglasii, Hook.
Rubus macropetalus, Dougl.
Populus vancouverensis, Trel.
Equisetum Telmateia, Ehrh.

BOOK REVIEWS.

CHECK-LIST OF THE FISHES OF THE DOMINION OF CANADA AND NEWFOUNDLAND.—By Andrew Halkett, Naturalist, Dept. Marine and Fisheries. C. H. Parmalee, King's Printer, Ottawa, 1913.

A sumptuous quarto volume in grey art cloth and gold, bearing the above title, has been issued from the Fisheries, Museum, O'Connor Street, under the Marine Department. It consists of 138 pages of text, introduction, and indexes, with fourteen heliotype plates of a costly character. The author, it will be recalled, is a former President of the Ottawa Field-Naturalists' Club, and is engaged in the Fisheries' Museum, and, as stated in the introduction, his object has been to supply a complete list of the fishes of Canada. Such lists as that of the Fresh-Water Fishes of Canada, printed in Montreal in 1864 for the author, Mr. H. Beaumont Small, a former active member of the Ottawa Club, and the excellent little volume by Mr. C. W. Nash, a check list of the fishes of Ontario, issued in 1908, are the only existing lists, apart from some New Brunswick, British Columbia and Manitoba lists, which cover the fresh-water species, while the lists of Kendall, Eigenmann, and, above all, of Jordan and Evermann, include marine fishes, but do not profess to treat specially of Canadian species, excepting Kendall's Labrador list. Mr. Halkett has drawn upon these authorities freely, and as the printer has excelled himself, the paper is thick plate paper with wide margins, and as the plates are costly heliotype reproductions, the result is a very striking publication. The value of such a check list, however, is not in plates or costly paper, but in completeness of matter, handy form and size, and compact description and arrangement. In these respects the

work will be disappointing to some, and the figures, 181 in number, are in very many cases from defective coloured casts, not from the actual specimens, and details, such as the plates in the gill-cover, and especially the fin-rays, are without exception, absent or blurred. The value of this check list would have been very substantial had each species been represented by an actual drawing instead of a very indistinct protographic effigy. The State of New York, some years ago, issued some plates, in annual reports, with details most perfectly delineated, and the colours accurately reproduced. Such drawings a large number of working naturalists have found most useful, and plates of that valuable character are far less expensive than costly heliotypes, such as the present volume contains. It is to be regretted that some figures show nothing at all. Thus, figures 151 and 152 Plate XIII, resemble figures of policemen's batons, but really are photographs of the Californian hag-fish. If the two figures of the pickerel or pike-perch in Mr. Nash's Check List be compared with the four very indistinct figures 112 and 113 (*Stizostedion vitreum*) and figures 114 and 115 (*Stizostedion canadense*), the contrast will be appreciated, and the lack of scientific value in the latter realized. Very few of the figures in these costly plates are of any scientific or practical utility. The compiler is not to blame for this. Photography in such cases is the worst method to adopt. As to the work itself there is evidence of painstaking industry, and, on the whole, much accuracy. Occasionally a slip occurs, as, for example, the note on page 55, which suggests that the fish called grayling in southern Alberta is *Thymallus tricolor montanus*. It is nothing of the kind, but is the active, gamey little whitefish, *Coregonus williamsoni*, as the Commissioners of the Alberta Fishery Commission (Marine Department, Ottawa, 1912, page 19,) distinctly stated. The value of the work would have been greatly increased had the author followed the plan of the Rhode Island Commission's Check Lists and given some details, wherever possible, of the spawning period and the nature of the eggs. Much information has been recently accumulated in regard to that important phase of fish life, and it is stated that a forthcoming Check List, to be issued by the Biological Board, will include such valuable scientific information. Mr. Halkett must, however, be congratulated on completing a very handsome volume, involving much thankless drudgery and consultation of authorities, and the book fills a vacant place, much needing to be filled.

C.

FODDER AND PASTURE PLANTS. By Geo. H. Clark, *B.S.A.*, and M. Oscar Malte, *Ph.D.*, with water colour illustrations by Norman Criddle. Available at the office of the Superintendent of Stationery, Government Printing Bureau, Ottawa; price 50 cents.

This admirable work is a valuable contribution to our knowledge of fodder and pasture plants in Canada. It has been several years in preparation and may be described as a companion volume to "Farm Weeds in Canada," a work which, upon its appearance several years ago, called forth very favourable comment because of the excellence of the matter and the effective method of its presentation.

In "Fodder and Pasture Plants," the authors have succeeded exceptionally well in treating a technical subject in language intelligible to the general reader. Without sacrificing scientific accuracy, they have presented, in a popular way, the essentials in the successful production of fodder and forage crops adapted to general growing in Canada. The information relative to these crops has been presented in concise, yet sufficiently comprehensive, form. The practices advocated by the authors have behind them the sanction of accepted good farm practice, supplemented by the results of recent experimental research.

In addition to containing forty coloured drawings of the seeds of grasses and legumes of greatest economic importance in Canada, the volume contains twenty-five full-page illustrations, in natural colours, of the principal crops under consideration. These artistic reproductions are from the work of Mr. Norman Criddle and contribute much to the attractiveness and value of the text. With the exception of the root systems represented, the illustrations are remarkably true to life.

The quotations from early agricultural writers are, in the main, apt. In a work of this character, the wisdom of quoting so freely from such sources leaves room for difference of opinion. Since, however, the arrangement of the plates determined the paging of the text, this departure is perhaps justifiable.

This publication has been issued under the direction of the Hon. Martin Burrell, Minister of Agriculture for the Dominion. Copies may be had from the Superintendent of Stationery for the nominal sum of fifty cents. Farmers, students and teachers alike will find in this excellent work much valuable information relating to fodder and forage crops the value of which, in the economy of general farming, agriculturists have been slow to appreciate.

L. S. KLINCK.

The Ottawa Field-Naturalists' Club.

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