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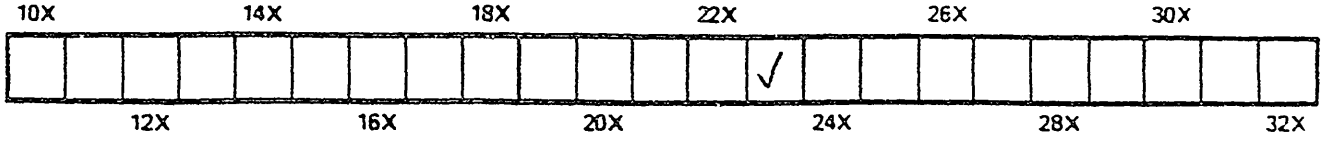

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NOTES ON A JOURNEY THROUGH THE NORTH-WEST TERRITORY, FROM MANITOBA TO ROCKY MOUNTAIN HOUSE.*

By A. R. C. Selwyn, F.G.S

Director of the Geological Survey of Canada.

Having during the past summer made a rapid journey through a very considerable portion of the north-western territories of the Dominion, I thought it would perhaps be interesting to the Society to hear a brief account of how we travelled, and what we met with in those distant and as yet but little explored regions. If in relating my experiences I should refer to matters with which doubtless many members are already familiar, either from personal experience or from having read the narratives of previous travellers in the same region, my excuse must be that without doing so, I should probably have little if anything to relate which has not been dwelt upon and described, either by Palliser, Hector, Blakiston, Bourgeau, Hind, Milton and Cheadle, Butler, Ross or Grant, and is consequently more or less known to all who have read the interesting and detailed narratives which have been published by these travellers in the north-west.

The explorer of these vast western regions, so appropriately designated by Captain Butler *The Great Lone Land*, leaves behind him hotels, railroads and stages, as well as all other ordinary facilities for travel. He is thrown entirely on his own resources; and therefore before starting has to provide himself with everything requisite for the subsistence, transport and shelter of himself and his companions during the entire journey.

* Read before the Natural History Society, Jan. 26th, 1874.

The staple articles of food in general use by *voyageurs*, and hunters and travellers in the North West, are pemmican, flour, tea and sugar. Persons, like ourselves, starting from civilized life, generally provide themselves in addition with a moderate supply of pork, ham, or bacon, and a few other luxuries, and for some days, especially when prairie chickens or ducks are abundant, look with disdain, not to say disgust, upon the *richôt* and *rubeiboo*. After a few weeks, however, the feeling wears off, and pemmican, richôt and rubeiboo, varied by dried buffalo meat, boiled, are eaten not only without a murmur but with keen appetite, at breakfast, dinner and supper; and I have even seen these dishes selected in preference to roast duck or prairie chicken or fried pork, ham or bacon, by persons who, on starting, declared that nothing short of absolute starvation would ever induce them to make a meal on pemmican.

Captain Butler, who was evidently not an admirer of pemmican, thus describes it: "Pemmican, the favorite food of the Indian and the half-breed *voyageur*, can be made from the flesh of any animal, but it is nearly altogether composed of buffalo meat: the meat is first cut into slices, then dried either by fire or in the sun, and then pounded or beaten out into a thick flaky substance; in this state it is put into a large bag made from the hide of the animal, the dry pulp being soldered down into a hard, solid mass, by melted fat being poured over it—the quantity of fat is nearly half the total weight, forty pounds of fat going to fifty pounds of 'beat meat'; the best pemmican generally has added to it ten pounds of berries and sugar, the whole composition forming the most solid description of food that man can make. If any person should feel inclined to ask, 'What does pemmican taste like?' I can only reply. 'Like pemmican.' There is nothing else in the world that bears to it the slightest resemblance. Can I say anything that will give an idea of its sufficing quality? yes, I think I can. A dog that will eat from four to six pounds of raw fish a day when sleighing, will only devour two pounds of pemmican, if he be fed upon that food; yet I have seen Indians and half-breeds eat four pounds of it in a single day. Pemmican can be prepared in many ways, and it is not easy to decide which method is the least objectionable. There is rubeiboo and richôt, and pemmican plain and pemmican raw, this last method being the one most in vogue amongst *voyageurs*, but the richôt, to me, seemed the best; mixed with a little flour

and fried in a pan, pemmican in this form can be eaten, provided the appetite be sharp and there is nothing else to be had; this last consideration is however of importance."

I do not altogether agree with Capt. Butler in his estimate of pemmican, and for my own part, I never disliked it and could always make a hearty meal off it, and for voyaging it certainly has very great advantages not possessed by any other description of food.

The land transport of heavy goods, throughout the country westward from Red River to the Rocky Mountains, is effected with carts drawn by single horses or oxen. They usually carry from six to eight hundred pounds, or sometimes less, according to the length of the journey and the rate at which it is intended to travel; twenty to thirty miles is an average day's journey. These carts, known as Red River carts, are exceedingly rough and clumsy looking vehicles, with wheels 5½ to 6 feet in diameter. They are built entirely of wood, oak, ash and birch, and cost when new from fifteen to twenty dollars. Notwithstanding their appearance, however, they are, from the absence of iron in their construction, wonderfully light; this, together with the facility from the same cause with which they can be repaired, renders them very suitable for the country and for the work required of them. If an axle breaks or otherwise fails it can be quickly replaced: an oak or birch log of the required size, an axe, an auger and a drawing knife being all the tools and materials required for the purpose. From the rough character of some of the tracks, this accident is of such common occurence that when travelling on the prairie where no timber can be had, it is customary to carry suitable pieces of wood for replacing them slung to the side of each cart. Another advantage which these carts possess, is that with the aid of a waterproof tarpaulin or a buffalo hide they are readily converted into serviceable rafts, and are often used in this way for floating goods and passengers in safety over any unbridged, deep or swollen streams which have to be crossed. Besides the carts described, the light express waggon is gradually coming into use in the North West, but for expedition and comfort in crossing the plains, the buck-board is decidedly to be preferred to any other vehicle, and is much less fatiguing to both man and horse than the saddle. Connected with the means of transport I must not omit to say a few words about *Shaganappi*. Shaganappi is a most valuable institution, and must on no ac-

count be overlooked in the outfit of a prairie traveller. The word is Indian, and I believe really signifies line, rope or cord of any kind; it is, however, commonly used by voyageurs to designate dressed and smoked moose-skin, which on the plains serves for almost every purpose, for which, under ordinary circumstances, either string, cord, line, rope, nails, cloth or leather would be used. Hobbles, tether-ropes, whip-thongs, boot-laces, and moccassins are made of it; harness, saddles, bridles, carts, tents and clothes are repaired with it; and it may be regarded as the *sine qua non* of the voyageur, and only second in importance to pemmican itself.

The general use of the Red River cart for the inland transport is, I believe, only of comparatively recent date, and even now is confined to the open country bordering the great valleys of the two Saskatchewans, the Qu'Appelle and the Assiniboine Rivers. Beyond these limits, in the mountains where there are no navigable waters, and in the thick woods where there are no cart roads, everything is transported by pack animals. Formerly, before the opening up of the Red River and the Lake Superior routes, and when the whole trade of the country was carried on by the Hudson's Bay Company, imports and exports of all kinds were transported by water in canoes or boats via Hudson's Bay; the distributing and receiving depots being York for the western district, and Albany, Moose and Fort Rupert on James' Bay for the eastern districts.

The boats in general use on all the large inland waters for voyaging and freighting purposes are known as Hudson's Bay batteaux, full and half size. The full sized batteau is a staunch and commodious, though rather clumsy looking craft, of the following dimensions: keel, 30 ft; over all, 42 ft., giving an equal shear to both ends, which are sharp as in a whale-boat; beam, 9–9½ feet, with a depth amidships of about 3 feet. For river navigation they are steered by a long sweep-oar passed through a ring bolted to the side of the projecting upper end of the stern post, and are usually propelled by five, six or eight heavy pine oars. When under sail a rudder is shipped, and they are rigged with a large, nearly square lug-sail: they draw about two feet when loaded with from 2½ to 3 tons, besides crew and equipment. Before the wind, they sail well and easily, and when properly handled, going at a speed of from eight to ten miles an hour, seldom take in water, even in very heavy seas, such as are fre-

quently encountered on Lake Winnipeg. Such boats are, of course, not adapted for beating against a head wind, and with a side wind also they make considerable lee-way. They are, however, admirably suited for the mixed river and lake navigation for which they are designed. The voyageurs, occasionaly Indians, but mostly either French, Scotch or English half-breeds, pull a long steady stroke, averaging 19 per minute, always rising from their seats at each stroke. Every 20-25 minutes they cease pulling, lay in their oars, and light their pipes. The smoke occupies from 8–10 minutes, and during the interval the boat either drifts with the current, or, in still water, comes to a stand. So regular is this practice that *the smoke* is used as a measure of distance, and the guide will often tell you it's so many smokes to any point, the distance to which you may have occasion to enquire about.

My expedition last summer, was performed, the outward journey by land and the homeward journey by water transport. And, all things considered, I have arrived at the conclusion that for exploration purposes the latter mode of travelling is to be preferred, as being the cheapest, the most expeditious and the most comfortable, as well as affording better opportunities for observation and for the collection and preservation of specimens.

On the afternoon of the 25th of July, all our preparations being completed, we left Fort Garry or Winnipeg, the capital of the Province of Manitoba, situated at the confluence of the Assiniboine and Red Rivers,—latitude 49° 52′ north, and longitude 96° 50′ west—and in 49 days, or on the 12th of September, I reached Rocky Mountain House, situated on the upper waters of the Saskatchewan—latitude 54°20′ north and longitude 115° 10′ west. According to the measurements of the route which I made by means of an odometer attached to the cart wheel, the distance travelled was 1,056 miles. Stoppages and detentions from various causes during the journey amounted to nine days in all, five days on which we did not move camp, and eight on which we travelled for only half the day. We therefore averaged 26¼ miles per day, to do which, without fresh horses and seldom travelling at more than a walk, necessitated early starting and late camping, so that we were rarely less than ten hours on the road. My own party consisted of six persons besides myself, two of whom were thoroughly experienced half-breed voyageurs who spoke English and French as well as the Chippeway and Cree Indian languages. Travelling with us as far as Edmonton were two English gentle-

men and their servants, so that our whole party numbered eleven persons. For the transport of this party, together with all necessary—and some very unnecessary—baggage and supplies, we had seven Red River carts, three of them belonging to our fellow travellers, one buck-board and sixteen horses, or Red River ponies. These were used either for saddle or harness, as occasion required, and four or six of them were left to run loose, as spare horses, so that each horse, as a rule, would not be worked for more than half the day's journey, by which means, although travelling almost every day for eight, nine or ten hours, all the horses had time enough to feed and rest, and sore backs, sore shoulders and knocked-up horses, together with the delays and troubles so commonly resulting from these causes on a long journey, were entirely avoided.

During the whole journey we were favoured with remarkably fine weather. On the outward trip we were detained only one whole day by rain, and half a day only from the same cause on the homeward trip. We had a few wet nights, and snow fell on two or three days between the 11th and the 30th of September. The first frost was experienced on the 4th of September when the thermometer at 4 a.m. registered 28° Fahrenheit. On the 6th, at 6 a.m. it registered 26°. The next frost occurred on the 11th of September, the thermometer falling during the night to 20°; and on the 23d of September the thermometer again registered 12° degrees of frost. Thence forward, frosty nights were of pretty frequent occurrence, and on the 29th of October the steamboats on the Red River were all frozen in. These, as I was informed, unusually early frosts, injured many if not all of the wheat crops on the upper Saskatchewan, and also some of the potatoes that were still in the ground.

We met with no hair-breadth escapes, no startling incidents, and no accidents or casualties of any kind worth recording, nor did we experience any trouble or annoyance from the various parties of Indians we fell in with on the road. The only real trouble which we experienced was occasioned by mosquitoes and other flies, black-flies and sand-flies. I have seen and felt the annoying attacks of these pests in various parts of the world; the valleys of the Columbia and Fraser Rivers are noted for them, and I used to think they could not be much worse than they are in Australia and in various parts of Eastern Canada, but if any one desires to know what mosquitoes and black-flies really can be, I

can only say cross the Saskatchewan plains in August. Even the sharp frosts of September, though they lessened the activity of the mosquitoes, had no apparent effect upon that of the black-flies; directly the sun rose, even though the ground was covered with snow, they were as virulent as in the hottest day in summer; and I was credibly informed that horses have frequently died from the result of their attacks; there is no doubt that they suffer frightfully from this cause, and if measures are not taken to protect them, rapidly become so poor and weak as to be unable to travel.

Not many years ago, the region we traversed was swarming with buffaloes; now their skulls whitening on the plain, and the deep worn and grass-grown tracks which traverse the prairies in all directions are the only evidence of their former existence. Not a single buffalo was seen during the journey, and very little large game of any kind,—only a few antelopes or *cabri*, one moose and one red deer. Foxes, wolves, badgers, skunks, minks and beavers were seen or heard occasionally. Muskrats are very abundant and swarm in the delta of the Saskatchewan. The officer in charge at Cumberland House informed me that he had last year collected and sent away 240,000 skins of these animals. On the prairies, the little gopher or ground squirrel is almost equally abundant. It is about the same size as the Canadian chipmunk, and its habits appear to be similar to those of the prairie-dog of the southern prairies. Like them, they live in colonies underground on the open treeless prairies, and are generally seen sitting erect and motionless on their hind quarters either perched on the hillocks or in the grass near their burrows into which they quickly disappear at the least alarm. Their skin is of no value, and, except foxes, they have few enemies to contend with in the 'struggle for life.' Moles, judging from the large earth-mounds thrown up by them over extensive areas, though we did not see any, must be almost as numerous as the gophers. The moles seem invariably to select the tracts of deep, rich, black soil, and the gophers and badgers the intervening dry, sandy and gravelly ridges, so that between them the greater part of the surface is more or less burrowed, ridged and furrowed; and where this is the case, the prairie, which would otherwise be as smooth and even as a lawn, becomes not only exceedingly rough and unpleasant to travel over on wheels, but also very dangerous to horsemen, and often fatal to the wooden cart axles.

Of feathered game we could always procure while on the plains as much as we required. From Red River to Rocky Mountain House, prairie chickens abound; ducks of various kinds swarm upon nearly all the lakes and pools, and geese are frequently seen, especially on the saline lakes. The geese are however not easily approached, and without a good dog to bring them out of the water, neither geese nor ducks when shot can be secured, except by wading through the broad belt of mud and high reeds by which nearly all the lakes are more or less encompassed. Cranes, bitterns, plovers, sand-pipers, snipe and other waders, as well as pigeons, black-birds, larks and a number of other small birds are plentiful on the prairies or in the swamps, or along the river valleys, and crows and several kinds of hawks are also very common. On our passage down the river in September and October, large flocks of wavy's, grey, and black and white geese, and of the large blue cranes, were frequently seen flying southward, generally at a great height; a few wild swans and pelicans were also seen passing in the same direction. Between Fort Pitt and to near the Elbow of the North Branch, a good many magpies were seen along the river, but none were obse ved elsewhere. I am told that these birds are very common on parts of the Qu'Appelle River and of the South Saskatchewan, but I believe they are not met with eastward of Red River. West of Cumberland or Pine Island Lake, where the Saskatchewan spreads out into a vast swampy delta, numbers of large white owls were observed sitting perfectly motionless, perched either on boulders or snags, or on some of the many small patches of bare sand just appearing above the level of the surrounding waste of water and swamp which was here seen stretching on all sides, as far as the eye could reach.

There are very few fishes of any description in the Saskatchewan above its confluence with the South Branch, but from Fort a la Corne downwards to Lake Winnipeg, sturgeon, white-fish and other excellent varieties are abundant. So far as I could ascertain there are no fishes at all in any of the numberless lakes and pools on the prairies between Red River and Carlton. West and north-west of Carlton and Edmonton, however, and in most of the lakes, many of them of large size, along the water-shed between the MacKenzie and the Saskatchewan, white-fish are said to abound. Jack Fish Lake and Lake St. Ann are two of these lakes in which they are annually caught in large numbers.

Many of the lakes which we passed between Fort Ellice and Carlton, especially some of those in the Touchwood Hills, seem to be as well suited for fish as others do where they abound, and the cause of their partial and irregular distribution in the country is not very apparent, though perhaps a careful investigation of the character of the waters in the different lakes would afford a satisfactory explanation of the circumstance. Westward from the summit of the ascent to the second prairie steppe of Palliser, the eastern slope of which forms the long range of low hills extending from the Pembina Mountains to the Basquia Hills near Cumberland House, and including the Riding, Duck and Porcupine Mountains, the country on the route which we travelled, especially after crossing the Assiniboine River at Fort Ellice, is generally undulating or rolling, and often hilly: some of the hills rise to from 200-300 feet, and occasionally to as much as 400 feet above the general level of the prairie, and afford from their summits extensive views of the surrounding country which everywhere presents a park-like aspect; belts, patches and clumps of woodland with intervening grassy meadows, or wide stretches of open prairie interspersed with countless lakes and pools, are seen on all sides, while the wonderful variety and beauty of the flowering plants, roses, lillies, gentians, lark-spur, a beautiful purple, aromatic mint like plant, buffalo-root, varieties of sunflowers and a host of others, lend an additional charm to the beauties of this picturesquely lovely landscape.

The ridges, which do not appear to maintain any constant direction or parallelism, as well as the hills, are all covered with drift sand and gravel, and scattered over them, resting on their flanks and summits, or partially imbedded in the soil, are numbers of angular ice-borne boulders or rock masses of enormous dimensions, consisting of limestone, granite, gneiss, mica schist and other metamorphic rocks. Absolutely level and open plains constitute but a small proportion of the total area of the region, while by far the larger part of it may be described as a vast billowy plain without either deep valleys or prominent hills. Besides the lakes which have streams constantly flowing out of them, and which all contain fresh water, there are others, far more numerous, holding water of almost every degree of saltness. Some of these saline lakes are as much as three, four or five miles in length and often from one to two miles wide. They occur either in isolated, irregular basin-

shaped hollows, or forming chains of lakes in broad, flat, valley-like depressions, often extending many miles, but closed in on all sides by rounded, drift-covered hills with grassy slopes. When occurring in this manner, the lowest lake in the valley receives the drainage of the others, and I observed in all such cases, that while the water of the uppermost lake would be either quite fresh or only very slightly saline, that in the lowest lake of the chain would be intensely salt and bitter. This peculiarity may also often be observed as regards isolated lakes near each other situated at different altitudes, and the traveller seeking good water should always look for it in those pools or lakes which occupy the most elevated positions, because the water in them is supplied by rain and snow alone, and not by drainage and percolation from higher levels. All the old voyageurs and traders in the country state that good water was formerly much more plentiful on the prairies than it is now, and in the course of our journey numbers of places were pointed out to me as the sites of pools or lakes, formerly holding fresh water at all seasons, which are now only irregular shaped, flat-bottomed, dry depressions, clothed with a growth of long, coarse grass, and surrounded with a fringe of low willow bushes or banks of sand and gravel. This drying up of the country has been ascribed to various causes, but is generally supposed to be connected with the gradual destruction of the forests over large areas by fires. Whatever the effects may be of these destructive conflagrations in reference to the water supply of the region, there is no doubt that at different times almost every square mile of the country between Red River and the Rocky Mountains has been subjected to them, and that hundreds of miles of forest have thus been converted into wide and almost treeless expanses of prairie. And there is little room for doubting that the tendency of this would be to gradually diminish the rain fall.

The second and third prairie steppes, from Fort Ellice to Rocky Mountain House, may be said to be absolutely denuded of good timber. Between the Assiniboine and the English River, 120 miles west of Carlton, or for a total distance of 400 miles, neither oak, ash, elm, birch, spruce or pine trees were seen, and even the poplars are of small size, and suited for little else than firewood. Around the Little Touchwood Hills Fort, there is a small extent of forest, in which the largest poplar trees attain a diameter of two feet, and in the same district there are also some fair-

sized white birch trees. On the English River, and thence westward, both along the banks of the Saskatchewan and of the northern tributaries, spruce, pine and tamarack of small size are tolerably abundant. Along the river, above Edmonton, large spruce timber is plentiful and is annually cut in considerable quantities, and floated down the river for the supply of the posts and settlements below, as far as Carlton.

The greatest extent of uniformly rich soil in all this vast region is certainly to be found on the first prairie steppe, which stretches in an almost level plain westward from Red River for about eighty miles to the base of the hills already mentioned as extending from Pembina, in a northerly direction to near Cumberland Lake on the Saskatchewan. Its lesser elevation, probably in no part exceeding 750 feet above sea-level, renders it still more favorable for the cultivation of wheat and other products liable to injury by early and late frosts. The general luxuriance of the vegetation, however, both on the second and third steppes, over many hundreds of miles, at heights varying from 1,500 to 2,500 feet, amply testifies to the exceeding richness and fertility of the soil. Even on the hills and ridges where for the most part somewhat lighter and shallower soil prevails, and which might not be well suited for cultivation, there is, with few exceptions, an abundant growth of the most nutritious grasses and herbs, on which all kinds of cattle thrive admirably; while in the low lying flats and swamp beds an abundant supply of the finest hay can readily be secured for winter fodder in case of need. At present there are very few cattle in the country, and it is customary to house them and feed them on hay during the winter, the prevailing belief being that they cannot otherwise survive. There is, however, every reason to believe that this is a mistake; and that if a hardy race of cattle, suitable to the climate, were introduced, they would speedily become acclimated, and not only be able to survive, but that they would thrive through the winter without the aid of artificial feeding and shelter; and if so, vast herds might soon be reared on these rich and boundless pastures, reanimating the now deserted feeding grounds of the buffalo, and not only becoming a source of large profit to the settler, but also affording a ready and cheap means of providing for the Indians, who are now frequently reduced to the verge of starvation, owing to the annually increasing scarcity of the buffalo, upon which they are at present entirely dependent.

I took some trouble to enquire into this subject, and though I found the prevalent belief to be as I have stated, yet I was informed of several instances of cattle having been lost in the fall, and, in every case, they had not only survived but had been recovered in excellent condition in the following spring.

Such facts speak for themselves: but in any case the question is one of such immense importance to the country, that it seems to me to be well deserving the consideration of the Government whether it would not be advisable to devote a sum of money for the purpose of practically and thoroughly testing it. The threatened and much dreaded Indian trouble in the North-West is, in reality, simply a question of food; and if this experiment proved successful, it would certainly be the easiest possible means which could be adopted to overcome it. Intoxicated or hungry Indians are dangerous animals, and in this respect they do not differ much from their more civilized white brethern. Remove the causes which produce the intoxication and the hunger, with which they are now periodically afflicted, and I venture to say that very little trouble would be experienced in dealing with the Indians. To convert the plain Indians into tillers of the soil might never be accomplished, but to induce them to undertake pastoral pursuits, would, I conceive, not be attended with similar difficulties. At all events, the experiment is worth a trial; and may, I think, be said to offer a fair probability of success, if carried out with intelligence and energy.

With the exception of the limited extent of land which is cultivated at the Hudson's Bay posts and at the various Mission stations, no cultivation has yet been undertaken on either of the higher prairie levels. We saw abundant proof, however, at Pitt, Victoria, Edmonton and Prince Albert, of the fitness of the soil and climate for the growth of cereals and of all kinds of vegetables which can be successfully grown elsewhere under similar conditions of elevation and climate. It would be impossible in any other part of the world to find finer barley, wheat, potatoes, turnips, carrots, onions and cabbages than those we saw growing at Victoria and at the St. Albert R. C. Mission station near Edmonton. Even at Rocky Mountain House, a hundred miles nearer the mountains, and according to my observataions 3,432 ft. above the sea, barley, potatoes, turnips and onions were being grown successfully, while on the farm of Mr. McKenzie, 62 miles west of Fort Garry, the crops, which included wheat, barley,

oats, rye, peas, beans (French and broad), potatoes, onions, carrots, swedes, turnips, mangolds, cabbages and timothy grass, would, I believe, compare favourably with the best crops of the same description, grown on the highest cultivated farms in any part of Canada or even in Britain. The returns given me by Mr. McKenzie of the following crops were, per acre, wheat, 30-40 bushels, oats, 50 bushels, barley, 35-40 bushels, potatoes 300-400 bushels, turnips, 600-700, and peas, 20-25. Mr. McKenzie has 40 acres under cultivation, and no better or more practical illustration could be desired than is afforded by this farm, of what the soil of these magnificent prairie lands is capable of when cultivated with intelligence and enterprise.

I now propose to make some brief remarks in connection with the incidents of our homeward journey, and upon the facts which were observed relating to the general character of the valley of the Saskatchewan and to the geological features displayed along its course. The homeward journey or voyage, which, as I have already stated, was performed entirely by water, was commenced on the 13th September from Rocky Mountain House and terminated at Fort Garry on the 2nd of October. During this interval we accomplished about eleven hundred miles of river, and three hundred miles of lake navigation; from Rocky Mountain House to Carlton in a half-sized, and from Carlton to Fort Garry in a full-sized, Hudson Bay batteau. Between Edmonton and Carlton, a distance by the river of about 400 miles, our party consisted of only five persons besides myself, and as none of the party had ever before descended the river, we had to find our way as best we could through the dangers and difficulties of the navigation, consisting of intricate channels, sand banks, shoals and rapids, none of which are, however, of a very formidable nature. Four of the party worked at the oars, the fifth took the helm, and I acted as bowsman, and by noting the bearing and distances of every bend, succeeded in making a tolerably accurate plan of the course of the river, sketching it in my note book to scale as we went along. Sometimes we were tempted by the prospect of a more direct course, to leave the main channel, and in almost every instance were landed on shoals or sand-bars, obliging us to retrace our steps at the expense of much laborious pulling, and poling against the current. Notwithstanding these mishaps, however, we made a prosperous and tolerably rapid passage, reaching Carlton on the thirteenth day after our departure from Edmon-

ton, and thus averaging considerably more than thirty miles per day, the time we were actually travelling being only eleven and a half days On arriving at Carlton, we found that a full-sized batteau, well equipped and manned by five experienced half breed and Indian voyageurs, had just arrived with '*pieces*', i. e. goods, from Cumberland House, and would be starting on the return voyage on the following afternoon. I at once arranged with Mr. Clarke, the Hudson's Bay officer in charge at Carlton, to allow our party to proceed down the river in the boat. The same boat, but with three different crews, subsequently carried us the whole way to Fort Garry, a distance by Lake Winnipeg and Red River of about eight hundred miles, and the termination of our journey, which by land and water had extended over about 2,400 miles, performed in eighty-two days of actual travel, or, including stoppages and detentions, in ninety-three days, without the aid of stages, steamboats or railroads.

Once during the voyage we narrowly escaped encountering an accident, which would certainly have been exceedingly unpleasant, and might even have endangered the lives of the party. This occurred during our traverse of Lake Winnipeg, on the evening of the 17th of October, when a violent gale overtook us while we were running for a group of islands far out on the lake. We did not succeed in reaching these till long after dark, and as they were quite unknown to any of our crew, the landing on them in safety in a dark night with a heavy gale blowing and a corresponding sea, became a somewhat difficult and hazardous undertaking; but it had to be attempted, so running between two of them we neared the shore of the one which looked most promising, and rounding a stony point on which the breakers were dashing with tremendous force, we fortunately succeeded in gaining a small sheltered cove with a sandy beach of only a few yards in extent. Had we missed this cove and been blown off the shore, we must almost certainly have gone upon the rocks, and our boat been dashed to pieces.

Starting from Rocky Mountain House, lat. 52° 20′ north, and long. 115° 10′ west, the North Saskatchewan River runs in a general north-easterly direction till it reaches a point about 90 miles below Edmonton in lat. 54° 10′ north, long. 111° 30′ west; it then sweeps gradually round to the south-east, on which course it runs with many minor bends, till it reaches "*The Elbow*," lat. 52° 20′ north, and longitude 107° west. At this point, as the

name implies, a sharp bend occurs, again giving it a general north-easterly course, which it maintains to the vicinity of Cumberland Lake, where it a second time reaches the latitude of 54° north between the 101st and 103rd degrees of west longitude, thence a comparatively short south-easterly course of about one hundred miles, carries it to its mouth in Lake Winnipeg, while the three upper sections above described, have a nearly equal length of about 300 miles each. In this great distance of more than eleven hundred miles, as might be expected, the character of the country bordering the river exhibits considerable diversity. The most prominent features, however, may be summarised in the three words prairie, swamp, forest, and we may add vast, boundless, immense, illimitable, and yet scarcely convey an adequate idea of their greatness.

The rapidity with which we were obliged to travel through this vast region in order to escape being overtaken by winter was a matter which I regretted exceedingly, as no time was afforded for anything like minute investigation, or for the collection of specimens; and such notes as I was able to make upon the geology of the country are the result of observations of the most hurried description, and will probably add very little to the information which has already been supplied by the labours of Dr. Hector in his admirable sketch of the geological structure of the region published in the Journal of the Geological Society (Vol. XVII–1861) and which is the result of observations extending over a period of nearly four years. I have already mentioned the prevalence of drift-covered hills and ridges, strewn with large, ice-borne boulders. From Fort Garry westward, on the route we travelled, no rock exposures were seen till within a few miles of Edmonton. An universal mantle of drift-sand, clay and gravel are spread over the face of the country but gradually diminishes in thickness towards the higher levels, though even where the drift is thin, the rocks are still concealed by a deep, rich, black soil. Without doubt, however, interesting exposures of the underlying strata might be found if sought for in the banks of some of the numerous creek valleys which we crossed between Carlton and Edmonton running from the high plain towards the river, but which, on the present occasion, we could not stop to examine.

In connection with the distribution of the materials forming the drift some noteworthy facts were observed. Blocks, and often

enormous rock-masses of Silurian limestone holding characteristic fossils are widely and abundantly distributed over the first and second prairie steppes. The ascent to the third prarie level which has an average elevation of from 1,900-2000 ft. above the sea, commences at the Thickwood Hills, 20 miles west of Cartlon and on it the limestone boulders do not appear to have reached further west than the longitude of Fort Pitt, and between Pitt and Edmonton not a single boulder of limestone was observed either along the Saskatchewan River or on the plains. On the Saskatchewan above the the confluence of the Brazeau—a large tributary coming in from the west about mid way between Rocky Mountain House and Edmonton—there are no boulders, and very few pebbles of either granite gneiss or mica schist. At Rocky Mountain House the pebbles and boulders in the drift which is there seen in contact with the coal-bearing rocks, as well as those seen along the river bed are nearly all of either coal measure sandstone or conglomerate, or of varieties of hard quartzose and siliceous rocks, and though I searched carefully, I did not succeed in finding any of a granitoid or gneisic character. Small pebbles of grey and whitey-brown limestones holding fossils, but too fragmentary for determination, were also observed, but by far the larger proportion of the pebbles and boulders in the river at Rocky Mountain House, are composed of the hard siliceous rocks already mentioned, and many of these are traversed by cylindrical forms, having all the appearance of the *Scolithus* of the Potsdam sandstone formation. It may further be stated that along with the disappearance in ascending the river of the boulders of granitic, gneissic and micaceous rocks, the auriferous character of the drifts likewise dies out, and I was credibly informed that no gold could be found on the North Saskatchewan above Rocky Mountain House, though it had frequently been prospected for by experienced miners. The first gold washings which we saw in descending the river were rather more than forty miles below the mouth of the Brazeau, and thence to Edmonton, and for some miles further down, more or less gold has been found on the bars and in the river banks, but always in a very finely divided state, shewing evidence of having been transported from afar. Even as low down as Carlton, gold can, I believe, be found, though not in quantities sufficient to pay for working. On the South Saskatchewan, at the crossing place about twenty miles S.E. of Carlton,

I washed out a few minute specks of gold from the gravel in the bed of the river, small red garnets and magnetic iron sand, constituting the bulk of the residue in the pannings. It would thus appear that the gold of she Saskatchewan has not been derived from the mountains at its source, but from the drifts composed of granitoid gneiss, or hornblendic and micaceous schist, which are spread over the face of the country, and which must themselves have been in a great part derived from the denudation of the great belt of Laurentian and other crystalline rocks which extends from Lake Superior, north-westerly to the Arctic sea. Numerous fragments and large pieces of silicified wood are frequently met with along the shore of the river, derived from the Tertiary and Cretaceous rocks. In the banks of Red Deer River, Dr. Hector observed a bed of this silicified wood in which there were silicified roots eighteen inches in diameter. I did not see any of it *in situ*, but loose specimens of these fossil woods have been collected by Mr. Bell, Mr. George Dawson and myself from widely separated regions, and it will be both interesting and important to know how far those from the North Saskatchewan correspond with those from the plains further to the south and with other recent and fossil woods from the western side of the Rocky Mountains.

Dr. Dawson has already examined and compared some of the specimens referred to, and will doubtless be able to give some interesting information about them, but larger and more perfect collections will be required. From the Rocky Mountain House to Edmonton, and thence to a short distance below Victoria, there are numerous fair exposures of the strata at comparatively short intervals along the river; soft, friable, green, grey and brown, concretionary sandstones, alternating with blue and grey, arenaceous and argillaceous shales, and layers and beds of lignite and bright, jet like brown-coal are the prevailing features in these exposures. In the shales, there are layers of nodules, or septaria, of clay iron ore holding numerous fragments of plants and containing an average of 34.98 per cent. of iron. At one place on the right bank of the river, about 40 miles below the confluence of the Brazeau, I found a seam of this jet-like coal which measured from 18 to 20 feet thick, in two exposures, rather more than four miles apart. In the first exposure which extends some 50 or 60 yards in length, but which, owing to the swiftness of the current running at its base, is not easily examined, the seam is almost

flat, and rises from the water in a nearly-vertical cliff, exposing eighteen feet of apparently excellent coal. The bottom of the seam here was beneath the water and could not be examined; above it, the cliff was not accessible and the rocks were concealed by slides of earth and other debris. The second exposure, which is no doubt a continuation of the same seam occurs in an arched form and shews eighteen feet of coal with one small, two to three inch parting of shale. The specimens collected were all taken from the surface, and it is not unlikely that beyond the influence of atmospheric action the coal in these seams will prove of better quality than is indicated by these specimens.

At intervals, the whole distance from Rocky Mountain House to Edmonton, 135 miles following the course of the river, and thence to Victoria, 76½ miles further down the river, similar rocks with coal seams and ironstone concretions, were observed. Dr. Hector has separated the Edmonton coal rocks from those which he saw at Rocky Mountain House by an intervening area which he considered to be occupied by a somewhat higher section or division of the Cretaceous series. He did not apparently see the thick seam of coal which I found, as already stated, below the Brazeau River, about eighty-six miles from Rocky Mountain House, and numerous indications of other seams which I saw, probably also escaped his notice, as he descended the river in the winter, when many of the exposures along the banks must have been concealed by snow. At present I am unable to say whether the seams retain their thicknesses for long distances, or whether the numerous exposures and indications seen in the cliffs along the river, represent only more or less lenticular shaped patches repeated at different horizons and over large areas. Dr. Hector appears to incline to the latter idea.

Below Victoria, the river valley widens considerably, and often rises by successive broad steps or terraces to the level of the prairies on either side; sometimes these terraces are quite bare, while at others they are pretty thickly clothed with small poplar trees, a few spruces and pines, and brushwood of willow, alder, and other shrubs. Occasionally the banks abut steeply upon the river, and afford imperfect exposures of the strata, which differ considerably from those met with at and above Victoria. Hard flaggy sandstones and impure limestones, associated with soft blue and gray clay, with layers of large concretions of olive-brown cement stones, or septaria, seamed by veins of yellowish

calc-spar, and holding fossil shells (*Inoceramus*, &c.), are here met with, but without associated coal or lignite beds, or, so far as I observed, any plant remains. These are, I believe, a higher series, and overlie the great brown-coal and lignite formation seen on the upper portion of the river. Similar strata are then seen wherever sections occur the whole distance to the Elbow, about fifty miles above Carlton. Here (at the Elbow) the river leaves the eastern limit of the third or uppermost prairie level, formed by the Eagle Hills on the south, and by the Thickwood Hills on the north side of the valley, and making a sharp bend to the north-east, more or less parallel with the trend of the eastern slopes of the hills named, it flows across the second prairie level, making for the nearest point of its eastern limit, which it reaches about forty-five miles below Fort a la Corne. Between the Elbow and this point, and especially below Carlton, the immediate banks of the river are either low and flat, or rise in well-wooded slopes to the prairie level. In a few places, especially at Cole's Falls and for short distances both above and below Fort a la Corne, the valley closes in, and high cliffs rise steeply from the water's edge nearly to the prairie level. They are, however, all of drift, consisting of gravel underlaid by sand and clay, in which there are occasionally seen one or two layers of imbedded boulders of Silurian limestone, gneiss, and other rocks. The average level of the plains here, above the river, and at some distance back, does not probably exceed 300 feet. And according to my barometric observations, the river at Fort a la Corne is about 1172 feet above sea level, giving a fall between Carlton and Corne of about 172 feet in a distance by the river of 102 miles.

After leaving the eastern limit of the second prairie level, the river banks rarely rise to an elevation of fifty feet above the water, and the adjacent country is everywhere low and swampy and scarcely elevated at all above the flood level of the river, the marks of which were occasionally observed on the trees and bushes some eighteen inches or two feet above the surface which is formed of a deep, rich, alluvial silt. Similar low, swampy country everywhere intersected by water channels extends, with but few intervals to Cedar Lake, at the entrance to which ledges of the white, flat-lying Silurian limestones first make their appearance. Thence, to the mouth of the river, these limestones are either at the surface, or only thinly covered by soil or drift.

They are well exposed in vertical cliffs at the Grand Rapids, and they likewise occupy the whole of the western shores of Lake Winnipeg, extending in a south-easterly direction for 350 miles to Fort Garry. Some of the beds would, I think, afford good slabs for lithographic purposes, while from others a rich harvest of fossils awaits the collector. Between these limestones and the eastern slopes of the second prairie level, on the shores of Lake Winnipegosis and Manitoba, somewhat similar limestones have, I believe, been observed, holding fossils of Devonian age; so that we have in the great low-lying region which constitutes the first prairie level, a large part of which is occupied by the waters of lakes Winnipeg, Winnipegosis, and Manitoba, the eastern outcrops of a thick series of Devonian and Silurian strata, and it becomes an interesting question to determine how these eastern Palæozoic rocks are related to those of more disturbed and altered aspect which rise from beneath the coal-bearing Cretaceous formations at the sources of the Saskatchewan and there form the eastern slopes, as well as many of the higher summits of the Rocky Mountains. We know at present little or nothing respecting the total thickness of the Cretaceous rocks which are spread over a breadth of 1000 miles between Manitoba and the Rocky Mountains, neither do we at present know to what extent the upper part of the series, which is supposed to occupy the surface from the 100th meridian westward to about the 112th, may or may not be underlaid by the supposed older beds, with their associated seams of brown-coal and iron ore. The general scarcity and the poor quality of the timber over hundreds of miles of country, renders it, however, a matter of the very greatest importance in connection with the future settlement of a large portion of the "Fertile Belt," and with the opening it up either by land or by water steam transport, to ascertain where and at what depth beneath the surface coal could be procured which would be available for domestic purposes as well as for the supply of railroads and steamboats. Surface examination and survey alone, however minute, cannot be expected to lend much aid to the solution of this question, owing partly to the almost universal covering of superficial deposits, and partly also to the extreme flatness of the strata and the comparatively few points where they can be observed in natural exposures. It would, I think, not be difficult, however, to settle this point by means of a series of bore holes made at intervals along the valley of the Saskatche-

wan, between Carlton, Victoria, and Edmonton. The sites selected for these trials should be as near as possible to the level of the river, by which means the penetration of a considerable thickness of gravel, boulder drift, and sand, before reaching the cretaceous strata, would be avoided, and the trouble and expense would be proportionately diminished.

In conclusion, I may perhaps make a few remarks respecting the fitness of the Saskatchewan River for steamboat navigation, a subject which at the present moment is attracting considerable attention in connection with the establishing of a Canadian trans-continental route to British Columbia.

My journey down the Saskatchewan was performed between the 12th of September and the 17th of October, and therefore, in some respects, at a very unfavourable season to judge of the practicability of navigating it with steamboats. Throughout the whole length of the river, the channel is more or less subdivided by islands, and every sub-channel is further cut up and obstructed by sand-banks and shoals. Of course I saw them almost at their worst, as the water was everywhere from two to four feet lower than it would be at the opening of navigation in May or early in June. Nothing whatever can, I believe, be done that would obviate or lessen the constant formation and shifting of the shoals and sand-banks and the consequent annual changes in the position and depth of the main channel; a circumstance which must always render the navigation of the Saskatchewan above Fort a la Corne more or less subject to delays, and especially so towards the latter end of the season. For four months, however, under ordinary circumstances, no very serious obstacles would be encountered in the navigation of the river from above the Grand Rapid to Rocky Mountain House, by properly constructed steamboats. Moderate length, powerful engines, light draft, and as much strength as possible below the water line are essential points in the construction of any steamer which may be built for the navigation of the Saskatchewan. Last year, the Hudson's Bay Company built a steamboat intended to run from above the Grand Rapids to Edmonton, and her complete failure and loss on the Cross Lake Rapid may be ascribed almost entirely to want of attention to these requirements. She was far too long, and also too weak both in hull and machinery; and my impression, when I saw her lying a wreck on the bank of the river, was that the person who constructed her could never have travelled the route

for which she was designed. Towing flat-boats or barges, as practiced on Red River would, I think, be impracticable on the Saskatchewan for the reasons that in many parts the current is too strong, while in others the available channel between the islands and sand-banks and shoals are too narrow and tortuous. The only really insurmountable obstruction to steam navigation from Fort Garry to Rocky Mountain House is the Grand Rapid. It appears to have been carefully measured and examined by Professor Hind, who states it to be 2¾ miles in length with a total fall of 43½ feet. Whether the outlay requisite for a canal and locks to surmount this would be repaid by the result, is a matter for consideration. Between the head of the Grand Rapid and the confluence of the two Saskatchewans, there are only two places where, especially during the latter part of the season when the water is low, steamboats might experience some difficulty and would possibly require to be warped against the current, these are the Cross Lake Rapids and Tobin's or Thobon's Rapid, the one between Cedar Lake and Grand Rapid and the other between Cumberland or Pine Island Lake and Fort à la Corne. Immediately above the confluence of the North and South Branches are the *Coal* or *Cole's Falls*. Next to the Grand Rapid these falls appear to me to constitute the most serious impediment to the navigation. They extend over a length, according to my estimate, of rather more than twelve miles. I am not able to say exactly what the total fall is, but my two barometers gave a difference of 0.44 and 0.45 respectively, between the junction and the upper end of the falls. This would indicate a fall in that distance of from 40–45 feet. The width of the river is from 150 to 170 or 200 yards, and the rapids vary in length from one hundred yards to about a quarter of a mile. The bed of the river is everywhere filled with large, rounded boulders of gneiss, granite and limestone, and when we passed, many of these were shewing above the water, while more were covered only a few inches deep. This was on the 4th of October, and then no steamboat could have passed either up or down with safety. Our boat, an ordinary Hudson's Bay batteau, drawing only about eighteen inches, touched the rocks several times, notwithstanding that we had a careful and experienced steersman, well acquainted with the deepest channel. With two or three feet more water in the river, of course the appearance of these rapids would be greatly altered, and as there is no solid rock, the

danger and difficulty of their navigation might be greatly lessened, if not altogether obviated, by the removal of some of the large boulders, a work which might probably be effected at a comparatively small cost. The current on this peice of the river would, however, always be very heavy, and proper arrangements for warping boats up these rapids in case of necessity, should be made in advance.

There is another very important matter connected with the Saskatchewan navigation which would require careful consideration. I allude to the great scarcity and poor quality for steam purposes of the wood which could be procured on long stretches of the river above Carlton; indeed the whole distance between Carlton and Edmonton this difficulty would arise, and I question whether it would not be more economical to establish coaling stations which could be supplied from the thick seam above Edmonton, than to use either poplar or spruce wood, neither of them of much value for steam purposes, especially where constant full pressure would be necessary. The coal in the seams referred to is very favourably situated for working and shipment, and could be taken down stream at a comparatively small cost. The arrangements for the return of the empty barges up stream would be the principal item of expense. My impression at present is that the coal-bearing rocks which crop in the banks of the river from near Victoria upwards pass with their associated coal-seams and iron ores beneath the Cretaceous septaria clays which are observed in the vicinity of Fort Pitt and the Elbow, and it may be that boring along the river valley would reveal workable seams of coal at such a limited depth beneath the surface as would render them available even as low down as Carlton.

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TABLE OF HEIGHTHS AND DISTANCES, &c.,

ON THE SASKATCHEWAN RIVER, FROM ROCKY MOUNTAIN HOUSE TO LAKE WINNIPEG.

	Mean Barometer Readings. *Selwyn.*	Mean Barometer Readings. *Palliser & Hector.*	Difference.	Distance by the River. Stat. miles. *Selwyn.*	Distance by the River. Stat. miles. *Palliser & Hind.* Rep't	Map.	Difference.	Height above sea-level. *Selwyn.*	Height above sea-level. *Palliser & Hector.*	Difference.	Rise and fall in feet. Total, and ℔ mile. *Selwyn.*	Rise and fall in feet. Total, and ℔ mile. *Palliser & Hector.*
Rocky Mt. House..	26.536	26.515	0.021	.....	.....	.....	.....	3229	3195	34	1070	1107
to				136	211	135	+ 1 −55				7.86 ℔ m	5.20 ℔ m
Edmonton	27.688	27.626	0.062	.....	.....	.....	.....	2159	2088	71		
to				62							177	
Victoria	27.826	.....	.....	191	251	205	−14 −60	1982			2.85 ℔ m	
to				129							190	
Fort Pitt.....	28.069	.....	.....		.....	.....	.....	1792			1.47 ℔ m	
to				198	225	195	+ 3 −37				448	
Carlton House.....	28.565	28.555	.....	.....	.....	.....	.....	1344	1321	23	2.26 ℔ m	1874
to				102							1885	
Fort a la Corne....	28.769	.....	.....	.....	*Hind.*		.....	1172	.....	.....	3.58 ℔ m	3.65 ℔ m
to				153	150	132	+ 3 − 21				172	
Cumberland House											1.67 ℔ m	
to				59		56					2057	
The Pas Post and Mission											3.12 ℔ m	
to				106		102						
Grand Rapid Post.				.....	.....	.....	.....	620	.....	.....	543	
							+120				1.86 ℔ m	
Lake Winnipeg....				945	1005	825	− 60	.....	.....	.....	2600	
											2.81 ℔ m	*

no value owing to stormy weather.

* Taking 925 miles the average of the three totals given.

REMARKS.—The distances given in Palliser's Report differ from the same measured on his map—both are given, the latter nearly correspond with mine. None of the distances given are from actual measurement.

LONGITUDES, LATITUDES AND MAGNETIC VARIATIONS,

From the Reports of *Palliser, Blakiston* and *Hind.*

	Longitude.	Latitude.	Var'n.	Year.	Var'n.	Year.	Var'n.	Year.
R. M. H.	115.10.45	52.22.06	27.08	1873	26.20	1857	.....	....
Edmonton (mean of four)....	113.23.22	53.30.59	26.05	1873	25.20	1858	24 19	1844
Pitt	109.17.03	53.33.01	24.37	1873	.....	....	23.10	1844
Carlton	106.20.00	52.52.30	.....	....	23.25	1857	22.55	1844
Fort a la Corne	104.30.00	53.27.00	22.30	1858	.....	....	.....	....
Cumberland	102.19.00	53.56.00	.....	....	.....	....	19.16	1844
Fort Garry.....	96.52.27	49.52.06	.....	....	12.03	1857	.....	....
	96.54.41	49.53.18	.....	....	.....	....	.....	....

BOTANICAL AND GEOLCGICAL NOTES.

By A. T. Drummond.

OWL'S HEAD, LAKE MEMPHRAMAGOG.

The floras of the Canadian mountain summits have not as yet received much attention. This is largely due to the almost inaccessibility of the mountains of the Lower St. Lawrence, especially of the north shore, where a rich harvest of semi-Arctic vegetation may be expected. The opening of the Intercolonial Railway will give better access to those on the south shore, and will, it is to be hoped, lead some of our naturalists, who have the opportunities, to visit them.

The flora of Owl's Head, one of the outliers of the Green Mountain range, I refer to here, not because it includes any characteristic plants but because it may be regarded as a type of the vegetation of the lesser peaks throughout Ontario and Quebec. The base of the mountain on the eastern side is washed by the waters of Lake Memphramagog. Here, at a height of 756 feet above the sea level—an elevation greater than that of Lake Superior—is a fair representation of the general New England flora, and it recalled to memory excursions made years ago among the Thousand Islands of the St. Lawrence. Precipitous moss-grown rocks, their moist, tree-shaded sides tenanted here and there by tufts of little spleenworts (*Asplenium Trichomanes*, L.), rise from the water's edge; and on the numerous ledges in often scanty soil and thence up the mountain side, more or less everywhere found, are red, mountain and sugar maples interspersed with aspens, beech trees and spruce. In the lake here are some of our more common fresh water shells as *Anodonta cataracta*, Say, *Margaritana undulata*, Lea, *Unio complanatus*, Sol., *Sphærium sulcatum*, Lam., and *Paludina decisa*, Say. In the course of the ascent up the little valleys and glens through which the mountain path winds there is not much change in the aspect of the flora until the summit is reached. The woods of any eastern Ontario township would present much the same appearance. Even among the Lichens there is nothing to indicate the smallest change of elevation.

There is one peculiarity observable among these little organisms, the Lichens, worthy of a place here, and it is a peculiarity

not confined to the mountain plants but equally conspicuous on the trees, rocks and old palings everywhere. Lichens seem to delight in a situation having a northerly aspect. Though no rule can be laid down, still this is so often observable that it becomes quite possible to in a general way judge of the direction of one's path. Frequently on some old palings, the more northerly side is quite encrusted with various species which on the opposite side are almost wanting, and here as elsewhere on the barks of trees, they will often be seen thickly grouped together on the northerly exposure and gradually becoming less prevalent on either side as the southern exposure is approached. Now, it is well known that the last forms of vegetation met with on the highest peaks of the Himalayas or which greet the traveller in Arctic lands are Lichens, and it would seem as if here, in a temperate climate, these little plants evince a longing for the cold and exposure which suits so well the species in the polar zones.

Another feature connected with Lichens is their economic value as sources of dyes, though this has lost much of its importance during recent years by the discovery of aniline dyes. The old Orchella Weeds of commerce which yield beautiful purple tints have not yet been found on the American coast of the Atlantic ,nor thus far have I found more than one species in Canada —*Parmelia Borreri*, Turn. which yields to ammonia a purple dye. This is a very common Lichen of wide-spread range on this continent and noticeable here on Owl's Head alike on rocks and on the beech trees. But there are other dye Lichens also here. Some of those crisp, blackish species, resembling bits of old cast away leather, attached by their centres to the sides of the rocks, yield beautiful red tints, as also does *Theloschistes parietinus*, Fr., one of those very common but pretty yellow species everywhere observable alike on rock and tree and paling.

At 2000 ft. above the sea, the beech is still sometimes seen and even the bass-wood climbs as high. But climbing over the large angular blocks which, chaos-like, lie piled around the north-eastern side, an almost bare peak is reached, protruding as it were above the green of the foliage below. Here we are at a height of 2600 ft. above the ocean level, and, strange as it may seem, nearly one thousand feet above the level of the central parts of the continent. The botanist must be an enthusiast who is so taken up with his favourite science that he cannot spare a moment for what from this summit is presented—one of the grandest panoramic views

we have in Canada. To the northward Orford, reputed to be one of our higher peaks, with its broad, irregular outline obscuring the view of the extensive country behind, looks like a gigantic boulder set up in relief against the horizon beyond. At its base as it seems, though some miles distant, is the lower end of Lake Memphramagog, which with its beautiful bays and inlets and the hills on either side, sloping here abruptly and there gently to its shores, seems from this height like a large pond, though it stretches a distance of thirty miles past Owl's Head southward into Vermont. To the eastward of Orford and reposing in the lap of the hills which skirt the Massiwippi Valley is Massiwippi Lake. From this point beyond Lake Memphramagog in the middle distance between its shores and the horizon, the eyes wander southward over a rolling country mottled with light and sombre green, indicative of fields and forest, past Stanstead, with hardly a break on the horizon beyond, until they meet the Green Hills which group themselves around Newport and which extend thence southward peak beyond peak until they are lost to the eye in the hazy distance. Far away in the background of the view here but their outline somewhat dimmed, is the group of summits which form the White Mountains of New Hampshire.

The flora of the summit of Owl's Head is confined to a few common species and these of inconspicuous size. Here where the summit is but a narrow peak, exposed on every side, the scantiness and small growth of the vegetation is to be attributed to the bleak winds which must at this height be constantly hurricaned across it, as well as to some extent to slides which have taken place, rather than to the altitude. There are no flowering plants here which we might not also find in almost any part of the Province of Quebec south of the St. Lawrence. Tadousac and River du Loup at the sea level have several boreal forms in abundance: here there is almost nothing to remind one of Arctic life. The only northern plants are Lichens. Encrusting the rocks is that little cosmopolite of the mountains and Arctic and Antarctic regions of the globe, *Buellia geographica*, Schaer., the Map Lichen, its yellowish hue made more conspicuous by the blackish fringe surrounding it: near at hand is another pretty yellow species *Cetraria juniperina*, Ach, var. *pinastri*, Fr., and growing beside both and contrasting strongly with its pitchy color is another northern Lichen, *Parmelia Stygia*, Ach., the Blackalslaf of the Swedish Hills.

ADDITIONS TO THE CANADIAN LICHEN FLORA.

In the number of this journal for October, 1865, there was published a provisional list of the Lichens of Ontario and Quebec. This embraced every species then known to occur within these provinces. The nomenclature of Prof. Tuckerman's Synopsis, published in 1848, was necessarily followed as being the only accessible authority on American Lichens. The views of the author of the Synopsis are now, however, widely different—the result of long, patient investigation—and following the arrangement of his recent Genera Lichenum, the same provisional list published now would indicate many generic and specific changes. The additions now made to the list include a number which are interesting as being semi-Arctic in range. In determining many of these species, I am again indebted to the valued assistance of Prof. Tuckerman.

I trust that those who have the opportunities will pay special attention to the Lichens of the Lower St. Lawrence coasts, Newfoundland and Nova Scotia as, particularly there, new or interesting species may be expected.

Cetraria Fahlunensis, Schaer. Tadousac and Owl's Head, Lake Memphramagog.

Parmelia stygia, Ach. Tadousac.

Umbilicaria crosa, Hoffm. Tadousac.

U. hyperborea, Hoffm. Tadousac.

Peltigera malacea, Ach. Tadousac.

Pannaria nigra, Nyl.

Collema pycnocarpum, Nyl. Durham, P.Q.

C. flaccidum, Ach. Tadousac.

C. pulposum, Bernh.

C. furvum, Nyl.

Leptogium chloromelum, Nyl.

Lecanora Hageni, Ach. Ottawa. London.

L. molybdina, Schaer.—an Arctic plant hitherto only known from Greenland but now detected at Tadousac and more recently by Prof. Tuckerman at Mt. Desert on the coast of Maine.

L. cervina, Sommerf. vars *prainosa* and *simplex*.

Rinodina ascociscana, Tuck. Bark of trees.

Pertusaria hymenia, Tuck. Syn.

Biatora sanguineo-atra, Tuck. Syn.

B. mixta, Fr.

B. hypnophila, Turn. Ottawa.

B. rubella, Rabenh. vars. *suffusa* and *Schweinitzii*. London.

B. atro-rufa (Dicks) Fr. On earth, Tadousac.

Lecidea fusco-atra, Ach. Tadousac.

L. sanguinaria, Ach. Tadousac.

Buellia albo-atra, Hoffm.

Calicium fuscipes, Tuck. This is a new species approaching C. subtile, Fr. but "larger and stouter and with larger spores. apothecia exactly turbinate-lentiform, the under side as well as the upper portion of the brown stipe as if thinly white-varnished." London. Only other locality thus far—oak rails, New Jersey.

Staurothele umbrina, Wahl. Limestone rocks, Kingston.

Trypethelium virens, Tuck.

Verrucaria muralis, Ach. Limestone, Kingston.

V. Nylanderi, Hepp. A limestone species from Kingston approaches this in character.

V. microbola, Tuck. Limestone rocks. Kingston. This is a provisionally new species, allied to *V. pyrenophora*, Ach. but with apothecia less than half the size. "Thallus of minute, rounded, olivaceous, becoming grayish, commonly discrete granules; spores ovoid 4-locular."

Pyrenula hyalospora, Nyl. London.

THE DISTRIBUTION OF SOME CANADIAN PLANTS, AN ARGUMENT FOR THE MARINE ORIGIN OF THE ERIE CLAYS.

I have long thought that some of the striking anomalies in the distribution of our native plants throw considerable light upon the origin of the Erie clays and their relations to the marine clays and sands of the Province of Quebec. These Erie clays underlie the Saugeen clays, but contain no fossils, and we have therefore to look to extraneous sources for information regarding their origin. On more than one occasion I have maintained that the sea shore plants now so widely scattered around the Great Lakes and elsewhere indicate an extensive inroad of the ocean, and that their original migration to the interior is clearly referable to post pliocene times subsequent to the glacial drift. The clays and sands succeeding the Erie clays are lacustrine, and the underlying glacial drift, whatever its origin may be, points to a period of cold too excessive for temperate vegetation. It is difficult, then, to resist the conclusion that the migration of

these plants took place during the deposition of the Erie clays, and then judging from the characteristic habits of the plants and their range, and the distribution of the clays, that these clays are of marine origin. Circumstances also seem to favour the view that the Leda clays and Saxicava sands of the Ottawa and St. Lawrence valleys were deposited about the same time. Mr. C. H. Hitchcock of Hanover, N.H., thinks that "as Lake Superior is 638 feet above the ocean, and the maritime plants surround its shores, there is an argument for its submergence at least to the depth of its surface, and probably to the height of its terraces, so that we may add 330 feet to the altitude of the lake. This would give nearly 1000 feet, which corresponds well with the known height at which marine shells have been found in Arctic America, viz., one thousand feet on Cornwallis and Beechey Islands."

It seems most probable that the boreal and semi-Arctic plants of the Lake Superior coasts, migrated thither contemporaneously with or prior to the maritime plants. They are not now numerous, but are of a marked northern type. They are not distributed beyond the lake shores. It is only on the headlands which jut far into the lake, and on the islands and the coast where the bleak winds which sweep across and down the lake have full play, and where the broad deep expanse of water keeps the atmosphere cool and moist, that they are met with. A few miles inland, beyond Fort William, the vegetation is in almost as great profusion and is as rank as in the central districts of Ontario. Even at the heads of deep bays on the northern coast, though in a higher latitude, the plants are of a more temperate type than those of Thunder Cape and other promontories. Upon some headlands of the southern shores of the lake such boreal and semi-arctic plants as *Anemone parviflora*, Michx., *Saxifraga aizoides*, L., *Saxifraga aizoon*, Jacq., *Saxifraga tricuspidata*, Retz., *Polygonum viviparum*, L., *Empetrum nigrum*, Linn. and *Carex capillaris*, L., likewise occur, and though it may, perhaps, be argued with apparent reason that the presence of some of these may be due to the play of winds and currents from the northern and western sides of the lake, yet there are others of these semi-arctic plants which have not yet been seen on the upper coasts. Now if these northern species here form colonies isolated from their fellows to the far north, without present means of communication, in accounting for their

occurrence we must revert to some prior age when the conditions of temperature were such as to facilitate their migration from higher latitudes. The fossil remains in the clays and sands overlying the Erie clays are of a temperate type and preclude the hypothesis that the connection took place during their deposition. The Leda clays on the Lower Ottawa, on the other hand, contain plants of a northern temperate range, leaving it strongly open to probability that in the higher latitude of the country to the immediate northward of Lake Superior there was during the early periods of the deposits of these clays a temperature congenial to the growth of boreal plants. Nor is this probability dispelled by the hypothesis that the sea shore species were driven inland relatively about the same time, as, with the exception of *Cirsium horridulum*, Michx., a perhaps doubtfully maritime plant, and *Rumex maritimus*, L., which also occurs in the interior, all of those which are now distributed around the Great Lakes range high on the North Atlantic coast, mingling with semi-Arctic species on the shores of the River and Gulf of St. Lawrence, and on the Nova Scotian coast.

If the hypothesis which I have here ventured be correct, it is interesting thus to find that the Alpine flora of the White Hills of New England, the boreal colonies of the headlands of Lake Superior, the sea-shore plants now spread around the Great Lakes, and the fossil plants of the Leda clays, have all a contemporaneous origin; and that, considering the present normal range of these species on this continent, the wide distribution of some of them over Northern Europe, and the associations suggested by their exceptional locality and habits here, we obain a slight glimpse at the pre-historic record of existing species.

inted March 22nd, 1874.

OCCURRENCE OF GIGANTIC CUTTLE-FISHES ON THE COAST OF NEWFOUNDLAND.

By A. E. Verrill.

Considerable popular interest has been excited by several articles that have recently been published and extensively circulated in the newspapers of Canada and the United States, in regard to the appearance of gigantic "squids" on the Newfoundland coast. Having been so fortunate as to have obtained, through the kindness of Prof. S. F. Baird, the jaws and other parts of two of these creatures, and through the courtesy of Dr. J. W. Dawson, photographs of portions of two other specimens, I have thought it worth while to bring together, at this time, the main facts respecting the several specimens that have been seen or captured recently, so far as I have been able to collate them, reserving for a future article the full descriptions and figures of the jaws and other portions, now in my possession.

We now have reliable information concerning five different examples of these monsters that have appeared within a short period, at Newfoundland. (1). A specimen found floating at the surface, at the Grand Banks, in October, 1871, by Captain Campbell, of the schooner B. D. Haskins, of Gloucester, Mass. It was taken on board and part of it used for bait. Dr. A. S. Packard has given, in the American Naturalist, vol. vii, p. 91, Feb., 1873, all the facts that have been published in regard to this individual. But its jaws have since been sent to the Smithsonian Institution, and are now in my hands to be described and figured. They were thought by Professor Steenstrup, who saw a photograph of them, to belong to his *Architeuthis monachus*, which inhabits the northern coasts of Europe, but is still very imperfectly known. The horny jaw or beak from this specimen is thick and strong, nearly black; it is acute at the apex, with a decided notch or angle on the inside, about ·75 of an inch from the point, and beyond the notch is a large prominent angular lobe. The body of the specimen from which this jaw was taken is stated to have measured 15 feet in length and 4 feet 8 inches in circumference. The arms were mutilated, but the portions remaining were estimated to be 9 or 10 feet long, and 22 inches in circumference, two being shorter than the rest. It was estimated to weigh 2000 pounds.

(2.) A large individual attacked two men, who were in a small boat, in Conception Bay, and two of the arms which it threw across the boat were cut off with a hatchet, and brought ashore. Full accounts of this adventure, written by Mr. M. Harvey, have been published in many of the newspapers.* One of the severed arms, or a part of it, was preserved in the museum at St. John, and a photograph of it is now before me. This fragment represents the distal half of one of the long tentacular-arms, with its expanded terminal portion covered with suckers, 24 of which are larger, in two rows, with the border not serrate, but 1·25 inch in diameter; the others are smaller, very numerous, with the edge supported by a serrated calcareous ring. The part of the arm preserved measured 19 feet in length, and 3·5 inches in circumference, but wider, "like an oar," and 6 inches in circumference, nearer the end where the suckers are situated; but its length, when entire, was estimated at 42 feet.† The other arm was destroyed and no description was made, but it was said to have been 6 feet long and 10 inches in diameter; it was evidently one of the eight shorter sessile arms. The estimate given for the length of the "body" of this creature (60 feet) was probably intended for the *entire length*, including the arms.

(3.) A specimen was found alive in shallow water, at Coomb's Cove, and captured. Concerning this one I have seen only newspaper accounts. It is stated that its body measured ten feet in length and was "nearly as large round as a hogshead" (10 to 12 feet); its two long arms (of which only one remained) were forty-two feet in length, and "as large as a man's wrist;" its short arms were six feet in length, but about nine inches in diameter, "very stout and strong;" the suckers had a serrated edge. The color was reddish. The loss of one long arm and the correspondence of the other in size to the one amputated from from No. 2, justifies a suspicion that this was actually the same individual that attacked the boat. But if not, it was probably one of the same species, and of about the same size.

(4.) A pair of jaws and two of the suckers were recently forwarded to me from the Smithsonian Institution. These were received from Rev. A. Munn, who writes that they were taken

*Also in the Annals and Magazine of Natural History, January, 1874, with a wood-cut of the arm.

† Doubtless these long arms are very contractile and changeable in length like those of the ordinary squids.

from a specimen that came ashore at Bonavista Bay; that it measured thirty-two feet in length (probably the entire length, including more or less of the arms); and about six feet in circumference. This jaw is large and broad, but much thinner than that of No. 1, and without the deep notch and angular lobe seen in that specimen. It probably belongs to the *Architeuthis dux* of Steenstrup, or at least to the same species as the jaw figured by Dr. Packard.

(5). A smaller specimen, captured in December, in Logie Bay, about three miles from St. John, in herring nets. Of this I have a description in a letter to Dr. Dawson, from M. Harvey, Esq., who has also published a brief account of it in the "Morning Chronicle," of St. John. The letter is accompanied by two photographs of the specimen: one showing the entire body, somewhat mutilated anteriorly; the other showing the head with the ten arms attached. The body of this specimen was over seven feet long, and between five and six feet in circumference; the caudal fin was twenty-two inches broad, but short, thick, and emarginate posteriorly on each side, the end of the body being acute; the two long tentacular-arms were twenty-four feet in length, and two and a half inches in circumference, except at the broader part near the end; the tips slender and acute; the largest suckers 1·25 inch in diameter, with serrated edges; the eight short arms were each six feet long; the two largest were ten inches in circumference at base; the others were 9, 8 and 7 inches. These short arms taper to slender acute tips, and each bears about 100 large, bell-shaped suckers, with serrated margins. Each of the long arms bears, about 160 suckers on the broad terminal portion, all of which are denticulated; the largest ones, which form two regular alternating rows, of twelve each, are about an inch in diameter. There is also an outer row of much smaller suckers, alternating with the large ones, on each margin; the terminal part of these arms is thickly covered with small suckers: and numerous similar small suckers are crowded on that portion of the arms where the enlargement begins, *before* the commencement of the rows of large suckers. The arrangement of the suckers is nearly the same as on the long arm of No. 2, but in the latter the terminal portion of the arm, beyond the large suckers, as shown in the photographs, is not so long, tapering, and acute, but this may be due to the different conditions of the two specimens. It is probable that this was a young specimen of the same species as No. 2.

From the facts known at present, it appears probable that all these specimens, and several others that have been reported at various times from the same region, are referable to two species; one (probably *Architeuthis monachus*) represented only by the first of those enumerated above, and having a more elongated form of body and stouter jaws; the second (probably *A. dux*) represented by Nos. 2 to 5, above described, having a short, thick, massive body, and broad, but comparatively thin jaws, which are also different in form. Some of the differences in size and proportions, and in the suckers, observed among the four specimens referred to the latter species, may be due to sex, for the sexes differ considerably in these characters in all known cuttle-fishes.—*American Journal of Science.*

THE LATE ROBERT McANDREW, Esq., F.R.S., F.L.S., F.Z.S., &c.

In these days, when dredging operations are common, and their results carefully tabulated and easily accessible, it is instructive to remember that when some of us were boys even the most frequented seas had not been explored except by fishermen, and the geographical distribution of species had not been studied. Foremost in the ranks of new discoverers were the late Prof. Edward Forbes and his friend Mr. M'Andrew. The latter gentleman was of Scotch parentage, but born in England in 1802. He spent the first 27 years of his active life in Liverpool, and the remainder at Isleworth House, Middlesex, where he died after a brief illness last May. He was one of the largest wholesale fruit merchants, and it was "accident" that led him to devote his spare time to scientific pursuits. His wife having amused herself at the seaside by picking up all the cowries (*Trivia Europæa*) she could find, he suggested to her that it would be far better to see how many different kinds she could pick up. The variety surprised him. He began to collect shells, about the time that Deshayes was editing Lamarck's Animaux sans Vertèbres. Then he began to dredge, as the oystermen did, in an open boat. But when the results of his researches began to attract the attention of scientific men, he fitted out a yacht with what were then unheard of conveniences. Fixed to the outside were frames for the fine sieve, and the coarse within. His trained sailors managed the dredge, threw the haul into the sieves, drenched

the contents, and the sieves were brought in to be examined in comfort. The soft parts of the mollusks were gobbled by the poultry, which formed an integral portion of the establishment. In those days governments paid nothing for marine scientific explorations, and even the doles of £5 or £10 granted by the British Association had not begun. Naturalists are generally too poor to hire the necessary outfit; and an invitation to join a dredging party in Mr. M'Andrew's yacht was a rare treat. How seldom do wealthy commercial gentlemen confer such favors on working naturalists. All honor to the foremost in this noble aristocracy! With the results chiefly of Mr. M'Andrew's explorations, Prof. Forbes developed his theory of geographical distribution, founded, however, on what we now know to have been but partial data. The importance of the investigations was quickly perceived and the knowledge gained was systematized in the "History of British Mollusca" by Forbes and Hanley; a work which has formed a model for all subsequent accounts of local faunas, and the value of which has been by no means lessened by the recent volumes on the same subject by Mr. J. G. Jeffreys.

After fully exploring the different sub-faunæ of the British seas, a work which the late Mr. Barlee continued for Mr. Jeffreys' benefit, Mr. M'Andrew pursued his researches on the coasts of Spain and Portugal, the Levant, north coast of Africa, and the Western Islands, especially the Madeira group. Here he dredged in deeper water than had ever been before attempted. Among the many new species which he discovered, none were more interesting than the recent *Bifrontia*, till then only known as a fossil. During this period, Prof. Forbes made his researches in the Egean sea.

The temperate and subtropical portions of the Atlantic fauna having been thus carefully worked-out, Mr. M'Andrew directed his yacht to the Nothern Ocean, dredging among the fiords of Norway as far as the North Cape. The shells of this region have proved very valuable to us, as illustrating those of our own Gulf. In these expeditions, the late S. P. Woodward, Barrett, and other celebrated naturalists were invited to take their share.

For the first time then in the history of science, a merchant was found who, without training in college, and without any assistance, explored the whole fauna of the North Atlantic from the icy to the sub-tropical seas. This having been accomplished, Mr. M'Andrew sold his yacht, gave up his active share in busi

ness, and devoted himself to the arrangement and distribution of his great collections.

Having, however, taken a pleasure-tour in the Holy Land and Egypt, he was struck by the surpassing richness of the shores at Suez; and returned, resolved to fit out another expedition to explore that Gulf, the furthest northern and western nook of the great Indo-Pacific fauna. This, the last labour of his life, was happily accomplished, and gained for him the gold medal of the French Academy in 1870.

Throughout his life, he was remarkable for his extreme modesty. He declined to describe his own species; and, as an author, contented himself with brief papers and reports in the transactions of the British Association, the Philosophical Society of Liverpool, the Annals of Natural History, &c. He generously distributed the riches he had acquired, to the British Museum, to those of Edinburgh University, Harvard College, Mass., the Smithsonian Institution, and to various other public and private collections. Only a week before his death, he made up an additional parcel for the British Museum. To this he had presented the fullest possible series, including some unique specimens, on the express condition that a catalogue of them should be published. This condition is still however unfulfilled.

To the collection now the property of McGill College, he presented not only a fine series from all of his Atlantic dredgings and those of the Red Sea, but also from his general duplicates. His last donation, received only a few weeks before his death, was a share of type E. Indian collections of Benson, which he had lately purchased.

Mr. M'Andrew's own collection was invaluable to the student from the accuracy and beauty of the arrangement, and the very full suites of all ages, varieties and localties, selected from the myriads which had passed through his hands. Some time ago he made exact conditions with the University of Cambridge, (Eng.), in accordance with which it has become their property, and will be preserved intact for the use of students.

Would that some portion of his spirit might descend on this side of the Atlantic; and that some of our "merchant princes" would adorn their calling, as he did, with the generous prosecution of scientific research; as well as with the strict integrity, the unostentatious charity, and the earnest perseverance of the Christian gentleman! P. P. C.

Montreal, Nov. 2nd, 1873.

ON SOME NEW OR LITTLE KNOWN FOSSILS FROM THE SILURIAN AND DEVONIAN ROCKS OF ONTARIO.

By E. Billings, F.G.S.

SILURIAN.

Fig. 1.—*Aulocopina Granti.*—A nearly perfect specimen.
" 2.—The summit of a larger specimen.

(Both figures natural size. The true characters of the surface cannot be perfectly represented by wood engravings.)

Genus Aulocopina (N. G.)

In a box of fossils lately sent to the Geological Survey by Major Grant, of Hamilton, there are several specimens which appear to me to belong to a new genus of sponges. The most perfect is of an elongate, ovate, or pyriform shape. The larger, or upper extremity, is more or less concave, with a small circular space in the centre, which appears to be the mouth of a tubular cavity that penetrated inwards and downwards, along the vertical axis of the sponge. I shall call it the "oseulum." From its edges numerous small, irregular, sometimes branching ridges, radiate outwards in all directions over the surface, and descend the sides to the base. Several polished sections, through the osculum, downwards, show that the centre, at least in the upper half, was occupied by a large tubular canal, with smaller ones branching from its sides, outwards and downwards. This structure is only indicated by the dark colour of the material which fills the canals, in contrast with the light grey chert, which constitutes the mass of the fossil.

This genus somewhat resembles *Aulocopium* in its structure, but differs in having its whole surface covered with the rounded

irregular ridges above mentioned. I propose to call it *Aulocopina*, and shall, hereafter, with additional material, endeavour to give a more detailed account of it.

I shall dedicate the only species known to me, to its discoverer, Major Chas. Coote Grant, H. P. 16th Regt. Foot.

1. A. GRANTI.—One of the specimens is 16 lines in length and 12 lines in width about the middle. The osculum is a little over two lines in width. There are in general from 5 to 9 striæ or ridges on its surface in the width of 3 lines. These radiate from the osculum and continue down to the base, so that the whole surface is covered with them. The specimen is somewhat compressed, so that a transverse section through the mid-length would be a somewhat irregular ellipse, the greater axis 12 lines, as given above, and the lower 9 lines.

The second specimen is also somewhat compressed, and is elongate-ovate, proportionately more slender than the former. Length 14 lines; greater diameter at the middle 8 lines; lesser diameter 6 lines; diameter of the osculum 2 lines. There are 6 to 8 striæ in the width of 3 lines, and they cover the whole surface.

The third specimen shows only the summit of a large individual. The diameter is 14 lines; width of the osculum 2 lines; there are from 6 to 8 ridges in the width of 3 lines. The central portion is concave, the osculum being situated in the bottom of the concavity.

A fourth specimen, a fragment, has a diameter of 2 inches at the summit; the osculum 4 lines wide.

Occurs in the Niagara formation at Hamilton.

DEVONIAN.

The Devonian fossils, described in this paper, having been all collected within a limited area in Ontario, I shall not give the localities after each species, but only mention here that all the Corniferous species are from the Counties of Haldimand, Welland, and Oxford. The species of the Hamilton formation are from the Township of Bosanquet.

The internal structure of the corals, was ascertained principally from polished sections, skillfully prepared by Mr. T. C. Weston, the Lapidary of the Survey.

Genus Amplexus.

2. A. exilis.—Corallum more or less curved, expanding to a diameter of 14 lines at 3½ inches from the base. Surface with very distinctly defined costal striæ, of which there are 5 in the width of 3 lines, where the diameter is about one inch, and 6 or 7 in the same space at the base. There are about 64 septa where the diameter is 14 lines. The larger of these are scarcely a line in depth; the smaller about half that size. The tabulæ are very thin, flat or slightly undulating, distant from each other from 1 to 6 lines.

Owing to the fragile character of the shell, good specimens of this species are rare. The best in our collection consists of the lower 6 inches partly imbedded in the rock. By the application of acid, the whole of the interior has been completely freed from the limestone which filled it, so that it shows the tabulæ and septa perfectly. It is curved, somewhat irregularly, to a radius of between 4 and 5 inches. There are numerous small rings of growth, in general not very prominent, but with some that are angular and strongly elevated. These are, sometimes, so deep that they give to the costal striæ a nodose appearance.

The extremely rudimentary state of the septa distinguishes this species from all the described American forms known to me.

Occurs in the Corniferous.

3. A. mirabilis.—Corallum sometimes abruptly curved in different directions, expanding to a width of from 15 to 20 lines in a length of 4 or 5 inches from the base; above which it becomes more nearly cylindrical. Surface with fine engirdling striæ, in general 4 or 5 in the width of 2 lines, but in some places, the same number occur in the width of one line. There are also numerous angular rings of growth, distant from 2 to 15 lines from each other, with sub-concave spaces between. Septal costæ rounded, distinctly defined by sharp striæ between them, 7 or 8 in the width of 3 lines near the base, and 4 or 5 in the same near the calice. There are about 40 large septa at the calice, where the diameter is about 18 lines, with the same number of small ones between them. The larger have a depth of 3 or 4 lines and the smaller 1 line. All of the septa are more or less curved, sometimes very tortuous. The tabulæ have not been observed.

The above description was drawn up from a specimen, 1E

inches in length, measured along all the curves. It is 15 lines in diameter at 5 inches from the base, and about 18 lines at the cup. The septal costæ are very distinctly defined at the base but become more flattened and obscure upwards. In external characters it resembles *A. exilis*, but the much greater developement of the septa distinguishes it therefrom

To *A. mirabilis*, I add, provisionally, a specimen which when perfect, must have been 2 feet in length. It is 17 lines in diameter at the calice and about 11 lines at 12 inches below There are about 45 large septa at the base of the cup, with an equal number of smaller ones. Depth of the larger, 3 to 5 lines, and of the smaller, 1 or 2 lines. As in the former specimen all the septa are more or less curved.

Both specimens occur in the Corniferous.

Genus ZAPHRENTIS.

4. *Z. inveneusta*.—Corallum somewhat slender, expanding to a diameter of 16 lines in a length of 7 inches. Surface with numerous rounded rings of growth, of all sizes up to 3 lines in width. Costal striæ about 8 in the width of 3 lines, where the diameter is 10 or 12 lines. Where the diameter is 15 lines there are about 50 large and the same number of small septa. The larger have a depth of about 5 lines and the smaller 4 lines. They seem all to be slightly flexuous at their inner edges. The cup is about 1 inch in depth, the bottom smooth, flat or slightly concave and 4 lines wide. There is a small septal fossette. Occurs in the Corniferous.

5. *Z. Eriphyle*.—Corallum turbinate, slightly curved, expanding to a width of 2 inches in a length of about 4 inches. Surface with numerous small, mostly sharp-edged rings of growth. Near the base there are 7 or 8 costal striæ in the width of 3 lines; near the calice there appear to be 4 or 5. There are about 60 large septa, at a diameter of 2 inches. Many of these extend inwards to the centre. There are also 60 small septa, of a depth of from 5 to 7 lines. Bottom of the cup nearly flat, about 10 lines wide. The septal fossette is of an ovate form, its outer edge not reaching the margin, its inner extremity about half way to the centre.

This species is allied to *Z. inveneusta* in having about the same numbers of septa in the same width. It differs in having a much greater diameter, and the large septa reaching the centre. Occurs in the Corniferous.

6. Z. HECUBA.—Corallum large, expanding to a diameter of 2½ inches in a length of 4 inches. Surface with numerous, slightly elevated, rings of growth. Costal striæ at the margin of the calice about 1 line wide; 5 or 6 in a width of 3 lines at the base. Where the diameter is 28 lines, there are 50 large septa, many of which reach the centre. Between these there are 50 smaller septa of about 1 line in depth. The calice in a specimen 5½ inches in length, measured along the convex curve, is 20 lines deep. The wall is very thin, all the septa reaching the margin, on approaching which, they all become of nearly the same size, and reduced to thin elevated ridges, less than a line in heighth, with concave grooves between them. The bottom of the cup occupies about half the whole width, nearly flat, the septa forming small elevated lines upon its surface, converging to the centre. The fossette is large and has three septa in it; one large and two small. This species resembles the last, but differs therefrom in being a larger form, with the rudimentary septa less developed. There is also a strong likeness between it and *Z. Stokesi*. Corniferous.

7. Z. EGERIA.—Corallum, often strongly curved for 2 or 3 inches at the base, becoming more nearly straight above; expanding to a width of from 18 to 26 lines in a length of 4 or 5 inches. Surface with numerous rings, and a few undulations of growth. Epitheca thin, with 8 or 10 costal striæ in a width of 3 lines near the base; about half that number in the same space in the upper part of the coral.

In one specimen, in a transverse polished section, 3 inches from the base; there are 64 large septa 3 or four lines in depth, and the same number of small ones between 1 and 2 lines in depth. The diameter of the coral is here 18 lines.

In another individual, there is the same number of septa as in the former, the larger 5 or 6 lines in depth and the smaller from 2 to 4 lines. The diameter of this section is 25 lines and was cut across the coral at 4½ inches from the base.

A silicified specimen, 6 inches in length, shows that the cup is over an inch in depth, and the tabulæ excessively thin and fragile.

This is a more slender species than *Z. Hecuba*. It differs further in having more numerous septa at the same diameter and the large ones not reaching the centre except apparently near the base. It occurs in the Corniferous.

8. Z. GENITIVA.—Corallum turbinate, curved, expanding to a width of 21 lines in a length of 4½ inches. Surface with a few rounded folds of growth. Septal striæ 8 or 9 in the width of 3 lines at the base; in the upper part where the surface is perfect the striæ are not visible (in the specimen examined), but where a little worn there are about 6 in 3 lines, indicating both the large and small septa; or 3 where only the large septa are represented. At a diameter of 18 lines there are 56 large septa, 6 or 7 lines in depth; some of them reach nearly to the centre. The small septa are two or three lines in depth. The bottom of the cup is smooth with a slightly elevated, low pyramidal columella, forming a low ridge in the direction of a line drawn through the fossette. The latter is large, ovate, the smaller extremity pointing outwards. Occurs in the Corniferous.

9. Z. SUBRECTA.—Corallum somewhat straight, flexuous, gradually expanding to a diameter of 21 lines in a length of 6 inches. Surface with rounded folds of growth and a few broad undulations. Septal striæ 9 in the width of 3 lines at the base, becoming wider and more indistinct upwards. There are 38 large septa at a diameter of 18 lines, from 3 to 5 lines in depth; small septa, in general from ¼ to 1 line in depth. Occurs in the Corniferous.

Genus HETEROPHRENTIS (N. G.)

Corallum simple, turbinate. Calice large with a well defined septal fossette, the bottom either smooth or with a pseudocolumella.* Septa below the calice sharp-edged, often with their inner edges twisted together; above the floor of the calice they are usually rounded, especially on approaching the margin. There is apparently only a single transverse diaphragm, and this forms the floor of the cup.

This genus is intended to include (more especially) such species as *H. spatiosa*, *H. excellens* and some of those referred to *H. prolifica* = (*Zaphrentis prolifica*).

10. H. SPATIOSA.—This species I have heretofore called *Zaphrentis spatiosa*. It is a short, rapidly expanding species. Length of the typical specimen 3 inches, width at the margin 2½ inches,

* For the sake of brevity, I shall hereafter make use of the word columella.

where there are about 90 low rounded septa, somewhat unequal in size but in general 6 or 7 in the width of $\frac{1}{2}$ an inch. As all the specimens seen, are partially filled with siliceous limestone, which cannot be removed by the application of acid, I have not, therefore, been able to ascertain the characters of the bottom of the calice. Corniferous.

11. H. EXCELLENS.—Corallum turbinate, moderately curved, expanding to a diameter of $2\frac{1}{2}$ inches in a length of 6. Surface with numerous more or less angular folds of growth. Depth of calice 21 lines. Septa about 100 at the margin, rounded, slightly elevated, becoming sharp-edged and serrated as they descend. Bottom of the calice, striated by the edges of the large septa, a few of which reach the centre and ascend the columella. The latter 2 or 3 lines in height. A large and deep septal fossette. Corniferous.

12. H. COMPTA.—Corallum turbinate, curved, expanding to a diameter of 18 lines, in a length of 4 inches. Surface with rounded or sub-angular folds of growth. Calice 12 lines in depth. No columella. A moderate sized, septal fossette. There are about 100 septa at the margin of the cup. Corniferous.

13. H. PROLIFICA.—This species was published in Canadian Journal, March, 1859, and was made to include a number of closely allied forms, which could not be then separated for want of sufficient material. I now propose to confine it, to the group typified by the specimen figured with the original description, and in the Geology of Canada, page 365. It may be thus described—Corallum simple, turbinate, curved, expanding to a width of from 18 to 24 lines in a length of from 2 to 4 inches. Surface with a few undulations of growth. Septal striæ 8 to 10 near the base and 6 to 8 in the upper part in a width of 3 lines. Septa from about 100 to 120 at the margin (where they are all rounded), most common number from 100 to 110. In general they alternate in size at the margin; the small ones becoming obsolete on approaching the bottom of the calice; the large ones more elevated and sharp edged. The septal fossette is large and deep, of a pyriform shape, gradually enlarging, from the outer wall inwards for one-third, or a little more, of the diameter of the coral, at the bottom of the calice. Its inner extremity is usually broadly rounded or, sometimes, straitish, in the middle. It cuts off the inner edges of from 8 to 12 of the principal septa.

which may be seen descending into it to various depths. The surface layer of the bottom of the cup, extends the whole width, bending downwards a little near the margin, as in *Zaphrentis*, and uniting with the inner wall of the cup all around. It thus seems to represent one of the tabulæ of a *Zaphrentis*. The following are the principal variations observed in this part of the fossil.

1. Specimens with a perfectly smooth space in the bottom of the cup; no columella.

2. A smooth space with a small conical tubercle near the centre.

3. Smooth with a small ridge, two lines in length and half a line in heighth and width.

4. Smooth with a compressed columella 3 lines in length, 2 lines in height, most elevated next to the fossette, gradually declining in height towards the opposite side.

5. Smooth spaces very small, columella, a low elongated ridge, with a few tubercles on its crest.

6. Columella well developed, but with tubercles on it and around it.

7. Septa reaching the columella and more or less corrugated and either with or without a columella.

In all cases where the columella is elongated, its length extends in a direction from the fossette to the opposite side. In those which have the septa extending to the centre the columella is often represented by a low rounded elevation.

It is difficult, perhaps impossible, to decide whether or not this group of forms, is specifically distinct fram *H. excellens*. The greatest difference is seen in the surface characters. In *H. excellens* the folds of growth are in general numerous and angular, although some are rounded. In *H. prolifica* they are in general few and nearly always rounded. In *H. excellens* I have only been able to make out the septal striæ distinctly in one specimen. At 1 inch from the base there are 5 and at $2\frac{1}{2}$ inches 4 in the width of 3 lines. In *H. prolifica* there are 8 to 10 at 1 inch, and 6 to 8 at $2\frac{1}{2}$ inches.

To this may be added that *H. excellens* is extremely rare, while *H. prolifica* is very abundant.

H. prolifica is abundant in the Corniferous. I have seen only one specimen from the Hamilton group.

Genus Gyroceras.

14. G. Numa.—The only specimen of this species in the collection is a cast of the interior, which is sufficiently perfect to give us the number of the whorls and their form, but does not show the distance of the septa from each other, nor the position of the siphuncle. Shell large, consisting of about three whorls, all in contact, except a small portion of the last one at the aperture, which is disengaged. The dorso-ventral diameter of the whole coil is about 10 inches; of the two first whorls about $3\frac{1}{2}$ inches. The transverse diameter of the third whorl at its smaller extremity is 30 lines; dorso-ventral diameter of the same about 21 lines. The dorso-ventral diameter of the last whorl at about the point where it becomes separated is 4 inches, but as only a part of the transverse section of this whorl is seen, and the shell appears to have been compressed laterally, this dimension may be too great. On the ventral side of the last whorl there is a wide, slightly depressed furrow along the median line. This also may be the result of pressure. On a part of the second whorl, six or seven shallow rounded annulations are indicated, each of them two or three lines wide, and separated by grooves of the same width. A fracture in one place shows that the septa are deeply concave. As the aperture is broken away, it cannot be determined how much of the last whorl is free in the perfect fossil, but judging from appearances I should say not much more than two inches. Corniferous.

Genus Orthoceras.

15. O. Anax.—Shell about 2 feet long and from 3 to $3\frac{1}{2}$ inches in diameter at the aperture. Septa from 6 to 8 in a length of 2 inches, where the diameter is 18 lines. Siphuncle nearly central, cylindrical or nearly so, 2 lines in thickness where the diameter of the shell is 16 lines.

The best specimens in the collection, (those from $1\frac{1}{2}$ to 2 feet in length) show none of the septa except in the 5 or 6 inches of the smaller extremity. One only, shows a single septum which is $5\frac{1}{2}$ lines deep where the diameter is $2\frac{1}{4}$ inches. In the same locality, and in the same state of preservation, were found a number of fragments in which there are 8 or 9 septa in a length of 4 inches, where the diameter is between 2 and 3 inches. I think these all belong to the same species.

Genus LICHAS.

16. L. SUPERBUS.—The frontal lobe of the glabella of this extraordinary trilobite has almost exactly the form of an egg, covered with tubercles, and placed on the anterior half of the head; its greater length corresponding, in direction, with the length of the body. Behind this there are two much smaller, sub-conical elevations, separated from each other by a depressed space or channel, the bottom of which is either flat or slightly convex. Close behind these the occipital furrow crosses the head; and next in order, the occipital ring or neck segment. The channel between the cones, proceeding in a direction forwards, divides into two branches, which diverging right and left, separate the anterior sides of the cones from the posterior part of the large frontal lobe. The base of the frontal lobe has a concave constriction all around, so that on a side view, the lobe seems to stand upon a low pedicel, nearly as broad as itself.

Judging from the fragments I have examined, if a perfect specimen were placed flat on the ventral side, then the depressed space or channel between the two posterior nodes of the head, would be horizontal, while the longer axis of the ovate frontal lobe would slope forwards and downwards, at an angle of between 60 and 80 degrees. In this position the length of the head of one of our specimens is about 3 inches, divided as follows: width of the neck segment 4 lines; from the neck segment to the posterior part of the median lobe 12 lines; thence to the most projecting point of the frontal lobe, forwards, 17 lines, in all 33 lines.

Placing the base of the frontal lobe in a horizontal position, the dimensions are as follows: greater length of the lobe (along the median line) 21 lines; greatest width about the mid-length 17 lines; greatest height above the constriction that surrounds the base 10 lines.

The frontal lobe, although 21 lines in length, owing to its sloping condition, only contributes about 17 lines to the length of the head.

The width of the space, between the bases of the two cones is six lines; height of the cones 5 lines. These cones perhaps represent the anterior pair of the glabellar lobes of an ordinary Lichas.

We have one specimen in which the length of the frontal lobe is 3 inches and its width about 2 inches.

The surface is covered with tubercles of various sizes up to 2 lines in width in the largest specimens. The space between the 2 cones is nearly smooth.

There are about a dozen specimens of the frontal lobe in the collection, and they vary from a length of 9 lines up to 3 inches.

Occurs in the Corniferous.

CHANGES OF NOMENCLATURE.

In 1860–1861, I described, in the Canadian Journal, a number of species of Devonian fossils, which appeared to be new. During the thirteen years that have elapsed, many changes have taken place in palæontological nomenclature, and several of the names then adopted must be changed.

1.—*Athyris Clara*, also described by Prof. Hall under the name of *Meristella elissa*. I am informed that this species has been long understood to be *Atrypa nasuta*, Conrad, although it was not recognized as such by Prof. Hall in 1860. If it is truly Conrad's species it should be called *Athyris nasuta*.

2.—*Rhynchonella ? Laura*, published May, 1860, is the same as Prof. Hall's *Leiorhynchus multicosta* of a later date. See Am. Jour. Sci. 2d Ser. vol. 31, p. 293. Our species may be called *Leiorhynchus Laura*.

3.—*Stricklandinia elongata*, may be changed to *Amphigenia elongata*.

4.—*Strophomena inæquistriata* is *S. inequiradiata*, according to Prof. Hall.

4.—*Favosites basaltica*. When Goldfuss published this species he figured three specimens:

4*a*—From Lake Erie. 4*b*—from Gothland. 4*c* & *d*—from Eifel.

These represent, either two, or three species. The specific name can only be retained for one of these species. The question to be decided is "which of them"?

Lonsdale and McCoy, have expressed the opinion, that the specimen (c, *d*), from the Eifel, is *F. Gothlandica*. Prof. H. A. Nicholson, says in reference to this opinion, that "it is probable." —(Canadian Journal, 1873 ?)

Supposing these three authors, to be correct in this view—then (c, *d*) must be referred to *F. Gothlandica*, and the name, *F. basaltica*, retained for either one or both of the others.

The specimen figured by me as *F. basaltica*, is of the same species as 4*a*.

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