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THE

CANADIAN NATURALIST

AND

Quarterly Journal of Science.

WITH THE

PROCEEDINGS OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

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EDITOR.

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THE

CANADIAN NATURALIST

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Quarterly Journal of Science.

NOTES ON THE LOCUST INVASION OF 1874 IN MANITOBA AND THE NORTH WEST TERRITORIES.

By George M. Dawson, Assoc. R. S. M., F. G. S.

The ravages of the western locust, or devastating grasshopper, have of late years been very great, over all the eastern fertile region of the plains, and the insect has forced itself on the attention not only of the farmer, who directly bears the loss, but also on that of all interested in the western spread of settlement and civilization: liability to its inroads constitutes in fact, at the present time, the greatest difficulty in the way of the rapid occupation of a vast tract of otherwise desirable country.

While a member of the British North American Boundary Commission, I had the opportunity of passing over a great part of the region subject to the ravages of the locust; and it was intended to include in my first report as complete an account of the locust raid of 1874 as I could compile. For several reasons, however, this proved impracticable. Though by circulars, with a list of specific questions, issued for the purpose, much information was obtained from various parts of British North America, and the Western States, much of it was of a somewhat indefinite character. Mr. C. V. Riley, Entomologist to the State of Missouri, has also since published a pretty full account of the invasion in so far as the Western States of the

Union are concerned, in his Seventh Annual Report, to which my information could only enable me to add a few particulars. I therefore present here in a summary form the facts collected from the region lying north of the forty-ninth parallel, as a contribution to the history of the invasion of the summer of 1874, and a slight addition to the general knowledge of the locust and its migrations.

My thanks are due to the gentlemen who have kindly answered the questions addressed to them, and especially to those who have furnished me in addition with general results of their experience.

It now seems certain that the locusts causing such widespread damage on the western plains, belong to a single species, known to entomologists by the name of *Caloptenus spretus*. For its description, Prof. Thomas' Synopsis of the Acrididæ, or Mr. Riley's report above mentioned, may be referred to. The locust is a native of the high and dry western portion of the interior plain, and not of the alpine vallies of the Rocky Mountains, as at one time supposed. North of the forty-ninth parallel, the whole area of the third, or highest prairie-plateau, and probably much of the second, are congenial breeding places, and here the locusts are always in greater or less numbers, but in certain seasons they sweep eastward and southward in immense hordes, reaching to, and even beyond the limits of the region of prairie. In range, the insect is not bounded westward by the Rocky Mountains, save where they coincide with the eastern unbroken front of the western forest region, as in British America. They extend southward at times to the Raton Mountains, and into Texas, while to the east they have spread to the prairie country of the Mississippi, and on more than one occasion have penetrated far into Iowa. Northward, they appear to be limited by the margin of the coniferous forest which opportunely follows the line of the North Saskatchewan River.

It is difficult to ascertain exactly what the causes are which lead, or drive the locust in certain years to leave its western habitat, though it is possible that simply an excessive increase in numbers may bring about that result. Only a mere fraction of the vast multitude of eggs deposited can under ordinary circumstances come to maturity, and their vitality and the survival of the young insects, may depend on so many circumstances, climatic and otherwise, that even on the above simple supposi-

tion a broad margin of uncertainty appears. It is probable, however, that the great locust invasions are the resultants of the actions of many agents, favorable or otherwise, all which it is highly desirable should be known as a preliminary to methodical and carefully devised efforts towards amelioration.

The spring and summer of 1874 in the northern part of the interior region were unusually dry, A dry climate is generally supposed to be favourable to the locust, and chiefly to the greater dampness of the eastern cultivated region is attributed the deterioration in vitality of the insects produced in a following year from eggs laid by an invading swarm. It is also noticed that in the eastern region the insect seldom survives to a third year. Over the western breeding-grounds, therefore, a dry and temperate spring may enable great numbers to come to maturity; while the continuance of the drought, combined with the unusual abundance of locusts, may tend to bring about wholesale emigration.

The locust has, however, many specific enemies, of which Mr. Riley catalogues four. *Trombidium sericium* and *Astoma gryllaria* are mites and external parasites; *Tachina anonyma* and *Sarcophaga carnaria*, flies, the larvæ of which feed on the grasshopper and live within it. All these, or at least representatives of both classes, appeared with the locust swarms in Manitoba in 1874, and the insects of some swarms appear to have been weak and sickly from the number of parasites clinging to them; circumstances lessening to a considerable degree the damage done by the insects, and the vitality of their eggs. The quantity of locusts destroyed by birds, especially while the insects are quite young, must be very great, and it has even been suggested that the rapid succession of invasions during the last few years may be due to the destruction of game birds, especially the prairie chicken. It would hardly seem, however, that this is by itself sufficient cause, though it may be one among the many.

The position of Manitoba near the north-eastern limit of the range of the locust, is in so far favourable, as it is only exposed to invasions from directions included between west and south, and the prevailing winds being north-westerly and coinciding with the direction of the migration instinct of the insect, carry the greater number of the swarms from their breeding places to the South-Western States. The northern situation of

the province also tends to exempt it from a double visitation, first from southern, and then from northern and north-western broods. This Mr. G. M. Dodge shows, has occurred in Nebraska, southern swarms arriving as early as May and June, and others in July and August. The number of grasshoppers borne to Manitoba is, however, more than sufficient, and in the neighbouring State of Minnesota, according to Mr. Solberg, the grain destroyed in 1874 by the insects is estimated at over 5,000,000 bushels!

The years in which the locust has appeared in Manitoba in great numbers, are as follows, as far as I have been able to learn: —In 1818, six years after the foundation of Lord Selkirk's colony, they arrived on the wing in the last week of July, and destroyed nearly all crops except wheat, which being almost ripe partly escaped. Eggs were deposited, and in the following spring wheat and all other crops were destroyed as fast as they appeared above ground. In 1819 eggs seem again to have been deposited,* and in 1820 the crops are said once more to have suffered greatly. The next recorded incursion is that of 1857, from which it would seem that for 36 years the insect had not appeared, or at least not in numbers sufficient to attract attention. In 1857 the crops are said to have been so far advanced as to escape great damage, but eggs were left, and in 1858 all the young grain was devoured. We do not now hear of them for five years, but in 1864 they again appeared, but neither the adults nor the young of 1865 were sufficiently numerous or widespread to do much injury. They did not visit the province in 1866; and in 1867, though numerous swarms poured in, they arrived late in summer, and did little damage, showing a practical exemption for nine years, or since 1858. In 1868, however, the young brood devoured everything, causing a famine. They left Portage La Prairie in a southerly direction. Foreign swarms again arrived in 1869, but too late for the crops, which were very bountiful. The young in 1870 did much harm, but were, I am told, chiefly confined to the vicinity of the Red River, not extending up the Assineboine as far as Portage La Prairie. In 1872, fresh swarms arrived, but as usual too late to do much damage to wheat. Eggs were, however, left in abundance in the northern part of the province, and about Winnipeg and Stone Fort the farmers did not sow in 1873. The young grasshoppers were migrating southward up the Red

* Hon. Mr. Gunn states from fresh swarms in August.

River Valley before their wings were fully developed. In 1874, winged swarms again came in from the west, leaving an abundant deposit of eggs over all parts of the province.

The records thus include, for this area, a period of fifty-eight years, and during that time locusts may be stated to have appeared either on the wing from abroad, or directly from the egg, in numbers sufficient to attract attention, in fifteen seasons, but caused wide-spread and serious destruction of crops in ten years only. The record shows an exceptional and alarming increase in the frequency of invasion of late years, an increase which has also been noticed in the Western States, and which though no doubt partly due to the fact that larger tracts have come under cultivation and consequent observation, apparently leaves a balance in favour of some real cause of increase; and this it should be the object of every one interested in the matter, to ascertain if possible.

In 1874, in British America, it would seem that no locusts were produced from the egg east of the 103rd meridian, and perhaps not east of the 104th, though southwards, in Dakota, some are said to have hatched near Minnie Wakan Lake, long. 99°, and the young insects also appeared in several localities on the Missouri River, near long. 101° lat. 47°. From various places included between the 104th and 111th meridians, and the 49th and 53rd parallels of latitude, the insects are known to have been produced in large numbers; and from the outcoming direction of swarms, and other facts, it may be safely concluded that eggs were hatched in many places over this great uninhabited tract. The young locusts do not seem to cover uninterruptedly any great area, but to occur in extensive patches here and there, where flights of the preceding season have rested. Nor do the separate swarms arrive at maturity at exactly the same time, though a sudden change in the weather, and more especially of the wind, may cause a nearly simultaneous departure of broods from a large tract. In 1874, in the area in question, movement appears to have begun late in June, and continued during July; the direction of flight where it has been recorded, lying between east and south. On July 12th, I observed swarms ready for flight on the high plains near White Mud River (long. 107° 35′ lat. 49°.) The day was hot and calm, and though many of the insects were on the wing at all altitudes, they were following no determinate direction, but sailing in circles and crossing each

other in flight. The greater number were hovering over the swamps or spots of luxuriant grass, or resting on the prairie. A slight breath of wind would induce them all to take to wing, causing a noise like that of the distant sound of surf, or a gentle breeze among pine trees. They appeared ill at ease, and anxiously awaiting a favourable wind.

These eastern and northern hordes were those which afterwards fell on Manitoba, though a part of those hatched near the 49th parallel probably went south of that line. The dry season must have brought them to maturity rapidly, for in some parts of the province they arrived earlier than before known, though coming from the latest hatching grounds.

When examined in detail, the advance of the host loses to a considerable extent the definite form which it appears to have when more broadly viewed; for the grasshopper, like a sailing vessel, depends on the wind for propulsion, not having intrinsic power of swift flight; and the movement of the different bands is affected by all the mutations of the weather. Even omitting a few dubious dates, the well authenticated ones show a difference in the times of arrival in some parts of Manitoba, not corresponding with their geographical position. It appears certain that one extensive swarm traversed a part at least of the province north-eastward. They reached the Red River further south at Scratching River on July 11th. We hear of them on July 8th and 10th at St. Norbert, on the 14th at Winnipeg ten miles off, on the 17th at Little Britain seventeen miles further in the same direction. Swarms also arrived at Fort Ellice—180 miles west of Red River—with a similar direction of flight, on July 14th, or on the same day that they arrived at Winnipeg. These must have been a separate body travelling parallel to the first.

These dates only refer to the first arrival of locusts in considerable numbers, and the localities mentioned were afterwards traversed by other swarms. The second main direction of invasion, was from west to east, with occasional slight local deviations, and was that followed by most of the insects. Bands first appeared within the limits of the province on the Assineboine River at Portage La Prairie on July 3rd. They seem to have travelled eastward along the river, reaching Poplar Point—fifteen miles off, on July 12th; other and very extensive swarms are heard of north-westward of Portage La Prairie, at Beautiful Plain on July 15th, at Burnside, July 17th, Palestine, July 19th;

and on the 18th and 19th at St. Laurent, on the eastern shore of Lake Manitoba. On July 11th we find other hordes at Pembina Mountain, on the boundary line, and these in the course of their migration reached West Lynne on the Red River —thirty miles distant on the 15th.

On July 11th the front of the various swarms would be approximately bounded by a line drawn from Pembina Mountain on the forty-ninth parallel, to Scratching River, thence following the Red River to a point between St. Norbert and Winnipeg, from there probably bending southward through a region for which we have no information, but again turning northward, and striking the Assineboine a few miles west of Poplar Point, and thence running—though no doubt with many flexures—north-north-westward.

It will be observed that while great swarms of the locusts had thus nearly reached the eastern border of their range, there were still immense numbers just beginning their migration about the 107th and 110th meridians. These are no doubt the hordes which according to the Hon. Mr. McKay arrived in Manitoba during August. The directions taken by the insects on their departure from the various localities in Manitoba, show much diversity. They often remain some time on the ground, and after depositing their eggs they are weak and their organization is broken.

The most astonishing fact in connection with the habits of the locust is the fixed determination of the swarms to travel in a certain direction, and the wonderful instinct which leads them to wait for a wind favouring their intention. The usual direction of migration when swarms fall upon the cultivated lands and settlements, is south-eastward or eastward, and to this there is abundant testimony. There is evidence, however, that the insect occasionally migrates in great bodies in a nearly opposite direction, and in 1875 it would appear that many swarms, the progeny of those of 1874, have shown a like decided inclination to travel northward, toward the breeding grounds of their parents, while yet in their full strength and vigour. It would be a fact surpassing in interest the journeys of birds of passage, if it should be found that the locust requires two generations to complete the normal cycle of its migration.

The locusts are recorded on one occasion at least (1867, by Prof. Hind) to have reached the shores of the Lake of the

Woods, but I have not heard that they did so in 1874. Their limit in this direction is pretty definitely fixed by the western margin of the great woods, about long. 96°. They did not appear at Fairford Port, on the northern part of Manitoba Lake, nor at Swan Lake House (long 100° 30′. lat. 52° 40′), Cumberland House (long. 102° 30′, lat. 54°), Prince Albert (long. 105° 30′, lat. 53° 10′), or Fort Pitt (long 109° 20′, lat. 53° 30′). They are very seldom seen at the second, and never at the third and fourth of these localities. The exemption of Prince Albert is noteworthy and instructive, as, on the testimony of several gentlemen acquainted with the locality, it is due to a *belt of coniferous timber*, which stretches between the North and South Saskatchewan Rivers here; and though grasshoppers in great abundance have visited the country south of the line thus formed, *they have never been known to cross it.*

The only crops which under ordinary circumstances the locust will not eat, appear to be sorghum and broom corn; but besides a general preference for those plants which are tender and juicy, it shows a considerable degree of aversion to certain species, and these generally escape when the insects are not in very great number. Potatoes, beets and tomatoes are usually thus exempt, and a very decided dislike is shown to the *Leguminosæ* or plants of the pea and bean family. May not this last fact serve to explain, to some extent, the vast number of leguminous plants found on the western plains, which have no doubt been subject for ages to the ravages of grasshopper armies? In *Astragalus pectinata* the leguminous flavour is developed to a very offensive extent. I have seen *A. adsurgens* stripped of its flowers by the locusts, while the leaves, though young and tender, remained entire.

Experience abundantly proves that in years when foreign swarms are to be expected, wheat is one of the safest crops, as it is very generally too far advanced to be much injured at the time of their arrival. It is essential, however, that it should be as early as possible.

It seems hardly necessary at this date, to review all the means which have been proposed or tried, on a more or less extensive scale, to protect crops from winged swarms, or to destroy the eggs and young insects. Methods applicable with advantage to well settled countries, are not useful, or only to a very limited extent, in those with much waste land in proportion to the cul-

tivated, yet by persistent and combined effort much may be done towards the protection of limited areas, by disturbing and harrassing the winged insects on their arrival in summer, and by collecting and killing the eggs and young brood in autumn and spring. A great area of the western plains incapable of cultivation or use for other purposes than stock raising, must, however, always remain as a breeding place for the locust, and it is only by the application of some broad and general remedy, if such can be found, that permanent amelioration can be effected. It would seem possible by an organized system of supervision, and the division of a large part of the prairie region into blocks protected by rivers and other natural fire-guards, and by ploughed lines, to prevent the general spread of prairie fires in the autumn, and afterwards to destroy the young locusts by burning the grass off over those areas found to be tenanted by them in spring. A similar course is urged by Dr. Studley as worth trial. Mr. Mair informs me that it has been attempted in the spring of 1875 near Portage La Prairie without effect; but by choosing a time when the grass is dry, the wind moderate, and the young insects pretty well advanced, it seems scarcely possible that many should escape. Again, when winged swarms are known to be moving on the province, making use of a similar system of fire-guards, it would be possible to form by preconcerted firing a strip of black country of great width, altogether beyond its limits, over which it is improbable the locusts would voluntarily attempt to pass. The extensive planting of trees in all the cultivable districts, besides probably effecting a climatic change causing increased damp and rainfall, which would be unfavourable to the locust, would so break up and divide the now uniform surface of the country as to prevent the destruction of crops being so universal as it now sometimes is. Coniferous trees, from the experience of Prince Albert Post, seem specially worthy of attention.*

It is my intention in a future paper, to summarize and discuss the facts concerning the grasshopper visitation of 1875, with especial reference to Manitoba and the North-west Territories, and I shall be much indebted for any particulars which will help me in this object.

* This and other points will be found more fully treated in my Report on the Geology and resources of the regions in the vicinity of the 49th parallel, 1875.

The following is a summary of the more important items of information for the summer of 1874, the localities being arranged in order from west to east:—.

Battle River and Red Deer River, North West Territory.—(W. McKay, from reports of H. B. Company's officers) A tract of country extending sixty miles north and south, and fifty miles east and west between Battle River and Red Deer River. Grasshoppers produced from the egg about the beginning of June. Left about the end of July, going southward from the Battle River.

Fort Pitt, North West Territory.—(W. McKay). Did not appear within 140 miles of this place.

Observations in the vicinity of Wood Mt. and Westward.—On the 7th, 8th, 9th, and 10th of July, I noticed grasshoppers in great abundance on the high plateau of Wood Mt. (long. 106° 30′) and its vicinity. They were migrating eastwards with the prevailing winds during the warm hours of the day, and flying at a great height. On the 12th they were met with in vast numbers covering the country to the west of White Mud River (long. 107° 35′.)

Swarms were also observed by other members of the Boundary Commission parties, on the 9th, 10th and 11th of July, at numerous points between long. 108° and 109° 30′, the last named meridian being about the western limit of the main horde at this time. Their general direction of travel was eastward, with the wind. On July 11th, their course is stated at several localities to have been south-east.

It would thus appear that on July 9th to 11th, the width of the belt of grasshopper-covered country was about 150 miles on the forty-ninth parrallel, stretching from beyond the West Fork of Milk River nearly to Wood Mountain.

Carleton House, North West Territory.—(L. Clarke.) Produced from the egg in 1874 almost immediately after the disappearance of the snow, early in May. When full grown took flight southward. Foreign swarms appeared in the beginning of September and stayed all the autumn. No crops put in here.

Mr. Clarke writes:—East of this there is a settlement called Prince Albert, about fifty miles distant. Between us and this place there is a tract of sandy soil covered with a forest of fir.

Strange to say the grasshoppers have been in myriads from Carleton to the boundary of this timber, but none on any occasion have ever passed it, or troubled the farmers of Prince Albert.

Prince Albert, North West Territory.—(Philip Turner). No grasshoppers appeared here.

Missouri Coteau, North West Territory.—Long. 105° 30′, lat. 49° 30′. On June 19th, 1874, I passed over about twenty miles of country near the western edge of the Tertiary Plateau, which was covered with young grasshoppers, not yet able to fly.

Fort Qu'Appelle, North West Territory.—(Wm. J. McLean.) Produced from the egg, hatching from early in May to the beginning of July. On July 25th began to take flight, going south-east by south. Foreign swarms were first observed about July 20th coming from north-west, and north-west-by-north. Continued passing for ten or twelve days, and remained on the ground only while contrary winds lasted. All were gone early in August, and no eggs were deposited.

Crops totally destroyed before the insects began to fly. Mr. McLean observes, that the insects before they were able to fly, took certain directions for several days at a time, and all travelled simultaneously in the same direction.

In 1875 full grown insects appeared June 17th in myriads. Seemed to come from about the same direction in which they flew from here last year, but rather more southerly.

Wood End, North West Territory.—Long. 103°, lat. 49°. Dr. Burgess on July 1st and 2nd noted grasshoppers flying westward with the wind. They are said to have been very numerous. (The wind at Wood Mt., 150 miles further west, was variable on these days, changing from south-east on the first, to east-north-east, south and north-north-east on the second.) The observed direction of flight is abnormal.

Cumberland House, North West Territory.—(H. Belanger.) Grasshoppers never known to appear here in swarms.

Fort Ellice, North West Territory.—(R. McDonald.) Not produced from the egg here. Arrived in swarms July 14th, from the south-west. Left July 17th, after devouring all the crops, going north-east. Eggs were deposited and some were

observed to hatch in the autumn. (On June 7th, 1875, the young insects had already destroyed all growing crops.)

Swan Lake House, North West Territory.—(D. McDonald.) The grasshoppers did not appear here this summer, and are said to do so very seldom.

Beautiful Plain, North West Territory.—(Prof. Bell, Geological Survey of Canada.) Not produced from the egg here. Swarms arrived on the wing July 12th and were nearly all gone July 15th. Came from the west, and departed about east-south-east. Eggs were deposited in great numbers in gravel and sand ridges, on badger mounds, &c. Very few were observed to hatch in autumn. Between Prairie Portage and Headingly about two-thirds of crop destroyed.

Manitoba House, North West Territory.—(J. Cowie, J. P.) Not produced from the egg here. Swarms arrived about the third week of July, from the south-west, but not in great numbers. Passing over the place for about a week, going generally south-east. Eggs were deposited.

Crops destroyed, about one-tenth.

None were seen to the north of this place. Multitudes were drowned in the lake (Manitoba Lake), on the shores of which they were piled up in masses three feet deep.

Fairford Post, North West Territory.—(J. Cowie, J. P.) No swarms of grasshoppers have as yet appeared here.

Palestine, M.—(D. Ferguson.) Not produced from the egg here. On July 19th a few appeared, and were afterwards followed by great swarms coming from the north-west. Insects left about July 30th, going north-east. No eggs deposited.

Destruction of grain total, of potatoes one-fifth.

Burnside, M.—(K. McKenzie). Half-breeds told Mr. McKenzie that grasshoppers were very thick in the Saskatchewan country, and within sixty miles of Burnside on July 14th; on July 17th they arrived. Came from the west, and kept pouring in till July 22nd, being most numerous on July 19th. By July 29th had nearly all gone. Direction of flight on departure east or north-east. Eggs were deposited.

Wheat crops at Burnside averaged 16 to 20 bushels per acre against 28 to 32 in former years; in western settlements not

4 bushels per acre. Oats and barley nearly all destroyed. Potatoes not much damaged. Turnips half crop. Peas uninjured. Carrots nearly all taken. Onions one half. Beets and mangolds hardly touched.

The grasshoppers made their appearance, especially in the western part of the province, earlier than ever before. Mr. McKenzie was informed by the half breeds that the insects hatched at Qu'Appelle and other western localities, and that very few were left there to deposit eggs in the autumn of 1874. Mr. McKenzie also writes, "I was at Lake Manitoba, twelve miles north, about August 10th. Grasshoppers were dead and dry on the shore from four to ten inches deep, and from twenty to thirty feet wide as far as I could see all along the beach."

Portage La Prairie, M.—(Charles Mair). Not produced from the egg here. Swarms first seen about July 3rd, coming from the west. Left about July 10th, going eastward. Many eggs deposited. Crops destroyed. Oats seven-eighths, barley three-fourths, wheat one-half. Potatoes not much injured; gardens much damaged.

Mr. Mair also observed the grasshoppers to be covered with parasitic mites, and the presence of the larva of an ichneumen in the bodies of many of the insects.

Poplar Point, M.—(L. W. McLean.) Not produced from the egg here. Swarms first appeared July 12th from the west. Insects left about the last of July, going east. Eggs were deposited.

Barley and oats totally destroyed, wheat one-third.

Pembina Mt., M.—(Lt. Col. French, Commissioner N. W M. P.) First met large flights of grasshoppers at Pembina Mt., July 11th. They were going eastward, and continued to appear for several days while Col. French travelled westward but were afterwards no more noticed. The grass from La Roche Percée to the Old Wives Lakes, and possibly to the Cypress Hills, appeared to have been eaten down by grasshoppers. In the vicinity of the Three Buttes, no such appearance.

They nearly destroyed a field of grain sown by the Mounted Police at Fort Ellice.

St. Laurent, M.—(J. Mulvihill.) Not produced from the egg here. Swarms appeared July 18th and 19th from the west and north-west. Left about August 4th, going southward. Eggs were deposited. At least one-fourth of crops destroyed.

Headingly, M.—(John Taylor). Not produced from the egg here. Swarms arrived from the south, and from the west, about the first week of August. The majority remained till about the first of September and then went southward. Some stayed till the end of September. Eggs were deposited and a few of them hatched in the autumn and the young insects were killed by the frost. About half the crops destroyed.

St. Charles, M.—(W. Adshead). Not produced from the egg here. Appeared about the middle of June (?) from the west. Most remained till killed by frost, though a few went southward after depositing their eggs. Destruction of barley and oats total, wheat one-third, potatoes somewhat injured.

Rockwood, M.—(J. Robinson). Not produced here from the egg. Swarms appeared about the last of July from the south and west. Departed about the middle of August, going south and west. Eggs were deposited, a few were hatched in autumn and the insects destroyed by frost. More than half the crops destroyed.

Scratching River, M.—(W. C. Cowan). Not produced from the egg here. Swarms arrived July 11th, from the southwards, bearing westerly. Left July 16th, going northward. Eggs were deposited and some insects came out and were killed by the winter. Crops destroyed, two-thirds.

West Lynne, M.—(Colton M. Almon.) Not produced here from the egg. Swarms arrived on July 15th, about 11 a.m., from the westward. Commenced rising early on the morning of July 22nd, and by noon had disappeared. Direction of flight, north. Eggs were deposited, and it is reported that many hatched in the autumn. Oats and barley, two-thirds destroyed, wheat about one-fourth, potatoes a little damaged.

St. Norbert, M.—(Joseph Lemay, M. P. P.) Not produced from the egg here. Swarms first seen July 8th or 10th, and arrived both from the south-west and north-west. Remained about seven weeks, departing south-eastward. Eggs were depo-

sited, but many said to have been destroyed by "small red insects." The whole of the oats and barley, three-fourths of wheat, and four-fifths of garden stuff destroyed.

St. James, M.—(Hon. J. McKay.) Mr. McKay furnishes various particulars, from which I extract the following points of interest:—No grasshoppers were hatched in Manitoba in 1874. The nearest breeding ground for the swarms is said to have been about 250 miles west, and thence to extend westward for about 400 miles. The nearest swarms moved in July and passed St. James overhead, going eastward, about the end of July. Other swarms from further west arrived about the beginning of August, and left after a few days without doing much damage. Then came larger swarms till the middle of August, carrying everything before them. Estimated that two-thirds of crops of entire province destroyed.

Winnipeg, M.—(James Stewart and R. H. Kenning). Not produced from the egg here. Swarms arrived July 14th from south-west, and the majority remained about two months, leaving about the middle or end of September, and going to the west and north-west. Many remained, however, till killed by frost. Eggs were deposited about the end of August, and it is reported that some young insects came out and were destroyed by frost in autumn.

The whole of the oats and barley, and about one-fourth of wheat destroyed.

Mr. Stewart observed that nine-tenths of the grasshoppers had small red parasites under the wing, and that those remaining late in the autumn had, almost invariably, each a fully developed grub within it.

Little Britain, M.—(Hon. D. Gunn.) Not produced from the egg here. Swarms first appeared July 17th, from the south and south-west, and continued passing over the settlement till the last of August. Those that alighted deposited eggs, and generally left afterwards east or south-east. Many eggs deposited. Crops destroyed, about one-third.

In a more recent communication (February, 1876), Mr. Gunn states that, the spring of 1875 having been late, the young locusts from the eggs began to appear about the tenth of May, and continued to come out until the end of that month. They

were very numerous and destructive, but he noticed that many were attacked with a small red parasite. When mature, the swarms went, in part at least, to the north; and some were stated to have deposited their eggs near Lake Winnipeg. Other facts contained in Mr. Gunn's letter I hope to include in the report for 1875.

Stone Fort, M.—(W. Flett.) Appeared in swarms from the south and south-west, generally departing easterly. Eggs deposited, and some hatched in autumn.

Cook's Creek, M.—(G. Miller.) Not produced here from the egg. Swarms appeared about July 26th from the north-west. Remained about two weeks and departed south-eastward. Many passed overhead without alighting. Crops about two-thirds destroyed.

St. Ann's, M.—(J. H. Stanger). Not produced from the egg here. Swarms first seen July 22nd, and coming from west-by-south. Continued arriving and departing for about two months, some leaving in the latter part of September, but many remaining till they died. The first swarms went from here eastward, the last more to the south. Eggs were deposited and some were hatched in autumn.

Barley, oats, potatoes and vegetables suffered most. Some wheat escaped. Peas suffered least of all field crops.

NOTES ON NORTH-WESTERN AMERICA.*

By ALEXANDER CAULFIELD ANDERSON, J. P. (Formerly of the Hudson's Bay Company.)

WATERSHEDS.—The main continental watershed is of course the general line of the Rocky Mountains, which continue through Alaska to the extreme point, near Cape *Lisburne*. There is, however, an exception to this general rule near the heads of Peace River, where the main chain is disrupted, and the waters originate in the Peak Range of Arrowsmith's Map, which range here forms an extraordinary loop with the main line. Both afterwards unite with the N.W. Coast Range, and continue as one, nearly as far as the 60th parrallel, where a divergence again takes place, and the Southern Coast Range of Alaska originates.

The Sierra Nevada, the chief range of California, separates near the frontier of Oregon; the eastern branch, known as the Blue Mountains, dividing the waters of the main Columbia River from those of its great tributary, the Snake; the western, under the name of the Cascade Range, continuing north-westward into British Columbia, as far as the junction of the Thompson with the Fraser in 50° 13′, where it terminates. The Cascade Range is disrupted at a point between Mounts Hood and St. Helens; the Columbia River then breaking through and forming a strong rapid known as the "Cascades," whence the name given to the range. This name, however, originates not from any peculiarity in the rapid itself, but from several lofty waterfalls, formed by streamlets pouring down the perpendicular face of the disrupted mountain in the immediate vicinity. The height of the passes in this range varies from 3,000 to 5,000 feet; the peaks sometimes rising to an altitude of 15,000: Mount Rainier, the most lofty of the northern portion, has an elevation of 12,360 feet. Most if not all of these summits are volcanoes, either extinct or in partial eruption at distant intervals. It may here be mentioned that the term

* Descriptive matter intended to accompany a "Skeleton Map of North-West America," prepared by Mr. Anderson to send to the Philadelphia International Exhibition of 1876.

"Cascade Range," through a total misapprehension of the leading features of the country, has of late years been extended so as to include also the North-West Coast Range, from which the true Cascade Range is geographically quite distinct. Hence much confusion has arisen. Against this perversion I have always protested; and now once more endeavour to restore the distinction before most properly made by the original explorers, and established on their maps.

The North-West Coast Range, just referred to, originates opposite to Langley near the mouth of Fraser River, and continues north-westward, nearly parallel with the coast, till it is merged in the Rocky Mountains between 56° and 57°—thus forming the whole western watershed of Fraser River, as the northern part of the Cascade Range, with its offset connected with the Rocky Mountain Columbian spur, does the eastern. The contour of this range, especially on the coast-ward side, is extremely broken and irregular; its rugged spurs forming the sub-divisions between the numerous arms with which the north-west coast is indented. As we advance northward, however, the summit itself is not of a broken nature; but exhibits a vast plateau, yielding lichens and other congenial vegetation, together with a stunted growth of pines in parts. This portion of the range is the resort of innumerable Rein-deer of the mountain variety, and abounds also with Ptarmigan. Its elevation opposite to Bentinck Arm, between lat. 52° and 53°, is 4,360 feet, and at the head of Bute Inlet Pass, where the characteristics are somewhat different, 3,117 feet; but there are other points where depressions occur, as for instance between Stuart and Babine Lakes, where the altitude does not probably much exceed 2,000 feet above the sea level. The highest summits in parts, rise to about 10,000 feet; but amid the general ruggedness of contour there are no strikingly conspicuous peaks as on the Cascade Range.

Diverging from the Rocky Mountains near the 49th parallel is the ridge forming the *Southern and Eastern Watershed of Hudson's Bay.*—Under the varying cognominations of Coteau de la Missouri, Coteau des Prairies, &c., this watershed, passing the heads of the Red River, forms the northern and western boundaries of the Provinces of Ontario and Quebec, and, dividing Labrador, terminates at Hudson's Strait, opposite to Southampton Island. The average elevation of the Prairie

portion of this ridge, as given by Mr. G. M. Dawson, is 2,000 feet. The western and northern portions of this vast watershed are the Rocky Mountains as far as the head of the North Saskatchewan. From this portion of the watershed, in about lat. 64°, the range forming the Arctic watershed diverges, terminating at the mouth of the Mackenzie.

Alaska.—The Kwitchpak or Yukon is the principal stream of this extensive region—a river of very considerable magnitude. The Hudson's Bay Company have long had posts on the upper waters of this stream, within the British territory; but it is chiefly from the reports of the party sent for exploration in connection with the projected telegraph through Siberia that our knowledge of the lower portion is derived. Thence it appears that the river is navigable for steamers for 1,000 miles or more; that the ice breaks up about the 23rd of May, and that navigation is practicable about the 25th. The length of the Yukon, including its windings, I compute to be about 1,600 English miles. The volume of water ejected by it, according to the accounts received, is probably not less than that emitted by the Mackenzie; but the area drained by it and its tributaries (about 229,000 square miles) is very much smaller. Hence it may be inferred that the snow-fall in the mountains of Alaska is proportionately heavy, a result readily conceivable from its geographical position—directly interceptive of the vapour-drift from the Pacific. The upper portions of the Yukon and its tributaries, the Porcupine and other streams, are well wooded, and abound with animals yielding furs of a quality peculiarly fine. Moose-deer are numerous along the rivers and in the lower elevations. In the more precipitous ridges of the mountains the Wild Goat is found; on the sloping spurs the Mountain Sheep or Big-horn. Rein-deer are numerous; the larger variety frequenting the interior parts, the smaller, or Barren-ground Rein-deer the coast-ward tracts. Fish of various kinds are numerous in the waters; and among these, two varieties, at least, of Salmon periodically ascend from the sea. The larger of these (*Salmo dermatinus*, of Richardson) attains a weight of from forty to fifty pounds; the smaller (*S. consuetus*) from twenty to twenty-five pounds. The natives of the interior of Alaska, distinguished as the Koochin tribes, are a branch of the great *Dinnee* (or '*Tinneh*') family. The Koochins have the character of being industrious, and are in many respects a somewhat superior race. They are divided into some

twenty or more different septs, each bearing a specific cognomen with the general affix "Koochin," meaning I believe "people." Approaching the coast the country assumes the generally desolate aspect of the Arctic Ocean confines, and the Esquimaux occupy the immediate sea-board. It is probable that with time mineral deposits of various kinds may be developed in Alaska. So far copper is known to exist in parts; and during the past summer some gold-seekers have been working upon streams falling into Cook's Inlet, the daily yield of whose labours is reported to have been moderately productive, averaging from $4.00 to $5.00 per man. Fossil ivory, as on the Siberian shore, is known to exist in the northern part of Alaska, adjoining Behring's Strait.* The name Alaska I believe to be a modification of the term for this coast employed by the natives of Kamtchatka; who, according to Benyowski (Voyages et Mémoires, &c. Paris 1791) distinguished the main shore of America as Alaesina (or Alaesa), the termination being apparently an affix. The Point "Le Grande Alaesina" mentioned at page 413 of vol I, I identify with what is now known as Cape Prince of Wales.

Mackenzie River.—This river, with its tributaries, drains an area of about 520,000 square miles, or more than double that drained by the Yukon. Its length from the mouth on the Arctic Ocean to its remote heads in the Rocky Mountains, by the line of Peace River, and including windings, is little, if at all, short of 2,000 miles. Unlike the Yukon, there are several lakes of very large dimensions connected with it. The lower part of the Mackenzie shares the generally barren and inhospitable nature of the Arctic coast; and there is little vegetation beyond a few stunted willows, the cranberry, the widely distributed "Labrador Tea" (*Ledum palustre*) and other products of a congenial class. Yet even amid this scene of desolation, Mackenzie noticed, in July, tracts of luxuriant grasses mingled with gay flowers, covering the ice-bound soil; just as navigators have noticed the same seeming anomaly in Kotzebue Sound and elsewhere along the Strait of Behring. Rein-deer are the only species of the family found here; Foxes of several varieties, including the white (*Vulpes Lagopus*) occur; also the Marmot, the Bear,

* Kotzebue, in 1816, when landed on Chamissa Island in Kotzebue Sound, discovered the remains of *Elephas primigenius*, apparently portions of a large deposit, imbedded in the land ice.

&c. In addition to the many kinds of migratory water-fowl that resort to these localities to breed, the white Grouse or Ptarmigan (*Lagopus albus*) appears abundantly as a permanent resident, as indeed along the whole Arctic watershed and the shores of Hudson's Bay. The White-fish (*Coregonus*), several varieties of Carp, Trout, and other fish, including the Inconnu (probably grayling, *Thymallus signifer*, of Richardson ?), are common to the stream and its tributaries. The Pike also is found, but no Salmon ascend this river ; which in this respect forms probably the solitary exception among all the larger streams from California upwards to this point. For the deficiency of this valuable fish there is no apparent cause ; nor does there seem to exist any reason why it should not be artificially introduced at some future day. Higher up, as we approach the discharge of the Great Bear Lake, the evidences of an improving climate appear. The Service-berry (*Amelanchier*), the Wild Gooseberry and other fruits are common ; the country throughout is well timbered, chiefly with varieties of fir and pine ; and a greater variety of beasts of the chase, including the Moose, the Beaver, &c., appear. Little has been ascertained of the mineral characteristics of the lower Mackenzie ; but Sir Alex. Mackenzie, whose name it bears, mentions a seam of coal (or lignite ?) which was on fire when he passed in 1789 ; and which was noticed by Dr. Richardson, still in a state of ignition, as late as the year 1848. Upon the heads of the Rivière aux Liards, an extensive tributary joining from the southward, productive gold-beds have been wrought for the last three years ; and here, within the limits of British Columbia, under the name of " Cassiare," a settlement has been formed in connexion with this alluring, if precarious, industry. This river, it may be mentioned, derives its name from the profusion along the banks of its lower portion, of the Cotton-Wood Poplar (Liard = *Populus balsamifera.*) It is needless to add that in the mouths of the many, the name has already been wonderfully transformed.

Peace River.—The lower portion of this tributary of the Mackenzie, after its junction with the Athabasca, where it is upwards of a mile in breadth, is known as the Slave River ; a name originating with the Cree Indians, who applied the designation (*Awâh-can*, or slave) in derision of the lower Chipewyans, who were formerly treated by them as enemies, and whom they had driven from their lands. Towards the end of the last

century a general pacification of the hitherto hostile tribes took place, a treaty of amity having been concluded at the spot since known as Peace Point. Hence the name of La Rivière a la Paix, now translated into "Peace River," given to the stream by the first explorers. Its original name, however, is Unjigah, the signification of which, if haply it have a signification, I have never been able to ascertain. The whole extent of country through which this noble river flows, from the point where it breaks through the Rocky Mountains (*vide supra*) to its junction with the Athabasca, is very attractive, and a vast area for future settlement is presented. The want of space will prevent my dwelling on the charming features exhibited by this beautiful region; and I merely remark that its general characteristic is that of extensive plains, stretching on either side clear up to the foot-hills of the Rocky Mountains and their several spurs, and amid which groups of aspens, &c., are picturesquely interspersed. With reference to the climate of this portion of the country, the mere consideration of latitude would, if entertained, mislead the uninformed enquirer very gravely. A glance at the isothermal lines will show that leaving the Atlantic coast they trend abruptly northward till they reach the vicinity of the Rocky Mountains; and finally the actual difference of the mean temperature as between positions on the Atlantic and the Pacific, may be stated in approximate terms as about ten degrees Fahrenheit in favour of the latter. Hence the denizens of the Peace River country and the Saskatchewan enjoy a climate far more genial than might be supposed. The confined space at my disposal prevents my entering upon any prolonged discussion of this interesting theme, to which, however, I may again incidentally refer. I content myself by remarking that the snow, in most parts, seldom accumulates to a greater depth than eighteen inches on the levels, the warm south-west winds, of frequent recurrence during the winter, at once diminishing it, or at times removing it almost entirely from all the lower land. The river opens about the 25th of April, and is closed for navigation at the beginning of November. I shall here, however, avail myself of the valuable notes of Professor J. C. Macoun, drawn from the railway reports and other sources. At Fort Vermilion on the 6th of August (1875), lat 56°. 42′, barley ripe and cut, and on the 12th wheat and oats fit for reaping. At Fort McMurray at the forks of the Athabasca, an excellent garden

containing many kinds of vegetables, including fine cucumbers. At Isle à la Crosse (English River) potatoes still in the ground on the 22nd September, there not having been any frost up to that date. Mr. Selwyn, Director of the Canadian Geological Survey, is reported to have brought down samples which will doubtless appear at the Centennial Exhibition; viz.: Spring wheat from Fort Chipewyan (Athabasca Lake), lat. 58° 45′, weighing sixty-eight pounds to the bushel—sown May 22nd, reaped in August. Barley from the same place weighing fifty-eight pounds to the bushel; and oats from Fort St. John on the Peace River, on the verge of the Rocky Mountains. The leading vegetable forms observed by Mr. Macoun in the Prairie section around Dunvegan, are as under :—

Anemone Virginiana.
" patens.
Geum triflorum (Bennet.)
Potentilla arguta.
" Pennsylvanica.
Amelanchier Canadensis, (Service berry.)
Achillea millefolium, (Yarrow or Millefoil).
Rosa blanda.
Hedysarum boreale.
Solidago (Golden Rod), two species.
Aster multiflorus.
" lævis.
Orthocarpus luteus
Troximon glaucum.
Oxytropis splendens.
Elæagnus argentea (Silver-berry.)
Vicia Americana (Vetch).
Artemisia frigida.
" discolor.
Bromus Kalmii.
Triticum repens, &c.
Aira cæspitosa.
Lathyrus ochroleucus.
Poa serotina.
Stipa Richardsonii.
" membrancea.
Trisetum subspicatum.
Calamagrostis Canadensis.
" stricta.

Mr. Macoun adds that every plant on this list grows also at Edmonton, on the Saskatchewan, and all grow where wheat will come to perfection. But nothing, perhaps, can more satisfactorily prove the true prairie character of the country than the fact mentioned by Mr. Macoun, that at Dunvegan he found growing the Disc-leaved Cactus (*Opunita Missouriensis*) which is always indicative of a dry locality with a considerable degree of mean annual heat. The whole of this region once abounded with herds of Bison, as still do parts of the Saskatchewan; but the remnants are now found only in remote places on the outskirts of the Rocky Mountains. Other beasts of the chase, such as the Rein-deer and the Moose are still numerous; while in the mountainous parts the Rein-deer, the Goat, the Mountain Sheep, the ordinary varieties of the Bear (black, brown and grizzly), &c., abound.

Athabasca River.—This is reached on crossing the divide, between it and Peace River. The summit of this divide, composed of a swampy plateau with a vegetation of corresponding nature, does not probably exceed 2,000 feet in height—that of Lesser Slave Lake, on the one hand, and Dunvegan on the other, being estimated, the former at 1,800, the latter at 1,000 feet above the sea-level. The banks of the Athabasca River are generally less inviting in appearance than those of the Peace. The lower portions, however, present many attractive features; and the climate, as indicated by the extract given above, is encouraging for agriculture. The borders upwards, are for the most part thickly wooded with the Spruce and *Cyprés* (*Pinus Banksiana*) interspersed with the Balsam Poplar, the White Birch, and other deciduous trees. Animals of the various kinds mentioned abound throughout in their fitting localities, while fish of the finest description are yielded by the lakes. Athabasca Lake, it may be here mentioned, is noted for the innumerable flocks of water-fowl which resort thither as a favorite breeding place, and which at the proper seasons yield store of food to the inhabitants. The mineral riches of the tract drained by these large rivers are varied; at the head of the Peace, on the borders of the Peak Range, there are extensive gold diggings, known as Ominеca, which are moderately productive, though now partially abandoned for richer fields. Coal, reported to be of good quality, is found at several points upon the Athabasca; while favourable indications appear upon the Peace. Bituminous pits exist in several places along the lower Athabasca; yielding an apparently inexhaustible supply of pure mineral tar. The product of some of these, duly prepared by boiling, &c., has long been used for pitching the boats employed for transport. Smoky River, falling into the Peace above Dunvegan, has its name from beds of coal or lignite, which were on fire when Europeans first visited the country, if indeed yet extinct. Mineral Salt is found between Athabasca and Great Slave Lakes. Near the mouth of the "Salt River" it appears in the form of a thick incrustation on the borders of the springs, and requires merely to be shovelled into bags. The salt thus procured has from the first been the sole resource of the European residents, and is of an excellent quality for all domestic purposes.

The Barren Grounds may be defined as extending from the watershed immediately north of Churchill River to the

Mackenzie, along the slopes towards Hudson's Bay and the Arctic Ocean. As shown in a previous note, referring to Isle à la Crosse, the soil and climate along the upper portion of the former stream are sufficiently favourable for agriculture; but lower down, and proceeding northward and westward, the whole region is extremely desolate and inhospitable. This is occupied by a portion of the great Chipewyan or Tinneh tribe, who regard it as the cradle of their race, whence they claim to have spread in other directions. Little description of this desolate region is necessary, beyond that information which the general reader will already have acquired from other sources. A few stunted shrubs of the hardiest kinds—dwarf birch, willows and the like—scantly clothe the more favoured spots along the water-courses; while elsewhere various lichens, the peculiar food of the Rein-deer, interspersed with stones and stagnant water-pools, alone characterize the dreary scene. Yet amid these unattractive wilds the natives obtain an abundant, if at times precarious, subsistence, by fishing and the chase. Rein-deer (of the smaller variety) are extremely numerous during the period of their northern migration, commencing in March; and the Musk-Ox (*Ovibos Moschatus*) finds in these solitudes a congenial and perennial field. On the immediate sea-frontier the Polar Bear appears; but no other of the larger quadrupeds than those enumerated I believe is found. The Beaver, common to nearly every portion of North America, shuns a scene where all its industry would fail to procure its living; and it is not till the hunters reach the line of about the 65th parallel that they are able to procure the fur of this animal for the purposes of barter. The Ptarmigan is found in abundance, as also the White Fox; with Wolves, some of which are white, and in parts the Arctic Hare (*Lepus variabilis*). Most of the lakes are well stocked with White-fish and other kinds; and probably Salmon, of some of the numerous varieties, ascend all the larger rivers between the Churchill and the Mackenzie, in neither of which do they appear. A variety called the "Copper Mine River Salmon" (*Salmo Hearnii* of Richardson) is known to ascend the river of that name; and the native name of the Back River—*Thleu-e-chodezeth* (or *tesse*)—lead some to infer that that also is frequented either by this or some other variety. (*Thleu-e-cho*, literally "big-fish," employed by the *Tâh-cully* of the upper Fraser to designate the sturgeon, is on the Mackenzie applied to the salmon of the

Yukon). Of the minerals in this quarter little can be said; but from the name of one of the rivers before mentioned, and from report, we may be justified in believing that rich deposits of copper, at least, exist. The Esquimaux occupy the whole sea-board.

The Portage à la Loche, or *Methy Portage*, (Methy = Loche = Fresh Water Cod = *Gadus barbatula ?*) is on the dividing ridge between the waters flowing to Hudson's Bay by the valley of the Missinipi, and those tributary to the Mackenzie through the Athabasca. The summit of this portage, which is elevated very considerably above the general level, has an altitude above the sea, as given by Mr. G. M. Dawson on the authority of Dr. Richardson, of 1566 feet; but this estimate strikes me as somewhat underrated. The length of the portage is thirteen miles, over a level sandy plateau, stony in parts, and wooded with the Banksian Pine, the Spruce, and other trees. The northern side is a steep escarpment, descending by eight successive stages, all more or less precipitous, to the borders of the Clear-water, which flows by a course of some eighty miles, through a charming valley of mingled plain and forest, to the Athabaska, the breadth of the united stream being about three-fourths of a mile at the point of the union, called "The Forks." It is by this route, and the Portage de la Traite on the opposite side of the Missinipi Valley, that the transport is effected between Athabasba and Lake Winnipeg viâ the Saskatchewan. This last portage has its name from the circumstance that Mr. Frobisher, the pioneer trader from Canada, here intercepted a large party of Indians on their way to Churchill in 1774, and secured their hunts. By the Crees this portage, from an old tradition, is called *Athikesi-pichégan* Portage—i. e. Portage of the Stretched Frog-Skin. Hence, I presume, the name applied to it in some recent maps "Frog Portage"—but it is better-known by the name given above.

Saskatchewan.—The general features of the tract drained by this river and the other tributaries to Lake Winnipeg are so well known that any attempt at description would be superfluous. The total area so drained, and discharged through the Nelson River, I compute at 376,000 English square miles: the length, including windings, from the mouth of the Nelson to the heads of the Saskatchewan, about 1,500 miles. The descent for a certain distance from Lake Winnipeg towards the sea, by the series

of lakes terminating in Split Lake, is necessarily very gradual; thence, consequently, to its mouth the Nelson rushes with great impetuosity. It is owing to the series of rapids thus formed that the navigation of the lower parts is avoided; and the ordinary boat route from York Factory to Lake Winnipeg is through Hayes' River and its connected waters, and over the divide by portage, striking the waters of Lake Winnipeg below Norway House. Thence to Edmonton on the Saskatchewan there are no impediments to the navigation of any moment, save the Coles' Rapids, near the confluence of the north and south branches, some twelve miles in length, which are navigable with care and skill, and the Grand Rapid near the mouth, where the river bursts through the ridge of limestone which forms the north-western boundary of Lake Winnipeg. The Saskatchewan becomes free from ice about the same time as the Peace River; but the navigation from Edmonton is rarely attempted before the middle of May, when the waters have usually risen enough to float the loaded bateaux over the frequent shoals. Much of what has been said of the Peace River might be repeated of this region. The vegetation has the same general characteristics, and the climate is not dissimilar. Of minerals it may be remarked that coal has been discovered in thick seams in the vicinity of Edmonton; and Mr. Selwyn is of opinion that, by boring, the seams may be struck at a small depth at various points, at least as low as Carlton near the confluence of the two branches. I may here incidentally mention that both at Edmonton and at Carlton the development of *goître* in the permanent residents is not uncommon. At the last mentioned post I have seen a whole family thus afflicted—the children exhibiting the marks of advanced cretinism. I am induced to think that the constant use of the river water, which is extremely turbid for the greater part of the year, without filtering or other preparation, is the proximate cause of this affliction, which does not attack the roving population, who are not confined to the use of the river water. The digging of wells, in such case, suggests the obvious remedy. I may add that I arrive at the conclusion stated the more readily, because that on Peace River, where the evil is also manifested in less marked degree, I have known a family who had partially contracted the disease during a long residence at Fort Vemilion, to entirely recover after a comparatively short residence at McLeod's Lake, at the head of Peace

River, where the waters are pure and limpid. There may, however, be deeper latent causes; but I suggest these which appear to me the more obvious. Yet even under this view there is a difficulty; for on Fraser River, where a similar condition of the water might be argued to produce a similar effect, no case of the kind has ever appeared. The Saskatchewan, like the Mackenzie, the Churchill, and I believe all the rivers falling into Hudson's Bay, is destitute of Salmon.

The West Side of the Rocky Mountains.—This region must be noticed very briefly. The lengths of the Fraser flowing entirely, and of the Columbia partially, within the limits of British Columbia, are respectively, including windings, the former about 800, the latter 1,200 miles; the approximate areas of drainage being, by the Fraser 66,400, by the Columbia 215,900 square English miles. Immediately on crossing the Rocky Mountains by the heads of the latter river, after the autumn frosts have already invaded the eastern side, a great improvement in the temperature is perceptible, while all the external evidences of a warmer climate appear. Descending the Grande Côte, within twenty miles of the summit, huge trees of the "Red Cedar" (*Thuja gigantea* of Nuttall) are for the first time seen; and lower down the timber and other vegetation are also different. About Colville the Columbian Red Pine (*Pinus ponderosa*) and the Larch (*Larix occidentalis*) of large dimensions are seen—the latter confined apparently to the vicinity of the 49th parallel, the former extending north-westward nearly to the great divide beyond the Thompson, and westward to the head of Anderson Lake near the Coast Range. About one hundred miles below Colville the borders of the great Columbia Desert are reached; extending thence, with occasional oases, as far as the Dalles of the Wascopum; and by the Snake River finally meeting with the deserts of the Youtah. Artemisia, the Cactus, and other congenial plants, characterise the whole of this arid tract; while the more favoured spots, near the water-courses, yield abundant pasture of rich Bunch-grass, and are extremely fertile. At one point upon the Okinâgan River, this arid waste extends for a short distance into British Columbia; and I do not question that, acting as a great reservoir of heat, the vast expanse exercises a marked influence on the temperature of the whole vicinity; and to the extension of this influence, partly, in conjunction with the warm winds from the Pacific, I ascribe

the general mildness of the climate upon the Peace River. On the lower Columbia, and through Oregon to California, the country is too well known for its fertility and resources to require comment.

British Columbia.—In British Columbia proper, the general features may be thus briefly summed up. Westward of the North-West Coast Range the whole tract is excessively mountainous, and penetrated by numerous inlets of the ocean. Eastward of the Coast Range (besides the intervening portion of the Cascade Mountains in the southern part), numerous ridges of moderate elevation appear, between which are broad valleys of great fertility, abounding with rich pasture, and partaking generally of the prairie character. The upper portion is more densely wooded, with fertile openings at intervals. The lower portions, along the line of the Fraser, with a generally dense growth of gigantic timber, present openings in parts of great fertility. The whole of the north-west coast, with a portion of Vancouver Island, is richly clothed with valuable timber of stupendous growth. In minerals the whole province is extremely rich. Nearly all the eastern coast of Vancouver Island abounds with coal; the most southern portion yet discovered being at Saanich near Victoria, where there is an apparently rich seam. The coal is esteemed of excellent quality, the chief export at present being from Nanaimo and its vicinity; and though some mines are wrought upon the neighbouring mainland, bordering on Puget Sound, the product does not command an equal price in San Francisco, nor is it apparently in demand. Iron ore, of the finest quality and easily accessible, with limestone for smelting purposes in the vicinity, exists in inexhaustible quantity on Texada Island near Nanaimo. Gold is found at the well known "Caribou Mines"; at the "Omineca"(i.e. "Mountain Whortleberry") diggings at the head of Peace River; at the head of the Dease tributary of the Rivière aux Liards, called "Cassiare" from the name of the reputed discoverer; on the upper waters of the Columbia near the Big Bend; on the Koutanais and elsewhere both on the mainland and Vancouver Island* Silver, not yet productively worked, exists in various parts of the Pro-

* The total yield of gold, however, from British Columbia in 1875 did not probably exceed three millions of dollars, of which about five-sixths only passed directly through the Banks.

vince, and especially at Cherry Creek near the head of the Okinâgan Lake, and at a point near Hope on the Lower Fraser. Copper is generally distributed along the north-west coast, in some parts very abundantly; but so far has not been effectually wrought. A very rich deposit of galena, yielding a moderate percentage of silver, exists on the Flat-bow Lake (Koutanais), but the position is too remote and inaccessible for its profitable working. The Islands of Queen Charlotte, from what is already known, will probably be found extremely rich in all the metals mentioned, iron perhaps excepted. A seam of Anthracite coal of excellent quality was for a time worked there; but for some reason has been abandoned.*.

Prominent Vegetation in this Section.—(1.) Along the north-west coast: Douglas Fir (*A. Douglassii*, Lindl.); Spruce Fir (*A. Menziesii*); Hemlock Fir (*A. Canadensis* or *Mertensiana ?*); "Red Cedar" (*Thuja gigantea*, Nutt:) "Yellow Cedar" or Cypress (*Cupressus thyoïdes*, Doug.) &c.: all of gigantic growth. Undergrowth: various shrubby Vaccinia; the "Sallal" (*Gualtheria shallon*); varieties of *Rubus*, *Ribes*, &c. In rare positions low specimens of Mountain Ash (*Sorbus aucuparia*) and Service-berry (*Amelanchier*).

(2). Along the vicinity of the 49th parallel as far as the Rocky Mountains. I here adopt the list of Dr. Lyall of the British Boundary Commission, reported in the proceedings of the Linnæan Society (Botany, vol. VII.) including my own occasional and purely unprofessional notes in brackets, thus [ ].

(a). In the vicinity of Victoria and Esquimault, Vancouver Island:—*Pinus contorta*, Doug.; *Taxus baccata* [*brevifolia*, Doug.]; *Abies Douglasii*, Lindl.; *A. Menziesii*, Lamb; *Thuja gigantea*, Nutt.; *Cerasus mollis*, Doug.; *Arbutus Menziesii*, Pursh [*laurifolia*, Doug ?]; *Quercus Garryana*, Doug. [In a pamphlet recently sent to me by Dr. Robert Brown (Campster), of Edinburgh, he describes a second variety of Oak nearly allied to that mentioned, which, after Sir James Douglas, K.C.B., the late Governor, he calls *Q. Jacobi*. I may here mention that the oak, which is common in the north-east parts of Van-

* To the vast mineral riches of certain Territories south of the Boundary Line, I make no allusion, regarding these as entirely beyond my ken.

couver and the adjacent Islands, is not found in any part of the mainland of British Columbia.* The Oak (*Q. Garryana*) is common on the lower parts of the Columbia River somewhat remote from the ocean; ceasing abruptly at the Dalles of the Wascopum, above which there are none]. Species of *Acer*, *Betula*, *Alnus* and *Salix* are plentiful. Among the common shrubs are *Mahonia*, *Ceanothus*, *Nuttalia*, *Spiræa*, *Rosa*, *Ribes*, *Vaccinium*, *Salix*, *Gaultheria*, &c. Among the most conspicuous flowering plants in the early part of the season are several species of *Ranunculus*, of *Claytonia*, of *Potentilla*, and *Saxifraga*; *Plectritis congesta*, *Collonia gracilis*, *Collinsia violacea*, *Dodecatheon Meadia*, species of *Fritillaria* and *Trillium*, *Camassia esculenta* (*Scilla esculenta*, of Douglas). &c.

(b.) Along the lower Fraser: the several firs mentioned as found on the north-west coast, with also *Thuja gigantea* [but not *Cupressus thyoîdes*, which is peculiar to the coast vicinity, north of 49°, extending far into Alaska.] The circumference of a Douglas fir measured by Dr. Lyall was nearly thirty feet at five feet from the ground, and the length of a fallen tree measured, 250 feet, but neither an extraordinary specimen. [The height frequently exceeds 300 feet.] Circumference of a *Thuja* measured 26 feet 9 inches, at six feet from the ground; estimated height 250 feet [frequently exceeds this]. Interspersed among the trees mentioned are specimens of *Acer macrophyllum*, Pursh [*Platanus acerifolia*, of Douglas ?] sometimes attaining a height estimated at 150 feet—circumference of one measured twenty feet. Along with these the Vine-leaved Maple, *Acer circinatum*, Pursh; Dog-wood (*Cornus Nuttalii*); *Alnus viridis*, &c.; *Betula occidentalis*, Hooker, and *Populus balsamifera* of large size. [To these I may add that the White Pine (*P. strobus*), of magnificent dimensions, is common towards the summits of the southern portion of the Coast Range, and is found also, but of smaller size and more rarely, in the mountains of Vancouver Island. I have also noticed it in abundance and of fine size on the Cascade Range, about the skirts of Mount Rainier]. The under-shrubs consist chiefly of the fol-

* I noticed about a score of small trees in the portages above Yale on the Fraser River, as far back as 1847; but it is questionable if any one of these now remains.

lowing: *Mahonia*, two species; *Acer glabrum*; *Spiræa*, several species; "Sallal" (*Gaultheria shallon*, of Pursh); *Rubus* and *Ribes*, several species; *Lonicera*, two species; *Viburnum opulus*; *Vaccinium*, several species; *Panax horridus*. [By this last I conceive to be meant the *Bois piquant*, or "Prickly ash," a species of *Aralia* (?) Common in the damp vallies of the north-west coast, and re-appearing near the heads of Peace River and elsewhere along the verge of the Rocky Mountains.]

(c.). On the Cascade Range: *Abies amabilis*, Doug. [also found on the lower lands]; *A. grandis*; *Picea nobilis*, Don. [balsamea, Doug. ?], &c. [In this section are alse noticeable a fine red-flowering *Rhododendron*, (*macrophyllum* of Don.); two varieties of *Menziesia* (often mistaken for Heath); and among the numerous cyperaceous plants and Equisetæ the American Hellebore (*Veratrum viride*) is very common.]

(d.) [Approaching the Columbia River: As the valleys assume the Prairie character *Pinus ponderosa* and *Larix occidentalis* become common, as already mentioned (Supra). Dr. Lyall remarks: "The vegetation here is of a very different character "from that on the other side of the Cascade Mountains, and "bears indications of much drier climate. A good many of the "plants found in this region are strictly local in their distribu- "tion. Some of the orders such as *Ranunculaceæ*, *Vacciniaceæ*, "*Liliaceæ*, &c., of which species are so plentiful in the first "region, have here comparatively few representatives; whilst "others, such as *Leguminoseæ*, *Onagraceæ*, *Polemoniaceæ*, &c. "are more common in this district and give a character to the "vegetation."

I may mention cursorily that the Dwarf Sunflower (*Helianthus petriolaris*, Nutt.), here very common and characteristic, extends into British Columbia, as far nearly as Alexandria, the natives gathering its seed, and also preparing its root for food. The Flat-leaved Cactus, (*Opuntia Missouriensis*) too, extends to a point some miles above Alexandria, and downwards along the Fraser as far back as the Forks of the Thompson. It is also found in small patches on dry knolls on certain islands in the Gulf of Georgia; but not elsewhere in the northern section except, as before mentioned, on Peace River, near Dunvegan, where it was noticed by Mr. Macoun.]

DISTRIBUTION OF THE MORE PROMINENT QUADRUPEDS, &c. —Bison (*Bos Americanus*): plains of the Missouri, and of the Saskatchewan as low down as Carlton. Formerly abounded on the Peace River plains, but now rare and confined to the outskirts. Not found in British Columbia, save perhaps casually in parts of the Rocky Mountain frontier, nor on the Columbia River. Formerly used to descend the Snake River as far as Boisée River, and sometimes even lower. Will soon be all destroyed I fear. Caribou or Rein-deer (*Cervus tarandus*); the larger variety or "Rocky Mountain Rein-deer"; found in all the mountainous parts of the interior down to a certain latitude. Along the Rocky Mountains this limit I judge to be about lat. 49°; on the North-West Coast Range probably about 51°. The smaller variety, classed by Richardson as the Rein-deer of the Barren Grounds, is confined to the Arctic watershed during its northward migration (March to the beginning of November); frequenting the country around Hudson's Bay, &c., during the remainder of the year. The Moose or Elk (*C. alces*) is found generally throughout the northern parts of the country, except the Barren Grounds, and the immediate sea-board of Hudson's Bay, &c.; on the Pacific watershed along the verge of the Rocky Mountains as low as about 49°; on the upper Fraser, and as low down sometimes, but very rarely, as Fort George. The Chevreuil or Virginian deer is found along the Saskatchewan, but not in the mountainous parts, nor on the north-west coast, where the "Black Tail," (*C. macrotis*) is abundant. The last is not found on the Fraser higher than Fort George. The Red-deer or Biche (generally, but of course erroneously called "the Elk") is found in large herds over a wide extent of country. A large variety of *C. Elaphus*, it is classed as *C. Canadensis*, or the Wapiti. It is common along the Saskatchewan, Peace River, &c., and was so formerly upon the middle Fraser, but is now rarely, if ever, seen there. On Vancouver Island and the adjacent mainland very numerous. It is questionable whether there be any specific difference between these and those of the prairies. Bears, Black and Brown, (*Ursus Americanus*); generally throughout the country, except the immediate Arctic shores, where the Polar Bear appears. Grizzly Bear (*U. ferox*); plains of the Saskatchewan, &c., southwards; along the Rocky Mountains and in most parts of British Columbia, except Vancouver Island, and the north-west coast. Musk

Ox (*Ovibos Moschatus*), barren grounds of the Arctic Ocean. Probably frequents a portion of the Arctic slope of Alaska. Not found elsewhere. Lynx of two varieties, the spotted and the grey; the former confined to the lower country, the latter to the interior. Racoon (*Procyon lotor*); east of the Rocky Mountains, as far north as Manitoba; west-coast as high up as about 51°. Mountain Goat (*Aplocerus montanus*); Precipitous parts of the Rocky Mountains, coast range, &c., and north-west coast; not found east of the Mackenzie.* Mountain Sheep or Big-horn (*Ovis Montana*); along the slopes of the Rocky Mountains and their offsets. Marmot (*Arctomys*); several species, including the Rocky Mountain variety or "Siffleur" (*A. pruinosus*, Rich'n.) found in the Rocky Mountains, the Cascade Range and North-West Coast Range. A *black* variety appears to be found about the heads of the Rivière aux Liards, which I have not noticed elsewhere. Foxes, Red, Black, Cross, &c., are very generally found except on the north-west coast, which, owing probably to the humidity of the climate, they do not appear to frequent. The Arctic or White Fox (*Vulpes lagopus*) is confined to the Arctic regions and the shores of Hudson's Bay. [The Arctic Hare (*Lepus variabilis*) appears throughout the interior of the mainland, north of 49°, in moderately elevated positions; periodically in excessive numbers. A large variety, more resembling the European Hare, frequents the arid plains of the Columbia, &c.] The Marten (*Mustela martes*, Rich'n.), the Pekan or Fisher, and others of the same family, throughout the woodland regions. The Common Beaver (*Fiber Americanus*) and the Musquash (*Fiber zibethicus*, Rich'n) generally distributed, except in the Barren Grounds and other similar Arctic positions. The Carcajou or Wolverine, (*Gulo luscus*, Cuv.): very generally north of 49°. Wolves of divers varieties, Grey, Black, &c., generally throughout; a pure white variety being found on the "Barren Grounds." The Common Otter (*Lutra Canadensis*) throughout. The Sea Otter (*Enhydra marina*) is found only on the Pacific Coast, from California up to the Kodiak, &c., in which tract the Hair Seal and a large variety of other *Phocidæ*, are also common; especially in Alaska, where the chase of the Fur-Seal has long been systematically regulated.

* These are the animals described to Mackenzie by the Indians as "White Buffaloes."

Birds.—Exclusively of innumerable migratory birds, from the Swan and the Eagle down to the Humming Bird (the last confined to the Pacific slope, where it is found as high, at least, as 54° 26′, and doubtless beyond), the following permanent residents of utility may be noticed: Ruffed Grouse (*Bonasa umbellus*, Linn.); almost everywhere near streams, &c. Dusky Grouse (*Tetras obscurus*, Say), dry stony ridges, Vancouver Island, and mainland interior north of about 49° on western slope, as high as the vicinity of Alexandria. Spotted Grouse or "Spruce Partridge" (*T. Canadensis*, Linn.); dry uplands within certain limits on both sides of the Rocky Mountains. White Grouse or Ptarmigan (*Lagopus albus*); mountainous parts, Vancouver Island and northern mainland; very numerous throughout the Arctic slopes and Hudson's Bay. Sharp-tailed Grouse (*Pediocetes phasianellus*, Linn.); throughout the great Prairies; in the prairie-valleys of British Columbia, as high as the vicinity of Alexandria; and on the Plains of Peace River. Cock of the Plains or "Sage-Cock," (*Centrocercus urophasianus*, Bon.); borders of the Columbia River, from above Okinâgan to the Dalles of Wasco, and throughout the Wormwood deserts.

Fish.—Trout of many different kinds; varieties of Carp and other *Cyprinidæ*; the Methy or Loche; and many others, including that Prince of fresh-water fishes the White-fish (*Coregonus*), are general distributed. The last named (peculiarly a northern fish) appears to be almost universal in the boreal regions, even the lakes of the dreary "Barren Grounds" having their share. Westward of the Rocky Mountains, they are found as low, at least, as lat. 52°; and probably even somewhat south of that limit. Two varieties of Sturgeon are found, one (*Acipenser Sturio ?*) in the waters of Lake Winnipeg, the other (*A. transmontanus* of Richards) a fish of enormous dimensions, in the Columbia and the Fraser. Salmon, chiefly of large size, and of many varieties, ascend all the principal streams between the Sacramento and Yukon, including both those rivers; and probably several of the streams discharging into the Arctic Ocean; but as before remarked they do not frequent either the Mackenzie or the Saskatchewan; nor indeed any of the rivers communicating with the Hudson's Bay. The Pike (*Esox lucius*), common to the eastern waters, is unknown on the western watershed. To the above list may be added, as frequenting the waters of Manitoba, the Cat-Fish, the Sun-fish, and divers others, some of which are found elsewhere.

INDIANS.—The Chipewyan race, who for convenience sake are now classed as the "Dinnee" or "Tinneh" tribes, occupy as will be seen a very extensive tract. They have evidently been great wanderers; for to them the isolated sept of the Sarcees of the Saskatchewan owes its origin; and a similar offset, the *Klatskanai* (now extinct), not very long ago inhabited the highlands beyond the mouth of the Columbia River, while traces of the language appear even farther south. *Dinnee* means literally *a man*, but is sometimes applied in the plural sense, as *Ahahtodinnee*, the Mountain-men, &c.; and Sir A Mackenzie's interpreters, who were from Peace River, so applied it, calling *Nascudinnee* those whom we now know as the *Nasc-otin*, i. e. *People* of the *Nas-accôh* (Mackenzie's "West-road River.") Generally, however, the term is pluralized by changing it, eastward of the Rocky Mountains, into *hânie*, westward into *otin*, as *Sik-hanie* (or rather *Tsack-hânie*) People of the stones or rocks, &c *Nasc-otin* (as above): *Chilo-otin*, People of the *Chil-accoh* (River), &c. In the Alaska section this affix is changed into *Koochin*, having the same obvious signification. The Tâh-Cully-(otin) Branch, i. e. "People of the deep" (waters being probably understood) inhabit the upper waters of the Fraser, bounded southward by the *Shewhapmuch* (ch guttural) or *Sacliss* connexion (Atnah or "chin" of Mackenzie). Eastward of the Rocky Mountains the Chipewyans are bounded on the east by the Crees, who pass round the south end of Lake Winnipeg, and continue round the circuit of Hudson's Bay and through Labrador, to Hudson's Strait. Adjoining the Crees, and following along the upper Lakes and down the Ottawa River, &c., are the Algonquins or Sauteux, called also Ojibways or Chippeways. These are merely a branch of the Crees, and talk a dialect of the same language. The Assineboines are a branch of the Nadowasis or Sioux, and bound the Crees on the south along the course of the upper north Saskatchewan; succeeded on the west by the Sarcees, the small isolated tribe already noticed. A few families of Assineboines, abandoning the Prairie habit of the rest, frequent the heads of the Athabasca, among the "strong woods" (whence their distinctive appellation) and are now intercepted by the neighbouring tribes from the remainder of their race. The Black-feet, divided into several septs, as Gros Ventres, Blood Indians, &c., inhabit the prairie tract along the heads of the Saskatchewan and Missouri towards the border of the Sioux.

Opposite to them, west of the Rocky Mountains, in a small angle at the heads of the branch of the Columbia, are the Koutananais, a small tribe, numbering in 1848 in all 829 souls. These are isolated from all the surrounding races, and I have never been able to trace their connexion. Adjoining them are the Sacliss (called by the Black-feet "Flatheads") who with their congeners the Shewhapmuch extend nearly to Alexandria, meeting the Tâh-Cully branch of the Tinneh race as already mentioned. To the Shewhapmuch the Tah-Cully apply the same name of "Atnah" (= Stranger Race); to their neighbors wesward Atnah-yore. Mackenzie who descended the Fraser no lower than the Tâh-Cully frontier, and had with him no interpreters through whom to communicate freely with the few men of the lower nation whom he there met. He was thus led to adopt the term "Atnah" as the true name of the tribe—adding, however, the alternative "Chin" which has in reality no existence. The late Mr. Geo. Gibbs, shortly before his death, wrote to enquire the origin of the latter name. To this enquiry I had no opportunity of replying; and may now state that I believe it to have arisen from misapprehension of the meaning of the Indians while referring to the principal village, or at least that in the most prominent position, at the confluence of the Thompson with the Fraser. This is called *Thlik-um-cheen* (or-chin), the first two syllables very rapidly pronounced, and the last strongly dwelt upon. To this village the natives, both above and below, are fond of referring, apparently with some pride, as the chief seat of their section of the general tribe: and the conspicuous syllable dwelling on the ear of Mackenzie, led him, I imagine, to suppose it was the name given by themselves to their nation. I notice that the late Mr. Simon Fraser, who with Mr. John Stuart first descended the river, now named after the former, in 1808, and a M.S. copy of whose Journal is now before me, was partially misled in the same probable way. He gives the name of the village (but not as of the people) as *Cum-chin*. The whole ordinary nomenclature of Indian tribes, however, such connexion invariably giving a different, and derisive name, originating in some imputed or imagined characteristic (e. g. Blackfoot, Flathead, Slave, &c.), requires to be received with much caution. For this reason, and to avoid the endless confusion of names, I have along the north-west coast reduced them in the map as much as

possible to classes, on the principle of the "Tinneh." Thus along Paget Sound,&c., I comprise the numerous *homish*, *âmish*, and *wâmish*, all modifications of the same general affix, under one head as the *âmish* tribes; and along the west coast of Vancouver's Island, and the adjacent coast southward, the *âht* tribes, this being the general affix, *Nootk-âht*, *Clayo qu-âht*, &c. Northward of these the *Hâi-dah* occupy Queen Charlotte's Islands and the Prince of Wales portion of the Archipelago. On the mainland north of Vancouver's Island and in the Islands of Milbank Sound and connected waters, is the Hâiltza connexion; succeeded northward by the *Chimseyan* tribes, who occupy as far as Observatory Inlet, near the southern line of Alaska Territory. Thence the *Thlinkitt* connexion to beyond the Tâh-Co River, who are succeeded by the tribe called by the Russians "Kaliuches"; and finally, beyond Cook's Inlet, the Esquimaux.

NOTES ON A COLLECTION OF GEOLOGICAL SPECIMENS.

Collected by WILLIAM MACLEAY, Esq., F.L.S., *President of the New South Wales Linnean Society, Sydney, from the coast of New Guinea, Cape York, and neighbouring islands, by* C. S. WILKINSON, *Government Geologist.* (*Read before the Linnean Society, Sydney, 28th February*, 1876.)

I have lately examined a small collection of geological specimens, brought from the coast of New Guinea by the President of of this Society, Mr. William Macleay, and which were collected by him when on his recent tour of exploration in the Chevert.

These specimens consist of—

1. Quartz porphyry (Palæozoic), from Cape York, found underlying beds of Tertiary ferruginous sandstone.

2. Vesicular basalt and brecciated volcanic tufa (Upper Tertiary), from Darnley Island.

3. Small concretions of limonite, with polished-looking surfaces, dredged up off the coast of New Guinea.

4. Specimens of chalcedony and flint, from Hall's Sound.

5. Oolite limestone (Tertiary), very friable, from Bramble Cay.

6. Yellow calcareous (Tertiary) clay, from Katau River.

7. Yellow and blue calcareous clays (Tertiary), from Yule Island and Hall's Sound.

It is with reference more particularly to the fossiliferous clays that I would offer a few remarks.

These clays, as indicated by the fossils contained in them, belong to the Lower Miocene Tertiary period.

So far as I am aware, this is the first notice of such fossils having been discovered in New Guinea; and this discovery of Mr. Macleay's is the more interesting inasmuch as the Miocene *marine* beds, which occupy a considerable area in Victoria and South Australia, have nowhere been found on the eastern coast of Australia, north of the Victorian border—Cape Howe. Referring to this fact the Rev. W. B. Clarke says that, "throughout the whole of Eastern Australia, including New South Wales and Queensland, no Tertiary *marine* deposits have been discovered."

The comparison of this Miocene fauna from a locality so near the equator, with that from higher latitudes, will be important work for a palæontologist.

Professor McCoy has already gone far to prove from the comparison of certain Miocene fossils, that the fauna of the Older Tertiary period in Australia was not so restricted in its geographical range as it now is, but was then closely related generically, and even specifically, to that of many parts of Europe and America. And I think that, perhaps, even the few fossils now before us may afford some additional evidence in confirmation of the views of that eminent palæontologist.

The Miocene clay beds of New Guinea, judging from the specimens collected by Mr. Macleay, are exactly similar in lithological character to the Lower Miocene beds near Geelong, and on the Cape Otway coast in Victoria.

The fossils from Hall's Sound are unfortunately not in a good state of preservation, being mostly imperfect casts; but amongst them appear to be the following genera:—

Voluta macròptera, a small specimen; *Voluta anti-cingulata*, *Ostrea*, *Cytherœa*, *Crassatella?* *Pecten*, *Turritella*, *Natica*, *Triton?* *Dolium?* *Astarte*, *Corbula*, *Leda*, *Venus*, *Cyprœa*, 2 *Echinoderms*.

Most of the above I have found in the Victorian beds, and two of them have been figured and described by Professor M'Coy in his *Decade No.* 1 of the *Palæontology of Victoria.*

The small specimen of calcareous clay from the Katau River on the west side of the Gulf of Papua contains only a few broken fragments of shells; but it appears to be of the same formation as the clay beds of Hall's Sound or Yule Island.

The oolitic limestone of Bramble Cay I believe to be also of the upper beds of this Miocene formation.

Mr. Macleay, in his letter to the *Sydney Morning Herald* of October 11, 1875, describes the formation of Yule Island as a sedimentary rock, nearly horizontal on the sea face, but with a great dip inwards. The rock itself is calcareous, and composed of corals, shells, echini, &c.—in fact a concrete of fossils resembling the coral rag of Oxford. Mr. D'Albertis also gives a similar description of the formation of Yule Island, and mentions the occurrence of basaltic trap in the valleys, and that the higher portions of the hills, which attain a height of 700 or 800 feet above sea level, are composed of coralline limestone. It is worthy of remark that in Victoria the Miocene strata occur in a similar manner—yellow and blue calcareous clays full of fossil shells, overlaid by thick beds of coralline limestone consisting of an aggregate of comminuted fragments of corals, shells and echinoderms.

The discovery of these Miocene beds on the southern coast of New Guinea is one of considerable importance. Their occurrence, I believe, suggests the former land-connection of New Guinea with the Australian continent, and this belief is further borne out by the fact of the shallowness of the intervening sea. I am not aware that any Miocene rocks have yet been identified as such on the northern coast of the Cape York Peninsula; but it is not improbable that the ferruginous sandstone described by Mr. Macleay as overlying the porphyritic granite at Cape York, and perhaps other Tertiary deposits which may occur in that locality, may be correlated with the Miocene beds on the opposite coast of New Guinea.

Wallace, referring to this subject in his very interesting and valuable work, *The Malay Archipelago*, says:—"It is interesting to observe among the islands themselves how a shallow sea always intimates a recent land-connection." . . . "We find that all the islands from Celebes and Lombock eastward exhibit

almost as close a resemblance to Australia and New Guinea as the Western Islands do to Asia." And again—"Australia, with its dry winds, its open plains, its stony deserts, and its temperate climate, produces birds and quadrupeds which are closely related to those inhabiting the hot damp luxuriant forests which everywhere clothe the plains and mountains of New Guinea."

Baron von Mueller's remarks on some of the Papuan plants collected by Mr. Macleay are also evidence in favour of the former land-connection of New Guinea with Australia, so that our geological evidence is supported by that of zoology and botany.

From geological data it is believed that this continent has not been submerged to any great extent, since the Lower Pliocene period; and we know that it has risen a little since the Upper Pliocene epoch, at least in Victoria, for the lava flows of that age, now forming the Werribee Plains, were *submarine* flows. And Mr. Daintree, formerly Government Geologist of Queensland, shows, in his pamphlet on the *Geology of Queensland*, that little upheaval of this portion of Australia has taken place since the volcanic outbursts of a late Tertiary epoch. Now, it is in the Upper Pliocene or Pleistocene deposits that are found the remains of the gigantic marsupials—*Diprotodon*, *Macropus*, *Titanotherium*, and others; and, as their allied representatives now occupy both Australia and New Guinea, it is not improbable that those gigantic animals whose bones are found in Northern Queensland, also roamed in both those countries. And further, as the luxuriant vegetation and climatic conditions which we suppose to be favourable for the support of those immense marsupials still exist in New Guinea, is it rash to conjecture that some of these large creatures may be living there at the present time? Further researches may prove this.

I will conclude with the following very apposite extract from Wallace's *Malay Archipelago*:—

"From this outline of the subject, it will be evident how important an adjunct natural history is to geology; not only in interpreting the fragments of extinct animals found in the earth's crust but in determining past changes in the surface which have no geological record. It is certainly a wonderful and unexpected fact, that an accurate knowledge of the distribution of birds and insects should enable us to map out lands and continents which disappeared beneath the ocean long before the earliest traditions

of the human race. Wherever the geologist can explore the earth's surface, he can read much of its past history, and can determine approximately its latest movements above and below sea-level; but wherever oceans and seas now extend, he can do nothing but speculate on the very limited data afforded by the depth of the waters. Here the naturalist steps in, and enables him to fill up this great gap in the past history of the earth."

THE WINTERS OF 1874–75 and 1875–76.

By C. H. McLeod, Bac. App. Sc.

The saying "it's all in a bag and must come out," so frequently applied to the weather, is in a certain sense true, but we must not be in too great a hurry for the bag to empty itself. This *meteoric sack*, so to speak, disgorges its contents in an intermittent sort of fashion—now we have heat above the normal, and again an excess of cold. The velocity of discharge varies throughout a day, varies continually; the *means* of the elements for a day exceed or fall below those on either side of it, so also the means for a year show a marked difference from that preceding or following it, and the average temperature or rainfall of one season often bears but little resemblance to the same period in another year. On the other hand, given a period of from five to ten years, it is found that the mean of any element for that time does not differ materially from those derived from any other similar period. It therefore takes several years for the truth of the saying above quoted to be verified, and when after continuous observation of an element for the required time, an average or mean for that element is determined, the normal proper to the place and any given time is said to be known; and this is the average of what we have chosen to term velocity of discharge—to be so determined for each and all of the meteorological elements.

How much one of our seasons may differ from another has been most markedly illustrated during the past two winters and it is to that we propose calling attention at present.

The following table derived from the observations recorded at the McGill College Observatory, institutes a comparison between the periods we are considering.

Winter.	Mean Temperature of Dec.	Mean Temperature of Jan.	Mean Temperature of Feb.	Mean Temperature of the season.
1874—75	14.60	5.44	9.02	9.69
1875—76	16.73	17.73	14.57	16.34

It will be observed that between the *means* for the two seasons there is the large difference of nearly seven degrees, and that January of 1876 was warmer than the same month in 1875 by more than twelve degrees, that is, on the average each day of the month was more than twelve degrees warmer than the corresponding day in the preceding year.

The primary cause of this most remarkable discrepancy is, at present, beyond us to discover; but if it affords any satisfaction to connect it with facts which themselves require explanation we may state that in the winter of 75–76 winds blowing from the south-west to south-east exceeded in duration those from the same quarter in the winter of 74–75 by about fifty per cent. Or expressed otherwise, the time during which winds in each season blew between these directions bears about the same relation between themselves as does the average temperature for the seasons expressed in degrees Fahrenheit to one another.

The connection is evident, and it is of course also true, that there was during the winter of 1874–75 a great excess of winds blowing from the cold regions to the north and north west.

In connection with the table given below, which shows the total precipitation in each month and season, it should be stated that in 1875–76, (taking ten inches of snow as equal to one inch of water) 79.1 inches only, fell as snow, the remaining 3.67 inches being rain ; whereas in 1874–75 the rainfall only amounted to .48 of an inch.

Winter.	December.	January.	February.	Season.
1874—75	2.20 ins.	3.50 ins.	1.71 ins.	7.41 ins.
1875—76	3.10 ins.	4.61 ins.	3.87 ins.	11.58 ins.

The predominance of rainfall during last winter is a natural result of the mildness of the season, and there is apparently also a close connection between the excessive precipitation and increased temperature.

The two seasons contrast very strongly in other respects beyond a divergence in temperature and rain or snowfall. For while the winter of 1874–75 was characterized by unusual meteoric uniformity last winter was remarkable for its extreme; the barometer having ranged from 28.766 to 30.989 in the latter season, against from 29.303 to 30.753 in the former; and the wind's velocity having attained a maximum of 60 miles per hour, or ten miles greater than any previous record. The thermometer, too, showed an excessive range, although the minimum is slightly above that recorded in 1874–75, when it reach 24 below zero, while the maximum recorded was 43.5, giving a range of only 67.5 degrees against 77.5 with a maximum of 54 degrees last winter.

NOTE ON THE PHOSPHATES OF THE LAURENTIAN AND CAMBRIAN ROCKS OF CANADA.

By J. W. Dawson, LL.D., F.R.S., F.G.S.

The extent and distribution of the deposits of apatite contained in the Laurentian of Canada and in the succeeding Palæozoic formations, have not escaped the notice of our Geological Survey, and have been referred to in some detail in Reports of Mr. Vennor, Mr. Richardson, and others, as well as in the General Report prepared by Sir W. E. Logan in 1863. Some attention has also been given, more especially by Dr. Sterry Hunt, to the question of the probable origin of these deposits.* My own attention has been directed to the subject by its close connexion with the discussions concerning *Eozoon;* and I have therefore embraced such opportunities as offered to visit the localities in which phosphates occur, and to examine their relations and structure. I would now present some facts and conclusions respecting these minerals, more especially in their relation to the life of the

* Geology of Canada, 1863; Chemical and Geological Essays, 1875.

Laurentian period, but which may also be of interest to British geologists in connexion with the facts recently published in the 'Journal' of this Society in relation to the similar deposits found in the Cambrian and Silurian of Wales.*

In the Lower Silurian and Cambrian rocks of Canada, phosphatic deposits occur in many localities, though apparently not of sufficient extent to compete successfully for commercial purposes with the rich Laurentian beds and veins of crystalline apatite.

In the Chazy formation, at Alumette Island, and also at Grenville, Hawkesbury, and Lochiel, dark-coloured phosphatic nodules abound. They hold fragments of *Lingulæ*, which also occur in the containing beds. They also contain grains of sand, and, when heated, emit an ammoniacal odour. They are regarded by Sir W. Logan and Dr. Hunt as coprolitic, and are said to consist of "a paste of comminuted fragments of *Lingulæ*, evidently the food of the animals from which the coprolites were derived." † It has also been suggested that these animals may have been some of the larger species of Trilobites. In the same formation, at some of the above places, phosphatic matter is seen to fill the moulds of shells of *Pleurotomaria* and *Holopea*.

In the Graptolite shales of the Quebec group, at Point Levis, similar nodules occur; and they are found at Rivière Ouelle, Kamouraska, and elsewhere on the Lower St. Lawrence, in limestones and limestone conglomerates of the Lower Potsdam group which is probably only a little above the horizon of the Menevian or Acadian series. In these beds there are also small phosphatic tubes with thick walls, which have been compared to the supposed worm tubes of the genus *Serpulites*.‡

The Acadian or Menevian group, as developed near St. John, New Brunswick, contains layers of calcareous sandstone blackened with phosphatic matter, which can be seen, under the lens, to consist entirely of shells of *Lingulæ*, often entire, and lying close together in the plane of the deposit, of which in some thin layers they appear to constitute the principal part. § Mr. Matthew informs me that these layers belong to the upper part of the forma-

* Davies & Hicks in Quart. Journ. Geol. Soc., August, 1875.

† Geology of Canada, p. 125.

‡ Geology of Canada, p. 259; Richardson's Report, 1869.

§ Bailey and Matthew, "Geology of New Brunswick," Geol. Survey Reports.

tion, and that the layers crowded with *Lingulæ* are thin, none of them exceeding two inches in thickness; but he thinks that the dark colour of some of the associated sandstones and shales is due to comminuted *Lingulæ*.

At Kamouraska, where I have studied these deposits, the ordinary phosphatic nodules are of a black colour, appearing brown with blue spots when examined in thin slices with transmitted light. They are of rounded forms, having a glazed but somewhat pitted surface—and are very hard and compact, breaking with glistening surfaces. They occur in thin bands of compact or brecciated limestone, which are very sparingly fossiliferous, holding only a few shells of *Hyolithes* and certain *Scolithus*-like cylindrical markings. In some of these beds siliceous pebbles occur with the nodules, rendering it possible that the latter may have been derived from the disintegration of older beds; but their forms show that they are not themselves pebbles. Phosphatic nodules also occur sparingly in the thick beds of limestone conglomerate which are characteristic of this formation; they are found both in the included fragments of limestone and in the paste. The conglomerates contain large slabs and boulders of limestone rich in *Trilobites* and *Hyolithes;* but in these I have not observed phosphatic nodules.

In some of the limestones the phosphatic bodies present a very different appearance, first noticed by Richardson at Rivière Ouelle, and of which I have found numerous examples at Kamouraska. A specimen now before me is a portion of a band of grey limestone, about four inches in thickness, and imbedded in dark red or purple shale. It is filled with irregular, black, thick-walled cylindrical tubes, and fragments of such tubes, along with phosphatic nodules—the whole crushed together confusedly, and constituting half of the mass of the rock. The tubes are of various diameters, from a quarter of an inch downward; and the colour and texture of their walls are similar to those of the ordinary phosphatic nodules.

Under the microscope the nodules and the walls of the tubes show no organic structure or lamination, but appear to consist of a finely granular paste holding a few grains of sand, a few small fragments of shells without apparent structure, and some small spicular bodies or minute setæ. The general colour by trans mitted light is brown; but irregular spots show a bright blue colour, due probably to the presence of phosphate of iron (vivi-

anite). The enclosing limestone and the filling of the tubes present a coarser texture, and appear made up of fragments of limestone and broken shells, with some dark-coloured fibres, probably portions of Zoophytes. Scattered through the matrix there are also small fragments, invisible to the naked eye, of brown and blue phosphatic matter.

One of the nodules from Alumette gave to Dr. Hunt 36·38 of calcic phosphate; one from Hawkesbury 44·70; another from Rivière Ouelle 40·34; and a tube from the same place 67·53.* A specimen from Kamouraska, analyzed by Dr. Harrington, gave 55·65 per cent. One of the richest pieces of the linguliferous sandstone from St. John yielded to the same chemist 30·82 of calcic phosphate and 32·44 of insoluble siliceous sand, the remainder being chiefly carbonate of lime.

Various opinions may be entertained as to the origin of these phosphatic bodies; but the weight of evidence inclines to the view originally put forward by Dr. Hunt†, that the nodules are coprolitic; and I would extend this conclusion with some little modification to the tubes as well. The forms, both of the tubes and nodules, and the nature of the matrix, seem to exclude the idea that they are simply concretionary, though they may in some cases have been modified by concretionary action. There are in the same beds little piles of worm-castings of much smaller diameter than the tubes, and less phosphatic; and there are also *Scolithus*-like burrows penetrating some of the limestones, and lined with thin coatings of phosphatic matter similar to that of the tubes. Further, the association of similar nodules in the Chazy limestone with comminuted *Lingulæ*, as already stated, is a strongly confirmatory fact.

The tubes are of unusual form when regarded as coprolitic; but they may have been moulded on the sides of the burrows of marine worms; or these creatures may have constructed their tubes of this material, either consisting of their own excreta or of that of other animals lying on the sea-bottom. In any case, the food of the animals producing such excreta must have been very rich in solid phosphates, and these animals must have abounded on the sea-bottoms on which the remains have accumulated. It is also evident that such phosphatic dejections might either retain their original forms, or be aggregated into nodular masses, or shaped into tubes or burrows of Annelids, or,

* Geology of Canada, p. 461. † Ibid.

if accumulated in mass, might form more or less continuous beds.

The food of the animals producing such coprolites can scarcely have been vegetable; for though marine plants collect and contain phosphates, the quantity in these is very minute, and usually not more than that required by the animals feeding on them.

We must therefore look to the animal kingdom for such highly phosphatic food. Here we find that a large proportion of the animals inhabiting the primordial seas employed calcic phosphate in the construction of their hard parts. Dr. Hunt has shown that the shells of *Lingula* and some of its allies are composed of calcic phosphate: and he has found the same to be the case with certain Pteropods, as *Conularia*, and with the supposed worm-tubes called *Serpulites*, which, however, are very different in structure from the tubes above referred to.

It has long been known that the crusts of modern Crustaceans contain a notable percentage of calcic phosphate; and Hicks and Hudleston have shown that this is the case also with the Cambrian Trilobites. Dr. Harrington has kindly verified this for me by analyzing a specimen of highly trilobitic limestone from the Lower Potsdam formation at St. Simon, in which the crusts of these animals are so well preserved that they show their minutely tubulated structure in great perfection under the microscope. He finds the percentage of calcic phosphate due to these crusts to be 1·49 per cent. of the whole mass. It is to be observed, however, that the crusts of Trilobites must have consisted very largely of chitinous matter, which, in some cases, still exist in them in a carbonized state. A crust of the modern *Limulus*, or King Crab, which I had supposed might resemble in this respect that of the Trilobites, was analyzed also by Dr. Harrington. It belonged to a half grown individual, measuring 5·25 inches across, and was found to contain only 1·845 per cent. of ashes, and of this only 1·51 per cent. of calcic phosphate. The crusts of some Trilobites may have contained as large a proportion of organic matter; but they would seem to have been richer in phosphates. Next to *Linguloe* and Trilobites, the most abundant fossils in the formations containing the phosphatic nodules are the shells of the genus *Hyolithes*, of which several species have been described by Mr. Billings*. Dr. Harrington has

* Canadian Naturalist, Dec. 1871.

ascertained that these shells also contain calcic phosphate in considerable proportion. The proportion of this substance in a shell not quite freed from matrix was 2·09 per cent. These shells have usually been regarded as Pteropods; but I find that the Canadian primordial species show a structure very different from that of this group. They are much thicker than the shells of proper Pteropods; and the outer layer of shell is perforated with round pores, which in one species are arranged in vertical rows. The inner layer, which is usually very thin, is imperforate. In one species (I believe, the *H. americanus* of Billings), the perforations resemble in size and appearance those in the shells of *Terebratulæ*. In another species (*H. micans* probably) they are very fine and close together, as in some shells of tubicolous worms. I am therefore disposed to regard the claim of these shells to the rank of Pteropods as very doubtful. They may be tubicolous worms, or even some peculiar and abnormal type of Brachiopod. In connection with this last view, it may be remarked that the operculum of some of the species much resembles a valve of a Brachiopod, and that the conic l tube is in some of them not a much greater exaggeration of the ventral valve of one of these shells than the peculiar *Calceola* of the Upper Silurian and Devonian, which has been regarded by some palæontologists as a true Brachiopod. I have not, however, had any opportunity of comparing the intimate structure of *Calceola* with that of these shells. Shells of *Hyolithes* occur in the Lower Potsdam in the same beds with the phosphatic nodules; and in one of these Mr. Weston has found a series of conical shells of *Hyolithes* pressed one within another, as if they had passed in an entire state through the intestine of the animal which produced the coprolite.

Inasmuch, then, as some of the most common invertebrates of the Cambrian seas secreted phosphatic shells, it is not more incredible that carnivorous animals feeding on them should produce phosphatic coprolites than that this should occur in the case of more modern animals feeding on fishes and other vertebrates.

We may now turn to the question as to the source of the abundant apatite of the Laurentian rocks. Were this diffused uniformly through the beds of this great system, or collected merely in fissure or segregation veins, it might be regarded as having no connexion with other than merely mineral causes of deposit. It appears, however, from the careful stratigraphical

explorations of the Canadian Survey, in the districts of Burgess and Elmsley, which are especially rich in apatite, that the mineral occurs largely in beds interstratified with the other members of the series, though deposits of the nature of veins likewise occur. It also appears that the principal beds are confined to certain horizons in the upper part of the Lower Laurentian, above the limestones containing *Eozoon*, though some less important deposits occur in lower positions. *

The principal apatite-bearing band of the Laurentian consists of beds of gneiss, limestone, and pyroxene-rock, and has a thickness of from 2600 to 3600 feet. It has been traced over a great extent of country west of the Ottawa river, and has also been recognized on the east side of that river as well. The mineral often forms compact beds with little foreign intermixture; and these sometimes attain a thickness of several feet, though it has been observed that their thickness is variable in tracing them along their outcorps. Several beds often lie near to each other in the same member of the series. Thin layers of apatite also occur in the lines of bedding of the pyroxene-rock. In other cases disseminated crystals are found throughout thick beds of limestone, sometimes, according to Dr. Hunt, amounting to two or three per cent. of the whole mass. Disseminated crystals also occur in some of the beds of magnetite, a mode of occurrence which, according to Dr. Hunt, has also been observed in Sweden and in New York in the Laurentian magnetites of those regions.

The veins of apatite fill narrow and usually irregular fissures; and the mineral is associated in these veins with calcite and with large crystals of mica. In one instance, at Ticonderoga, in New York, the apatite, instead of its usual crystalline condition, assumes the form of radiating and botryoidal masses, constituting the Eupyrchroite of Emmons. Since these veins are found principally in the same members of the series in which the beds occur, it is a fair inference that the former are a secondary formation, dependent on the original deposition of apatite in the latter, which must belong to the time when the gneisses and limestones were laid down as sediments and organic accumulations.

In all the localities in which I have been able to examine the Laurentian apatite, it presents a perfectly crystalline texture,

* Vennor's Reports, 1872–73 and 1873–74.

while the containing strata are highly metamorphosed; and this appears to be its general condition wherever it has been examined. Numerous slices of the more compact apatite of the beds have been prepared by Mr. Weston, of the Geological Survey; but, as might be expected, they show no trace of organic structure. All direct evidence for the organic origin of this substance is therefore still wanting. There are, however, certain considerations, based on its mode of occurrence, which may be considered to afford some indirect testimony.

If, with Hunt, we regard the iron ores of the Laurentian as organic in origin, the apatite which occurs in them may reasonably be supposed to be of the same character with the phosphatic matter which contaminates the fossiliferous iron ores of the Silurian and Devonian, and which is manifestly derived from the included organic remains.

If we consider the evidence of *Eozoon* sufficient to establish the organic origin, in part at least, of the Laurentian limestones, we may suppose the disseminated crystals of apatite to represent coprolitic masses or the débris of phosphatic shells and crusts, the structure of which may have been obliterated by concretionary action and metamorphism.

Such Silurian beds of compact and concretionary apatite (without structure, yet manifestly of organic origin) as that described by Mr. Davies in the 'Journal' of this Society, may be taken as fair representatives of the bedded apatite of the Laurentian. Further, the presence of graphite in association with the apatite in both cases may not be an accidental circumstance, but may depend in both on the association of carbonaceous organisms, whether vegetable or animal.

Again, the linguliferous sandstone of the Acadian group is a material which, by metamorphism, might readily afford a pyroxenite with layers of apatite like those which occur in the Laurentian.

The probability of the animal origin of the Laurentian apatite is perhaps further strengthened by the prevalence of animals with phosphatic crusts and skeletons in the Primordial age, giving a presumption that in the still earlier Laurentian a similar preference for phosphatic matter may have existed, and, perhaps, may have extended to still lower forms of life, just as the appropriation in more modern times of phosphate of lime by the higher animals for their bones seems to have been accompanied by a dimution of its use in animals of lower grade.

The Laurentian apatite pretty constantly contains a small percentage of calcium fluoride; and this salt also occurs in bones, more especially in certain fossil bones. This may in both cases be a chemical accident; but it supplies an additional coincidence.

In the lowest portions of the Lower Laurentian no organic remains have yet been detected; and these beds are also poor in phosphates. The horizon of special prevalence of *Eozoon* is the Grenville band of limestone, which, according to Sir William Logan's sections, is about 11,500 feet above the fundamental gneiss. It appears, from recent observations of Mr. Vennor and Mr. W. T. Morris, that the bed holding the Burgess *Eozoon* is on the same horizon with the limestone of Grenville. The phosphates are most abundant in the beds overlying this band. This gives a further presumption that the collection and separation of the apatite is due to some organic agency, and may indicate that animals having phosphatic skeletons first became abundant after the sea bottom had been largely occupied by *Eozoon*.

I would not attach too great value to the above considerations; but, taken together, and in connection with the occurrence of apatite in the Cambrian and Silurian, they seem to afford at least a probability that the separation of the Laurentian phosphate from the sea-water, and its accumulation in particular beds, may have been due to the agency of marine life. Positive proof of this can be obtained only by the recognition of organic form and structure; and for this we can scarcely hope, unless we should be so fortunate as to find some portion of the Lower Laurentian series in a less altered condition than that in which it occurs in the apatite districts of Canada. Should such structures be found, however, it is not improbable that they may belong to forms of life almost as much lower than the *Lingulæ* and Trilobites of the Cambrian as these are inferior to the fishes and reptiles of the Mesozoic.—*From the Quarterly Journal of the Geological Society.*

NATURAL HISTORY SOCIETY.

PROCEEDINGS FOR THE SESSION 1875–76.

MONTHLY MEETINGS.

1st Monthly Meeting, held October 25th, 1875.

The Rec.-Secretary having read a letter in which the Messrs. Allan Bros. of Liverpool, undertook to convey to the Society a box of specimens presented by Lieut.-Col. Bulger, free of charge: It was moved by Prof. Darey, seconded by E. E. Shelton, and resolved:—"That the thanks of the Society be voted to the Messrs. Allan Bros. for their liberality in this matter."

A number of donations to the Library and Museum were announced and exhibited, and the thanks of the meeting were voted to each of the donors.

Dr. B J. Harrington then read an obituary notice of the late Sir W. E. Logan. This will be found on pages 31–46 of the present volume.

Rev. Dr. De Sola, who occupied the chair in the absence of the President, having made some remarks on the great loss which the Society had sustained by the decease of one of its most eminent and oldest members: it was moved by Principal Dawson, seconded by G. L. Marler, and resolved unanimously: "That Dr. Harrington be requested to publish the obituary notice just read in the Proceedings of this Society in the *Canadian Naturalist*, as a testimony to the honour in which the Society, in common with all other friends of science in this country, holds the memory of Sir W. E. Logan, and that copies be sent in the name of the Society to his surviving relatives."

Dr. P. P. Carpenter made a communication "On the life and labours of the late Dr. John Edward Gray, of the British Museum, and of Prof. G. P. Deshayes, formerly of the Jardin des Plantes, Paris," after which the meeting closed.

2nd Monthly Meeting, held November 29th, 1875.

After the transaction of the usual routine business, a discussion ensued on the question of the proposed union with the Fraser Institute; and the previous correspondence on the sub-

ject, and conditions suggested, having been read, the President, A. R. C. Selwyn, F.R.S., &c., on behalf of the Committee appointed to confer with the Governors of the Fraser Institute, asked authority from the Society to carry on the arrangements to completion, and to submit a definite proposal for vote of the Society thereon at its next meeting, on the basis of the recommendations now submitted.

It was moved by the Rev. Canon Baldwin, seconded by G. L. Marler, and unanimously resolved:—"That in accordance with the constitution of this Society, the proposal now read for Union with the Fraser Institute, in so far as the collections and library of the Society are concerned, be submitted to the meeting to be held in January, for final vote thereon, and that notice be given by circular to each member of the Society of the business to be submitted."

"That in the meantime, the Committee be instructed to complete the necessary arrangements, as far as possible, with the Fraser Institute, and also with the Royal Institution."

Rev. R. W. Norman, M.A., was elected a resident member.

In consequence of the unavoidable absence of the author, a paper by Mr. H. G. Vennor, of the Geological Survey, on the Galena and Plumbago Deposits of Eastern Ontario, was read by the Recording Secretary.

The President subsequently remarked that it was unfortunate that Mr. Vennor was not able to be present, as on some points suggested by the paper just read, further information was desirable. A short discussion ensued, at the conclusion of which the meeting was adjourned.

Special Meeting, called instead of the ordinary Monthly Meeting for January 31st, 1876.

In accordance with a resolution to that effect, passed on the 29th of November last, the present meeting was called by a circular mailed to each member, of which the following is a copy:

MONTREAL, January 22, 1876.

SIR,—You are requested to attend a Special Meeting of the Natural History Society, to be held at its Rooms, on Monday evening, January 31st, at 8 o'clock precisely, instead of the ordinary monthly meeting.

Your obedient servant,

J. F. WHITEAVES, *Secretary.*

BUSINESS: Final consideration of the proposed connexion of the Society with the Fraser Institute.

A copy of the following Memoranda was also sent at the same time to each of the members:

MEMORANDUM *of the Terms upon which it is proposed to transfer the Museum and Library of the Natural History Society to the custody of the Fraser Institute.*

1st. The Natural History Society agrees to transfer its Museum and Library, also any movable cases, furniture or fittings, that it possesses, permanently and without reserve, to the custody of the Fraser Institute.

2nd. The Natural History Society agrees to pay to the Governors of the Fraser Institute, the net proceeds arising from the sale of their land and building after payment of the undermentioned liabilities:

a $1000.00 Mortgage and any interest which may have accrued thereon.

b $4000.00, the amount of the Somerville bequest.

c $2000.00, the amount due to the Royal Institution for the Advancement of Learning, on account of the land now held by the Natural History Society.

MEMORANDUM *of the Terms upon which the Governors of the Fraser Institute agree to accept the custody of the Museum and Library of the Natural History Society.*

1st. The Governors of the Fraser Institute agree to provide a suitable building for a Museum of Natural History, of not less capacity than that which now contains the collections of the Society, together with such cases or fittings as are required and cannot be furnished by the Natural History Society.

2d. The Governors of the Fraser Institute agree to provide for the Society, free of expense, suitable lecture and committee rooms; the former for the delivery of free popular lectures, and for the annual and monthly meetings of the Society; the latter for its Secretary's office, and for its Council and Committee meetings. Also a room for the Curator of the Museum, and a work-room for a Taxidermist. The said rooms to be of not less capacity than those used for these purposes in the present building of the Society.

3d. The Governors of the Fraser Institute agree to provide for the safe-keeping of the collections, and for their proper and scientific arrangement by competent Curators and otherwise. The salaries of such officers to be paid by the Institute.

4th. The Original Museum and Library of the Natural History Society, with such additions as may from time to time be made by the Society, shall be known and distinctly labelled as the Collection and Library of the Natural History Society of Montreal. The books many be incorporated with the general library of the Institute, but are to be stamped with the name of the Society.

5th. The Museum shall at all times be open to the inspection of the Council of the Natural History Society, or of such other officer or officers as the Society may appoint.

6th. The Council of the Society shall have power to make recommendations to the Governors of the Institute as to the safe keeping and improvement of the Museum, and shall be consulted in any contemplated changes of its arrangement or management.

7th. The Society shall have power to add to its Museum and Library, from time to time, such specimens and books as it may acquire, and the books of the Natural History Society shall have the same care as those of the Fraser Institute.

8th. The Museum and Library shall be opened to Members of the Society and their friends, on terms not less liberal than those provided for by the present rules of the Natural History Society.

9th. All current expenses connected with the maintenance of the accommodation specified in clauses 1 and 2, such as furniture, repairs, city assessments, fuel, lighting, cleaning and insurance, are to be paid by the Fraser Institute.

NOTE.—The dimensions of the present Museum of the Society are 87 x 42½ feet, with a gallery entirely round the room, two sides 5 ft. 8 in. wide; one side 17 ft. 4 in., and one do 16 ft 8 in wide, and there is also available space in two halls, and on the sides of the staircase. The Lecture room is 42½ feet x 43 feet, and folding doors permit the Library, 28 x 16 feet, to be thrown in.

The President and Council of the Natural History Society, would suggest in the event of the proposed transfer being mutually agreed upon, that the Governors of the Institute should secure the services of J. F. Whiteaves, Esq., the present Scientific Curator of the Natural History Society, as it would, in their opinion, be impossible to find any one so well fitted by local experience and otherwise to undertake the duty of the re-arrangement and classification of the collections in the new Museum; and also its subsequent superintendence.

There were twenty-two members present.

On motion of Principal Dawson, Rev. Dr. De Sola was requested to take the chair.

The presiding officer, after briefly stating the nature of the business which the meeting was specially called to consider, regretted the absence of the President, who had taken an active part in the negotiations with the Governors of the Fraser Institute, and called upon the Recording Secretary to read the minutes of the last monthly, and of the last two Council meetings, also a copy of the "Memoranda" printed above.

On behalf of the Committee appointed to confer with the Governors of the Fraser Institute, Principal Dawson gave a verbal report of the action taken so far, and stated the terms of the agreement arrived at between the Governors of the Royal Institution and the Natural History Society, in the event of the sale of the buildings and ground at present occupied by the latter corporation.

The following resolutions (which were subsequently amended by consent of the mover and seconder, so as to include some additions, suggested later on in the evening), were moved by G. L. Marler, seconded by Prof. Darey:

"That the report now presented be adopted as amended, and the terms therein stated for union with the Fraser Institute, be, and hereby are, accepted by this Society, and that the Council be, and hereby is, empowered to prepare and execute the necessary agreements and deeds so soon as the building of the Fraser Institute shall be erected, and the Trustees thereof be in a position to carry out the stipulations entered into by them. The Council shall have the drafts of the said agreements and deeds prepared with legal advice, and shall submit them to the Society before signature."

"Farther, that the said deeds and agreements shall contain provision for the disposal of the collections and library, in event of either the Fraser Institute or Natural History Society ceasing to exist as at present constituted, or failing to fulfil its obligations."

The "Memoranda" were then discussed, paragraph by paragraph, and upon a motion to that effect being made, it was resolved unanimously:

"That the words—for use as a free Museum and Library—be added to the first paragraph of the first Memorandum."

It was moved by Dr. P. P. Carpenter, seconded by C. Robb:

"That the words—'permanently and without reserve'—be struck out of the same paragraph."

The motion was put to the meeting, and was declared by the Chairman to be lost.

Dr. P. P. Carpenter moved, seconded by G. L. Marler:

"That the following qualification be added to paragraph 3 of the second 'Memorandum,' after the word Institute—'But no appointment of Chief Curator shall be made without ratification by the Society.'"

This resolution was unanimously adopted.

The main motion was then submitted to the meeting, and was carried *nemine contradiscente*.

4th Monthly Meeting, held February 28th, 1876.

Messrs. Armand Thielens (Director of Posts, Tirlemont, Belgium), Professor Edouard Morren (University of Liege, Belgium), André Devos (Conservator of Botany, University of Liege, Belgium), and Robert Middleton, of Victoria, Vancouver Island, were elected corresponding members.

Mr. J. W. Spencer then read a paper "on the Nipigon or Copper-bearing Rocks of Lake Superior, with notes on Copper Mining in that region," which is printed on pages 55-81 of the present volume.

A discussion took place after the reading of the paper, in which Messrs. A. R. C. Selwyn, Principal Dawson, Prof. R. Bell, and C. Robb took part. The points upon which most of the speakers seemed to agree were: 1st, that lithological and stratigraphical differences exist between the beds on the north and south shores of the Lake, and that a satisfactory correlation of the deposits at these two localities has not yet been established; and, secondly, that the exact geological horizon of the copper-bearing series is still uncertain.

Principal Dawson called the attention of the members present to an interesting collection of ferns and other fossil plants which had been recently obtained by Mr. Albert J. Hill from Cossett's Pit, near Sydney, Cape Breton, some of which were exhibited. He said they were of interest as showing the occurrence of forms hitherto known only in the middle and upper coal formations in beds assigned, on stratigraphical evidence, to the upper part of the Millstone-Grit. They were also of interest from the presence of at least four species of ferns showing fructification, which would shortly be described. They were further of interest as occuring in the same beds with the remains of a fossil larva of a dragon-fly, which will be described by Mr. Scudder in the next number of the *Canadian Naturalist*, and which is the first insect of that family found in the Carboniferous Rocks.

5th Monthly Meeting, held March 27th, 1876.

A paper by Mr. G. M. Dawson, entitled "The Grasshopper visitation of 1874 in Manitoba and the North West Territories," was read by Principal Dawson.

After some remarks on this subject by A. R. C. Selwyn, Prof. R. Bell, E. L. Marler, C. Robb, and Principal Dawson, the proceedings terminated by a vote of thanks to the author of the paper of the evening.

6th Monthly Meeting, held April 30th, 1876.

Mr E. J. Major was elected a member of the Society.

A paper by Lieut. Col. Bulger, entitled "A visit to Port Blair and Mount Harriet, Andaman Islands," was read by the Rec. Secretary and an interesting collection of shells from that

locality (presented by Lieut. Col. Bulger) was exhibited. The paper may be found at pages 95–103 of the last number of this Journal.

A letter from Lieut. Col. Bulger was also read in which it was endeavoured to interest the members in the taking of phenological observations, and the scope of a pamphlet forwarded by Mr. Bulger, giving instructions for the taking of the same, was explained by the Rec. Secretary.

A committee was appointed, to consist of Dr. John Bell, J. B. Goode, F. B. Caulfield and the Rec. Secretary, with power to add to their number, to endeavour to draw up a series of instructions for the use of phenological observers in the Dominion.

SOMMERVILLE LECTURES.

The following is a list of the titles of the lectures of this course, with the dates at which they were delivered, and the names of the lecturers.

1. Jan. 20th, 1876. Insectivorous Plants. By Principal Dawson LL.D., F.R.S.
2. Jan. 27th, " A bit of life on the Ocean. By W. G. Beers, L.D.S.
3. Feb. 3rd, " Some facts in Psychology. By Dr. G. A. Baynes.
4. Feb. 10th, " Selections from the study of Vegetable Life. By Prof. J. B. McConnell, M.D.
5. Feb. 17th, " Animal Parasites and their relation to Public Health. By Prof. W. Osler, M.D.
6. Feb. 24th, " The climatology and resources of our North West. By Prof. J. Macoun, of Albert College, Belleville.
7. March 2nd, " Spiritualism, as viewed in the light of the Baconian Philosophy. By Rev. J. T. Stevenson, L.L.B.

ANNUAL MEETING.

The Annual Meeting was held on the 18th of May, 1876, Mr. Charles Robb presiding.

After the minutes of the last Annual Meeting had been read, the Rec. Secretary read a letter from the President, A. R. C. Selwyn, F.R.S. (who was absent in Philadelphia), expressing his regret at not being able to be present, and distinctly declining.

re-nomination on the ground that he found it impossible to attend properly to the duties of the office.

The following report of the Chairman of Council was read by Mr. G. L. Marler.

REPORT OF THE CHAIRMAN OF COUNCIL.

Your Council in presenting its annual Report deeply regret to announce the loss of four life members, who were distinguished alike for their long connection with the Society and for the deep interest they took in its proceedings. In mentioning the name of Sir William E. Logan, there is little need for me to do more than allude to his geological researches: the result of his life-long labours are known to you all, and have secured for him a high place in the annals of Canadian science.

Sir G. Duncan Gibb, whose recent loss we have also to deplore, although not lately a resident in Canada, was once a very active member of this Society, and was at one time the Scientific Curator of its museum. He was fond of the study of Natural History, and contributed the following papers to the Society's Journal:

1. A Pedestrian Tour from Brighton to Hastings.
   (*Canadian Naturalist*, 1st series, vol. 2, page 382.)
2. On the existence of a Cave in the Trenton Limestone at the Côte St. Michel, on the Island of Montreal.
   (*Canadian Naturalist*, 1st series, vol. 3, page 192.)
3. The Natural History of the *Sanguinaria Canadensis*, or Canada Blood Root.
   (*Canadian Naturalist*, 2nd series, vol. 2, page 432.)

The late John Swanston, of the Hudson's Bay Co., was also a warm friend and strong supporter of the Society, to whose museum he made many valuable contributions. George H. Frothingham, another life member, has been removed from among our midst; as has also Mr. Walter McOuat, with whose reports, as a member of the staff of the Geological Survey, many here will be familiar.

While death has thus severely visited the Society, the increase to its ranks has been very small, only two new members having been added during the session; though, on the other hand, in spite of the prevailing commercial depression, fewer resignations than usual have been received.

The arrangements for the transfer of the museum and library of the Society to the custody of the Fraser Institute, have, as you are aware, been completed as far as possible, and the terms of union agreed upon. Your Council are of opinion that by the proposed transfer the Society will be relieved of much pecuniary responsibility, and that in future it will be able to devote its funds more exclusively to such objects as the improvement of the library and museum, as well as to that of the "Canadian Naturalist."

The regular monthly meetings have been held during the past session, to the number of six, and were very fairly attended. The titles of the papers read will be found in their proper place in the Proceedings of the Society.

Your Council regret to report that the Government has seen fit to discontinue deep-sea dredging operations in the Gulf of St. Lawrence, but your Council hope that the discontinuance will be only temporary, and that the Government may be again induced to resume this most interesting and important work.

The lecture room has been rented during the year, and the sum of $347.00 has thus been added to the funds of the Society.

The Sommerville Course of free public Lectures have been delivered as usual, and that they have been fully appreciated is shewn by the large audiences by which they were attended. The subjects of the lectures, the date at which they were delivered, and the names of the lecturers, will be found in the Proceedings.

The customary grant of $750 has been duly received from the Provincial Parliament, but an application for an increase of the amount was unsuccessful.

At the suggestion of Lieut.-Col. Bulger a Committee has recently been appointed to issue directions for the use of phenological observers, and your Council would urge upon its successors the desirability of taking prompt action in this matter.

Arrangements have just been completed for the whitewashing and re-tinting of a large portion of your building.

The number of persons visiting the museum has been about equal to the average of former years.

Owing to the backward state of the season, it was thought desirable to postpone the holding of a field meeting on the Queen's birth-day.

The report of the Scientific Curator and Rec.-Secretary was then read as follows:

REPORT OF THE SCIENTIFIC CURATOR.

A large part of the time during the past session has been devoted to the completion, as far as possible, of the re-classification of the Society's collection of Canadian insects. Since the cabinet was first arranged, in 1865, numbers of new specimens have been added, and these were, from time to time, pinned into any convenient place, until the whole should be re-arranged. Catalogues of the coleoptera of the island of Montreal have been published by Mr. D'Urban and the late Mr. A. S. Ritchie, in the *Canadian Naturalist.* These collectively make up a list of about 300 species. Mr. Ritchie's collection, which was specially valuable as having been named by Drs. Horn and Leconte, is now in the possession of the London branch of the Entomological Society of Canada. The first step taken towards an entire re-arrangement of the Society's rather extensive collection of Canadian beetles was to compile a MSS. catalogue, based on the lists referred to above, of the species so far known to inhabit the island of Montreal. During the past few years Mr. Caulfield, Mr. Passmore, and myself, have given a good deal of spare time (mostly Saturday afternoons in summer), to the collection of local coleoptera. We have been able to add about 80 identified species to the lists already published, while a number of specimens remain yet to be named. After completing this MSS. list, 4 drawers in the cabinet were selected and spaces, with a printed label to each, were allotted for every species known to inhabit the Island. Efforts have been made to fill these spaces with new and high pinned specimens, and the result has been that 193 species were obtained. The important collection recently presented by Mr. Billings, has been removed from the collecting boxes in which it was originally contained, and the insects pinned into the cabinet. The remainder of the collection consists of such specimens as are not in either of the two previously mentioned series. This part of the cabinet, which was previously in a state of chaotic confusion, is now in very fair order, all duplicates having been rejected, also specimens without either locality or name. The Coleoptera now fill 7 drawers, in three separate series, as follows:

1. Beetles from the Island of Montreal exclusively, 193 species.
2. Mr. Billings' collection - - - - - 444 "
3. Specimens mostly from the Province of Ontario, 198 "

In all - 835 "

While engaged in endeavouring to collect fresh specimens of local beetles for the cabinet, other orders have not been neglected, and fair series of hymenoptera, diptera, and orthoptera have been obtained. The proper setting of large numbers of insects, and their correct determination, has of course taken up considerable time.

During Mr. Selwyn's explorations in the vicinity of the Peace River, attention was given to collecting the insects of that region. A large series of coleoptera were brought from that part of the world, and were kindly presented to the Society by Mr. Selwyn. The whole of these have been sent to Dr. Leconte, of Philadelphia, who has kindly promised to report upon them. When they are returned they will form a very valuable and indeed unique feature in our cabinet. Dr. Leconte moreover promises to examine and determine all our local coleoptera which remain unnamed, particularly the Curculionidœ, of which little or nothing is known at present. The whole of the Canadian Lepidoptera have also been re-arranged, and the collection now fills 6 drawers. Many of our local species are still unrepresented, and entomologists are respectfully reminded of the many vacancies to be met with in this part of our cabinet. As a great difference of opinion unhappily exists as to what is the proper nomenclature in this group, the old names have been provisionally retained.

Dredging operations have been carried on during the past summer in the Gulf of Georgia by Mr. Richardson. The dredgings extended from outside Victoria Harbour to within a short distance of Race Islands lighthouse and thence to the Constance bank, the average depth being from 25 to 50 fathoms. A few successful casts were also made in Baynes Sound, also between Texada and Harwood Islands. The specimens obtained in this way are of unusual interest; there is one small sponge; six Echinoderms; thirteen species of Polyzoa, many of which are new to science; fifty-four species of Mollusca, and four Crustacea. Three of the shells are novelties, two of which have recently been described by Mr. Dall from Alaska, which was the

only previously known locality for them, while ten are new to the fauna of the Gulf. Mr. Richardson also collected thirty-one species of marine shells in the neighbourhood of Victoria, and of these three are new to the district. The whole of the specimens collected by Mr. Richardson have been presented to the Society by its worthy President, to whom the Society is already so largely indebted. Thanks to his liberality, the Society now possesses quite a rich collection of the products of the Pacific coasts of the Dominion. It has been quite a labour of love to study these interesting and often unique specimens: the whole of the Mollusca, eighty-five species in all, have been carefully determined, as have also most of the Echinodermata. We have also received during the past session a small but beautifully prepared series of the crustacea, marine algæ, &c., of Vancouver Island, prepared by Mr. R. Middleton of Victoria. The crustacea have been sent to Mr. S. J. Smith of Yale College for identification, and have been since returned. There are six species, most of which are rare in collections, while one is entirely new. The Hydroids were sent to Prof. Verrill, who in returning them, reports that there are seven species, all referable to well-known Californian types. Mr. W. H. Dall, who has spent many years in exploring the marine zoology, &c., of Alaska and the Arctic fauna of the Pacific, paid Montreal a visit last August, and spent several days in examining and making notes on the shells from the Gulf of St. Lawrence in the Society's collection. Unfortunately, Mr. Richardson's shells had not been received when Mr. Dall was here, but a list of the whole of them was forwarded to him at Washington, and many of the most critical of the shells themselves. Dr. J. Gwyn Jeffreys, who superintended one of the dredging cruises of the Porcupine, accompanied the British Arctic expedition as far as Greenland, in H. M. S. Valorous. An accident occurred to the vessel, which somewhat interfered with dredging operations; still Dr. Jeffreys' cruise was not altogether unsuccessful, and he is now engaged in a study of the specimens obtained. He has expressed a wish to see several of the shells obtained in the Gulf of St. Lawrence on recent dredging expeditions, and they have accordingly been sent to him; these have also been since returned. The Society has now had the advantage of having all its St. Lawrence shells critically compared with Arctic Atlantic forms by the ablest living authority on the mollusca of the north of Europe, and as complete a set of duplicates as could be spared were forwarded to

Mr. Dall for comparison with nearly related forms from the Arctic waters of the North Pacific, in his cabinet.

Some progress has been made in the determination of such species of marine animals (obtained during three dredging expeditions to the Gulf) as had not been previously studied. My own time has been given to the sponges and polyzoa, also to a revision of the mollusca. About fourteen species have been added to the known fauna of that region. Several critical crustacea and echinoderms, dredged by Principal Dawson at Metis last summer, have been sent to Profs. Smith and Verrill, who have kindly reported thereon. The whole of the echinodermata from the Gulf in the collections of Principal Dawson and of the Society are now determined.

Lieut.-Col. Bulger, whose donations to the Society have been so numerous and valuable, has added to his favours by presenting to the Society a fine collection of the shells of the Andaman Islands in the Bay of Bengal. It contains 137 species, in excellent order, most of which have been mounted on tablets, and 87 have been named.

In last year's report it was stated that the whole of my own private collection of fossils and shells had been imported from England. They fill four large packing cases, and had not been opened for fourteen years. It was found that many of the most delicate shells had been attacked by mildew, and some had been so much injured as to be worthless. An attempt has been made to remedy this state of things, but my time has been so much occupied with other work that only two of the cases have been opened.

At a late meeting of the Library Committee, I was requested to examine into and report upon the present condition of the library. All the American exchanges that are unbound have accordingly been tied up in volumes, and the numbers of the missing parts, or the word complete, as the case may be, written on each set. The whole of the Society's collection of pamphlets has been gone through with the view of selecting sets for binding.

The ordinary secretarial duties, such as the calling of meetings, the posting of the minutes, and other routine work, has been much the same as in past years, but the purely scientific correspondence entailed by the constant addition of new specimens, is very largely on the increase.

The report of the Treasurer was next read by Mr. E. E. Shelton. This will be found on the next page.

Dr. THE NATURAL HISTORY SOCIETY *in account with* E. E. SHELTON, *Treasurer.* *Cr.*

1875-'76.		1875.	
To cash paid Mr. Whiteaves	$400.00	By Balance in Treasurer's hands	$509.57
" " Mr. Passmore	200.00	1876.	
" " Foote's com. on Collections	16.15	By Government grant	750.00
" " Coal and Wood	107.06	" Members' Yearly Subscriptions	355.00
" " Gas Bill	56.70	" Museum Entrance Fees	51.50
" " Water	42.05	" Rent of Rooms	347.00
" " City Taxes	82.50	" Cash for 7 vols. of the Naturalist	10.00
" " Insurance	35.00		
" " Repairs and petty expenses	128.30		
" " Dawson Bros.—Naturalist	175.30		
" " Printing and advertising	79.34		
" " Interest to Royal Institution	80.00		
" " Prof. Macoun's Lecture	16.75		
" Balance in Treasurer's hands	603.92		
	$2023.07		$2023.07

E. & O. E.
Montreal, 17th May, 1876.

Audited and found correct after comparing with vouchers.

G. L. MARLER,
J. H. JOSEPH, } *Auditors.*

On motion of Dr. J. Baker Edwards, seconded by Prof. Darey it was resolved:

"That the reports now read be adopted and printed in the *Naturalist*, and that it be a suggestion to the new Council to take such measures as may seem feasible to bring under the notice of the public the importance of the operations of this Society and its claims to a more extended and liberal support from the community."

The election of officers was then proceeded with, and it was moved by G. L. Marler, seconded by E. E. Shelton, and resolved:

"That the by-law providing for the election of every officer by ballot, be suspended, and that Principal Dawson be elected President by acclamation."

Mr. E. E. Shelton was also re-elected as Treasurer, Prof. Darey as Corresponding Secretary, and Mr. J. F. Whiteaves as Scientific Curator and Recording Secretary, in the same way, the form of balloting being dispensed with in each case, by a special resolution to that effect.

Messrs. J. B. Goode and Prof. R. Bell having been appointed scrutineers, the following officers were elected by ballot in the usual way:

Vice-Presidents,—A. R. C. Selwyn, F.R.S., F.G.S.; Rev. A. De Sola, LL.D.; J. Baker Edwards, Ph.D., D.C.L.; C. Robb; His Lordship the Metropolitan; G. L. Marler; and E. Billings.

Council,—Prof. R. Bell, Dr. B. J. Harrington, R. W. McLachlan, Rev. Canon Baldwin, J. H. Joseph, J. B. Goode, Dr. W. Osler, N. Mercer, and M. H. Brisette.

It was moved by Dr. J. Baker Edwards, seconded by Prof. Darey, and resolved unanimously:

"That the thanks of the Society be voted to Dr. Harrington for his valuable services in editing the *Naturalist*."

It was also moved by G. L. Marler, seconded by E. E. Shelton, and resolved:

"That the Library and Membership Committee of last year be re-elected."

On motion of Prof. Bell, seconded by J. B. Goode, a vote of thanks was passed to the officers of the past session.

DONATIONS TO MUSEUM AND LIBRARY—SESSION 1875-76.

From	TO THE MUSEUM.
A. H. Foord, F.G.S.	Two species of Sponges, 7 of Polyzoa, an isopod crustacean (*Œga psora*, Linn) and some marine shells, from Cape Cove, and Percé, Gaspé.
Lieut.-Col. Bulger, F.R.G.S., L.S., Z.S.,	137 species of shells, mostly marine, from the neighbourhood of Port Blair, Andaman Islands.
	Skin of Sonnerat's Jungle fowl. Male. *Gallus Sonneratii.*
Dr. W. E. Scott.	Specimen of the Sulphur Crested Coakatoo.
Mr. James Leslie.	Water snake, *Nerodia sipedon.*
A. Lewis, Esq.	Fine inlaid Indian stone pipe-bowl from the North-West.
W. McLennan, Esq.	Indian stone pipe and 12 species of insects from Savannah.
J. B. Goode, Esq.	Large dried frond of *Polystichum lonchitis*, from Cape Bon Ami, Gaspé.
Dr. Godfrey.	Long-tailed Duck. *Harelda glacialis.*
James Gardner, Esq.	*Pleuura crassa*, and a large Asterias, both from Bermuda.
The Geological Survey, per A. R. C. Selwyn, F.R.S., &c.	85 species of marine shells, 6 do. of echinodermata, 5 do. of crustacea, and 13 do. of polyzoa, also axis of a large Gorgonia, all from the Gulf of Georgia.
Robert Middleton, Esq Victoria, Vancouver Island.	A fine series of mounted sea-weeds, also 7 species of hydroids, 4 of polyzoa, floats of Portuguese man-of-war, and 6 species of crustacea, all from the neighbourhood of Victoria, V. I.
N. P. Leach, Esq.	The "Black Longe" of Lake Memphremagog. *Salmo confinis* Dekay, from Magog, P. Q.

From	TO THE LIBRARY.
The Author.	Report on the Geology and Resources of the Region in the vicinity of the Forty-ninth Parallel, from the Lake of the Woods to the Rocky Mountains By G. M. Dawson, F.G.S., &c.
The Author.	Revision of the North American Porifera With remarks upon foreign species. Part 1. By Alpheus Hyatt.
Trustees of the British Museum.	Catalogue of Cyclostomatous Polyzoa in the British Museum. By G. Busk.
	Catalogue of Birds Volume 2.
The Dominion Government.	Statutes of Canada, 38th Victoria, 1875 Vol. 2. (In French.)
The Author.	Annuaire de Ville Marie, origine, utilité et progrès des Institutions Catholiques de Montreal. Supplement a l'edition de 1864. Par L. A. H. Latour, M.A., &c.
The Cobden Club.	Free Trade and the European Treaties of Commerce. Being a report of Proceedings at the dinner of the Cobden Club, July 17th, 1875.
The Belfast Naturalists Field Club.	Guide to Belfast and the adjacent Counties.
Executors of the late Henry Christy, Esq.	Reliquiæ Aquitanicæ. Parts 11 to the end, inclusive.

THE DAWN OF LIFE,

Being the history of the oldest known Fossil Remains, and their relations to Geological time and to the development of the Animal Kingdom.

By J. W. DAWSON, LL.D., F.R.S., F.G.S., &c. &c.
Principal of McGill University.

One vol. 12*mo*, *with many Plates.*

$2.00.

(From the *Daily News*, London, England.)

"In a little volume entitled "The Dawn of Life" (Hodder and Stoughton), Dr. Dawson, the well-known Canadian geologist, has sketched in a style strictly popular, yet without the least sacrifice of scientific exactness, the curious discovery of the Eozoon, in the limestones of the ancient Laurentian series which attain such an amazing thickness in Canada. Although the existence of organic remains in those rocks was, as the author justly remarks, a fair inference from our knowledge of them, and we may add, of the kindred rocks in Scotland and Ireland, better known to us as the Lewisian, it is entirely to the Canadian geologists that this curious solution of a difficult problem is due. It was they who perceived that, the basis of these rocks being limestone, it was more than probable, in spite of the metamorphic character they had assumed, that they were originally sedimentary deposits like the basis of other limestone, and had the same origin in the corruption of the remains of the myriads of little creatures which, both on the surface and in the depths of the ocean, are still, as the dredges of the Challenger teach us, forming beds of chalks and probably vast white cliffs to be revealed in future ages inconceivably remote. To the shrewdness of these American men of science we also owe the inference of vegetable life during the Laurentian period as evidenced by the existence of graphite or plumbago. Thus the final discovery of Eozoon, or the "Canadian dawn-animal," as it has been called from its presence in what we have ground to assume to be the very first of all aqueous deposits, was, as has been observed, somewhat like the discovery of the planet whose existence had been first determined *a priori* from planetary disturbances. How far back this discovery, at first received with scepticism, but now fairly established as a scientific fact, pushes the period of life on our globe beyond what was till lately known as the "primordial period," may be faintly conceived from the circumstance that the Laurentian was found on measurement by the officers of the Canadian Geological Survey to be 3,500 feet thick, in three beds, which have been computed to extend over an area of 200,000 square miles. Next to Sir William Logan, perhaps Dr. Dawson himself has had more to do with this discovery of the earliest known fossil than any one else. He speaks therefore with authority in his account of the nature and probable habits of the dawn-animal, and in tracing out the important relations which the discovery bears to facts and theories which extend far beyond the strict domain of the geologist. His monograph *is written in a vein of quiet enthusiasm which is justifiable, and* while it attracts the novice, will not be unpleasing to the scientific reader. Very little is really wanting to the full comprehension of his theme beyond the preliminary explanations, the condensed sketch of geological periods, and the wood-cut illustrations which accompany the book. We will undertake to say that even a reader who is entirely unacquainted with the science will, if he have only ordinary curiosity about natural phenomena, find this volume not only perfectly intelligible, but entertaining in a high degree."

PUBLISHER'S NOTICE

COMMENCING with Volume Seven, the Natural History Society of Montreal has arranged to give to each of its Annual Subscribers a copy of the 'Canadian Naturalist' without additional charge.

The Magazine is issued four times a-year as before, but the parts consist of 60 pages only. The volume of 480 pages will thus spread over two years, and as the former price of three dollars has been retained, it is now quoted "per volume" instead of "per annum." Those who are not members of the Society will thus obtain the Magazine at precisely the same price as heretofore, viz. three dollars for 480 pages.

☞ The Editor of this Journal is responsible only for such communications as bear his name or initials.

Transactions of Learned Societies or other Publications, sent in exchange for this Journal, or Books for the Society's Library (and for review), may be addressed to the

NATURAL HISTORY SOCIETY,
MONTREAL,
CANADA.

And may be sent by mail direct, or to either of the following Agents of the Smithsonian Institution, Washington, U. S. A.:

Dr. Felix Flugel. LEIPSIC. **Mr. Gustave Bossange.** PARIS. **Mr. Fred. Muller** AMSTERDAM.

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188 FLEET STREET,
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