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CONTENTS OF VOL. III.

ERRATA.

Page 403, 19th line, for Oxytropus read Oxytropis.
Page 403, 20th line, for Shoenoprasum read Schoenoprasum.
Page 423, 1st line, for Graptotites read Graptolites.
Page 425, 20th line, for dichosomous read dichotomous.
Page 427, 29th line, Kjrulfi read Kjirulfi.
Page 431, 3rd line, for Nemaloxyten read Nematoxylon.
Page 431, 4th line, for tenne read tenue.
Page 431, 13th line, for museptate read non-septate.
Page 431, 20th line, for Celluloxyten read Cellutoxylon.

ERRATA.

Page 502. For *Thureani* read *Thureaui*, and elsewhere where the name occurs, including the Index.
Page 503. 1st line. For *Suprx* read *Suprâ*.
Page 503. For *Drityograptus* read *Dictyograptus*.
Page 503. For *Trene* read *Irene*.

THE

CANADIAN RECORD

OF SCIENCE.

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The Distribution and Physical, and Past-Geological Relations of British North American Plants.

By A. T. Drummond.

(*Conclusion.*)

In illustrating the groups into which the flora of the Dominion may thus be divided, lengthy lists of plants will be avoided. Sufficient examples will be given under each division to show the distinctiveness of the group. It has, however, to be borne in mind that new facts in distribution are always coming to light. The explorations of the country between Lake Superior and the Pacific Coast are, comparatively speaking, recent and limited, and in coming years, with fuller knowledge of the rangé of each species there, it will be possible to speak with more confidence of, and to group more accurately, the flora of the western half of the continent. At present, in the case of too many species, we have only general locations given, covering a wide stretch of country.

CANADIAN GROUP.

There are no temperate plants in Canada of wide range from Atlantic to Pacific, which are exclusively Canadian, but there are many species of which it may be predicated that their maximum distribution is in this country rather than in the United States. The species which are common to Europe and America, and range to the Pacific, being chiefly northern temperate plants, have, as a rule, the mass of the individuals of each species in Canada. Exclusive of these, however, the following are illustrations of the group:—

Viola blanda, Willd.	Alnus viridis, D. C.
Lathyrus ochroleucus, Hook.	Vicia Americana, Muhl.
Potentilla arguta, Pursh.	Geum triflorum, Pursh.
Rubus triflorus, Rich.	Rosa blanda, Ait.
R. strigosus, Mq.	Cornus stolonifera, Mx.
Cornus Canadensis, L.	Chiogenes hispidula, T. & G.
Nardosmia palmata, Hook.	Menyanthes trifoliata, L.
Kalmia glauca, Ait.	Shepherdia Canadensis, Nutt.
Apocynum androsæmifolium, L.	Betula papyracea, Mx.
Corylus rostrata, Ait.	Smilacina trifolia Desf.

The question naturally suggests itself—Why are many species of wide range, reaching from one side of the continent to the other, whilst many others are circumscribed in area? It is quite clear that the size and weight of the seed, and the appendages which it may have in the shape of wings or silky plumes, to aid in its dissemination, the high winds, the crops, feathers and feet of birds, the different relations of land and water and temperature in past ages—all have been important factors in the extension of the range of plants. But there is another conclusion, the drawing of which analogy warrants. Every plant may be said to have an area where the number of its species and the condition of its growth are at the maximum. Outside of this area, the individuals are found in diminishing numbers until their progress, varying in different directions, finally ceases on every side. The growth, again, of each individual plant, has its birth in the swelling seed, its maturity when it expands its flower, and its death when, after ripening its seeds, it withers and decays. Similarly, each species has had its beginning, in past ages, in the development and permanency of a well defined variety formed from an already existing species. This new species, thus formed, would, in the course of downward geological time, reach its highest stage of existence as a species,—its period of most active growth and of largest area of distribution, when its ability, under further new conditions, to give rise to further new species, is greatest. Finally, such species has, in after geological time, its period of decline, when the activity of its individuals is gradually lessened and its area of distribution diminished, until extinction comes, leaving to the palæobotanist the duty of revealing its story when he discovers the remains in the clay nodule or the hardened rock. Applying this idea, the older existing species, which are at their maximum of activity, would, with the greater opportunities which in time they had had, have naturally a wider range, under the same set of circumstances, than those which were of more recent creation. Others, again, of the older species, would have passed their maximum of energy and, even though wide of range, would, in each passing century, become more rare. The species of newer creation would, on the other hand, be gradually extending their range wherever circumstances of climate and situation admitted, but, from the shorter lapse of time, would have a more limited range than the older species. Thus, for illustration, *Viola Selkirkii*, Pursh, being common to Europe and America, is probably one of the older species, but being now rare on this continent, may presently be on the decline; *Viola blanda*, Willd., which is a frequent species of wide range, is doubtless about its maximum of energy; whilst *Viola hastata*, Mx., which is uncommon, may be either a recently formed species, or an older species on the decline.

The same idea can be equally well applied in the case of animals.

Forest Group.

The species of this group are, with few exceptions, shrubs and herbaceous plants. That in the far west so many of these plants avoid the open prairies, is an illustration of what might be termed a companionship which nature has arranged between many of the smaller forms of plant life and their towering congeners, the trees, and which brings to light the dependence of the former and the protecting influence of the latter. Amidst the great bluffs of trees which margin the prairie, the general temperature is modified, the play of the sun's rays on the ground is less continuous, the ground itself is more moist, and the high, drying winds of the prairies are greatly diminished in force. Whilst such smaller representatives of plant life find within the line of forests or bluffs such congenial conditions, they afford, as they die, some return to the trees by joining with the trunks and leaves of the trees in enriching the soil by their decay.

The group is illustrated by the following:—

Nuphar luteum, Smith.	Viburnum nudum, L.
Corydalis aurea, Willd.	Erigeron bellidifolium, Muhl.
Claytonia Virginica, L.	Diplopappus umbellatus, Hook.
Acer spicatum, Lam.	Gaylussacia resinosa, T. & G.
Rhamnus alnifolius, L'Her.	Vaccinium macrocarpon, Ait.
Potentilla tridentata, Sol.	Epigæa repens, L.
Ribes prostratum, L'Her.	Polygonum cilinode, Mx.
Cicuta bulbifera, L.	Populus tremuloides, Mx.
Diervilla trifida, Mœnch.	Abies balsamea, Marsh.
Lonicera ciliata, Muhl.	Larix Americana, Mx.

Maritime Group.

As I, several years ago, endeavoured to explain, the species of this group, which are presently found along the shores of the Great Lakes, and of saline ground farther westward, are evidently the remnants of a larger maritime flora which margined the coast in glacial or post-glacial times when the sea made great inroads over Eastern Canada. Their existence in their present positions far inland, may be an argument for the saltness of the great interior seas of these times, but this does not necessarily follow in the absence of other more direct evidence. The very fact of their flourishing now on the fresh-water lake coasts shows how—no doubt after a severe struggle—they have, but in greatly diminished numbers, adapted themselves to the new conditions in which in the one case the saline element, and in the other, the moist atmosphere of the sea shore, were wanting. We can conceive how, in these distant times, when the sea had receded and when the struggle with changed circumstances had ended in the survival of some, these survivors could, in the usual course, find their way from the former sea shore to the inland seas, and spread themselves around their borders. Some further evidence is needed of the fresh or saline condition of these inland seas of glacial and post-glacial times. In the meantime, it is to be observed that the largest number of the inland maritime plants are found around Lake Ontario and smaller sheets of water east and south of it.

The maritime plants occurring on the coasts of the Great Lakes include the following:—

Ranunculus cymbalaria, Pursh.	Euphorbia polygonifolia, L.
Cakile Americana, Nutt.	Myrica cerifera, L.
Hudsonia ericoides, L.	Naias major, All.
H. tomentosa, Nutt.	Ruppia maritima, L.
Spergularia media, Presl.	Triglochin maritimum, L.
Hibiscus Moscheutos, L.	T. palustre, L.
Lathyrus maritimus, Bigel.	Juncus Gerardi, Lois.
Atriplex hastata, L.	Sciopus maritimus, L.
Salicornia herbacea, L.	Calamagrostis arenaria, Roth.
Polygonum aviculare, L.	Leptochloa fascicularis, Gray.
Var. littorale, Link.	Spartina stricta, Roth.
P. articulatum, L.	Var. alternifolia, Gray.
Rumex maritimus, L.	Hordeum jubatum, L.

These inland maritime plants can be regarded as one of our older floras, dating back to at least the times of the Leda clays.

EASTERN COAST GROUP.

The following species may be taken as illustrative of this group in Canada. Where they occur in the United States, they have, with two exceptions, a similar range there :—

Hudsonia ericoides, L.	Gnaphalium sylvaticum, L.
Potentilla nemoralis, Nest.	Gaylussacia dumosa, T. & G.
Rosa nitida, Willd.	Calluna vulgaris, Salisb.
Lythrum salicaria, L.	Kalmia latifolia, L., if localities confirmed.
Aster radula. Ait.	Rhodora Canadensis, L.
A. Novi-Belgii, L.	Betula alba var. populifolia, Spach.
A. tardiflorus, L.	Corema Conradii Torr.
Dipplopappus linariifolius, Hook.	Solidago puberula, Nutt.
Solidago speciosa, Nutt.	

Some of the special influences which limit the range of the species of this group, are not difficult to conjecture. The Appalachian chain of mountains has no doubt acted as a barrier to the westward progress of many plants, as it has to the eastern extension of many others. The more equable temperature, the moister atmosphere and the prevailing fogs, so pronounced on the immediate coast, especially of Nova Scotia, New Brunswick, Newfoundland and the St. Lawrence estuary, must exercise some influence inland as well, though this influence necessarily diminishes as the distance from the coast increases. A marked illustration of this influence will be referred to in the case of the British Columbia plants.

The most remarkable feature, however, in the eastern coast distribution, is the absence of such a large number of the familiar trees, shrubs and herbaceous plants of the Upper St. Lawrence valley. It is quite probable that the same local causes which favour the distribution of the species of this eastern coast group, may be prejudicial to the extension towards the coast, of many of these more inland plants now absent. Causes which affect even human life differently in different individuals, may equally well, even in a greater degree, we can readily suppose, have different effects on the plants of different species. It has always appeared to me probable that the dense fogs of the Nova Scotia coast may have something to do with the absence of such a northern and widely ranging tree as the white cedar, *Thuja occidentalis*, L.; and a similar cause, and the moister atmosphere generally, may have also some influence in limiting the range in both New Brunswick and

Nova Scotia of the white oak and butternut. A more immediate cause for the absence of Ontario and Eastern Quebec plants is, however, the lower temperature arising from the Labrador current, which, by a branch through the Straits of Belle Isle, extends its influence up the St. Lawrence on both sides towards Quebec, whilst its main stream, after washing the eastern coasts of Newfoundland, spreads along the Nova Scotia and New Brunswick coasts in its course south westward. Of the effect of this cold current on plant life on the immediate coast, there is no question.

ERIE GROUP.

The area in Canada in which this group of plants is distributed, is practically limited to that part of Ontario lying between Lake Erie and a line drawn from the eastern end of Lake Ontario to the mouth of the St. Clair River. This area is in the latitude of Southern Michigan and of Central and Southern New York State, and forms the most southern portion of Canada. It has, further, its climate modified by the proximity of the three lakes, Huron, Erie and Ontario. These facts sufficiently account for the middle temperate nature of the flora which, in its relations to Canada, has here been termed the Erie group.

The south-western peninsula of Ontario is also marked by the great variety in species of its trees, and by, in the past, their remarkable growth. It is possible to find on a single farm of two hundred acres, more than half of the species of trees which occur in Ontario. The peninsula is now well denuded of its large trees, but fifty or more years ago its splendid forests were the admiration of travellers. Near where the present city of London stands, were white pines six feet in diameter and one hundred and sixty feet in height, and magnificent button-woods averaging about eighteen feet in girth and sending upwards straight stems to a height of even thirty feet before branching. Farther north, these button-woods were sometimes found of nearly twelve feet in diameter. Oaks in the district watered by the River Thames, varied from ten to fifteen feet in circumference, and had often forty-five to fifty feet of clear, straight stems. The stately elms were in great abundance and of remarkable size, attaining occasionally even twenty-five feet in circumference, whilst the tulip trees around Niagara were not only of considerable height, but were not unfrequently ten to twelve feet through.

The following plants are characteristic of this group:—

Liriodendron tulipifera, L.	Aster Shortii, Boot.
Asimina triloba, Dunal.	Solidago Riddellii, Frank.
Nelumbeum luteum, Willd.	Coreopsis tripterus, L.
Corydalis flavula, Raf.	Gerardia flava, L.
Euonymus Americanus, L.	Hydrophyllum appendiculatum, Mx.
Polygala incarnata, L.	Phlox subulata, L.
Agrimonia parviflora, Ait.	Sassafras officinale, Nees.
Cornus florida, L.	Morus rubra, L.
Nyssa multiflora, Wang.	Castanea vesca, L.

St. Lawrence Group.

It is a remarkable fact, pointed out by me some years ago, that a considerable number of the forest trees of Ontario in their range westward, come to an abrupt termination in Canada in the district lying between Lake Superior and the Lake of the Woods, whilst others are hardly seen west of the Sault St. Marie. In Ontario, there are sixty-nine species of forest trees, of which thirty-five are known either on the north or the south shores of Lake Superior. Of these thirty-five, only fourteen cross into the prairie region in central and southern Manitoba. Similar circumstances are apparent in an even greater degree among the shrubs and herbaceous plants. In Canada, many of these seem to be limited in their westward course by the outlet of Lake Superior, though in the United States they range more or less along the southern shores of that lake. The reason of this limit in Canada is readily understood when the rocky, hilly nature of the country around the northern coasts of Lake Superior and the boreal character of the climate there are considered.

The rough nature of the country immediately to the westward of Lake Superior—being successions for over three hundred miles of rocky hills, swamps, and large and small lakes with their connecting rivers—has had, no doubt, its influence in limiting the distribution of many species there. As the prairie is approached, the drier atmosphere, the lighter rainfall, the more prevalent winds and the lower temperature must also have their effect on westward range. It has, however, always appeared to me that the gradual widening, by forest and prairie fires, of the prairie area in a direction easterly from the Red River, has been a leading cause in checking the farther westward extension of the eastern trees, shrubs and herbaceous plants presently confined to the country to the east of the Lake of the Woods. There is much reason to believe that the forest area may have at one time extended westward beyond its present limits in this district, even on what is now treeless prairie, but that fires—no doubt almost entirely since the advent of man there—have, by their annual depredations, extended the prairies gradually eastward, carrying with them the destruction not only of the trees, but of the numerous smaller plants, which are dependent on or influenced by the vicinity of forest areas. Whether the whole prairies have been at one time covered with forest, may be open to question, but, as I have already shown in this journal, there is a strong probability that to forest fires, constantly recurring, may be attributed the gradual enlargement of the prairie area and the formation of new prairies within forest areas. Another visit to the Northwest Territories the past summer, has only confirmed this opinion. It may be objected that were this the case, the stumps and roots of trees should be found on the surface of the prairie. That they have not been more frequently observed is probably due to the rapid decay—one authority gives four years—of the stumps of the poplar, the almost universal tree of the prairies and the immediately surrounding forests.

The brief list hereunder given, enumerates species which range from the Maritime Provinces or Lower St. Lawrence to Lake Superior on either side, or immediately west of it. It is merely in its relations in Canada that the name St. Lawrence is applied to the group.

Acer Pennsylvanicum. L.
Acer saccharinum, Wang.
A. rubrum, L.
Waldsteinia fragrarioides, Tratt.
Dalibarda repens, L.
Rubus villosus, Ait.
Aralia racemosa, L.
Viburnum lantanoides, Mx.
Cephalanthus occidentalis, L.
Fraxinus sambucifolia, Lam.
Quercus rubra, L.
Q. alba, L.
Fagus ferruginea, Ait.
Betula lutea, Mx.
Pinus strobus, L.
P. resinosa, Ait.
Abies Canadensis, Mx.
Arisæma triphyllum, Torr.

Boreal Group.

The localities and their surroundings where the species of this group are found, sufficiently account for their presence now there. In regard to some which occur around the Lake Superior coasts, we can attribute their first migration thither to the same succession of circumstances which gave rise to the small colony of sub-arctic plants more or less associated with them there, and to which allusion will be made when referring to the sub-arctic group.

Illustrations of this group are:—

Anemone parviflora, Mx.
Sagina nodosa, Mey.
Oxytropis campestris, D. C.
Hedysarum boreale, Nutt.
Parnassia palustris, L.
Cornus suecica, L.
Viburnum pauciflorum, Py.
Aster graminifolius, Psh.
Tanacetum Huronense, Nutt.
Artemisia borealis, Pallas.
Arnica Chamissonis, Less.
Lobelia Dortmanna, L.
Pinguicula vulgaris, L.
Rhinanthus Crista-galli, L.
Polygonum viviparum, L.
Pinus Banksiana, L.

Ontario Group.

The species referable to this group, and some of which are confined to Ontario, have, in general, in the United States, a range from Western New England to Wisconsin—a stretch of country in breadth about similar to that of Ontario. They occur chiefly west of the Appalachian chain, and do not appear to cross from the forest lands of Wisconsin into the prairie country of Minnesota and Dakota. Their northward and northeastward range in Canada is probably limited by the colder climate.

The following species sufficiently indicate the group :—

Viola rostrata, Pursh.	Conopholis Americana, Wall.
Ceanothus ovalis, Bigel.	Pentstemon pubescens, Sol.
Staphyllea trifolia, L.	Lophanthus nepetoides, Benth.
Desmodium cuspidatum, T. & G.	Gentiana alba, Muhl.
Lespedeza hirta, Ell.	Asclepias phytolaccoides, Pursh.
Aster ericoides, L.	Montelia tamarascina, Gr.
Lobelia syphilitica, L.	Phytolacca decandra, L.
Vaccinium stamineum, L.	Quercus castanea. Muhl.

A number of representatives of this group, including such plants as *Coreopsis verticillata*, L., *C. lanceolata*. L., *Cacalia tuberosa*, Nutt., *Calamintha Nuttallia*, Benth., and *Scutelaria versicolor*, Nutt., are limited to the vicinity of Lakes Huron and Erie, sor : extending even to Lake Superior. In the United States, their range is similarly confined to Wisconsin, Illinois, Pennsylvania and southward. It is difficult to give a reason for this. The suggestion which I have already made that, in geological time each species has had its initial, its maximum and its final stage of existence as a species, will, however, I think, explain numerous eccentricities in range everywhere. Whilst many plants, at the present time, are at their maximum stages of activity in individual growth and in reproduction, and have now their maximum breadth of distribution, some are merely in the early or initial stages of this activity, and at the initial points of their ultimate area of range, whilst others must be on the decline when activity in reproducing the species is lessening and the area of distribution is being circumscribed. The range of each species is thus vastly affected. When the stage of decline has been reached, climatal and other causes which would in the ordinary course limit range, would have greater effects on the species than upon others which were in the progressive stage of activity or had reached the maximum.

In these modern times, cultivation itself is having a limiting effect on the distribution of plants as well as animals. The yearly extension of the cultivation of the soil, the demands of commerce, the enlargement of towns and cities, and forest and prairie fires, all contribute annually to this result.

Prairie Group.

The plants peculiar to the prairies are of relatively recent creation—perhaps the most modern group of species existing in America. The prairies, as I have elsewhere stated in this journal, are of comparatively recent origin, and, in some sections, are still in process of formation, and only since this formation of these prairies can we conceive it possible that plants to specially give them an individuality, were called into existence. The variation which gave rise to them was, no doubt, brought about by the very nature of the surroundings—the drier atmosphere, the lighter rainfall, the greater exposure to the sun's rays, the stronger winds, the different and more uniform soil, and the absence of any marked physical surroundings. That many of the flowers there have a wide range is readily understood from the facilities they have for diffusion. The vast expanse of generally treeless, level or relatively level plain, exposed to the uninterrupted play of winds, and the generally uniform soil over great stretches of country, afford an opportunity not elsewhere possible for the diffusion and propagation of seeds. The large representation of the Compositæ—a comparatively modern order—and the vast abundance of the individuals of certain species of this order, are noticeable.

Of the influence of soils on vegetation, both in their chemical and mechanical combinations, there is no question, but this influence in Ontario and Quebec is chiefly observable when considering local floras. Gravel ridges or a stretch of sand will be found frequented or deserted, as the case may be, by certain plants, but the causes which in distant times produced these ridges or this sand operated with similar results here and there over vast sections. Other causes as well, acting simultaneously, or afterwards, mixed and distributed the surface soils everywhere in such a manner that it is difficult to indicate very broad areas of the country from Lake Superior eastward, where special soils, uniformily the same, are alone to be found to the exclusion of their occurrence elsewhere. Other influences acting over greater areas have, therefore, to be songht in studying distribution. There are, however, illustrations of special, more or less uniform soils in the great deposits of black vegetable mould forming these newer Manitoba prairies, and possibly also in the drift deposits of the Missouri Coteau and other such localities, and these may be, in connection, however, with associated influences, found to have some effects on the distribution of species in these sections.

It is unnecessary to individualize this well-known group by a list of species.

Western Prairie Group.

Some species associated in range with true western prairie plants, appear to extend to the foothills of the Rockies, and even in individual cases climb the Rockies themselves. More information is needed with regard to the limits of this group. The following, however, in our present knowledge of their range, illustrate it:—

Cleome integrifolia, T. & G.	Potentilla fastigiata, Nutt.
Arenaria congesta, Cham.	Heuchera parviflora, Nutt.
Malvastrum coccineum, Gray.	Œnothera cæspitosa, Nutt.
Linum rigidum, Psh.	Œnothera triloba, Nutt.
Paronychia sessiliflora, Nutt.	Centunculus minimus, L.
Rhus trilobata, Nutt.	Plantago pusilla, Nutt.
Lupinus Kingii, Watson.	Heliotropium curassavicum, L.
Astragalus kentrophyta, Gray.	Polygonum imbricatum, Nutt.

Western Central Group.

The distribution of the members of this group from the Pacific Coast or the interior of British Columbia eastward towards or into Manitoba, is peculiar, but will be probably found to follow to some extent, the lines of mean temperature. The few species which occur in the Northern United States east of the Mississippi, have a general northwestward range. As more is known of the flora of the Saskatchewan and Peace River countries, the northern limits of distribution of many of the species of this group will, I think, be found to nearly parallel, as some do now, the trends of mean temperature as they, in a northwestward direction, cross the continent. Others again may find the dry prairies east of the Rockies and the dry interior plateaus of British Columbia equally congenial. Much more information is, however, yet needed.

The plants hereunder, are examples of the group:—

Myosurus aristatus, Benth.	Grindelia squarrosa, Dunal.
Vesicaria Ludoviciana, D. C.	Chrysopsis villosa, Nutt.
Silene Menziesii, Hook.	Helianthus annuus, L.
Astragalus aboriginum, Rich.	Artemisia dracunculoides, Psh.
Potentilla Hippiana, Lehm.	Troximon glaucum, Nutt.
Crataegus Douglasii, Lindl.	Androsace occidentalis, Pursh.
Œnothera albicaulis, Nutt.	Comandra pallida, D. C.
Sedum stenopetalum, Pursh.	Euphorbia serpyllifolia, Pas.

Rocky Mountain Group.

Further enquiry into the range, as well eastward of the mountains, as in British Columbia, of the species presently referable to this group, is needed before the group can be definitely determined. Some of the plants specially referable to it can be classed as boreal, and are known, to the northward, to fringe outward beyond the mountains into the Mackenzie River district, and even towards the coast. There are also some alpine plants, entirely confined in Canada to the Rocky Mountains, and there are others—arctic species—which, whilst they have a considerable range along the arctic coasts between Hudson Bay and Alaska, seem to use the mountains as a ridge along the higher summits of which they extend into latitudes far to the southward.

The following plants presently exemplify the group, in so far as their range is presently known:—

Clematis Douglasii, Hook.	Cymopterus terebrinthus, T. & G.
Aquilegia flavescens, Wats.	Musenium tenuifolium, Nutt.
Lychnis elata, Watson.	Brickellia grandiflora, Nutt.
Astragalus glabriuscula, Gr.	Erigeron bellidiastrum, Nutt.
Oxytropis viscida, Nutt.	Cnicus eriocephalus, Gray.
Rosa Fendleri, Crepin.	C. foliosus, Gray.
Parnassia fimbriata, Kœnig.	C. Hookerianus, Gray.
Bupleurum ranunculoides, L.	Populus angustifolia, James.

British Columbia Flora.

Excluding the sedges and grasses, there are over four hundred species of phænogamous plants in British Columbia, which are not known east of the Rocky Mountains. This number will be considerably increased along both the northern and southern boundaries. The knowledge, however, of this distribution, within the province, of these species is as yet limited, and at this stage it seems better not to draw conclusions too hastily. It may be said generally, that there are species which are well distributed over the province, except probably in the most northern sections, and these may be termed the British Columbia Group. To those confined to the declivities, the valleys and foothills of the Rocky Mountains, and sometimes crossing to the Selkirks, reference has already been made under the term Rocky Mountain Group. Towards the Alaska boundary will yet be found further representatives, not only of the Alaska flora, but of the Asiatic flora as well. There may thus be, in time, sufficient material for an Alaskan or an Asiatic Group. At and towards the southern boundary of the province, are numbers of species familiar in Colorado, Nevada, California, Oregon, or Washington Territory, and whose range across the border into British Columbia is very circumscribed. These, as their centre of distribution is probably in or near Oregon, may be termed the Oregonian Group. Perhaps, however, the most remarkable, as well as the largest flora in British Columbia, is what may be fitly called the Western Coast Group. The greater rainfall, and the general proximity to the coast and to the numerous very deep inlets which indent the coast, are the influences which appear to more or less control the disposition of this flora, and to affect its range also in Washington Territory and Oregon west of the Sierras.

Dr. G. M. Dawson has given considerable attention to the flora of British Columbia and particularly to the distribution of the trees there, and what are here intended by the Western Coast and Oregonian Groups coincide in general terms with areas of his there.

I purpose at an early day, illustrating these British Columbia groups more fully.

SUB-ARCTIC GROUP.

The Labrador current, which, laden with icebergs, descends from Baffin's Bay, and in a broad stream of three hundred miles, skirts the Labrador coast, sends an off-shoot of its waters through the Straits of Belle Isle, and past Anticosti, up the northern side of the estuary of the St. Lawrence. Meeting, as it proceeds upward, the warmer fresh waters of the river coming from the Great Lakes above, this branch current is diverted to the south coast of the estuary, where it appears as a stream, cold, but somewhat warmer than on the north side, and, proceeding onwards, finally leaves the coast at Gaspe. The effect of this cold current on the vegetation of the shores, is seen in the occurrence of a few arctic and many sub-arctic plants at the Straits of Belle Isle and on Anticosti and the Mingan Islands, and occasional sub-arctic species as far up on the north shore as Tadousac and Murray Bay. Even on the Island of Orleans, near Quebec, there are some boreal forms. The flora of the south shore of the estuary shows the milder character of the current there, whilst that of the Bay of Chaleur appears to prove its comparative absence in that locality.

On the jutting headlands of Lake Superior, and along the bays of its northern coasts, there are both sub-arctic and boreal plants, which appear to form an isolated group there. It is not difficult to account for their continuance in these localities. Northern species delight in a low, equable temperature and a moist atmosphere, and whether this is obtainable on alpine summits or on sea or ocean coasts, there they find a congenial home. The high northern shores of Lake Superior supply these conditions. To account, however, for their original presence there, it is necessary to go back to glacial or post-glacial times, when, with a somewhat colder climate, and with the area of the Great Lakes forming the bed of an inland sea, some sub-arctic and boreal plants found a natural highway along the coasts of this sea. With lofty mountains to the immediate northward in glacial times, these plants were probably, then, not uncommon. As the waters receded and formed the present lakes, and the climate became as it now is, these northern plants were driven to localities like the headlands of Lake Superior, where conditions were favourable to their continuance. In all other localities they would disappear. Even on Lake Superior, the struggle with changed conditions must have resulted in the extinction there of many of the more northern forms.

The following are some representatives of this group and of the boreal group presently occurring around Lake Superior:—

Draba incana, L.
Viola palustris, L.
Parnassia parviflora, D. C.
Hedysarum boreale, Nutt.
Dryas Drummondii Hook.
Rubus arcticus, L.
R. Chamæmorus, L.
Erigeron acre, L.
Solidago thyrsoidea, Mayer.
Solidago virga-aurea, L.
v. alpina, Big.
Arnica mollis, Hook.
Vaccinium uliginosum, L.
V. cæspitosum, Mx.
Castilleia pallida, Hun.
Euphrasia officinalis, L.
Empetrum nigrum, L.
Tofieldia palustris, Huds.

Arctic Group.

The species of this group include many that are common to Scandinavia, Lapland and the higher Alps, and to our arctic coasts. Whilst numerous arctic plants find their way southward on the higher summits of the Rocky Mountains, on the Pacific side of the continent, and along the Labrador coasts, even up to Anticosti and the Mingan Islands on the Atlantic side, the home of this large group is in the great stretch of country, continental and insular, from the high northern coasts of Labrador, and Greenland to Alaska.

It is unnecessary to illustrate the group.

Relations of the Laramie Flora.

Since the last number of this journal was published, I have had an opportunity of seeing, in the publications of the Geological Survey of the United States, Lester F. Ward's recent monographs on the flora of the Laramie group, and Sir William Dawson has shown me a proof of his paper on the same subject in the forthcoming transactions of the Royal Society of Canada. Whilst Ward still remains somewhat credulous about the age of the Laramie rocks, Sir William confidently refers them to the Lower Eocene, and concludes also that the Greenland flora usually referred to the Miocene is of later Cretaceous and early Eocene age, though he suggests the question whether this early flora of Greenland, and the floras of the Mackenzie River and North Western States—localities so far apart—may not have been successive within a long epoch in which climatic changes were gradually progressing. Ward's tables indicating the distribution of the Laramie flora not only geographically, but also through geologic time, are interesting to the student of distribution of existing plant life. They show—if the identification be correct—that four, and it may be five, of our living species, viz.: *Viburnum pubescens,* Pursh, *Corylus rostrata,* Ait, *C. Americana,* Watt, *Onoclea sensibilis,* L., and probably *Ginkgo biloba,* L., now of Japan and China, date their origin as far back as at least Eocene times, whilst many of the most familiar genera among the trees and shrubs of the present day were equally well, and in some cases more largely represented in this past period, though appearing for the first time then or in the middle Cretaceous. The tables also bring to light another circumstance of great interest in connection with the discussion, in an earlier part of this paper, on the identity, at the present day, between so many plants in Europe and America. Eleven species—all now extinct—were common to the Eocene of Europe and the Laramie of the United States, whilst two others—also extinct—were common to the European Eocene and to the Greenland beds, considered by Sir William Dawson as later Cretaceous and early Eocene. There is thus some evidence that in the later Cretaceous and Eocene times, not only was the climate in sub-arctic America sufficiently mild to admit there of genera which are, now at least, of a middle or possibly even southern temperate type, but that the relations of land and water were such as to allow migration between Europe and America. Is it unreasonable to suppose that the land then sufficiently elevated above the sea to connect the old world with the new, may have been in a similar position in Pliocene or Post-Pliocene times, and have afforded the facilities then needed for the intermingling of the flora still existing at the present day on the two continents?

Pre-Glacial Drift Plants.

It is interesting to find that in the pre-glacial drift which is thought to be either Pliocene or Pleistocene, and which is spread over a considerable portion of the Middle and Southern States, palæobotanists believe they have recognized three of the existing trees of these States—*Magnolia glauca*, L., *Liquidambar styraciflua*, L., and *Quercus imbricaria*, Mx. These species do not range as far as Canada.

Age of the Canadian Flora.

The relative ages of the species which comprise the Canadian flora form matters rather of speculation, and yet, from the foregoing pages, it will be seen that there are some data on which to found opinions. The conclusions may be thus summarized:—The species of whose presence in the Eocene there is fossil evidence, are the oldest known representatives of the existing flora. Next to these in age, as species, are the plants common to Europe and America, for they were apparently already well distributed at the time of the deposition of the Leda clays. It is probable that many of the Arctic species, which are now limited to America, are equally old, but, just as many plants now have but limited ranges, they had not in these older times found their way beyond the American continent. The American species, not also European in range, but which are denizens of Japan, may be contemporaneous with these Americo-European species, or even earlier in origin. Two of the plants now common to Japan and America date back to the Laramie times. The plants confined in range to British

Columbia, form probably, a later flora brought into existence after the first upheaval of the great parallel chains of mountains there. Following on all of these older floras, but possibly contemporaneous in age with some of them, are the sub-arctic species now on the headlands of Lake Superior and the maritime plants presently on the shores of all of the Great Lakes. The most recent creations are without doubt those species—well represented by compositæ—which frequent more especially the newer prairies of Manitoba.

It is not difficult to see that the development of life on the earth from its dawn to the present, time has been largely influenced by the vast changes which have proceeded gradually but constantly throughout geologic time. In the Laramie age, which was a prolonged period, the great central plains of North America parallel to and east of the Rocky Mountains, and throughout much of the length of the continent, formed a vast, perhaps relatively, shallow inland fresh water sea; during and after the glacial times, whilst an equally great inland, ice-laden sea again prevailed over the northern central parts of the same continent, the southern portions were dry land. In later cretaceous and Eocene times, the climate of the sub-arctic regions was, relatively speaking, warm; in glacial times and since, it has deen so cold as to give a meaning of its own to the name arctic. During the tertiary times, the great dividing ridges forming the Rocky Mountains, were finally raised to their present elevations; whilst, as glacial times were passing away, the then much higher elevations and mountain ranges, which gave rise to the eastern glaciers of this period, were gradually lowered in elevation to what they appear at the present day. And these vast physical and climatic changes in tertiary and post-tertiary times are but an illustration of what has been going on from age to age from the very dawn of life upon the earth. What vast destruction of animals and plants each change must have occasioned! What a struggle for existence must have taken place among those which were left! What adaptation to new conditions in which the survivors constantly found themselves, must have resulted! What changes in these animals and plants themselves must have been gradually brought about by altered habits and altered food, and by the process of selection which new surroundings would result in! It is not difficult to conceive how new varieties and species would from time to time follow, and how new genera would be created.

[NOTE.—Amid the great mass of material which it has been necessary to bring together in preparing this paper, it is difficult to single out special collectors, without referring to all, but I think it right to acknowledge the assistance in regard to our far western flora which Dr. G. M. Dawson and Mr. Macoun's publications haven given me, particularly by indicating in nearly every case the precise localities of occurrence.]—A. T. D.

ON A BASAL SERIES OF CAMBRIAN ROCKS IN ACADIA.

BY G. F. MATTHEW, M.A., F.R.S.C.

[*Read before the Natural History Society of New Brunswick*, 1st *Nov.* 1887.]

In tracing back the palæozoic systems to their base in the Cambrian, they are found to terminate in various countries at different horizons. Thus in Russia there is no fauna that establishes a horizon older than that of the Olenus beds *; in eastern North America, except along the Atlantic seaboard, the fauna with Olenellus seems to be that which exhibits the earliest trace of life in the Palæozoic formations; a high antiquity has been claimed for the Eophyton sandstones of Sweden, but apparently without sufficient warrant, as I shall endeavour to show further on; but in Wales, remains of animals of several orders have been found in Cambrian slates, equivalent to those of the Longmynd in Shropshire, which are as old, or older, apparently than the Eophyton sandstones.

* I have just learned from Dr. F. Schmidt, of St. Petersburg, that an older horizon, that of *Paradoxides Kjerulfi*, has been found at the top of the "Blue Clay."

Norway, Wales, Newfoundland and the eastern provinces of Canada (Acadia) are countries where the existence of a palæozoic formation older than that holding Paradoxides can now be fairly established. It seems better to regard these rocks as a lower series of the Cambrian system, for in Wales, the corresponding slates and sandstones have long been called Cambrian, whether we take the authority of Sedgwick, Murchison, Hicks or others; and although no physical break has been established in Europe, between the Paradoxides beds and these older Cambrian rocks, this is not the case in America; but, on the contrary, the red rocks at the base of the St. John group (as well as those beneath the Paradoxides beds of Newfoundland) are of a different series from the measures properly referable to this group.

The importance of these subjacent rocks was not fairly understood until explorations, made during the past summer, revealed their great thickness and some evidence of the fauna they contain. In the report on the geology of Southern New Brunswick, 1865, p. 24, this mass of sediments was spoken of as the upper member of the Coldbrook group, and thus distinct from the St. John group; later (Rep. Prog. Geol. Sur. Can., 1870-1, p. 59), it was joined to the latter formation, because the want of conformity existing between the two could not then be established; but it is now found that this red series is unconformable, not only to the St. John group, but also (as had been previously discovered) to the underlying Coldbrook group.

Near the city of St. John, only a few scores of feet in thickness of this formation is to be seen, and even this disappears in the town of Portland, where the St. John group rests directly upon the "upper series" of the Laurentian area. But in tracing these red rocks eastward, around the margin of the St. John Basin of Cambrian rocks, they are found to exhibit a much greater thickness, and at its eastern end there are no less than 1,200 feet in thickness of these underlying measures.

In the valley of the Kennebecasis, these underlying red rocks are wanting, and there the St. John group rests, in some places, on the "upper series," and at others on the old gneissic rocks of the Laurentian proper. In this valley the lowest beds of the St. John group are with difficulty distinguished from the underlying gneiss, and by the "arkose"-like composition of some layers and by the wave marks and worm trails on others, recall the Eophyton sandstones of Sweden.

In the next valley to the north, that of the Long Reach of the St. John R., the red series underlying the St. John group is found in full force, but has not received a careful examination.

There can be no doubt that this underlying series is one of considerable importance, and as we find it increase in thickness in the St. John Basin, the further east we follow it, until it is covered up by Carboniferous deposits, it is highly probable that the 1,200 feet of measures, at its easternmost exposures, does not represent the entire thickness of the formation.

Mr. Alex. Murray has described a mass of red, green and grey sandstones, with slates of similar color, in his report on the geology of Newfoundland (p. 238), which lie at the base of the Paradoxides beds on that island. He estimates their thickness at 1,500 feet, and states that while they are present in the Cambrian basins of Trinity, St. Mary's and Placentia bays, they are absent from those of Conception and Fortune bays. Hence we may infer that these lower sandstones, etc., form a lower series unconformable to the beds carrying Paradoxides. The only fossils reported from these rocks are "obscure forms like fucoids, and peculiar markings resembling annelid tracks." The conglomerate at Manuel Brook, Conception Bay, and the sandstones elsewhere at a corresponding horizon, appear to mark the break between this series and the higher part of the Cambrian rocks in Newfoundland.

Between the beds of this lower formation of the Cambrian system in New Brunswick, and those which lie at the same horizon in Norway and Wales, there is a strong resemblance in mineral character; in these countries, feldspathic sandstones, often of a red color, with some conglomerates and more or less of red and green shales or slates, make up the greater part of this basal formation.

Prof. Theodore Kjerulf has very carefully investigated this part of the Cambrian in Norway, where it is known as the Sparagmite formation. He divides it into two parts, viz.:—1. (Upper) Blue quartzite and quartziferous sandstones 310-500 metres (about 1000-1600 feet) thick. 2. (Lower) Grey and red sparagmite, also conglomerates and sandstones 630-910 metres (2000-2900 feet) thick.

In this formation, no fossils are known in the lower division, but they are found at the base of the upper division. The genera correspond to those of Bands *b* and *c* of Division 1 of the St. John group, and therefore the upper division of the Sparagmite formation is of Primordeal age, and the lower will correspond to the underlying series of red rocks of the St. John Basin.

It seems doubtful if this lower part of the Cambrian system is at all represented in Sweden. Here the oldest beds were first described as the "Fucoidal Sandstone"; but as the greatest thickness of this sandstone at several localities where it was measured by Hisinger, Wallin and Sidenbladh, did not exceed eighty feet, it seems impossible that this sandstone represents the great mass of sediments which in Norway, Britain, Newfoundland and Acadia, lie at the base of the Cambrian system; it seems rather to correspond to the grey sandstones and dark grey sandy shales of Bands *a* and *b* of Division 1 of the St. John group, which in their eastern exposures have a thickness, the former of about 200 and the latter of some 140 feet.

In Wales is to be found a series of beds, which, perhaps, more nearly than any others, correspond in mineral characters, and in the evidence which they contain of the presence of living forms at this period, to the Lower Cambrian series of Acadia. To the zeal and acumen of Dr. Henry Hicks, science is indebted for the discovery which made plain the existence of a somewhat varied fauna in these very ancient rocks, previously known only to have worm burrows. By the organic remains which they contain, consisting of crustaceans, brachiopods, etc., he was able, on palæontological grounds, to divide the obscure slates of the Lower Cambrian formation at St. David's into the Solva Group (upper) and the Caerfai (lower). The upper group has a thickness of 1800 feet, and in a former publication I have shown that its fauna is essentially equivalent to that of Band *c* of Division 1 of the St. John group; but from the thickness of the Solva group, it seems probable that it contains also the equivalent of the Band *b* and perhaps of Band *a*. This being the case, we may infer that the Caerfai group, which has a thickness of about 1600 feet, corresponds to the lower series of the Cambrian system in Acadia. But the Caerfai group in Wales is not known to be unconformable to the rest of the Cambrian system, and in this appears to differ from the beds in Canada and Newfoundland, which we suppose to be of corresponding age.

The writer is well aware that correspondence in the bulk or volume of measures in different countries, supposed to be coetaneous, is of uncertain value as a measure of time, but when, as in this case, it is checked at the upper limits by a well established faunal horizon, and at the base by a decided physical break, there being nothing in the constitution of the measures, or in the aspect of the known fauna, to suggest diversity of age, we are fairly justified in considering the measures contemporaneous.

Canada.		Newfoundland.	G. Britain.	Norway.	Sweden.
St. John Group (part) Division 1.	Band *d*.	Limestone of Chapel Arm in Trinity Bay.	Menevian Gr.	Etage 1 *d*.	Upper Paradoxides Beds.
	Do. *c*.	Shales of Manuel R.	Solva group part?	Part of Upper Sparagmite formation = Etage 1*b* & *c*.	Lower Paradoxides Beds.
	Do. *b*...	?			
	Do. *a*..	?	Solva group part ?	Part of Upper Sparagmite formation = Etage 1*a*.	Fucoidal & Eophyton Sandstone.
Lower series of Cambrian System in Acadia.		Lower series members *a* to *e* of the Lower Silurian (*i.e.*, Cambrian) System.	Caerfai Gr.	Lower division of the Sparagmite formation.	?

Norway, Britain, Newfoundland and the eastern provinces of Canada afford unusual facilities for the study of these old Cambrian formations, and in the above table, an attempt has been made to co-relate these rocks from the information thus far gathered as to their mineral composition, stratigraphy and faunas:

The double cross line in the above table indicates the point at which a break in the succession of beds occurs in the Cambrian system in America.

It may be remarked that the lower series in Acadia, though unconformable to the St. John group, is closely related to it in its distribution.

Fauna of the Lower Series.

Hitherto we have been accustomed to look upon the assemblage of organisms found in Division 1. of the St. John group as the first link in the chain of palæozoic faunas in America, but investigations made during the last summer compel me to modify this view. That there were earlier forms of life in the measures at the base of the palæozoic systems, seemed probable for various reasons, and it had been asserted of the Intermediate system in Newfoundland, which Mr. Murray has classed with the Huronian, that in it two obscure forms did exist; but neither in Newfoundland nor on the continent of America, so far as the writer is aware, have any organisms been described from these basement beds of the Cambrian system proper.

Such being the very imperfect condition of our knowledge of the pre-Primordeal life of the Cambrian system in America, a very small addition to the information on the subject may be of value, and the few observations on the fauna made in New Brunswick are therefore presented here.

A barren sandstone, Band *a* of Division I, some two hundred feet in thickness, cuts off the fossiliferous horizons of the St. John group from all below; but as the Lower Cambrian series is now found to contain vestiges of organic life, down almost to the base, the fauna marked by Paradoxides may no longer be regarded as the oldest palæozoic fauna in America.

This lower series is lithologically very different from the St. John group, and in the eastern part of St. John county, and on the St. John R., exhibits a far more important series of beds than can be seen at the section in the city of St. John, where the Cambrian rocks were first studied. The older series has at its base a conglomerate, which rests in some places on the Coldbrook group, and in others on the Laurentian rocks. A good section may be observed at Hanford Brook, St. Martin's, where it presents the following succession (roughly estimated):—

	Estimated thickness in feet.
Coarse, purplish red conglomerate, resting on an a mygdaloidal greenstone (toadstone) of the Coldbrook Group	60
Grey flags and sandstones with worm casts (*Scolites*) and worm tracks (*Helminthites*). Alternations of grey and purplish red sandstones	70
Purplish, red sandstones, with greenish layers, remains of seaweeds (?) gritty, purplish red sandstones and flagstones, animal tracks *Psammichnites* and *Helminthites*, worm burrows (*Arenicolites*) and worm casts (*Scolites*)	240
Purplish conglomerate (35 feet) soft, purplish red shales, with green (glauconite ?) grains, the upper part firmer and more sandy; greenish, greylayers interspersed, especially toward the base. Remains of seaweed (?) and a brachiopod	210
5. Purplish, sandy shales, with a few bands of greenish shale. Worm casts (*Scolites*)	300
6. Measures concealed, probably of this series	320
	1,200

In this important series of beds, the very oldest layers, which are fine enough to preserve organic markings, abound with the trails and casts of marine worms, and within one hundred feet of these, in ascending through the measures, we meet with branching organisms in fine shale, which have left a thin carbonaceous film upon the layers of the shale; these impressions appear to have been seaweeds, but they may have been organisms allied to the graptolites or the sponges.

About three hundred and fifty feet above the base, where the measures are flaggy, tracks of annelids are again abundant. Beside the smaller trails and burrows, there are frequent tracks of a marine animal, similar to markings on the Fucoidal sandstones which by Prof. O. Torrell have been referred to the genus *Psammichnites;* and a very similar, if not identical track, occurs on the surfaces of the purple-streaked sandstones of Band *b* in Division 1. of the St. John group; this track is different from *Cruziana semiplicata,* Salt., and *C. similis,* Bill., which belong to a higher Cambrian horizon.

About fifty feet above this horizon occur fine shales, with a recurrence of the seaweed-like organism, and some ninety feet higher up, in a loose fragment of sandy shale, a very thin dorsal valve of a brachiopodous shell of considerable size was found; this shell is something like *Lingula monilifera* of the Eophyton sandstone, but is wider, has a less prominent beak, and the fine, radiating ridges on the surface do not exhibit a beaded crest. Some of the layers in this part of the series abound in soft, green grains, similar to the glauconite grains of the cretaceous and other formations, but the paste enveloping them is red.

A number of beds between this point and the uppermost measures exposed, contain worm casts and burrows, so that the entire series gives evidence of the existence in America of living forms during the whole of this introductory epoch of the Cambrian age, and encourages the hope that important additions will in time be made to our knowledge of the earliest forms of life of the Palæozoic ages.

Additional Species of the St. John Group.

Some interesting additions have also been made to the faunas of other Cambrian horizons. The measures on the St. John R., corresponding to those of Band *b* in Division 1 of the St. John Basin contain a calcareous organism, which may be referred to *Oldhamia;* it resembles *O. antiqua,* but branches less freely. In the same sandstone occurs an elegantly ornamented *Lingulella* (?) of peculiar form; it may be compared to *Lingula* (?) *favosa* of the Eophyton sandstone, but is rounder, and the pitted surface occupies less space on the valve.

Division 2, of the St. John group has remains of several genera of seaweeds, among which are two graceful species related to *Taonurus* or *Spyrophyton.* In the same division are layers of fine grained shale, over whose surfaces are scattered fragments of the bodies of a small crustacean, with a very thin test; this is probably *Hymenocaris*, as the layers have frequent stiletto-like markings, such as the late Mr. J. W. Salter has attributed to this genus.

We now recognize four series of deposits in the Cambrian system of North Eastern North America, viz.: Series A, The Basal series, the subject of this paper; Series B, The St. John Group; Series C, The Georgian (Upper Taconic of Emmuns,) Series D, The Potsdam Sandstone. In a future article the writer proposes to show the grounds which exist for this quadripartite division of the Cambrian system in this part of America.

Proceedings of the American Association for the Advancement of Science for 1887.

By T. Wesley Mills, M.A., M.D.,

Professor of Physiology, McGill University, Montreal.

(*Read before the Montreal Natural History Society, October* 31.)

It is proposed in the present communication to give abstracts of a few of the papers read at the last meeting of the American Association, held in New York, and to make brief comments on some of them.

In the Geological Section, a communication on the action of glaciers gave rise to considerable discussion. Its author, Dr Spencer, had studied ice action in Norway, and his conclusions were, therefore, almost entirely the result of personal observations.

Professor Spencer believes that the eroding power of glaciers has been much over-estimated. He lays great stress on the plastic and flowing nature of glaciers; they do not, in his opinion, push much material before them, but they carry enormous quantities of débris, derived from the sides of the ravines through which they pass, on their backs. The section did not seem to incline to Dr. Spencer's views, though I understand they have been more favorably received by Canadian geologists.

Anthropology.

As usual, the greater number of the papers read before the Section on Anthropology were archæological. Mr. Geo. F. Kunz exhibited two objects which attracted unusual attention. One of these was a gigantic jadeite votive adze, the other a marvelously beautiful crystal skull. The origin of both is such a mystery that an almost romantic interest was aroused by their exhibition and the two short descriptive papers relating to them, read by Mr. George F. Kunz. He declared the adze to be of Mexican origin, and said it was the largest votive adze yet found. It was discovered twenty years ago in Oaxaca, Mexico. It is 10 13-16 inches long, 6 inches wide, and 4⅝ inches thick, tapering off to a blunt edge. The color is a light grayish green, with streaks of an almost emerald green on its back. Originally almost wedge-shaped, out of one side the features of a deity have been carved. These are decidedly of Mongolian physiognomy. The lapidarian work is probably equal to anything that has ever been found, and the polish is as fine as any produced by modern man. When the exceeding hardness of the stone is taken into consideration, resisting as it does the action of edged tools, the mystery regarding its production is deepened. The only explanation suggested was that the shaping of the stone had been accomplished by long-continued, patient scouring with sand. In reply to inquiries regarding any possible legends connected with the stone, it was said that the only one which deserved consideration was that the emerald-hued deity was originally of India, where it had been the object of worship, and that either away back in the mysterious ages of antiquity, when the Asiatic migration to America took place, it had been carried along by the tribe whose god it was, or else some casual refugee from the Orient had found his way with it in equally mysterious fashion to the western world.

After the adze had been exhibited and compared with certain uncarved adzes of jade of inferior size and beauty, Mr. Kunz produced a curious cabinet, made of the skin of a Mexican lizard, which, when opened, revealed a skull of nearly natural size and almost transparent. It was carved of crystal, without flaw or fissure. It was discovered by a Mexican officer just before the Maximilian conquest, and sold to Mr. Evans, the English collector, at whose death it passed into the hands of a French dealer in curiosities, of whom it was purchased by Mr. George H. Sisson, of New York. As to its origin, little or nothing more is known. Crystal of the same character is found in Calaveras County, Cal. Although similar in general appearance to many of the Chinese and Japanese crystals, it was clearly not of Chinese or Japanese origin, or nature would have been more closely copied. And on the other hand, if it were of European origin, it would have been more carefully finished in certain minor particulars. In the Californian locality, large masses of crystal have been found, and from the State of Michoacan, Valley of Mexico, small skulls of this same material, measuring rarely more than two inches across, have often been brought, indicating that the ancient Mexicans were acquainted with a means of carving and polishing, not inferior in results to the best modern inventions. The skull is 8 3-16 inches long, 5⅜ inches wide, and 5 11-16 inches high. The eyes are conical hollows about 1½ inches deep. The line separating the upper and lower teeth is thought to have been produced by a string or bow.

Palin Baba, the Japanese, gave some reasons why the remarkable skull could not be considered of Japanese or Chinese origin, the substance of which was that it was not sufficiently true to nature in contour.

Dr. Charles Porter Hart read a paper on "The Correlation of Certain Mental and Bodily Conditions in Man." He said his attention was first called to the subject by a patient who possessed such decided pessimistic views as to interest him. He was suffering from an abdominal disease which seemed to produce mental aberration. Upon every topic that could be suggested—social, governmental and religious—this gentleman was fearfully pessimistic. Dr. Hart gave a table showing that diseases above the diaphragm were optimistic in their tendencies, those below the diaphragm, pessimistic, and those of a constitutional and chronic character, such as rheumatism, malaria and dropsy, were equally pessimistic and optimistic. Chest diseases gave buoyancy to the system, and abdominal diseases were very depressing.

Dr. Hart offered no explanation whatever of these statements, which in themselves the experience of general medical practice will bear out. I would suggest that the large capacity of the blood vessels of the abdominal region; the tendency to stagnation in the veins; the great variations in the calibre of the arteries, effected through the nervous system; the abundant supply of nerves to the organs, and their connection with both spinal cord and brain; the partial starvation consequent on disease of certain organs below the diaphragm, and many other influences, which might be enumerated, will account fairly well for the relation of the physical to the bodily conditions noticed. And it must be remembered that lung diseases may run an almost painless course; but that with most abdominal maladies there is more or less of obscure irritation, if not actual pain, which must tend to exhaust the nervous centres, and, in consequence, to be followed by mental depression.

Dr. Jastrow's paper on "Modes of Apperception," which presents some aspects of truth of great practical importance, and with very direct bearings on methods of teaching. The author of this communication maintains that individuals may be roughly classified as "visualaires" or "auditaires," according as they perceive and remember better by the use of the eye or the ear. Certain tests have been proposed with a view of affording a means of classifying persons,—such as reading aloud a paragraph from some book and comparing the results, in the case of those examined, with similar results obtained by asking each individual to read the paragraph over silently. Those who would, other things being equal, remember the contents best when read to them, are natural "auditaires." That the author's views are in the main correct, I believe, the more so, perhaps, from being myself a pronounced auditaire; and in every instance in which I have unconsciously failed to recognize this, have I had reason to regret the oversight. The majority of persons are probably "visualaires." The modern method of teaching English spelling in our schools, seems to be an unconscious recognition of this fact. But it will be found that there are children who will learn spelling as readily by the old method of repeating the component letters aloud, as by the use of the eye and the hand. The latter must not be forgotten in the estimate. The subject is one of great interest, and commends itself strongly to teachers and parents.

Perhaps no papers read at the meeting attracted more general attention than those bearing on foods, as presented before the sections of Chemistry and Economic Science.

Instead of giving a little time to each of many subjects, as was the rule with the other sections, the section on Economic Science and Statistics devoted the whole of one day to two papers by Prof. W. O. Atwater, bearing upon the food question. The morning paper was upon "The Physiological and Pecuniary Economy of Food;" that of the afternoon upon "The Food of Workingmen and its Relation to Work Done." Both excited much interest, and were received with demonstrations of satisfaction by large audiences, many taking part in the discussions which followed. Prof. Atwater, whose papers have been published in the *Century*, illustrated his subject by many elaborate charts and diagrams.

Explaining, first, the elements of the common foods that combine to form the structure of the human system, and to supply it with potential energy, he indicated the quantity of each of the nutrients consumed by people in various walks of life in Europe, and compared them with the averages of the same entering into the composition of the

American diet. From this it appeared that the American consumed considerably above the standard of necessity, and wasted a great deal more, while the European rarely excelled the standard, and frequently fell below it. Among the working classes of Europe, the sewing girls of London and the factory girls of Leipsic were poorest fed, while the brewers were best fed. In America, all classes of working people consumed far more than was necessary for the maintenance of health and strength.

Under the term "Nutrients," he classed protein (the lean of meat, white of eggs, casein of milk, gluten of wheat, etc.,) which supply blood, muscle, tendon, and bones; fats, animal and vegetable, which serve as fuel for the body; carbo-hydrates, starch, and sugar, which also make fat and supply the body with heat. The nutrients of vegetable food are much less costly than those of animal foods, but the latter have the advantage of containing large proportions of protein in more digestible forms. At market prices current in the Eastern States, the cost of protein, which may be taken as a measure of the relative expensiveness, ranges from 8 to 34 cents per pound in staple foods, and from 18 cents to over $1 a pound in staple animal foods. In oysters it is from $2 to over $3 per pound, while in salmon it rises to over $5 a pound. In beef, at from 10 to 25 cents a pound, the protein ranges from about 40 cents to $1.10. In such fish as shad, bluefish, halibut, mackerel, lake trout, and whitefish, the nutritive material costs more. The less expensive kinds of meat, such as the shoulder and the round of beef and ham, contain as much nutriment as the costlier kinds, and the difference palatably is more the result of the manner of cooking than of any innate superiority in the higher priced cuts. So, too, the different grades of flour have a much more nearly equal nutritive value than is commonly supposed. Wheat flour, cornmeal, oatmeal, and other cereal products are in general, cheaper and richer in nutrients than potatoes and other roots. Taking the world throughout, the mass of mankind selects foods which analysis shows to furnish actual nutrients at the lowest cost. But the people of the United

States are a marked exception. Many, even among those who really desire to economize, use needlessly expensive kinds of food. They endeavor to make their diet attractive by paying high prices rather than by skillfully cooking and tastefully serving. Then, too, they are more wasteful than any other nation. An inexplicable sensitiveness upon this point exists among American workmen. The best the market affords alone is good enough for them, and by their constant demand for what they wrongly consider the choice cuts of meat, they maintain the present high prices. Improper eating, especially over-eating, is a source of disease more than any other one thing; the eating habit does more harm to health than even the drinking habit. The remedy lies in persuading people that economy is respectable, and in teaching them how to economize.

Prof. William H. Brewer, of New Haven, regretted that the lecturer had not recommended the forms of food to be substituted for more expensive ones of no more nutritive power. He believed that foods rich in protein and carbohydrates had not only a more beneficial effect upon the physical conditions of the people, but exerted beneficial influences as well over their morals.

Prof. Ordway, of New Orleans, thought Americans did not really consume so much more than Europeans as the lecturer inferred. Waste mostly explained the apparent difference.

At the Afternoon Session, the hall was again filled with an audience which appreciated the importance of the discussion, though some of them did not agree with the lecturer's propositions. "Statistics of dietaries of considerable numbers of Americans," said Prof. Atwater, "mostly of the working classes, show that their food is large in amount, and includes large proportions of meat. French-Canadians at home, consume three and a half pounds of food per day. On going to Massachusetts factories, their quantity of food is increased to five pounds. Other American factory operatives, mechanics, and laboring people, native and foreign, averaged a little more—in some cases seven pounds. Chemical examination of the dietaries, showed them to be richer in actual nutritive material and in potential energy, than even the large quantities would imply, on account of large proportions of meat. The quantities per day, of protein, ranged from 95 grams in the case of a Massachusetts glass-blower, to 254 grams in that of teamsters, marble workers, and other laborers, in a Boston boarding-house. German standards call for from 118 to 145 grams in the daily food of a laboring man, according to the severity of his labor. The proportions of fat varied from 109 grams in food of French Canadians at home, to over 360 grams in that of the Boston boarding-house referred to. The German standards include from 50 to 100 grams of fat. As the German standard represents the actual quantity consumed by well-to-do mechanics, and reliable data imply that laborers in France, Italy, and other countries of Europe, consume about the same quantities, it appears that the food of the American laboring man is much more nutritious on the average than that of his European competitors. As one result, the American workingman turns off much more work than the European. The American workman is better paid, better housed, better clothed, and better fed than the European. He has better opportunities for self-development, more to stimulate his ambition, and more hope of reward if his work is efficient. He accomplishes a great deal more. These factors are all connected, but the explanation of his superior capacity for work is to be found largely in his superior nourishment. What ought to be the panurgy of the American workingman, with his great opportunities, his superior intelligence, and the 6,776 foot-tons of potential energy in his daily food ?"

Some 12 or 14 members availed themselves of the opportunity presented to criticise and comment upon the propositions advanced. Mrs. Richards, of Boston, Mass., gave a description of the cooking schools in that State. They found that such knowledge was best inculcated when the girls were from 12 to 14 years of age. These lessons frequently resulted in such changes of cooking in the homes of the girls, as manifested beneficial results in the manners, dispositions, and morals of the family. She advocated industrial cooking schools in connection with the public schools.

Prof. E. J. James, of the University of Pennsylvania, thought the question of economy in food supply of fundamental importance to the welfare of the country. It was extremely unfortunate, he said, that some writers have accompanied their statements with remarks that have made the working classes suspect that cheap food means low wages, and that expensive diet means high wages. It does not. This is at bottom, a social question, and if it is not wisely treated, the result of advance in science may redound to the benefit of the few and possible detriment to the many, Every new food added to the list of those regularly consumed. tends to diminish the demand for the staple article, and, consequently, tends to lessen the cost of living.

Taking all Professor Atwater's papers together, as published in consecutive numbers of the *Century*, I gather that his views are broader than might seem from the above account; viewing the papers, however, as read at the Association meeting, they suggest to me a number of considerations worthy of more attention than I shall be able to give them on this occasion. One thing seems clear—that the food question, like so many others, is complicated by false views as to the meaning and purpose of human existence. People spend money for what is not bread, in both a literal and a figurative sense. The American workman wishes to appear, according to these witnesses, "better off" than he is.

Mrs. Richards' remarks are full of suggestiveness. Even from the discussion before the Association, it becomes very plain that the food question has other aspects than the economic, the chemical or the physiological. To say, as Prof. E. J. James does, that "this is at bottom a social question," is placing it on far too narrow a basis. Not to go beyond the papers and the discussion evoked, it appears that the subject has chemical, physiological, economic and moral aspects, at least. The ill-fed and the over-fed human being are alike liable, not only to physical, but to mental and moral disturbance. If the relations between mind and body are constant and absolutely dependent on fixed, though but partially known laws, it should be one of the aims of science to show more clearly what these laws are; and in this all the specialties may combine with a noble end in view.

In estimating the diet that is best, many considerations beside the chemical composition of the food, the action of the digestive juices, etc., must be taken into account. A food that is capable of maintaining one individual at his maximum of energy is not such for another; and this may depend on subtle influences of race, habit, occupation, and countless factors of the past and present, which neither chemist nor physiologist can estimate, except in the roughest and most general way. Fortunate it is that our instincts are wiser than ourselves—our conscious, scientific selves. Such considerations should not tend to lessen our estimation of the value of such work as the chemist, the physiologist, the anthropologist, the psychologist and others can do. It all has its place, but we must beware of drawing conclusions too hastily or making generalizations that are too wide.

Specialism, with its limited fields, its more elaborate methods and its minute details, is necessary to the advance of science. But the dangers are great, as the subject under consideration well illustrates. One of the questions of the day to not a few minds is: How may specialism exist so as to subserve the ends of science and not lead to narrow, and consequently erroneous, views? It is doubtful whether it is not better to have no definite conceptions of a subject than highly distorted ones. It is true, the critical spirit of the day tends to sift all views and errors are being constantly exposed; they may, however, be speedily replaced by another crop. The remedies or rather the means of preventing, at least in part, this state of things, it appears to me, are:—

(1) A sound and broad education on the part of the individual who proposes to specialize.

(2) Joint work—many different specialists attacking the problem from different points of view and comparing

results. In large laboratories this could be done. Such treatment of subjects as that given the food question by the American Association is highly suggestive.

(3) Attendance of specialists at societies where diverse topics, not of exclusive interest to any one specialty, are discussed. I think the occasional delivery of a popular lecture helps not a little to correct the specialist's natural tendencies to aberrations of one kind and another. His attention is thus turned to substantial results rather than to methods of work.

THE PRAIRIES OF MANITOBA.

BY A. T. DRUMMOND.

In August of this year, another opportunity occurred to me of examining the superficial deposits around Portage la Prairie, Birtle and Kinbrae—the last named place about thirty miles north-west of Fort Ellice. The resulting facts will prove of interest in connection with questions that have been discussed about the origin of the north-west prairies.

At Portage la Prairie the country is on all sides flat, and bears evidence of two to three periods of growth and decay of grasses and reeds in shallow water, alternating with periods of subsidence of the land. The general surface is perhaps twelve feet above the Assiniboine River, and that stream is in turn about the same number of feet higher than Lake Manitoba, which lies only fourteen miles to the northward. The banks of the river, in a height of twelve feet, show three layers of black loam, each from six to twelve inches or more in thickness, alternating with a creamy gray clay, and the whole underlaid near the water's edge by a reddish clay. Boulders throughout this section of the country and eastward to Winnipeg are unseen, even in the bed of the river at low water. Towards Westbourne, the large tract of low land, usually covered with water, and lying between Rat Creek and the Westbourne marsh proper, and through which the Manitoba and Northwestern Railway's track is built, was perfectly dry. That this was an exceptionally dry year, was shown by the enormous numbers of dead shells of *Limnæa, Planorbis, Physa* and other genera, which, everywhere, rendered the ground crisp under the tread of the foot. The ground was covered by a heavy growth of grasses of three or four species, scattered everywhere in great patches, each grass occupying its own patches to the exclusion of the other grasses. The soil is a heavy black loam, and the surrounding circumstances all clearly show how such soils have been formed in the valleys of the Lower Assiniboine and of the Red River, and around Lake Manitoba, by the annual decay of such marsh grasses.

To the westward of the Big Grass Marsh and the Westbourne Marsh, circumstances are changed. The country, after leaving the gravel ridges which strike the line of the Manitoba and Northwestern Railway at Arden, becomes of a slightly rolling character, and increasingly so some distance farther westward. As Neepawa is approached, the surface loam is underlaid by sand. Boulders become exposed in the river valley at Minnedosa and in the side valleys leading into it—washed out, no doubt, from the drift clays which at a greater or less depth underlie the surface soil. At Birtle, the Laurentian boulders are not only common in the deep valleys, especially on the eastern side, of the Bird Tail and of Snake Creek,—appearing in almost a solid mass of both large and small boulders at one point at the creek level near Birtle—but are also on the surface of the prairie above. They are in the latter case, generally more common in and upon the surface of the low ridges which here and there somewhat parallel each other. Proceeding still westward, boulders are not frequent in the valley of the Assiniboine River at Fort Ellice and at the railway crossing eighteen miles up the stream, but the bed of the river at the ford is formed entirely of very large sized gravel. Nor do boulders appear again until the country beyond Langenburg is reached. Here there are two or three gravelly knolls rising twenty-five or thirty feet above the general level, like the Spy Hills, also gravelly knolls, nearer Fort Ellice. In the vicinity of Kinbrae, the surface soil is a sandy loam with ridges of loam mixed with gravel. A well sunk here on George B. Fisher's farm, gave a section showing in descending order, one foot of sandy loam, eleven feet of clay, with a few rounded boulders in it, and thirty feet of sand, which grew coarser towards the bottom. At Langenburg, another well gave, before the sand was reached, one hundred and sixty feet of wet sticky clay, holding boulders. There was considerable difficulty in securing water at this latter place until this depth was reached. At neither place was there any appearance of layers of black loam as at Portage la Prairie and Winnipeg. The boulders here and at Birtle are relatively small, seldom exceeding two feet across, and, with the gravel, have rather the worn appearance resulting from the action of ice than the rounded look which the water on a sea or lake coast would give them. Both boulders and gravel in the neighborhood of Kinbrae are Laurentian, intermixed with some of a limestone which weathers a buff in colour. One of these larger limestone boulders was heavily striated and was, otherwise, worn smooth to the condition of a slab. Nearly all of the sloughs were dry, as a result of the drought this year, and some were, like the dry marshes near Westbourne already alluded to, dotted with the dead shells of *Limnæa* and other fresh water mollusks.

CONCLUSIONS.

The conclusions I have formed are, that the Manitoba prairies east of the Pembina and Riding mountains are the most recently formed, and are still undergoing a process of extension in the great marshes still existing and on the shallow lake margins, through the annual growth and decay of the luxuriant grasses growing there. There had been two or three depressions of the land in the course of the formation of these prairies, during each of which, deposits of sediment, carried down by the muddy northern and western rivers, were made over the loam formed by such decaying grasses, giving thus the alternate loam and clay now observable. There is no evidence to show that during these depressions the subsidence was sufficient for, or the other surrounding conditions favourable to, the action or even the existence of icebergs, though previous to this time, this section of the Northwest was no doubt also subject to the action of ice, all evidence being now covered up by the more recent deposits here referred to.

West of these lower and more recently formed prairies, are the rolling prairies, which have an origin somewhat different. The stretches of sand, both on the surface and under the clays, point to the existence of extended lake and sea margins at more than one period. The extensive, somewhat parallel gravel ridges at Arden, the gravel knolls, the smaller ridges with boulders in and on them at Birtle and west of Langenburg, and the uneven, rolling nature of the surface of the prairie, all seem to me to point to the action of icebergs in the glacial or post-glacial seas, modified afterwards by the water during subsidence, and to indicate the direction of the force, whether wind or current or glacier, which at these places impelled the bergs onward. Further, the thinner surface loam, mixed to the westward with some sand, would seem to point to a condition of growth and decay of plant life, less defined than and probably of a different character from that on the lower prairies to the eastward.

The Assiniboine, though presently a branch of the Red River, was not always so, and is in its upper reaches above Brandon, a much older river. When the whole prairie east of the Riding and Pembina Mountains was a vast shallow lake, the Assiniboine was a large stream varying from half a mile to a mile and more in width for most of its course, discharging into this lake the surplus waters of the country to the northward and westward. As the whole surface of the continent here, to the east and west, but more especially to the westward, continued to rise, in the long lapse of time, the Assiniboine, with the strongly increased current which its relatively higher level westward gave it, cut its way through the surface soils to its present great depth of about two hundred feet below the prairie level.

As the land eastward of Brandon rose above the water level, the river had of necessity to form a continuation of its course to some new outlet for its waters. This new outlet was eventually found at Winnipeg, where it joined the Red River, which must then have been a new stream, formed by the waters of the south, seeking, by reason of the rise of the land there, a new exit to the sea to the northward. That the Assiniboine had by this time become small stream compared with its former proportions, is shown by the contracted banks of this newer part of its course, those at Winnipeg and Portage la Prairie being not more than from two to three hundred feet apart, and from twelve to fifteen feet high.

Note on a Specimen of Lake Iron Ore from Lac la Tortue, P. Q.

By B. J. HARRINGTON.

Some time ago, through the kindness of Mr. George McDougall, of Three Rivers, P. Q., the writer was enabled to obtain a specimen of Lake Iron Ore from the bottom of Lac la Tortue, where the material is said to occur in considerable quantity. The Lake is situated about twenty miles north of Three Rivers in a region which, according to Sir William Logan's geological map, is occupied or underlaid by rocks of Laurentian age. In appearance, the ore closely resembles one of the concretionary bog ores found in so many parts of the country, and of which analyses have frequently been published. A few months ago, an analysis of the La Tortue lake ore was made by Mr. W. A. Carlyle, B. A. Sc., then a student in the laboratory of McGill College, and the results are deemed worthy of recording, especially as no facts concerning Canadian lake ores have hitherto been published. No. I. is Mr. Carlyle's analysis, while No. II. is one by Svanberg of a Swedish lake ore:—

Ferric oxide	69.64	69.95
Ferrous oxide	0.72	....
Manganic oxide (Mn_2O_3)	2.99	1.97
Alumina	2.43	3.47
Lime	....	1.82
Magnesia	0.60	0.06
Phosphoric anhydride	0.47	0.56
Sulphuric anhydride	0.09	0.12
Silica	8.17	5.85
Loss on ignition	15.00	16.19
	100.11	99.99
Metallic iron	49.31	48.96
Phosphorus	0.205	0.244
Sulphur	0.036	0.048

It will be observed that the correspondence between the two analyses is very striking, and also that in a general way, these lake ores resemble our ordinary bog ores in composition. Judging from published analyses, however, the average proportion of volatile matter in the latter is higher than in the lake ores. The average quantity of water, deduced from nine analyses of Canadian bog ores, is 19.78 per cent., while the average deduced from seven analyses of Swedish lake ores by Svanberg, is only 14.13 per cent. (*)

ROCEEDINGS OF NATURAL HISTORY SOCIETY.

SESSION 1887–1888.

The First Monthly Meeting of the Society was held on Monday evening, October 31st, 1887, at eight o'clock.

The minutes of the last meeting were read and confirmed, also the minutes of Council Meetings, June 9th, September 20th, October 24th and 31st.

The Honorary Curator reported the following donations to the Society. A collection, composed of native spears, clubs, dresses, mats, shells, stones, etc., from the Samoan

(*) For Svanberg's analyses and other particulars concerning the Swedish lake ores, see Percy's "Metallurgy of Iron and Steel."

Islands, bequeathed by the late Mr. George J. Bowles, presented by his son, Mr. George Bowles.

Specimen of *Vulpes lagopus* (Arctic Fox), by an unknown donor; Nest of Common Black Wasp (*Vespa maculata*) from Mr. W. G. Oswald, Belle de Revière, Two Mountains; Specimens *Belosoma americana;* Busts of Bishop Fulford and his father, from Mr. Charles Holland.

Dr. T. Wesley Mills then read a very interesting paper on "The Meeting of the American Association for the Advancement of Science, for 1877," a *resumé* of which appears in this number of the RECORD.

The Second Monthly Meeting was held 28th Nov., 1887, at eight o'clock. Sir Wm. Dawson in the chair.

The minutes of the last meeting were read and confirmed; the minutes of the last Council meeting were also read.

In the absence of the Hon. Curator, the Hon. Librarian reported a donation from Mr. Montpetit of an *Astrophyton vermicosum*, "Star of the Sea," from Labrador, for which the thanks of the Society were expressed.

The following gentlemen were elected: Walter Drake, Dr. Ruttan, Hon. Justice Baby, as ordinary members, and Rev. Dr. W. E. Winslow, of Boston, and Dr. D. B. McCartee, Amoy, China, as Corresponding Members.

A letter was read from Dr. L. N. Britton, Treasurer of the Audobon Memorial Fund, soliciting subscriptions, which was referred to the Hon. Treasurer.

Mr. A. T. Drummond read two very interesting papers, "The Prairies of Manitoba, and "The Physical and Past Geological relations of British North American Plants," which created considerable discussion.

These papers appear in the present issue of the RECORD.

MONTREAL MICROSCOPICAL SOCIETY, SESSION 1886-87

The annual meeting was held on Monday evening, October 18th, 1886, in the libra.y of the Natural History Society.

The following officers were elected for the session 1886-87;—

President—Very Rev. Dean Carmichael.

Vice-President—D. P. Penhallow, B. Sc., F.R.S.C.

Treasurer—A. Holden.

Secretary—Jeffrey H. Burland.

The second monthly meeting was held on Monday evening, November 15th.

After the regular business had been attended to, the President read a very interesting paper, entitled, "Rules for Distinguishing Animal from Vegetable Organisms." The Treasurer was elected Secretary-Treasurer, Mr. Burland having resigned as Secretary.

The third monthly meeting was held on Monday evening, December 13th, in the laboratory of Dr. J. B. McConnell, when he read a paper on "Bacteriological Methods," bringing before the society, in the most lucid manner, a general outline of the action of bacteria and the modes of sterilizing, propagating and detecting them.

The fourth monthly meeting was held on Monday evening, January 10th, 1887.

Mr. J. Stevenson Brown gave a demonstration on modes of mounting objects for the microscope, showing some very ingenious apparatus made by himself, which was most instructive and highly appreciated.

The fifth monthly meeting was held on Monday evening, February 14th, 1887.

The Secretary reported that in response to the invitation of the Natural History Society to attend the Conversazione held at the Museum on the 20th January, twenty members of the society were present, with their microscopes and objects, and were assisted by friends from the McGill University and others.

Mr. A. W. Clement read a very interesting paper, "The Use of the Microscope in the Inspection of Meat," illustrating same by appropriate slides.

The sixth monthly meeting was held on Monday evening, March 14th.

The paper of the evening, by the Rev. Dr. Smyth, "Chalk as seen through the Microscope," was well illustrated with drawings and slides.

The seventh monthly meeting was held on Monday evening, April 18th.

Dr. Wanless' paper, "The Determination and Results of Minute Materials, Physiologically and Microscopically Considered," was illustrated with interesting experiments and slides.

The eighth monthly meeting, held on Monday evening. May 9th, after the regular business, was devoted to the exhibition by the members of diatom slides.

Session 1887-1888.

The annual meeting of the society was held on Monday evening, October 10th 1887.

The following officers were elected for the session 1887-88.

President—Professor D. P. Penhallow.

Vice-President—J. Stevenson Brown.

Secretary-Treasurer.—A. Holden.

The annual reports were read and adopted.

The second monthly meeting was held on Monday evening, November 14th.

The President read a most interesting and instructive paper, "The Microscope as an Aid to Research," exhibiting some very fine objectives, and other accessories.

MISCELLANEOUS.

We have recently received the last published statement of the valuable series of investigations conducted by Sir J. B. Lawes at Rothamsted, England. This statement was first formulated in 1877 for the occasion of the twenty-fifth anniversary of the establishment of the First Experiment Station in Germany, at Mökern. Since then it has been continued each year, and extended to embody the more recent work of the field and laboratory. From the number before us, we find that from 1847 to 1887 the published results of the work conducted during this period by Sir J. B. Lawes and his staff of assistants, number no less than one hundred and four. As most of our readers are aware, these publications embody some of most important scientific results touching the chemistry of plant foods and their sources in the soil. Probably no experiment station has done more in the way of securing valuable and accurate scientific data, to advance the cause of scientific agricultnre, than Rothamsted.

The experiments at Rothamsted began in 1834 with a simple series of pot cultures, designed to throw light upon the relation of various chemical compounds to vegetable nutrition. These rapidly led to more enlarged operations in the field, supplemented by laborious researches in the laboratory by some of the most eminent chemists and botanists of the day. There was thus developed a systematic method of enquiry, which has resulted in throwing much important light upon many obscure or imperfectly understood laws. The peculiar value of the system adopted may be fully appreciated when we state that some of the experiments have been extended continuously for thirty-seven years, and are likely to be continued into the future for an indefinite period.

Although this valuable work is conducted primarily with reference to the practical application of the results, it has led to the accumulation of a large amount of data which are of the highest value from the standpoint of pure science. Very few institutions of a similar character have been able to surpass Rothamsted in the character, extent and general usefulness of its work. That the institution has a liberal endowment and is established on a broad scientific basis, reflects the highest credit upon its founder.

Unfortunately, many of the valuable papers embodying these results are no longer to be obtained. The annual statement, therefore, serves as an important means of gaining a summary of some of the more extended investigations and as a valuable historical and bibliographical record.