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OBSERVATIONS ON CANADIAN GEOGRAPHICAL BOTANY.

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The more observable features in the distribution of our native plants can now, I think, be indicated with some degree of accuracy by the aid of the catalogues, published and unpublished, of various collectors in different parts of the province. The range of many species is of course not yet satisfactorily ascertained, and doubtless in coming years there may be some plants at present thought to be restricted to particular localities, which will be found to have a somewhat wider distribution. I feel certain, too, that a careful search along our boundary-lines will be rewarded by the discovery of many species as yet unknown to Canadian collectors, which will thus increase the floras peculiar to different districts. Many details, therefore, require to be yet worked out, before results entirely satisfactory can be arrived at.

Geographically, Canada extends over an area of about twenty-eight degrees of longitude and ten and three quarters degrees of latitude; stretching from East Cape, Anticosti, to the River Kaminastiquia, which flows into Lake Superior, and from Point Pelée, which juts into Lake Erie, to latitude 52° 45′, the northern limit. This area, whilst extensive, has some peculiar physical features, which have a most important bearing upon the distribution of the plants composing its flora. The southern and western limits are bounded, for the greater part of the distance, by the river St. Lawrence and a chain of extensive sheets of water, which stretch through several degrees of latitude, locating our province in the same parallels with Maine, Vermont, New Hampshire, and nearly the whole of New York and Massachusetts on the east, and with Michigan on the west. Our north-eastern border, moreover, adjoins Labrador, and extends far into the Hudson's Bay Territory. We therefore meet in the western part of the province many plants having decidedly a southern character, and some of a peculiarly western type; while on Anticosti and the neighboring shores are found alpine species till recently unobserved south of the Labrador coast.

While the remarkable natural extension of our boundaries has the effect of including within our limits many interesting plants, other causes have also exerted their influence. Apart from the characters of soils, as their looseness and temperature, there is one cause—the chain of great lakes—which must exert a very considerable influence upon the vegetation of Canada. These bodies of water, on account of their great extent and depth, have an equalizing effect upon the temperature of the air near their shores, the water not being subject to those sudden extremes of heat and cold which we observe in the atmosphere. The great amount of evaporation, constantly taking place over the broad surface of each lake, also tends to make the neighboring air more moist than in inland localities. A similar effect being produced upon the sea-coast, instances of alpine and sub-alpine plants occurring far down on the coast-line are not rare.

In taking a general view of the distribution of the various species of plants which occur in Canada,—excluding mosses, lichens, and lower forms,—I think that the following types will be readily recognized:

I. Canadian Type.—Species generally distributed through the whole or greater part of the province.

II. Erie Type.—Species chiefly restricted to the district bordering Lake Erie.

Note.—In addition to published catalogues of plants, I have to acknowledge having received much valuable information from lists made at the following places:—Newfoundland, J. Richardson of Geol. Survey, coll. in herb. Bot. Soc. Can.; Gaspé, J. Bell, B.A.; Quebec, J. Richardson, coll. in herb. Bot. Soc. Can.; L'Orignal, J. Bell, B.A.; Carleton Place, J. Bell, B. A.; Ramsay, Rev. J. K. McMorine, M.A.; Brockville, R. Jardine, B.A.; Belleville, J. Macoun. My own collections have been chiefly made at Montreal, among the Thousand Islands, at Kingston, Stone Mills, Cobourg, Collingwood, Niagara Falls, London, and Port Stanley.—A.T.D.

III. SUPERIOR TYPE.—Species only found about Lakes Huron and Superior, and most of which have evidently migrated from the country watered by the Saskatchewan.

IV. MARITIME TYPE.—Species confined to the sea-shore.

V. ALPINE TYPE.—Species chiefly known, at present, to occur about our north-eastern borders.

I. CANADIAN TYPE.

The flora of Canada (as do the floras of all other countries) includes a very large number of species which are widely spread over the whole province. They are found thriving upon the shores of Lakes Superior, Huron, and Erie, and range thence to the mouth of the St. Lawrence, and many even beyond into Newfoundland. A considerable number appear to have their centre of range within the province or near its north-western border. They are distributed over the more northern portions of the United States, and, overspreading Canada, find their limit in the Hudson's Bay Territory; but the maxima of the individuals of each species appear rather to be in Canada than in the wide districts on either side. Other Canadian species, again, extend not only throughout the northern United States, but even as far south as the Gulf of Mexico. Very many, too, are common to Europe and America, whilst a number are widely diffused over the temperate regions of both hemispheres. And did I include the lower cryptogamic plants, numerous instances might be noted of species which are almost, if not quite, cosmopolites.

As yet the north-eastern and north-western limits of some of our most common plants have not been ascertained as definitely as could be desired. Some species met with in almost every other part of the province do not appear—judging by lists to which I have had access—to range down the St. Lawrence banks beyond Quebec; and quite a number, as *Tilia Americana*, *Hepatica acutilobia*, and *Hepatica triloba*, abundant in Central and Western Canada, are entirely wanting in the Lake Superior lists and in the lists from the maritime counties. More northern limits than hitherto observed may yet be ascertained for many of them. Distributed, however, as they are, over the greater portion of the province, they may be classed under the general Canadian flora.

It is not difficult to trace somewhat approximately the northern limit of distribution of some of the more conspicuous plants. Surveyors and others readily recognize our forest trees, and with the identity of some of these trees there can be no possibility of error. I shall only here instance the basswood (*Tilia Americana*), and the red oak (*Quercus rubra*),—trees not easily mistaken. Entering Canada from Maine, the basswood is observed in the counties of Arthabaska, Wolfe, and Nicolet, thence it ranges along the St. Lawrence to the river Ottawa, and far up that stream, through Argenteuil and Ottawa, to the Island of Alumette. Crossing the country, it is met with in the townships of Richards, Brunel, and Stephenson, and finally appears to take its leave of Canada at Sturgeon Bay on Lake Huron. It re-appears on the south shore of Lake Superior, and at Rainy Lake on the British side, whence it extends to the Red River, and northward to latitude 52°. A most remarkable locality is Lake St. John near its outlet into the Saugenay, recorded by Professor Bell in the Geological Survey Report for 1857. The red oak, again, ranges from the neighborhood of Quebec, where the variety *Q. rubra* var. *borealis* is said by Cooper (Smithsonian Reports) to attain its north-eastern limit, up to Montreal, and thence skirting the Ottawa, apparently sparingly, it extends westward to Lake Huron; on the north shore of which, and on the Manitoulin Islands, where it is said to attain considerable size, it is frequently observed. On the eastern shores of Lake Superior, too, red oaks are met with; but, according to Agassiz, Michipicoten Island forms in Canada the north-western limit of distribution.

The following species may be instanced as some which have a wide range over the province:

Anemone Pennsylvanica.	Solidago bicolor.
Thalictrum cornuti.	S. Canadensis.
Ranunculus repens.	Antennaria margaritacea.
Caltha palustris.	Vaccinium Pennsylvanicum.
Nuphar advena.	Chiogenes hispidula.
Nasturtium palustre.	Veronica Americana.
Drosera rotundifolia.	Lycopus Virginicus.
Stellaria longifolia.	Menyanthes trifoliata.
Impatiens fulva.	Ulmus Americana.
Rhus Toxicodendron.	Corylus rostrata.
Acer saccharinum.	Betula papyracea.
A. spicatum.	Populus tremuloides.
Lathyrus palustris.	Platanthera psycodes.
Prunus Virginiana.	P. dilatata.
P. Pennsylvanica.	Smilacina racemosa.
Geum strictum.	Streptopus roseus.
Rubus strigosus.	Scirpus Eriophorum.

Rubus triflorus.
Epilobium angustifolium.
Ribes lacustre.
Mitella nuda.
Sanicula Marylandica.
Linnæa borealis.
Lonicera ciliata.
Aster puniceus.
Eupatorium purpureum.
Carex aurea.
Avena striata.
Equisetum sylvaticum.
E. arvense.
Polypodium vulgare.
Struthiopteris Germanica.
Asplenium filix-fœmina.
Lycopodium complanatum.
L. dendroideum.

Among the larger orders, Rosaceæ and Ericaceæ afford, in proportion to the species represented in Canada, the greatest number of species of very extensive distribution. Coniferæ and Betulaceæ, among the smaller orders, have a large proportion of a wide range. Among the Coniferæ, in fact, only *Abies Fraseri*, *Pinus rigida*, *P. Banksiana*, and *P. mitis* appear to be sparingly diffused.

II. Erie Type.

The forests of that part of the deep peninsula of Upper Canada which borders Lake Erie, are characterised by an abundance of beech (*Fagus ferruginea*), sugar-maple (*Acer saccharinum*), oak (*Quercus rubra*, *Q. macrocarpa*, and *Q. alba*), and walnut (*Juglans nigra*). Clumps of white pine (*Pinus strobus*) are sometimes seen; but I have not yet observed the red pine (*Pinus resinosa*), so common in some parts of Canada. The flats on either side of the Thames, in the neighborhood of London, are remarkable for a splendid growth of the buttonwood (*Platanus occidentalis*), which in this locality is rarely seen elsewhere. Nearer the mouth of the river, where the country is very level, this tree attains an enormous size. The chestnut (*Castanea vesca*), though not abundant, is yet characteristic of these western forests. Neither the chestnut nor buttonwood appear to extend farther north than the counties of Middlesex and Halton. The tulip-tree (*Liriodendron tulipifera*) rarely occurs in the central part of the district around London and St. Thomas, but is a familiar tree at Chatham, and is occasionally met with in the Niagara district as far west as Hamilton.

The flora of the Lake Erie district resembles very much that of the western part of the State of New York; and this resemblance will become closer the more the district is explored. *Magnolia acuminata* and *Asimina triloba*, both of which have been observed at Lewiston on the Niagara river, *Gillenia stipulacea*, *Silphium trifoliatum*, and others of similar range in the Northern States, and not yet familiar to us as Canadian plants, are to be looked for here; and possibly some species of a more Southern type may, like *Viola villosa*, *Polygala Nuttallii*, and *Agrimonia parviflora*, also be discovered in this district.

The flora, peculiar as regards other parts of Canada to the neighborhood of Lake Erie, embraces no plant not likewise met with in one or other of the adjacent United States. Many of the species composing it form only the outliers, as it were, of a flora which has its centre in the central States of the Union. Others, again, are rather western in their range. To those of a somewhat southern type already mentioned, may be added *Polygala fastigiata*, *Phaseolus helvolus*, *Cornus florida*, *Lobelia puberula*, *L. Nuttallii*, *Scutellaria integrifolia*, and *Urtica purpurascens*. Among western and south-western species, or species not frequently observed in the Eastern States, are *Jeffersonia diphylla*, *Baptisia leucantha*, *Artemisia biennis*, *Lithospermum canescens*, *Platanus occidentalis*, *Juglans nigra*, and *Quercus castanea*. *Platanus occidentalis* is said to be also a native of Lower Canada, and I have seen one or two trees of *Quercus castanea* in the township of Pittsburg, near Kingston. The Erie district, however, here forms the northern limit of these species, though many of them extend north-westwardly to Wisconsin, and even penetrate the section of country watered by the Saskatchewan. This peculiar north-westward distribution of many American plants is a remarkable feature in the vegetation of both the northern United States and Canada. Humboldt, I believe, ascribes the circumstance to the different directions of the valleys in the Atlantic and Western States.

Among the species characterising the district along Lake Erie, are:

Liriodendron tulipifera.
Jeffersonia diphylla.
Iodanthus hesperidioides.
Viola villosa.
Hypericum kalmianum.
Euonymus atropurpureus.
E. Americanus.
Polygala Nuttallii.
P. fastigiata.
Lupinus perennis.
Campanula Americana.
Gerardia integrifolia.
Scutellaria integrifolia.
Onosmodium Carolinianum.
Lithospermum canescens.
Hydrophyllum appendiculatum.
Frasera Carolinensis.
Asclepias variegata.
Montelia tamariscina.
Sassafras officinale.
Benzoin odoriferum.
Euphorbia corollata.

Phaseolus helvolus.
Baptisia leucantha.
Gillenia trifoliata.
Agrimonia parviflora.
Lythrum alatum.
Œnothera chrysantha.
Thaspium barbinode.
Erigenia bulbosa.
Rudbeckia fulgida.
R. horta.
Artemisia biennis.
Lobelia puberula.
L. spicata.
L. Nuttallii.
Platanus occidentalis.
Castanea vesca.
Urtica purpurascens.
Boehmeria lateriflora.
Juglans nigra.
Quercus castanea.
Hypoxis erecta.
Lilium superbum.
L. Catesbæi.
Prosartes lanuginosa.
Andropogon argenteus.
Allosorus atropurpureus.

Two or three of the species above enumerated are stated by Prof. Gray to be common in the northern United States, but I am not aware that they have been observed in Canada in localities beyond the Erie district.

III. Superior Type.

It is upon the shores of Lakes Huron and Superior, especially of the latter, that the vegetation begins to partake somewhat of the character of that west of the Red River. Such plants as *Linum perenne*, *Lonicera involucrata*, *Crepis runcinata*, and *Coriospermum hyssopifolium* do not fail to remind us of the country watered by the Saskatchewan, and of the adjacent American territories. Not many of these far-western species have as yet been met with; nevertheless, the resemblance is sufficiently marked to be noticeable. Future collectors will, there is little doubt, not only increase the number of these species already detected, but also add to the list of sub-alpine plants whose occurrence has been noted on the north shore of Lake Superior.

Were these western plants absent, the flora of the east and north shores of Lake Superior would much resemble that of the section of country along the south shore of the St. Lawrence from about Quebec downwards to the Gulf. The Cupuliferæ find their limits upon the eastern coasts of the lake, whilst *Tilia Americana* is entirely absent. *Fraxinus sambucifolia* is still met with, but *F. Americana* does not penetrate much beyond the upper shores of Lake Huron.

Among the western species at present known to diffuse themselves as far as our borders, are included the following plants:

Anemone narcissiflora.
Ranunculus abortivus, var. micranthus.
Crepis runcinata.
Mulgedium pulchellum.
Tanacetum Huronense.

Caltha natans.
Aquilegia vulgaris.
Arabis petræa.
Turritis patula.
T. brachycarpa.
T. retrofracta.
Drosera linearis.
Linum perenne.
Rosa stricta.
Rubus Nutkanus.
Lonicera involucrata.
Symphoricarpus occidentalis.
Matricaria inodora.
Aster graminifolius
Cirsium Pitcheri.
C. undulatum.
Senecio canus.
Artemisia Ludoviciana.
Nardosmia sagittata.
Melampyrum pratense.
Mertensia pilosa.
M. paniculata.
Polemonium cæruleum.
Humulus Lupulus.
Coriospermum hyssopifolium.
Elæagnus argentea.
Comandra livida.
Echinodorus subulatus.
Carex Vahlii.
Allosorus acrostichoides.
Aspidium fragrans?
A. Lonchitis.

I have not stations for *Anemone narcissiflora*, *Turritis patula*, *T. retrofracta*, *Linum perenne*, and *Polemonium cæruleum*, beyond the mere fact of their presence in Canada; but judging by their range in British America, the Lake Superior or Lake Huron region must be the place of their occurrence.

The shores of Lake Huron, it may be mentioned, are the only recorded stations in Canada for *Matricaria inodora*, *Mulgedium pulchellum*, *Cirsium undulatum*, *Crepis runcinata*, *Senecio canus*, and *Aspidium Lonchitis*. Owen Sound, on the Georgian Bay, is a station for the very rare *Scolopendrium officinarum*. *Hesperis matronalis*, and *Poterium sanguisorba*, both garden-plants, are said by Hooker to have been found on the shores of the same lake. The very rare *Juncus stygius* has also been gathered at the Bruce Mines.

In addition to the plants enumerated in the above list, there are some which in Canada appear to be confined to this district, but in their range beyond the province cannot be classed as western plants. Such are *Sisymbrium canescens*, *Coreopsis lanceolata*, and *C. verticellata* (?), which extend into the southern United States.

There are also a few species met with around the upper lakes, which in the United States flora appear to be exclusively north-western plants, but which re-appear near the north-eastern Canadian boundary-line, and doubtless are spread over the intervening space. *Parnassia palustris*, a species of Upper Michigan, the Lake Superior region, and north-westward, likewise occurs in Labrador and Newfoundland; and *Artemisia borealis*, another north-western plant, appears also in Anticosti and Labrador. *Botrychium Lunaria*, a foreigner to the United States flora, and *Allium Schœnoprasum*, have a similar range to the Atlantic coast, the former occurring on Orleans Island, and the latter extending, according to Prof. Bailey, to the Nepisiquit in New Brunswick.

Some of the plants which I have above enumerated are distributed through Michigan, Wisconsin, and Minnesota, and others even extend to Oregon and California. The following are, however, not included in Gray's Manual of Botany, as being within those States east of the Mississippi River:

Anemone narcissiflora.	Crepis runcinata.
Caltha natans.	Matricaria inodora.
Aquilegia vulgaris.	Mulgedium pulchellum.
Arabis petræa.	Melampyrum pratense.
Turritis patula.	Mertensia pilosa.
T. retrofracta.	Polemonium cæruleum.
Linum perenne.	Coriospermum hyssopifolium.
Rosa stricta.	Elæagnus argentea.
Lonicera involucrata.	Echinodorus subulatus.
Senecio canus.	Carex Vahlii.
Nardosmia sagittata.	Allosorus acrostichoides.

Carex Vahlii and *Allosorus acrostichoides*, it is to be observed, have been found on Isle Royale; which island forms a part of the State of Minnesota, and is therefore within Gray's limits. *Melampyrum pratense* and *Echinodorus subulatus*, though not in the Manual, are, according to Dr. Parry (Owen's Geological Survey of Wisconsin and Minnesota), found at St. Croix in Wisconsin.

It will, in this place, be proper to mention, before adverting to the maritime type, that Upper Canada and Lower Canada appear each to have a peculiar flora. The materials requisite to define with sufficient accuracy the distinctive features of each flora, which are at command, are not, however, so ample as could be desired. From the upper province I have several full and reliable catalogues, though much may yet there be done; but the eastern townships and vicinity of the neighboring United States boundary-line, have not been sufficiently explored to preclude the hope that not a few species, at present thought not to range into Lower Canada, will be detected there. Most of the plants indigenous to the northern districts of Maine and Vermont, should occur there.

I may here, for the sake of illustrating the two floras mentioned, and with a view of more fully indicating in this paper the general features in the distribution of our Canadian plants, point out a few of the species which seem to be restricted, or nearly so, to each province.

There appears to be a very large number of Upper Canadian species which have not been met with in Lower Canada. Many of these, however, occur in Maine and Vermont, and will, I doubt not, be observed by collectors in the eastern townships. Still, there are a number in the upper province which, judging by the range ascribed to them by Gray, are not to be looked for far beyond the dividing-line between the provinces. Among these are such plants as *Hydrastis Canadensis*, *Alsine Michauxii*, *Polygala senega*, *Astragalus Canadensis*, *Myriophyllum heterophyllum*, *Lonicera oblongifolia*, *Viburnum pubescens*, *Liatris cylindracea*, and *Aster ptarmicoides*. *Pinus rigida* appears to be of very restricted occurrence,—the only reliable locality of which I know being the Thousand Islands; and recorded stations for, among others, *Helianthemum corymbosum*, *Rhus aromatica*, *Geum triflorum*, *Valeriana sylvatica*, *Pycnanthemum lanceolatum*, and *Asplenium ebeneum* (for which fern I may here mention the neighborhood of Kingston as a third Canadian locality), are as yet rare.

In Lower Canada there are a number of species which may be regarded as confined to that province, others which range for a considerable distance along the St. Lawrence towards Lake Ontario, and not a few which appear on the shores of Lake Superior, though not found elsewhere in Upper Canada. Thus *Draba verna*, *Stellaria crassifolia*, *Astragalus alpinus*, *Oxytropis Lamberti*, *Cornus suecica*, *Rhodora Canadensis*, and *Platanthera fimbriata*, have no recorded Upper Canadian stations; and *Corydalis glauca*, *Viola Selkirkii*, *Claytonia Caroliniana*, *Betula alba* var. *populifolia*, with others, have but a limited range in the triangular section of country between the rivers Ottawa and St. Lawrence. As to those eastern species which are common to Lower Canada and the Lake Superior country, in addition to *Allium Schœnoprasum* and *Botrychium Lunaria* already noted, it will not be necessary here to refer to more examples than *Anemone parviflora*, *Draba arabisans*, *Potentilla tridentata*, *P. fruticosa*, *Gentiana saponaria* var. *linearis*, and *Pinus Banksiana*.

I shall not at present farther illustrate these two floras, but hope to recur to the subject on some future occasion, and to be able to give fuller and more definite details.

IV. Maritime Type.

Dr. Gray, in the American Journal of Sciences, has enumerated sixty species of maritime plants inhabiting the American coast between Maine and Virginia. Our maritime district, in addition to being situated far up on the Atlantic coast-line, is of very limited latitudinal extent, and yet I have evidence of the occurrence there of twenty-eight shore species. This number includes *Sabbatia gracilis*, which is a Canadian plant according to Kalm, and *S. stellaris*, the occurrence of which within our limits rests upon the authority of Wood. The sea-lavender (*Statice Limonium*), judging by the range assigned it by Dr. Gray, is to be looked for upon the gulf-coast. It is a native of Newfoundland. *Aster Radula*, a coast form, which, in the United States, ranges from Delaware to Maine, is found in Anticosti and Newfoundland. Though resembling the sea-shore species in its preference for the coast, it does not appear to be a strictly maritime form. It is not included in Dr. Gray's list.

The small catalogue here given embraces every species known to me to occur on the gulf-coast between the Bay of Chaleurs and Labrador.

Ranunculus Cymbalaria.
Cakile Americana.
Hudsonia tomentosa.
Honkenya peploides.
Spergularia rubra,
var. marina.
Hibiscus moscheutos.
Lathyrus maritimus.
Ligusticum Scoticum.
Archangelica peregrina.
Solidago sempervirens.
Plantago maritima,
var. juncoides.
Armeria vulgaris.
Glaux maritima.
Mertensia maritima.
Sabbatia gracilis.
S. stellaris.
Atriplex hastata.
Salicornia herbacea.
Chenopodina maritima.
Salsola Kali.
Acnida cannabina.
Euphorbia polygonifolia.
Triglochin palustre.
T. maritimum.
Juncus bulbosus.
Calamagrostis arenaria.
Spartina polystachya.
Brizopyrum spicatum.

In connection with this subject, it may not be inappropriate here to notice the peculiar occurrence of maritime species in the interior of Canada, and of New York and other States. They are found as well upon the coasts of Lakes Superior and Huron, as near the margins of Lakes Erie, Ontario, and Champlain. Mr. J. E. Cabot, the author of the narrative of the expedition in Agassiz's Lake Superior, thus adverts to the eastern side of the lake: " The resemblance to the sea-shore often recurred to my mind. According to Dr. Leconte, several insects found here are identical with species belonging to the sea-shore, and others corresponding or similar. The beach-pea (*Lathyrus maritimus*), and *Polygonum maritimum*, both of them sea-shore plants, are abundant in this neighborhood; the former, indeed, throughout the north shore of the lake." In addition to these two species, six truly sea-shore species have been observed in the immediate vicinity of the same lake.

The neighborhood of the large lakes is not, in every instance, the place of growth of these maritime plants, for at the salt-springs of Salina in New York State, according to Torrey, Gray, and other authorities, there have been found *Ranunculus Cymbalaria*, *Hibiscus moscheutos*, *Salicornia herbacea*, *Triglochin maritimum*, *T. palustre*, and *Scirpus maritimus*.

From various sources, I have ascertained that the following species occur along the Great Lakes, or near salt-springs in New York.

Ranunculus Cymbalaria.	Euphorbia polygonifolia.
Hudsonia ericoides.	Polygonum maritimum.
H. tomentosa.	Rumex maritimus.
Cakile Americana.	Triglochin maritimum.
Hibiscus moscheutos.	T. palustre.
Lathyrus maritimus.	Scirpus maritimus.
Atriplex hastata.	Calamagrostis arenaria.
Salicornia herbacea.	Hordeum jubatum.

The occurrence of these maritime species in localities now so far distant from their natural homes appears to point to a time when a very considerable portion of the province was covered by the ocean; when the ocean limits were much farther inland than they are now, and sea-shore vegetation, as a consequence, occupied a different location from that which it at present retains. The most recent period during which such a change in the aspect of our province took place, was at the time when the marine clays of the Ottawa valley were deposited. There is evidence derived from vegetable remains in these clays that some of our most common plants had an existence then, and we have thus reason to suppose that present species, including maritime plants, had been created at that time. During this period, the maritime plants, compelled by the gradual depression of the land and the consequent inroads of the ocean over what is now eastern Canada, must have migrated to localities previously far inland, and towards the lakes. The lakes were then, doubtless, much larger than at present, and it may be that at that time they were united into one vast inland fresh water sea, extending from near the then ocean-coast westward. Means of diffusion was thus afforded, to these sea-shore plants. The presence of extensive bodies of fresh-water would have a moderating effect upon the atmosphere, which would, with the exception of the absence of the saline element, be much the same as that of the sea-coast. That the vicinity of these lakes would form a not altogether unfavorable habitat for a maritime vegetation is shown by the fact, that, as a general rule, the maritime species scattered through Canada at the present time, are only found in such localities. We may then readily imagine that having become settled there, when, after the gradual lapse of time, the waters of the lake retreated to their present limits, these plants would follow, still continuing to retain their positions near the shores, which would thus account for their wide diffusion throughout the country at the present time. We may then regard these peculiarly distributed plants as the relics of a more extended maritime vegetation of the post-tertiary period.

This theory of the causes of the distribution of sea-shore plants over Canada, which I have briefly endeavored to explain, resting as it does almost entirely upon a consideration of the past geological conditions of the country, and upon some assumptions not yet fully sustained by facts, may be open to objections. It may be a question whether the facilities for migration to the ancient lakes and for distribution along their shores, were, at that time, so ample as I have supposed. Still it is conceived that the peculiar diffusion of these species must have originated in some such way as that conjectured. I cannot think that it is due to mere accident.

V. Alpine Type.

The species enumerated in the list given below to illustrate our alpine and sub-alpine floras have been chiefly obtained from the Mingan Islands, Anticosti, and Gaspé. The Mingan Islands and Anticosti have recently afforded to collectors many very interesting alpine forms,—some hitherto unknown south of Labrador, unless found upon the high alpine tops of the White Mountains. *Draba incana*, *Cochlearia tridactylites*, *Dryas integrifolia*, *Rubus arcticus*, and some other boreal forms detected there, form valuable additions to the Canadian flora. On the Gaspé cliffs, however, the vegetation partakes more of a sub-alpine character. *Solidago thyrsoidea*, *Dryas Drummondii*, *Vaccinium Vitis-Idæa*, and *Saxifraga aizoon* are there, with *Asplenium viride*, a fern until lately unknown on the Atlantic coast south of Greenland. The northern shore of Lake Superior appears also to be sub-alpine.

The north-western parts of Newfoundland near the Straits of Belisle have been recently visited by Mr. Richardson of the Geological Survey of Canada, and in a small collection of plants made by him occur *Lychnis alpina*, *Dryas integrifolia*, *Rubus arcticus*, *Solidago virga-aurea* var. *alpina*, *Diapensia Lapponica*, *Salix reticulata*, and *S. phylicifolia*, all alpine species. *Rubus Chamæmorus*, *Vaccinium uliginosum*, *V. Vitis-Idæa*, *Empetrum nigrum* and two or three other sub-alpine forms, were also obtained by him in the same localities. On the neighboring coast of Labrador the alpine plants collected by the Abbé Ferland were *Silene acaulis*, *Rubus arcticus*, *Sedum Rhodiola*, *Arctostaphylos alpina*, *Diapensia Lapponica*, *Pleurogyne rotata*, and *Salix alpestris*. Anticosti and the north-western part of the island of Newfoundland appear to form the southern limit of alpine vegetation upon the Atlantic coast. Their complete exposure to the effects of the polar current, as well as the rather high latitude occupied by them, must aid in giving their shores an alpine aspect.

In addition to the list of alpine plants, I enumerate a number of species which, judging by their range in Canada, or their limits upon high mountains in the United States, must be regarded as sub-alpine. *Vaccinum cæspitosum*, *Loiseleuria procumbens*, *Castilleia septentrionalis*, and *Phleum alpinum* do not, according to Gray, descend beyond the alpine districts on the mountains of New England, but with us range into the sub-alpine districts around Lake Superior, and the latter two have been likewise observed in Gaspé. *Woodsia alpina* and *Asplenium viride* I also provisionally class as sub-alpine. *Cassiope hypnoides* can hardly be even regarded as sub-alpine, if Professor Bell's locality on the south side of La Cloche Island in Lake Huron be correct.

1. Alpine species.

Thalictrum alpinum.
Ranunculus affinis.
Draba incana.
Erysimum lanceolatum.
Vesicaria arctica.
Sedum Rhodiola.
Saxifraga stellaris.
S. nivalis.
Nabalus nanus.
Antennaria Carpathica.

Cochlearia tridactylites.
Thlaspi montanum.
Viola palustris.
Parnassia parviflora.
Dryas integrifolia.
D. octopetala.
Sibbaldia procumbens.
Rubus arcticus.
Epilobium alpinum,
var. majus.
S. Grœnlandica.
Senecio pseudo-arnica.
Erigeron acre.
Arctostaphylos alpina.
Andromeda tetragona.
Pleurogyne rotata.
Rumex domesticus.
Betula nana.
Salix reticulata,
var. vestita.
S. repens.

2. Sub-Alpine species.

Alsine Grœnlandica.
Hedysarum boreale.
Astragalus secundus.
Dryas Drummondii.
Rubus Chamæmorus.
Solidago thyrsoidea.
S. virga-aurea.
Arnica mollis.
Vaccinum uliginosum.
V. Vitis-Idæa.
V. cæspitosum.
Castilleia septentrionalis.
Euphrasia officinalis.
Polygonum viviparum.
Empetrum nigrum.
Tofieldia palustris.
Scirpus cæspitosus.
Poa alpina.
Phleum alpinum.
Woodsia alpina.
Asplenium viride.
Lycopodium Selago.

Of the alpine species enumerated, only eight are natives of the United States; but in the sub-alpine list there are only six,—*Astragalus secundus, Dryas Drummondii, Tofieldia palustris, Poa alpina, Woodsia alpina,* and *Asplenium viride,* which are not likewise indigenous to the Northern States. *Tofieldia palustris* is omitted from Dr. Gray's Manual, apparently under the mistaken impression that Isle Royale on which it has been observed does not form a part of the Union. The island belongs to Minnesota, and does therefore strictly come within the limits of the work.

London, C. W., Oct., 1864.

THE GEOLOGY OF THE OTTAWA VALLEY.

By Jas. A. Grant, M.D., F.R.C.S.E., F.G.S.

The channel of the river Ottawa, in this immediate neighborhood, is wholly excavated in the Trenton limestone, which, to a considerable extent, can be seen on both sides; it also constitutes the projecting points of rock seen from the Suspension Bridge, as well as the small island immediately beneath,—upon which island it has been proposed to erect a monument to the Prince of Wales.

The range of hills seen running along the north shore of the St. Lawrence from its mouth to Quebec, and onward in a westerly direction, along the north side of the Ottawa River, is looked upon as being at one time the shore of an ancient ocean. A view from the summit of one of these hills in a direction south, exhibits a great tract of level country, low lying, and considered as the wide, flat valley of an ancient ocean, whose waters, long since removed, have left behind, in remembrance of their existence, the great beds of Silurian rocks, abounding in fossilized remains of the various organisms which flourished during that interesting epoch. Of the strata entering into the formations of this section, the lowest rock is the Potsdam Sandstone, excepting the Metamorphic Rocks, which, although stratified, may be distinguished by a more or less granitic, and crystalline aspect, and are of older date. The greater number of the boulders scattered so profusely over the entire face of the country, are gneiss in one of two forms,—as either the micaceous or ordinary gneiss, or hornblendic gneiss. The former consists of quartz, feldspar, and mica; the latter, of quartz, feldspar, and hornblende. Gneiss is generally known from granite by its striped or banded character.

Potsdam Sandstone is a term given by the New York geologists to a formation which is well developed at Potsdam, in northern New York, and is there considered as forming the base of the palæozoic series of rocks. Sir William Logan considers this formation as a member of the Potsdam Group. It crosses from St. Lawrence County, New York, into Canada; the greatest development on this side being at the County of Beauharnois. It is said to fill up the inequalities of the underlying Laurentian series. This formation is met with to the eastward, between Lake Chaudière and a spur of Laurentian rocks, from three to five miles removed from the right bank of the Lac des Chats, to Nepean, a distance of fully thirty miles. In Nepean the rock dips northward, and thus sinks beneath the calciferous formation. By means of a dislocation, the south side of the band, after leaving the gneiss, is brought against the Chazy and Trenton formations. The continuation of the dislocation on the south side of the Laurentian spur, accounts for the absence of Potsdam sandstone in that particular position. In the "Geology of Canada" it is here stated as constituting the south side of a synclinal form, on the north side of which it rises in Hull, from beneath the higher members of the Lower Silurian series. In Hull it is observed about five miles north of the Ottawa, and about two miles east of the Gatineau, where it is also brought into view by a dislocation which branches in Osgoode and Gloucester, from the one previously mentioned, and, passing in a direction somewhat west of north, crosses the Ottawa at the Little Chaudière Falls, and shows a downward throw on the east side. According to Professor Dana, during the first half of the Lower Silurian era, the whole east and west were alike in being covered with the sea, and that in the first or Potsdam period, this continent was just beneath or at the surface. Afterwards, in the Trenton period, the depth became greater, and afforded pure waters for the very abundant marine life.

CALCIFEROUS SAND-ROCK succeeds Potsdam sandstone, and the characteristic portion of this formation, in Canada, is a granular magnesian limestone or dolomite, of a dark bluish-gray color, crystalline, strongly coherent, weathering yellowish brown, and frequently containing small geodes, filled either with calcareous spar, quartz crystals, sulphate of barytes, sulphate of strontia, or sulphate of lime. Its fossils are very imperfect, and in most cases only moulds of these are to be found. In some places the upper part of this formation is of a bluish-gray calcareous argilite. When exposed to the air, it turns yellow or brown, and frequently develops a bituminous odor. The calcareous beds in many districts yield a poor description of lime, and hence the term bastard limestones is applied to them by settlers and others. Calciferous Sandrock forms part of the great series of strata called the Quebec Group. It is seen along the south shore of the Ottawa in many localities from Carillon to the Chats. At Aylmer it occurs on both sides of the river, and from the Alumette Island extends south to Prescott, at which point it crosses the St. Lawrence into the United States. A little below Prescott, on the spot where the battle of the Windmill was fought, gentle undulations are to be observed in the strata of this formation, but more particularly on descending the river from Maitland to this point. According to Sir W. Logan, the total thickness of this formation is about 300 feet.

CHAZY LIMESTONE overlies the Calciferous formation, and derives its name from Chazy, in the State of New York, west of

Lake Champlain, where it was first described by the New York geologists. In Canada it is associated with sandstones and shale, and is here described as Chazy formation. It is exposed in the cutting of the Grenville canal, and there crosses the Ottawa to Hawkesbury. In its geographical distribution, it forms a zone around the geological depression between the Ottawa and the St. Lawrence. It forms two patches on the calciferous outlier of the Lac des Chats, also of the lowest outlier of the Alumette Islands. The arenaceous part of the Chazy is seen at Aylmer, in Hull, and in the eleventh range of Eardley, on the north side of the Ottawa. It is also found in the Townships of Huntly and Ramsay. The great mass of limestone which overlies the Chazy formation is divided into three portions by the New York geologists. The divisions are supposed to have been characterised by peculiar fossils. However, in Canada, a separation of this kind cannot be definitely carried out, owing to the circumstance that the Birdseye and Black River formations become very indistinct; they are, in consequence, grouped together. Not only are the strata blended together, but also the fossils characteristic of the one are found in the other; thus the difficulty of division. According to Sir W. Logan, the Birdseye, Black River, and Trenton formations constitute one of the most persistent and conspicuously marked series of the strata of the Lower Silurian period of North America.

The limestone of the Trenton group is found extensively in Canada East and West, and particularly between the Ottawa and the St. Lawrence, but more especially around the capital of Canada,—Ottawa. The limestones of this locality are affected by two parallel dislocations between five hundred and six hundred yards apart, west of the Rideau. "One of these dislocations comes to the Ottawa a little below the exit of the canal, in a small upthrow to the south; and the other about six hundred yards above it, beyond the Barrack Hill, is a downthrow of seventy feet in the same direction." Farther west this series of limestones come up against the Gloucester and Hull fault, extending from the west side of the junction gore of Gloucester across the Ottawa to the front of the sixth lot of the fifth range of Hull. Owing to these various faults it has been found difficult for the Geological Survey to estimate the thickness of the series in this neighborhood. It is, however, computed that the total volume of the limestones of this locality will not fall short of six hundred feet.

Utica Slate (so termed from Utica in the State of New York).—It comprises a series of dark-brown, bituminous shales, interstratified here and there with a few beds of dark limestone. It is found in considerable quantity near this city, and is seen cropping out directly across the Rideau Bridge, near the General Protestant Hospital. In the Townships of Collingwood and Whitby this shale is sufficiently bituminous to produce mineral oil in considerable quantity.

THE DRIFT OR BOULDER FORMATION, of which we have ample evidence in this locality, comes under the Post-pliocene or Post-tertiary period. The clay, sand, and gravel of the valleys of the Ottawa and St. Lawrence, containing sea-shells or the skeletons of marine fish, are also referred to it. Owing to the manner in which drift is supposed to have been formed (that is, transported by ancient glaciers), it is termed Glacial Drift. "The greatest development and extension of these glaciers is said to have been during the interval between the close of the Cainozoic period and the commencement of the existing epoch, properly so called." It forms the surface of country over a great part of the triangular area included by the St. Lawrence and Ottawa rivers. Stratified clays and sand fill up depressions of great extent over this surface, and erratic boulders of great size are to be observed, in localities the most unexpected. A granitic boulder of considerable magnitude is to be seen just above, and to the right of the Suspension Bridge, on the table of rock lying below; and one on the island immediately above the Chaudière Falls, of much greater size. Dana states that nothing but moving ice could have transported the drift, with its immense boulders. In the glacial regions of the Alps, ice is performing this work at present. In that locality there are evidences of stones of great size, which have, in former times, been borne, by a slow moving glacier from the vicinity of Mont Blanc across the low lands of Switzerland to the slopes of the Jura Mountains, and left there, a height of 2,203 feet above the present level of Lake Geneva. The channel of the Ottawa River is contracted at various parts by ridges of glacial drift, of boulders running north and south. The nearest of these is to be seen above the mouth of Green's Creek, between seven and eight miles below this city. In this locality a well-marked line of boulders runs quite across the river, and forms a considerable obstruction to navigation during low water, such as we have had this season particularly. Professor Dawson divides the eastern post-glacial beds into two series, the lower a deep-sea deposit, named the Leda Clay, from one of its characteristic shells; and the upper, for a similar reason, the Saxicava sand, formed in shallow waters. On the south bank of the Ottawa River, from this city to Hawkesbury, the lower clay formation of Dr. Dawson is to be seen in banks from twenty to forty feet high. "The overlying sand generally approaches the river and conceals the clay except along the streams." Wherever these clay formations exist along the river the shells *Saxicava rugosa* and *Tellina Grænlandica* are to be found, and in a bed of clay at Green's Creek nodular masses exist in considerable abundance. The most common fossil embedded in these, is the *Mallotus villosus* or capeling of the Lower St. Lawrence. This capeling is also found in nodules, in clay, on the Chaudière Lake, 183 feet; on the Madawaska at 206 feet; and at Fort Coulonge Lake, at 365 feet above the sea. This formation contains also various other fossils. On the north side of the Ottawa, from Hull to Isle Jesus, this clay formation covers a considerable breadth between the Laurentian Hills and the river. It can also be traced in considerable abundance along the banks of the Gatineau and river Rouge. In the former locality it is well known to the lumberers, who in wet weather describe it as the sticking clay of the Gatineau. A well-defined hill of clay exists on the front and to the left of the General Protestant Hospital, facing the Rideau River, and to the rear an extensive mound of sand, both of which are drift formations. The boulder formation or glacial drift, both in the British Isles and North America, is referred by Lyell to the age of the newer pliocene, of which it marks its close; while the stratified deposits which overlie it, consisting partly of boulder formation re-arranged by water, are placed among post-tertiary strata. The records of the drift or boulder period extend over North America, north of parallel 40°, as well as over all the northern countries of Europe, and the various boulders have been moved from the north towards the south. Throughout the regions occupied by the drift, the rocks in place are more or less polished, striated, or grooved. These marks are observed on the consolidated formations that appear at the surface, and constitute a very essential part of the records of this period.

Rock Basins or Pot-holes.—These are everywhere common along rapid brooks and rivers. They are most frequently seen on elevated ground, and present all the appearances of those formed at water-falls by the gyration of the pebbles. Professor Emmons gives an example of one, as seen at Antwerp, St. Lawrence County,

N. Y. He states that it is at least one hundred feet above the Oswegatchie, three-fourths of a mile distant, with an intervening hill higher by some fifty feet than this remarkable pot-hole, which is from twenty-four to thirty feet deep, and from twelve to fourteen feet in diameter, bearing the usual marks on the interior of water-worn surfaces. Another example of this kind is described in Grafton, New Hampshire, on the crown of a high valley, between the waters of the Connecticut and Merrimack rivers, at an elevation about 2000 feet above them, and a smaller one eight or ten feet higher. The celebrated basin at Franconia Notch is one of these wells, forty feet in diameter, and twenty-eight feet deep. It is filled to the depth of eight or ten feet with pure water, which revolves with such force that it is considered a dangerous place for even an expert swimmer. These basins have also been noticed in the granites of high and exposed regions of Devonshire, England, varying from one to several feet in depth, and from a few inches to several feet in diameter. At one time superstition ascribed the excavation of these basins or pot-holes, in that locality, to the Druids; but no person now doubts their true origin, as the results of decomposition and attrition on the softer portions of the granite. Pot-holes in process of formation are described in Chambers's Gazetteer, vol. i, p. 188, as seen in the course of the river Devon. Throughout various parts of Canada these pot-holes have been noticed, viz: At French River they occur at considerable distance above the river level, and range from one to three and a half or four feet in depth, and from twelve to eighteen inches in diameter. At the High Falls, on the River du Moine, several pot-holes are to be seen in the gneiss rocks. Very peculiar formations of this description are to be seen at the Roché Capetaine Rapids, on the Ottawa River, at an elevation of fifty to sixty feet above the present river level. Several small ones are met with at and above the High Falls of Dartmouth River, which enters into the north-west arm of Gaspé Bay; also on York River, which enters the south-west arm of Gaspé Bay; also seen in the black shale in the bed of the Black River, lots 16th and 17th, fifth range of Acton, in the Eastern Townships.* Those who take an interest in such formations, need not proceed beyond the limits of Ottawa City in order either to gratify curiosity or satiate a thirst for knowledge in this respect. Numerous small formations are seen in the surface-rock on the roadside towards the Little Chaudière Falls;

* Report of the Geological Survey.

also on the Le Breton Flat, in which locality they possess no small degree of interest, and have called forth considerable remark, owing to several of them appearing as natural wells. Of these, the one most recently discovered is in the foundation just excavated by Mr. Richards, Chaudière, near the residence of the Hon. James Skead. It was exposed after the removal of a bed of alluvium, about two feet in thickness, and was filled above for two feet with drift material, containing numerous recent shells; and below, with sand, pebbles and boulders of various sizes. These being all removed, the dimensions were shown to be in diameter three feet, and in depth thirteen feet. At present this pot-hole is filled with pure water, of excellent quality. Within the last few weeks several hundreds have visited this interesting locality, and a few have taken away a portion of the water, from a belief that it possessed medicinal properties, but in my opinion its properties are equal to those of any other well in that locality, but not superior. A pot-hole in the floom of Mr. Perley's mills, is ten feet in diameter, and fifteen to twenty feet deep.—*Extracted from a lecture on the Geological Structure of the Ottawa, read before the Ottawa Natural History Society.*

ON PEAT AND ITS USES.

By T. S. Hunt, A.M., F.R.S.

The peat deposits of Canada have been made the subject of repeated notice in successive Annual Reports of the Geological Survey, and are at length attracting the attention of practical men. A few years since attempts were made by Mr. C. M. Tate to work the peat of Chambly, which were partially successful; and more recently we learn that Mr. Hodges, having purchased a large area of peat-bog in Bulstrode, on or near the line of the Arthabaska railway, has imported machinery of the most approved construction, for the purpose of compressing the peat for fuel. We think therefore that the following pages extracted from "Geology of Canada" published in 1863, will not be without interest to our readers, as describing both the principal applications of peat, and some of its localities in Canada.

Great deposits of peat are met with in various parts of Eastern Canada, which seems to present conditions of soil and climate peculiarly favorable to its growth and accumulation. The peat-bogs, so far as known, are chiefly confined to the plains along the St. Lawrence and its tributaries, and appear to have been formed in shallow lakes, which have been gradually filled up by a vegetable growth. The peat often rests upon a layer of shell-marl, which at one time formed the bottom of the lake. The vegetation consists, for the most part, of mosses belonging to the genus *Sphagnum.* Besides these, however, the bogs often support a growth of tamarack (*Larix Americana*), and of various ericaceous plants, belonging chiefly to the genera *Cassandra*, *Andromeda*, *Kalmia*, and *Ledum.* The leaves, roots, and stems of these help, with the moss, to make up the peat. The peat near the surface of the bog, consists of the moss but little altered, and is very soft and porous; but in the older and deeper portions of the deposit it is more dense and darker in color; the vegetable tissue having undergone a partial decay, by which its fibrous structure, to a great or less degree, disappears, and the peat becomes earthy in its texture.

These different forms of peat present very great variations in their specific gravity. That from the surface of the Bog of Allen, in Ireland, according to Sir Robert Kane, has a density of 0.335, or only one third that of water; while the blackish-brown earthy peat, from a lower layer in the same bog, is from 0.639 to 0.672, or double that of the surface. A peat which is dug near Tavistock in Devonshire, has a density of 0.850. Similar differences will be found in the peat-bogs of Canada. A specimen of peat from Sherrington, described on page 642, is still more dense than any of these, being so heavy as to sink in water; while at the same time it only contains 3.5 per cent. of ash. One of the great obstacles to the use of peat is the large amount of water which it holds, and the obstinacy with which it retains this water. The average results of a great number of experiments made in the Irish bogs, show that the general mass of the undrained peat, including both the lighter and denser varieties, contains from 92 to 95 per cent of water; while the edges of the bog, and parts more or less drained, in the state in which peat is generally cut, contain from 88 to 91 per cent. The turf, as used in that country, often holds from 20 to 35 per cent of water; while that which has been stacked from six to twelve months, still retains from 18 to 20 per cent, and that which has been kept in a dry house for two years, from 10 to 15 per cent of water. The above details, and many of those which follow, are taken, in part, from Sir Robert Kane's work on "The Industrial Resources of Ireland," and a subsequent report by him on the working of peat; and also in part from a recent paper by Mr. C. Hodgson, read before the Institution of Civil Engineers of Ireland.

From this, it will be seen that in cutting out and removing the peat from the bog, it becomes necessary to transport about nine tons of water for each ton of real fuel. So long as a turf-cutter works along the edge of the bog, or of one of the main drains, he can spread the material as he cuts it; but when large quantities are wanted, additional laborers are required to carry the peat, with its great weight of contained water, to a proper place for spreading and drying. From the slowness of this process of air- and sun-drying, moreover, a given district can only produce a small amount of dried peat annually. The consequence is, that, although peat prepared in the ordinary way is a cheap domestic fuel, and is sold at a moderate price, it is found that as soon as the consumption increases in a district, the price increases, and that it is impossible to augment the supply beyond a certain limit. The Irish Peat Company, who a few years since constructed works near Athy, for distilling peat at the rate of fifty tons daily, had counted upon obtaining this supply at from 2s. 6d. to 3s. the ton; but it was found that before they had secured the quantity necessary for carrying on their works successfully, the price of peat increased to 5s., and ultimately to 6s. 6d., and 7s., sterling the ton. This increase, together, as we are told, with the impossibility of obtaining, at any reasonable price, a much larger supply, were among the causes of the failure of the enterprise.

It is obvious, then, that in order to extend the use of peat, either as a combustible, or as a material for distillation, it becomes necessary to introduce great improvements into its manufacture, which will make it possible to free it as rapidly and as completely as possible from the water which it contains. It is also desirable to reduce its volume, for the convenience of transportation; and to give it a solidity and tenacity approaching to coal, which will allow it to be used in ordinary grates and furnaces, and to bear a strong blast. For this purpose, many plans have been proposed, and numerous patents obtained within the last twenty-five years. One of the most satisfactory processes is said to be that now pursued at Ekman's iron works in Sweden, which is similar to that patented by Linning in 1837. According to his specifications, the peat is first ground to a homogeneous mass in a pug mill, similar to that used by brick-makers, but with longer and sharper knives, placed obliquely. The pulp thus obtained is moulded into convenient shapes, and consolidated by a hydraulic or other press; after which the blocks are dried by artificial heat. The use of hydraulic pressure was several years since tried on an extensive scale, by Mr. C. M. Williams at Cappogue in Ireland. He, having broken up the peat, placed it in layers between cloths, and subjected it to a powerful hydraulic press. By this means, he succeeded in reducing it to one half its original weight, and to one third its volume. The remaining water was, however, difficult to be expelled from the consolidated peat; and the more fibrous varieties expanded a good deal in drying. This experiment was lately repeated, on a considerable scale, by the Irish Peat Company; and with similar results. They also built large drying-houses, in which attempts were made to dry ordinary peat by artificial heat; but the quantity of fuel required to expel the great amount of water from the peat, was found to be so considerable that the process was not economical.

A different plan was some years since proposed for overcoming certain of the difficulties of the problem; which was, after drying peat in the ordinary manner, to pulverize it by passing it through rollers, then to drive off the remaining water by heat, and consolidate the dry powder by powerful pressure. This process is followed at Rosenheim, in southern Bavaria, where the peat is made into small blocks of eight or ten ounces, and weighing from seventy to eighty pounds to a cubic foot. The latter weight corresponds to a specific gravity of 1.25, which is nearly that of bituminous coal. (Percy's Metallurgy, vol. i, p. 78.) Several patents, based upon this plan of dry compression, have been within the last few years obtained in England; but practical difficulties were met with in the machinery for compression; besides which, as Mr. Hodgson has well remarked, the great problem of obtaining a cheap and abundant supply of dried and powdered peat still remained. This however, according to him, is in great measure resolved by a simple expedient. By passing a very light harrow over the surface of the bog, a thin layer is broken up. After a few hours of exposure to the air, for draining and partial drying, it is removed by scraping; and in this way a powdered peat, far drier than the general mass, may be obtained every day when it does not rain. The material thus collected costs five pence the ton, and contains, on an average, forty-five per cent of solid matter; while recently-cut peat contains only ten per cent. It is heaped in embankments, where it is found not to absorb water, and is dried by being spread out over iron plates warmed by the waste steam from the compressing engine. In this way, according to Mr. Hodgson, the peat standing in the bog in the morning may be harrowed and scraped, brought in, dried, compressed, and converted into an excellent fuel before night. He employs for its compression, an engine patented by himself; which he describes as a horizontal reciprocating ram, working in a cylinder five feet long, with a uniform bore. The powdered peat falls into this as the ram draws back at each stroke, and, soon filling the whole length, considerable friction takes place against the sides of the tube. This becomes so great that as each charge falls in, it is completely consolidated between the advancing ram and the column of peat in the tube, before the frictional resistance of the column is overcome, and the whole mass moves on; so that the blocks formed at the one end are successively discharged at the other, at the rate of sixty a minute; making in an hour about fifteen hundred-weight of compressed peat, equal in density to coal. This apparatus is now in operation at Derrylea, near Monasterevan; and it is said by the inventor to leave no doubt of the practicability of producing dry compressed peat on a large scale, and with profit.

Peat is not only an economical fuel for domestic use, but is in many countries employed for generating steam, and for the manufacture of iron. For the latter purpose, it is used in Sweden, France, and in many parts of Germany, where the supplies of mineral coal are not abundant. It is particularly well fitted for producing steam, and compressed peat has now for several years been used in locomotive engines in Bavaria; but we are told that before this application was successful, many difficulties had to be surmounted. Several years ago, according to Sir Robert Kane, it was in general use upon the steamers on the river Shannon in Ireland.

In a paper communicated to the Society of Arts in London in November, 1862, Dr. B. H. Paul—whose experiments on the distillation of peat are described further on—has given some interesting conclusions as to the relative value of peat and coal as fuel. According to him, while the calorific or heat-giving power of carbon is represented as 1000, that of the various mineral coals is equal to from 903 to 906; while that of perfectly dried peat, as deduced from its average composition, will be 660. But as ordinary air-dried peat contains about one fourth its weight of water, its calorific power is reduced to 495, or about one-half that of the same weight of coal. The average weight of a cubic foot of solid coal is about eighty pounds, while air-dried peat has a density corresponding to only sixty-four pounds. A cubic foot of broken coal, however, contains about sixty pounds, while the same volume of ordinary peat weighs only about thirty pounds; "so that with but half the calorific power, it takes twice the space; and thus to produce a given effect with air-dried peat, it would require twice the weight, and four times the bulk, of the coal necessary to produce the same effect." This calculation as to bulk of course refers to uncompressed peat; if reduced to the density of coal, as claimed by Mr. Hodgson's process, its volume is of course diminished one half. From his own experience in Lewes, Dr. Paul found that on the moors, where peat was to be had for two shillings the ton, it could be economically used for generating steam, and for burning bricks; while at Stornaway, near by, where the cost of the peat, delivered, was six or seven shillings, coal, which was eighteen shillings the ton, was found more advantageous. He concludes that peat cannot be economically transported to any considerable distance; but that wherever a peat having a fuel-value one half that of coal, can be delivered at the place of consumption at a cost of four shillings sterling the ton, it may advantageously replace coal, where this, under the same circumstances, costs more than ten shillings; but if the price of coal is ten shillings or less, there would be a disadvantage in the use of peat. During four years Dr. Paul used it as the only fuel under stationary steam-boilers, and found it to answer admirably; and he states that Mr. James Napier of Glasgow, having tried it upon a steamer, is of opinion that it might be used in place of coal. This, of course, applies to short voyages, and to conditions where space is not a great consideration. It is a question for Lower Canada whether properly dried peat can be furnished at a price per ton less than two fifths that of coal; in which case, it might perhaps be advantageously employed in our inland navigation.

Large quantities of peat-charcoal are manufactured in France, and in Germany. For this purpose, either ordinary stacks, or cylindrical kilns built of brick, are employed. A current of steam heated to 450° or 460° F. has likewise been employed for the purpose; and the compressed peat has also been distilled in iron retorts, like those used for making coal gas; by which means volatile oils and combustible gas are obtained besides the charcoal.

Good air-dried peat, in stacks or in kilns, yields from thirty to forty per cent of its bulk, and from twenty-five to thirty-five per cent of its weight of charcoal; much of course depending on the amount of ash which the peat contains. Large quantities of peat and of peat-charcoal are prepared for the market of Paris; where the latter fuel is largely used for domestic purposes. About fifty miles from Paris, near Liancourt, on the Northern Railway, is a large bog, from which, in 1855, 10,000 or 12,000 tons of peat were obtained. The peat from the whole thickness of the bog, about ten feet, was transferred to flat-boats, trampled, and turned over with shovels, and finally moulded by pressure into small bricks, which when dried are heavier than water. These were charred on the spot, and yielded about forty per cent of charcoal, which gave 27·0 per cent. of ash; the dried peat itself yielding 10·0 or 11·0 per cent. The wholesale price of this compressed peat in Paris was, at that time, $3·75 the ton of 2200 pounds, while the charcoal made from it was $18.00 the ton; its retail price being about $24.00. Its combustion is slower than wood-charcoal, which was sold at about the same price; while both mineral coal and firewood were retailed at from $7.50 to $9.50 the ton weight. These figures will aid in obtaining a notion of the comparative value of the various kinds of fuel.

The object proposed by the Irish Peat Company, as already mentioned, was the distillation of peat; by which it is made to yield a tar, from which are extracted illuminating and lubricating oils, and paraffine; besides ammonia, acetic acid, and pyroxylic spirit, which are dissolved in the watery products of the distillation. A large amount of combustible gas is also disengaged, which may be employed as a source of heat in various operations, such as distilling, burning bricks, and lime. By distilling the dried peat in retorts, a considerable amount of tar is obtained, besides a residue of coke or charcoal, which, however, is not sufficient to heat the retorts, so that there would be a further expenditure for fuel. It was therefore desirable to devise some more simple and economical way of conducting the distillation, and the works of the Company at Athy were built in accordance with the system patented by Mr. Rees Reece in 1849. This consists in burning the air-dried peat by means of a blast, in cylindrical furnaces of brick, shaped somewhat like iron blast-furnaces, but closed at the top, and furnished with pipes for carrying off the volatile products to a proper condensing apparatus. The furnaces being filled with peat, and closed, are lighted from below, and the blast applied. The heat from the combustion of the peat in the lower part of the furnace serves to distil the upper layers; while the gases from the combustion, together with the volatile products of the distillation, are carried forward by the blast towards the condensers.

This process was to a certain extent successful; but it was found that when the force of the blast was augmented, in order to obtain a more rapid combustion of the peat, the amount of tar was greatly diminished. Thus, according to Dr. Paul, it was found, by experiments in Antrim, with a furnace three feet in diameter and fifteen feet in height, that when one and a half tons of peat were burned in twenty-four hours, 3·1 per cent of tar were obtained; with two tons in the same time, 1·8 per cent; with three tons, only 0·98; and when nine tons were burned in twenty-four hours, only two pounds of tar were obtained to the ton. According to the experiments of Sullivan, Irish peat, when distilled in retorts, gave from 1·5 to 3·5 per cent, being an average of 2·5 per cent of tar; which furnished from 38·0 to 72·0 per cent of oil, the mean being 52·0 per cent. Of this oil, 5·0 per cent distilled below 212° F.; 20·0 per cent between 260° and 320°; 35·0 per cent between 320° and 550°; and the residue at a still higher temperature. Hence, as an average, 100 tons of Irish peat would yield 682 gallons of tar, and 333 gallons of refined oils. It was found that under favorable conditions, the amount of tar obtained by Mr. Reece's process was very nearly equal to that produced by distilling the same peat in closed retorts.

Dr. Paul has lately undertaken a series of experiments on the distillation of peat on a large scale, at Stornaway in the island of Lewes; the results of which he communicated to the British Association for the Advancement of Science, at Cambridge, in October, 1862. The mountain peat of that region is compact, heavier than water, and is superior for this manufacture to ordinary bog-peat. By distillation in a retort, it gave: tar 9·08, coke 31·50, water 37·88, gas (loss) 21·54; = 100·00. The tar thus obtained was a soft solid at 60° F., it had a specific gravity of ·960, an acid reaction, and gave, by rectification, forty-two per cent of a refined oil, boiling above 300°, besides from thirty to forty-six per cent of more volatile liquids. These, as well as the ammonia, acetic acid, and pyroxylic spirit were neglected by Dr. Paul in his experiments. The refined oil contained about one tenth its weight of paraffine (equal to four per cent of the crude tar). About one half of the oil boiled at a temperature between 330° and 500° F.; it burned without charring the wick, had but little odor, was not explosive at ordinary temperatures, and compared favorably with refined petroleum. The remainder, which boiled between 500° and 600° F., had a specific gravity of ·850, and, when mingled with fat oils, was an excellent lubricator.

In his early attempts to work this peat on a large scale, by distillation in brick furnaces or kilns, Dr. Paul substituted for the blast the draught of a chimney; but in this way he was unable to obtain more than three per cent of tar, instead of the nine per cent which the same peat furnished when distilled in retorts. It was found, moreover, that, on an average, only about fifty tons a week were distilled in each kiln; while in order to give a profitable return it was necessary to work about seventy tons weekly, and to obtain five per cent of tar. His apparatus consisted of cylindrical brick chambers, five feet in diameter and twelve feet high; furnished at the bottom with a fire-grate having an area of two feet, and at the top with a hopper and lid for feeding. Ten of these kilns were built side by side, in a block; and from the top of each, a pipe of twelve inches in diameter led to a main of three feet, and thence, through a condensing apparatus, to a chimney. In order to secure a regular current of air through the apparatus, a draught was finally established by means of a thirty-inch fan, of Schiele's patent, making 1600 revolutions a minute, and driven by an eight-inch steam-engine; which worked at the same time some pumps, and a winding-drum by which the peat was drawn up an incline to the kilns. This fan was capable of passing 2000 cubic feet of gas per minute, and of maintaining a steady powerful draught through seven inches of water, without raising the combustion at the fire-grate of the kiln to a greater extent than was desirable. By this means the vapor was rapidly drawn from the kilns, and was passed several times through water, and also through four chambers filled with bundles of heather. This contrivance was found effectual to separate the tarry matter mechanically suspended and carried over by the current of gas. This, when discharged from the fan, was highly inflammable, and was led by an underground tunnel to a proper furnace; where it burned with a flame from six to ten feet high, six feet long and six inches thick, and was available for generating steam, distilling tar, evaporating liquids, or drying peat. It was found that the whole of the charred peat was not required for the distillation; so that by means of an arched opening fitted with a door just above the fire-grate, a portion of the charcoal could be removed from time to time. By this means, the amount of peat which could be worked was much increased, The removal of the charcoal in this way was however attended with difficulty during the prevalence of high winds.

With these improved arrangements, it was found that the amount of peat distilled was always above seventy tons, and in favorable weather upwards of one hundred tons weekly, for each kiln; while the proportion of tar was raised from 3·9 per cent. to 7·5, and was on average as much as 7·0 per cent. In this way there were obtained in the year 1861–62, from one hundred tons of peat—

749 gallons of oil (with paraffine), at 2s,		£74 18 0
From which is to be deducted—		
For 100 tons of peat, at 2s,	£10 0 0	
" cost of manufacture,	28 14 6	
		38 14 6
Leaving a balance of		£36 3 6

These are given by Dr. Paul as his working results within the last year, and contrast most favorably with those obtained in Ireland, as stated by Mr. Sullivan in his report to the directors of the Irish Peat Company in 1855; according to which, one hundred tons of peat gave—

150 gallons of oil at 2s.,	£15 0 0	
300 pounds of paraffine, at 1s.,	15 0 0	
52 gallons of wood-naphtha,	2 10 0	
3 cwt. of sulphate of ammonia,	1 16 0	
		£34 6 0
From which is to be deducted—		
For 100 tons of peat, at 4s.,	£20 0 0	
" cost of manufacture	14 3 4	
		£34 3 4
Leaving a balance of		£0 2 8

It will be seen that the cost of the Irish bog-peat was, for reasons already mentioned, 4s., instead of 2s., the ton; while its yield was so much less than that of Lewes, that even at an expense of manufacturing which was only half the latter, its distillation appears to have been no longer profitable; although the wood-naphtha, pyroxylic spirit, and the sulphate of ammonia, products neglected by Dr. Paul, were preserved. While some of the advantages of the results obtained at Lewes are to be ascribed to the method pursued, the superior quality of the peat is, according to Dr. Paul, a more important element. The light refined oil from the Lewes peat was sold in 1862 in Glasgow, under the name of lignole; and, according to the report of Dr. Anderson, it compared favorably with the burning oils from coal, shale, and petroleum; being pale in color, and with much less unpleasant odor than the coal oils. The statements of Armand that peat may be made to yield as much as fifteen, or even eighteen per cent of tar, do not appear to be confirmed by other investigators. According to Vohl, who in 1858 published an elaborate investigation into the distillation of lignite, peat, and bituminous schists, the various peats, when distilled in retorts, yield from six to nine per cent. of tar; and in the case of a light peat, 5·37 per cent. In rectifying the tar, the distillation may be carried to dryness when it is wished to obtain the greatest amount of liquid products, as in Dr. Paul's operations. By arresting the process at the proper point, a large proportion of the material remains in the retort, as a kind of pitch; which may be used, like asphalt or solid bitumen, for covering roofs and similar purposes. In this way, according to Vohl, one hundred parts of tar yield forty-two parts of pitch. In order to purify the distilled oil for burning in lamps, it is first treated with a solution of soda, and afterwards with concentrated sulphuric acid, as in the refining of petroleum. The alkaline solution dissolves a considerable amount of creosote and of carbolic acid; which may be afterwards separated by means of an acid, and have a commercial value. The paraffine separates in a crystalline form from the heavier and less volatile oils, when these are exposed to cold. With the present demand for oils and paraffine, it is more profitable to distil the tar to dryness, than to manufacture a portion of it into pitch. The value of a ton of crude tar, capable of yielding one hundred gallons of oil and paraffine, may, according to Dr. Paul, be estimated at £5 sterling; and he concludes that peat approaching in richness to that of the Highlands of Scotland may be distilled with great profit. It remains to be seen whether some of the extensive peat-bogs of Canada may not produce a material equally available. The importance of these deposits as a source of fuel to the country should not, however, be lost sight of; and it is to be hoped that before long successful attempts may be made to introduce compressed peat as a combustible, for the generation of steam and for domestic purposes.

The principal deposits of peat which are as yet known in Canada, will now be noticed. It is to be remarked, that, with the exception of a partial trial made of the peat near Chambly, none of these deposits have ever yet been worked; and that it is only in a few localities that the thickness of the peat has been determined by pits, or by borings. Beginning to the westward, a deposit of peat occurs on the twelfth lot of the fourth and fifth ranges of Sheffield; where it overlies a bed of marl already described, and extends over three or four hundred acres. The average thickness of the peat is about four feet, and it is said to be of superior quality. In the level region between the St. Lawrence and Ottawa rivers, described in "Geology of Canada," page 8, several large peat-bogs occur; but from their nature, the vicinity has been avoided by settlers, and they are therefore difficult of access. There is said to be a considerable area of peat in the rear of the seigniories of Vaudreuil and Rigaud; and also in Caledonia, where its thickness does not appear to exceed three or four feet. Peat occurs at the sources of the Pain River in Roxburgh, Osnabruck, and Finch; and also in Clarence, Cumberland, and Gloucester. In the third, fourth, and fifth ranges of the latter township is a tract known as the Mer Bleue, which consists of two long peat-bogs, separated by a narrow ridge of higher land, and occupying each about 2500 acres. These deposits were sounded in many places, with a rod, to a depth of twenty-one feet, without finding bottom; in other parts, the peat was from eight to fifteen feet in thickness. This tract is situated only three miles from the Ottawa, and is about 280 feet above the level of the sea. Three large areas of peat, of from 1000 to 3000 acres each, occur in Nepean and Goulbourn; one of them to the east, and two to the west, of the village of Richmond. It is also found on the third and eighth ranges of Beckwith, to the east of Mississippi Lake; and an area of about 3000 acres of peat occurs in Westmeath, in the rear of front A, and from the first to the fifth range behind it. In the ninth and tenth ranges of Huntley, there are about 2500 acres of peat; which in some parts has a thickness of eight or ten feet, while in other parts no bottom was found at a depth of fifteen feet. It is probable that peat may be met with in many other localities throughout this region.

On the north side of the Ottawa, three small areas of peat have been observed in Grenville. One of these, on the fourth and fifth lots, covers about thirty-six acres, and has a depth of ten feet. It has been used in the neighborhood, and is pronounced of excellent quality. Another deposit of about the same extent occurs on the first lot of the same range, and is in some parts more than fifteen feet in thickness. A third, of about thirty acres, occurs on the fourth lot of the seventh range. On the fourth and fifth lots of the first range of Harrington, is a bog of about forty acres, the peat of which varies in depth from ten to twenty-five feet. Another bog is described as occurring on the first and second lots of the fifth range of the same township. It extends over about sixty acres, and has a thickness, in some parts, of twenty-five feet. All of these areas might be drained without much difficulty. To the eastward of this, a peat-bog is met with in the Rang Double of Mille-Iles. It exhibits a breadth, on the road from St. Janvier to St. Jerome, of about half a mile, and has an area of perhaps five-eighths of a square mile. Its depth along the road was found to be in several places from two to eighteen feet, the greater depth being towards the south-east side, and its average may be taken at eight feet. A smaller deposit of peat occurs half a mile nearer to St. Janvier ; it has a breadth of about a quarter of a mile, but its superficies and depth have not been ascertained. Upon the same great plain with these, a little to the north of the church of Ste. Anne des Plaines, and on the north-east side of the road leading to New Glasgow, is a peat-bog having an area of about a square mile. Its depth was not determined, but it is supposed to average about five feet. The farmers are in the habit of burning the surface of parts of this bog, and employing the ashes as a manure for the underlying portions, until by repeated burnings they reach the subjacent clay ; which, mingled with the last thin layer of peat and a portion of the ash, constitutes a very fruitful soil.

Near the front of the seigniories of Assumption and St. Sulpice there is a peat-bog three and a half miles in length with an average breadth of half a mile, giving an area of about 1100 acres. Its depth varies from two to fifteen feet ; and the result of ten trials made in two lines across the bog gave an average of ten feet. In the seigniories of Lavaltrie and Lanoraye, there are two extensive peat bogs, running parallel with each other. Of these the northern is the larger, and is known as the Grande Savanne. It has a length about eight miles from north-east to south-west, and a breadth of from half a mile to two miles and a half, covering a superficies of from twelve to fifteen square miles. Two sections were made across this bog; one on the line of the railway between Lanoraye and Industry, which traverses it about three miles from its south-west extremity. It here reaches to within four miles of the St. Lawrence, and has a breadth of two and a half miles. The depth along this line was found to be from four to fourteen feet; the average of twelve trials giving about eleven feet. The other section, along the Lavaltrie road, about four miles to the north-east, gave a breadth of half a mile, and a depth of from seven to fourteen feet; averaging, as before, eleven feet. The smaller of these bogs lies between that just described and the St. Lawrence at a distance from the last of about two miles. On the line of the railway it has a breadth of over half a mile, and an average thickness of about five feet. It has a length of more than five miles, extending four and a half miles to the south-west of the railway, and a superficies of about three square miles.

In the fief St. Etienne, about a mile and three quarters south-west of the Grès, on the St. Maurice River, the main road crosses a peat-bog, which is there half a mile in breadth, with an average depth of about six feet. Its extent to the north-east and south-west has not been ascertained. Another was met within the seigniory of Champlain, about three miles from the St. Lawrence, and on the road from the church to the river Champlain. Its breadth on the road is about three quarters of a mile, and its average depth in this part five feet. Its length from north-east to south-west appears to be about two miles; giving to the bog an area of about a mile and three quarters. In the fief D'Auteuil, on the road between Cap Santé and the village of L'Enfant Jésus, there is a peat-bog, with a breadth of about a quarter of a mile, which has not been farther examined. Several other peat-bogs are known to exist between this last locality and the vicinity of Quebec.

On the south side of the St. Lawrence, there is a large area occupied by peat on the west side of the river Richelieu. It covers portions of the seigniories De Léry and Lacolle, and of the townships of Sherrington and Hemmingford, embracing perhaps fifteen or twenty square miles. This area is drained in part by the Lacolle River. It has not been carefully examined as yet; but it contains in some parts, particularly it is said in Sherrington, a very great thickness of peat. Of two specimens from this township, one, which was dark-colored, fine-grained, compact, and so heavy as to sink in water, gave only 3·53 per cent of ash; while the lighter peat from near the surface of the bog yielded 4·66 per cent of ash. Both of these are very pure; and the compact peat, which is remarkable from its great density and its freedom from earthy matters, is particularly worthy of attention.

A large peat-bog occurs in the seigniory of Longueuil, on the road to Chambly; and an attempt was made a few years since to raise the peat and introduce it to the Montreal market. A peat-bog of large size is found in the seigniory of Ste. Marie de Monnoir; and another in the parish of St. Dominique, including part of Ste. Rosalie and St. Pie. Its dimensions may be five or six miles in one direction, by three or four in another. This extent is covered by a layer of peat; which, from two or three feet at the edges, attains a depth of six feet, and in some parts, it is said, is eighteen feet in thickness. The bog has been partially drained, and portions of the land reclaimed for agricultural purposes. The drained land being first cleared of trees, is ploughed, and then, in the dry season, set on fire. In this way, eight or ten inches of peat are burned, leaving an ash which serves as a manure, and enables the surface to yield one or two crops of barley or oats. After two years, the soil becomes exhausted, and it requires to be again burned over to render it productive. When by several repetitions of the process, the peat has been reduced to a few inches, the remaining portion is mingled, by ploughing, with the underlying clay, and a rich mellow soil is obtained. The peat from this bog yields, when heated in close vessels, about thirty-six per cent of coke, and contains from six to seven per cent of ash.

In the seigniory of the Rivière Ouelle, there is a peat-bog which covers about 4000 acres; and another one occurs in the seigniory of Rivière du Loup, having a superficies of 6000 acres. Its breadth on the Temiscouata road is a mile and a quarter, and its depth in some parts has been ascertained to be eighteen feet. Peat is found in abundance on the first and second concessions of the seigniory of Ile Verte; and from a point two miles below the Rimouski, there is a belt of peat-bog extending nearly all the way to the Métis River, a length of over twenty miles. Its distance from the St. Lawrence is from a quarter to half a mile, and its breadth from a quarter of a mile to a mile. The depth of the deposit, where observed, was from one to six feet. To the east of the Rimouski River, there is a peat-bog, which has a length of three or four miles, in the townships of Duquesne and Macpes; with a breadth of about three quarters of a mile, and a thickness which was found to be from five to twelve feet: it is said to be in one place, thirty feet in depth. Another locality of peat is stated to be in the townships of Matanne and Macnider, between the rivers Blanche and Matanne. A peat-bog of about one hundred acres occurs on the left bank of the Madawaska, just above the twelfth-mile post on the road to the Little Falls.

The most extensive peat deposits in Canada are found on Anticosti. Along the low lands on the south coast of the island, from Heath Point to within eight or nine miles of Southwest Point, a continuous plain covered with peat extends for upwards of eighty miles, with an average breadth of two miles; thus giving a superficies of more than one hundred and sixty square miles. The thickness of the peat, as observed on the coast, was from three to ten feet, and it appears to be of an excellent quality. The height of this plain may be, on an average, fifteen feet above high-water mark, and it could be easily drained and worked. Between Southwest Point and the west end of the island, there are many smaller peat-bogs, varying in superficies from 100 to 1000 acres.

NATURAL HISTORY SOCIETY.

The monthly meeting of the Society was held on Monday evening November 28, and, notwithstanding the unfavorable aspect of the weather, the attendance was large.

Among the donations announced, we notice the following:

To the Museum.

Fœtal monkey from Australia, also an antique spoon, two rings, and a fragment of (human) bone dug up in the fields near Cacouna, from Dr. A. Hall; eighty-two beautifully prepared specimens of Canadian butterflies and moths, from Mr. P. Kutzing; specimen of the spruce partridge (*Tetrao Canadensis*, Linn.), from Mr. Jas. Ferrier, jun.; an American woodcock (*Philohela minor*, Gray), from Mr. More; specimen of the painted bunting (*Plectrophanes pictus*), from the plains of the Saskatchewan, from Mr. G. Barnston; and a pair of fine black squirrels from Upper Canada, from Mr. W. Hunter.

New Members.

Captain Rooke, S. F. G., was elected a corresponding member, and Messrs. H. Abbot, T. F. Hanlon, R. E., and W. S. McFarlane, ordinary members of the Society.

Proceedings.

The Report of the Scientific Curator was first read, as follows:

Report of the Scientific Curator.

Since the annual meeting, the Society's yearly report for the session 1863–64 has been prepared and issued to the members. Under the auspices of the council, a catalogue of the Canadian vertebrata contained in the museum has been prepared and published with the Report, in order that friends at a distance may know what species are desiderata in our collection. Care has been taken to make the list of donations to the museum and library for the past year, full and complete. Efforts have been made to make the list of members accurate and trustworthy; but it is feared some errors may yet remain uncorrected. The co-operation of members is desired in order that such mistakes may be avoided in future.

At the date of my last report (May 18) about 1200 specimens of minerals had been carefully labelled. Since then, the remaining part of the Holmes collection, consisting of about 500 specimens has also been carefully labelled. The mass of confusion in the large case in the aquarium-room has been reduced to something like order, and about 430 specimens of rocks and minerals have been named and exhibited. Many packages, that have remained unopened for years, have been unpacked, and some of the best specimens selected, named, and exhibited. Although upwards of 2000 examples of minerals and rocks have been labelled, about as many more remain without their names affixed. As soon as proper cases can be obtained, it is proposed, first to name all those which are unlabelled, as far as possible, and then to thoroughly re-arrange and classify the whole collection. The rock-specimens we ultimately hope to arrange after the classification adopted by Prof. Dana, in the last edition of his Manual of Geology, and simple minerals after the plan followed in the "Mineralogy" of the same author. It is hoped that when the collection of rocks and minerals is thus arranged, it will be of far more use to the student of geology or of mineralogy than in its present scattered state. Our Post Tertiary, Tertiary, Cretaceous, Oolitic, Liassic, and Carboniferous fossils have been mounted on tablets, classified, and named. Mr. Billings has kindly promised to determine the Silurian and Devonian species. The most important part of the summer's work has been the arrangement of the insect-cabinet. Thanks to the liberality of Messrs. W. Saunders, W. S. M. D'Urban, John B. Goode, P. Kutzing, C. Foley, R. J. Fowler, and James Ferrier, jun., the Society's collection of insects, already somewhat large, has been nearly doubled. Our scattered series have been incorporated into one general collection; they have been arranged provisionally, and named as far as possible. Thirteen drawers (22 inches by 16¾ in diameter) are devoted to Canadian insects, and thirteen to British and exotic species. We have more specimens than one cabinet will hold: it would be desirable, at some future time, to get another similar one, to be devoted exclusively to the reception of British and exotic forms. The old specimens have been washed with a solution of corrosive sublimate in alcohol, as a preservative, and many have been replaced by fresh examples. The Annelida from the Gulf of St. Lawrence have been mounted, named, and classified. The Polyzoa (or Bryozoa), from the same district, have been sent to Dr. Dawson for microscopical investigation. They have just been returned, carefully named; and in a short time it is hoped that they will be available for the use of students.

Several of the exotic birds have been named, but as yet a large number of the species are still undetermined. Through the kindness of several personal friends in New Haven and New York, considerable additions have been made to the collections of mollusca, radiata, and fossils. These have had accordingly to be re-arranged and classified. A series of the most critical species of marine shells from the Gulf of St. Lawrence have been sent to Dr. Stimpson, at Washington; and when they are returned I propose to bring before the Society a paper, in which an attempt will be made to clear up the confused nomenclature of the Canadian marine mollusca. Printed labels have been attached to all the specimens of Canadian reptiles, and the snakes in particular have been carefully studied. J. F. W.

To this succeeded a paper on the Night Heron (*Nyctiardea Gardeni*) by Mr. H. G. Vennor, which was read by the Recording Secretary, in the absence of the author.

Mr. Braun's paper on the Atlantic Telegraph was also read by the Recording Secretary. It gave a somewhat elaborate account of the history of the whole scheme, with reasons for its failure; and concluded by a description of some mechanical appliances, the main object of which appeared to be to keep the cable firmly on the sea-bottom. The peculiar mechanism by which this was proposed to be effected was described, and illustrated by diagrams; which latter may be seen, by any persons interested in the subject, at the Society's Museum.

Specimens of the new cable were kindly lent for the occasion by Mr. H. Lyman; and Dr. Smallwood brought a diagram, taken from a series of soundings, in which the differences of level in the sea-bottom between Valentia and Newfoundland were clearly shown.

An animated discussion took place after the reading of this paper, in which Principal Dawson and others took part.

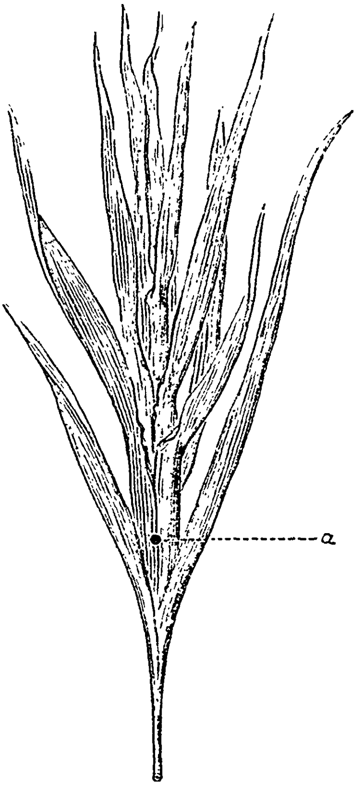
ENTOMOLOGICAL SOCIETY.

ON A GALL-PRODUCING HYMENOPTER, REARED FROM TRITICUM REPENS, LINN.

By Wm. Couper, Quebec.

There is a large extent of cleared land in the neighborhood of Quebec which does not appear to be exhausted for agricultural purposes, and yet it is neglected. The consequence of this neglect is that it becomes occupied by innumerable noxious weeds: one of these is the common creeping wheat-grass, *Triticum repens* of Linnæus. This grass is attacked by a hymenopterous insect which, I suppose, is the yellow-legged or New York barley-fly, *Eurytoma fulvipes* of Fitch. The insect appears in June, when the female deposits an egg in each joint of the grass, producing a gall as represented in the following figure.

This grass is most troublesome to the Canadian farmer owing to its creeping habit. "Its long underground stems penetrate the loose soil in every direction, and, when once they have possession, are very difficult to eradicate, as, broken up by the plough or spade, every fragment vegetates apart, thus renewing and extending the crop. Few plants exhaust the ground so rapidly of nutritive matter, and it can only be got rid of by repeated fallowing or laying down to pasture." If our farmers would appropriate such land to pasture it would help, in a great measure, to remove its present worthless parasite. Although this insect attacks the grass, it by no means lessens its growth; therefore, if we make no effort to check the increase of worthless plants, depend upon it the insects which are attached to them will increase as well, becoming, as in many other cases, a double evil,—for this very *Eurytoma* may some year be produced in such abundance that any of our useful cereals may be destroyed by it. It is different from the barley-straw insect described by Harris in the "New England Farmer," vol. ix, p. 2, as *Eurytoma hordei*. It is larger, and only one insect is found in each gall. As soon as the



Gall of *Triticum repens*.
a, the hole made by the insect by which it escapes.

larva issues from the egg, it places its head downwards in the gall, remaining in that position until it eats its way through. About the end of September it ceases to feed, and prepares to meet a Canadian winter (as far as I have investigated its history, it is able to stand a very low temperature). By this time the gall is hardened, and the larvæ remain in a torpid state, becoming active again in the following spring, changing to the perfect insect in time to attack the young grass of the season. Of thirty-six galls collected early last May, all produced the insect but three, which were empty. I have not detected a parasite on the *Eurytoma* during the advanced stage of the gall; but about the first of August, 1863, when the galls were brought to my notice by Mr. Kirkwood of the Crown Lands Department, I forwarded a few in the green state to Baron Osten Sacken, thinking that they were produced by a cecidomyia. He says, " It is not at all unlikely that *Triticum repens* is infested by a cecidomyia, but in the specimens you sent me I found nothing except a very minute larva of a hymenopterous parasite." Since then I sent more advanced galls, together with the insect, to Mr. Edward Norton, of New York, who is considered good authority on American hymenoptera. He had removed to New Orleans, where my letter found him, and he answers, " that on account of his collection having been left in New York, he was then unable to answer my questions"; however, he forwarded the galls and insects to Baron Osten Sacken for his investigation. The baron writes to me as follows: " The insect is a *Eurytoma*, but whether it is *E. fulvipes* of Fitch, as you suggest, I am unable to tell. This genus is very numerous and apparently very difficult, as the species seem to vary in size, and most of them have nearly the same coloring. I have reared numbers of them from galls, without ever attempting to separate the species."

If it is *E. fulvipes*, then I may safely state that it does not confine itself to a single species of plant, and any of the cereals may be destroyed by it. To bring this insect before Canadian entomologists is the object of this short notice; and I only wish that one of them will find sufficient leisure to investigate its complete history.—*Read before the Quebec Branch*, *Oct. 6th*, 1864.

MEETING OF BRITISH ASSOCIATION.

OBSERVATIONS ON THE SALMONIDÆ.

Dr. J. Davy read the following paper, entitled " Some Observations on the Salmonidæ, chiefly relating to their Generative Functions:"—It is now well known as an established fact that the young of the salmon in its parr-stage, has, in the instance of the male, the testes fully developed, so as to be capable of impregnating the ova of the adult fish. Remarkable and anomalous as this must be admitted to be, it is the more so considering that in the female parr of the same age, the ovaries are merely in their rudimentary state, and are indeed so small that they may readily escape observation, and give rise to the opinion that the parrs are exclusively males. Such a notion, I am informed, is even entertained by the fishermen of the river Tyne. That it is founded in error I need hardly remark. When at Newcastle-on-Tyne, in September last, I had an opportunity of examining, through the kindness of Dr. Charlton, six specimens taken the preceding day. Four of them were males, distended with milt, the milt nearly mature, and, notwithstanding, the fish had not fallen off in condition,—a noteworthy circumstance. Two had no vestiges of testes, nor could I discover their ovaries, which may have been owing to solution, to which the parts of the young fish are especially liable where adjoining to the pyloric appendices. From such observations as I have made when on angling excursions, I can state with confidence that the proportion as to number of the two sexes is much the same. A question naturally arises, is this peculiarity of the early development of the male organs confined to the salmon (*Salmo salar*), or is it to be met with in its congeners of the same stage of growth? The common opinion is that the parr of the sea-trout (*S. trutta*) has the same peculiarity; but I am not aware that the conclusion is founded on precise and reliable observation. The determination of this point is a desideratum. This is not an easy matter to accomplish, owing to the near resemblanne of the parr of the two species. To effect this, a river should be selected which is known to be frequented by the sea- or white-trout, of which there are many in Ireland. The probability, I think, is, that a confirmation of the opinion would then be obtained. I am led to think so from the few observations which I have made. These I shall relate. They were made, or part taken, in Leeven, a river that flows out of Windermere, and is frequented by salmon and sea-trout; the latter being most plentiful. Two parrs taken on the 29th of September were each about four inches long; the milt in each was large; their fins were yellow. From their size and yellow fins they were supposed to be the young of the sea-trout, or "morts," the local designation. Six parrs, taken on the 21st of October, were about six inches in length. Of these four were males; their testes voluminous, their fins light-yellowish. These were supposed to be the young of the salmon. A parr taken on the 1st of January was six and a quarter inches in length; it weighed 740 grains; the testes weighed fifty-five grains; the contents were nearly liquid;

its fins were bright yellowish; it, too, was inferred to be a salmon-parr. I need hardly remark that these few observations justify no more than the probability that the male parr of the sea-trout, like the male parr of the salmon, exercises generative functions. The size of the young fish and the color of the fins can scarcely be relied on as characteristics of species. Be this as it may, it is noteworthy in the history of the male parr, that it discharges its milt before it descends to the sea as a smelt, which is the name the young fish receives when the parr-markings are hid by a new growth of silvery scales. In no instance that I have examined smelts, in their advanced stage, when migrating seaward, have I found their testes otherwise than shrunk. No suspicion is entertained that I am aware of, that the brown-trout of our lakes and rivers (*S. fario*) exhibits the peculiarity in question,—the early development of its testes. The absence of it has, I believe, hitherto been taken for granted, rather than proved. To endeavor to satisfy myself about it, I have examined a certain number of young trout when in that stage of growth, similar to the parr; when about eight months old it may be presumed, about four inches long, and having transverse bar-markings on their skin like those of the parr but fainter, and distinguishable only when wet and during the life of the fish. In none of them have I found the testes more than rudimentary, merely fibre-cords, corresponding in size to the rudimentary state of the ovaries of the females of the same species. I shall pass on now to another point which is not without interest, the time, namely, when the salmon and sea-trout begin to breed. It may be stated, I believe, as an established fact, that the salmon breeds on its first return from the sea, when it is designated a grilse, and commonly weighs from five to seven pounds. That it breeds thus early is a conclusion founded on nature, or nearly nature, ova having been found in the female on entering the fresh water, and the disappearance of these ova when the fish is taken on returning to the sea. Is the breeding-time of the sea-trout analogous; is it, too, on its first migration from the sea sufficiently advanced to propagate its kind? I believe not. From my own observations, and from all the information I have been able to collect, its ovaries on quitting the sea as a "finnick" (the designation applied to it in the north at this period of its growth) are little more than in a rudimentary state; and, further, that they advance very little towards maturity during the sojourn of the fish in river or lake. The following observations, taken from my note-book, are given in evidence, justifying, as it seems to me, the conclusion:—On the 27th of August, fishing in the river that flows out of Morsgael Lake, in the Lews, I took with the fly nineteen sea-trouts, varying in weight from half a pound to two pounds and a half. They were all fresh run from the sea. Many had the sea-louse on them. The larger fish were full of milt and roe, both nearly mature. The smaller had the roe and milt very small, and so not likely to breed that year. The males and females were nearly of the same number. The following year, fishing in the lake just mentioned, and in the same month, viz., August 31st, I took with the fly forty-four sea-trout. Of these, twelve were males, the rest females; of the latter, twenty-two had roe nearly full size. The other ten were much smaller fish; each was about a quarter of a pound, in excellent condition, and yet their ovaries were so very small that they might have escaped detection had they not been carefully sought for. Of the males, all but two had the milt large; these two were also fish of about a quarter of a pound. Their testes had the appearance of fine threads. The "finnick," such as I have seen it in the Lews of the Hebrides, and in the fresh rivers, and lakes of Kerry, Donegal, and Connamara, is the same, I believe, as the whiting of the Eden and the Solway and the smaller sewen of the Welsh rivers. It is a beautiful and bright fish, rarely exceeding half a pound in weight, and is of great delicacy of flavor as an article of food. The color of its muscles is light-pink, very much lighter than that of the muscles of the salmon or of the full grown sea-trout, when in its best condition. The light silvery lustre of its abdominal portion, equally remarkable in the adults when fresh from the sea, fairly entitles it to the name of white-trout, as it is called in Ireland, to distinguish it from the brown-trout. There seems to be as little reason to doubt that they spawn on their second advent from the sea, as that they are not sufficiently advanced to perform that office on their first arrival. Their spawning-time is believed to be earlier than that of the salmon, about three weeks or a month, and is mostly, at least in the Lews, late in September. There is a third question which I beg to propose respecting these fish,—the salmon, the sea-trout, the common trout, and, I may add, the charr. Do they breed yearly or in alternate years? The generally received opinion, I believe, is that their fertility is continuous from year to year. From such observations as I have made, I am disposed to doubt the correctness of this conclusion, and to infer that their breeding takes place rather in alternate years, or at least not in successive years. The facts on which this inference is founded, are, that in the instance of each of the fishes above named, a number of them are met with which have their ovaries and testes so small as to preclude the idea of their spawning during the season, the ova in the one being merely granules, the testes in the other little more than slender cords or threads. As regards the salmon and the charr, it is admitted by experienced fishermen that what they call "barren fish" are taken at the same times as those of the sea-trout and of the common trout. Of the last it is remarkable that in the Rathay, a tributary of Windermere, this fish, even in the spawning-month, and throughout the year, is found in good condition, its testes and ovaries little developed. I have numerous notes to this effect. I shall give only one. "October 25th, of four trout from the river in flood, two were males, two were females; they were beautiful silvery fish; their ovaries and milts very small." The breeding-fish, it may be inferred, at the breeding-season quit the main stream and ascend the smaller ones. The peculiarity of the trout being always in season in this river may be owing to this circumstance, and to another, that it flows out of one lake into another, and is consequently throughout the year nearly of the same temperature, and so favorable to the production of such food as is required to keep the trout in the condition mentioned. I shall give only one note from my note-book relating to the sea-trout. "On the 11th of September, about eighty sea-trout were taken in an estuary of the Lews, in one haul of the net. The largest weighed about four pounds and a half. About one-half of the whole number were called barren fish, their milts and roes being so very small as to preclude the idea of their breeding that season." Now, as it seems improbable that so large a proportion should be really barren, the other conclusion that they were in a fallow state for the season, seems, I cannot but think, most reasonable. To have strict proof, in would be necessary that a special enquiry should be instituted, and that fish should be marked after the manner of those on which observations have been made to determine the rate of growth of the young salmon. The points of difference in nearly allied species, such as the salmonidæ, are an interesting subject for enquiry; they are to be witnessed, not only in certain qualities of organization, but also in ratio of growth, and, as we have seen, of generative power, and likewise in habits of feeding and the effects of atmospheric influences. The growth of the sea trout in the sea is slow in comparison with that of the salmon; it is not uncommon to find food in the stomach of the former when in fresh-water, but it is rare that any food is found in the stomach of the latter after leaving the sea. The sea-trout, as is well known to the experienced angler, is more readily taken, using the artificial fly, under circumstances of weather differing from those most favorable to the capture of the salmon; a dark windy day being best for the latter, a warm cloudy day with gleams of sunshine for the former. One quality they have in common with river and lake trouts,—that their ova are capable of being hatched only in fresh and well-aërated water, leading to the conclusion that the migratory species must always have been migratory, unless indeed we suppose that there was a time when the seas were less salt than at present and the lakes and rivers less fresh, and that then the habits of the salmonidæ were formed, and they gradually became divided into the migratory and non-migratory species.

Sir W. JARDINE offered some observations on Dr. Davy's paper. In reference to the male parr or young salmon being endowed with the power of impregnating the ova of the adult fish, he said the same power had not been found in any other of the salmon species. He was not aware that experiments had ever been made with any other variety, the fish not having been found in a state fit for the purpose. With regard to the salmon breeding yearly, or in alternate years, that was a very difficult point to prove; but, as Dr. Davy had observed, the number of barren fish occasionally taken, was presumptive of their breeding in alternate years. If Dr. Davy would go to the river Tweed in the end of November, and fish with salmon roe (which was now forbidden), he might kill a basketful of the *Salmon eriox* all in a fit condition for the table. Last year he (Sir W. Jardine) went there to try experiments, believing that the fence-time was far too protracted, and that the salmon kind should not be taken so late in the year as November. They netted the river, and in three draughts took out between seventy and eighty salmon and bull-trout, not one of which was fit for the table. Nothing was fit for the table except the small *Salmo eriox*. As to the spawning-time, he had no doubt that the common trout spawned earlier than the other varieties of the salmon. There was a great many common trout of all sizes barren, and it was the common trout caught in January and February that were now coming, in beautiful condition, into the London market. In the beginning of the season they would probably have, out of fifty trout taken, not three or four that were fit for the table; but as the season advanced, the seasonable fish increased in number. Dr. Davy, referring to the experiments made by Sir W. Jardine, said there ought to be no difficulty in carrying out these experiments, inasmuch as the Act allowed the capture of salmon during the fence-term for scientific purposes.

TRANSPORT OF SALMON OVA TO AUSTRALIA.

Mr. T. Johnson read the following paper:—At one of the sectional meetings of the British Association last year, I had the honor to read a paper giving some account of the attempt which had been made to transport to Australia the ova of the most beautiful specimens of the finny race, the salmon. Upon that occasion the President of the Section hoped that at the next meeting of the Association an account of the success of the undertaking to transport the *Salmo salar* to Australia, would be given to the members of the Association. Having kept the president's suggestion in view, and the fourth attempt to transport the ova of the salmon to Australia having this year terminated successfully, I have prepared a short account of the plan adopted; the arrival of the expedition at Melbourne and Tasmania; the progress of the most critical part of the experiment,—the rearing of the fish; the temperature of the rivers intended for the reception of the fish, and the further prosecution of the plan of acclimatizing this noble specimen of the species.

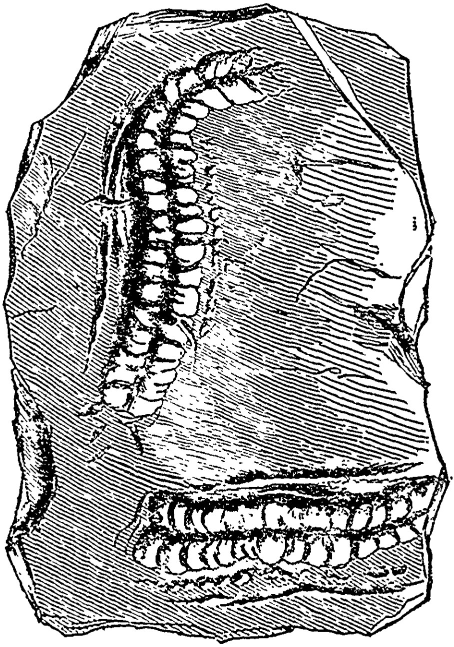
The plan of operations which has this time been crowned with success was confined to an ice-house, holding over thirty tons of Wenham Lake ice, which was built on board Messrs. Wigram's ship Norfolk, sailing from London on January 21st, and Plymouth on the 29th January, 1864. The ice-house was built of two thicknesses of three-inch deals, forming an open space of from seven to nine inches, which was filled-in with charcoal dust. The lining was of lead from seven to nine pounds per square foot, the watercourses and drain-pipes leading to the ship's timbers. In the ice-house, amongst the ice, were deposited 181 boxes of common deal, measuring twelve by nine inches by five inches deep, containing upwards of 100,000 salmon-ova, taken from English and Scotch rivers in the month of January, and 3000 trout-ova; all carefully packed amongst damp moss. One tier of boxes was placed upon the gratings at the bottom of the house, covered with ice, others about midway, and the remainder at the top of the ice-house. The Norfolk, after a fine passage of seventy-five days from Plymouth, arrived at Melbourne on the fifteenth of April last. Mr. Edward Wilson, president of the Acclimatization Society, and other gentlemen were soon in attendance, and examined eleven boxes containing the ova; every box of this number exhibiting its contents in a fine state of preservation. These boxes were detained at Melbourne, to form the nucleus of the salmon-supply for Melbourne. The remaining 170 boxes were then re-shipped, packed with the remainder of the ice, in large cases, on board H. M. C. steamship Victoria, and sent off to Tasmania. The Victoria arrived and anchored off Battery Point on the 20th of April, when the members of the Acclimatization Society boarded her. The following gentlemen composed the Committee of Management, viz.: Mr. Gibbon (officer), Mr. M. Allport, Mr. Falconer (Director of Public Works), the Hon. J. M. Wilson, Mr. Gould (the government geologist), and several others. The following plan was adopted as the means of transport to the breeding-boxes on the river Plenty: A considerable number of attendants were told off as carriers, the parties being again subdivided into two relays, destined to relieve each other from time to time on the way. The mode of carriage was that of the Chinese, and familiarly known as such to resident visitors to the neighboring colony of Victoria. Each case was provided with two handles of rope on either side, and through each pair was passed a bamboo-stick of some twelve feet in length, the extremities of which rested on the shoulders of bearers. On arriving at the pond some little delay was occasioned through a considerable accumulation of alluvial deposits on the gravel-beds which had to be removed before the ova could be deposited; this however, was soon done, and the ova afterwards speedily placed in the hatching-boxes. The analysis of the contents of the boxes at Melbourne and at Tasmania shows that out of the 103,000 ova transported, upwards of 31,000 were safely deposited in the prepared gravel-beds. We cannot but regret that out of 103,000 we should have so few left. Remarkable as the case appears, and considering the various and many precarious changes which the ova have been subjected to from the date of impregnation until the arrival at Melbourne and at Tasmania, we can scarcely fail to acknowledge that the experiment has been singularly successful. As it is intended to continue the transporting of salmon-ova during some years to come, and with the view of eliciting opinions or suggestions bearing upon the modes of transport, I may be allowed to state a few of the difficulties we have had to contend against. And let it be borne in mind that there are many dangers on board ship, such as we have not upon land. These difficulties may be gathered from the following extract from the letter of Mr. Joul. He says, " It is impossible to account for the difference, as it may arise from so many causes. Some of the ova was not in the best condition; it may be the moss, or the water it was washed with, or the water it was drenched with, or foul air in the ridge, or some of the ova got frozen before the Norfolk left the docks during the severe frost." To these probable causes I would add, the fish may have been partly or wholly diseased, or the impurities of the ice, or insect matter as it escaped through the melting of the ice, but more particularly, I should say, the bilge-water in the ship. In this opinion I am partly borne out by Dr. Officer, who, in a letter to Mr. Joul, dated 22nd of April, 1864, says—" Mr. Ramsbottom thinks that the boxes nearest the bottom were the least healthy." These causes, we may infer, are very serious drawbacks, and, in my opinion, the principal cause of destruction. Previous to the ice-house being commenced with, I proposed a plan of drainage to prevent the possibility of any bilge-water entering the ice-house, but could not have it carried out. Mr. Joul saw the necessity for such an arrangement, but the owners of the Norfolk refused permission, alleging that it would materially interfere with the stowing of the cargo. Mr. Joul gave way, although I could come to no such conclusion. The plan I proposed would have provided a thorough system of drainage, without being exposed to the evils attendant upon opening a communication with the ship's timbers. This could have been done by draining off the ice-water into two tanks, one on each side of the ice-house; having attached to each an ordinary pump, communicating with the upper deck. Had such an arrangement been carried out, a two-fold object would have been achieved, viz., there would have been no open channel, by which the bilge-water could have entered the ice-house; and the person in charge would have been enabled to pump up the ice-water and measure it off, showing correctly how much ice was being melted per diem. I should here observe, that as the owners of the Norfolk gave the space taken up by the ice-house gratis, and that, as it was very difficult to get a suitable ship, Mr. Joul had no other choice but to agree to the plan we worked out. The ova being safely deposited in the beds at Melbourne and Tasmania, we came to the next critical test—viz., the hatching-out, and the rearing of the young fry. The advices we have from Melbourne, and Tasmania record the appearance of the ova when deposited, and when the fish were hatched, the last day of hatching, and the number of young fry they have at each place up to the 20th June, 1864. It appears at the time the ova were deposited in the hatching-boxes, the formation of the fish in many instances was so far complete that their eyes were plainly visible. This fact led Dr. Officer and other gentlemen of the Acclimatising Society to conclude that, before many days, numbers of the young fry would emerge from the shell. Such, however, was not the case, inasmuch as the first fish was not hatched until the 4th of May, and at Melbourne on the 7th of May. By the 11th as many as forty trout and nine salmon were hatched, the numbers increasing daily. Unfortunately during the hatching, the mortality of the ova and the fry reached to something like 100 per diem, which decreased as the season grew colder. The last fish, says Dr. Officer, hatched-out on the 8th of June, fifty-four days after the arrival at Tasmania, and 147 days after the date of impregnation. After this great success, a want of caution, probably from an over-desire to do more than nature will bear, seems to be one of the greatest disorders we have to contend against. The advices down to the 20th June show the ratio of mortality amongst the ova and the young fry to be so great, that the total number of fish, both at Melbourne and Tasmania, does not exceed 3,300. To what cause are we to attribute the fearful mortality among the young fish? Mr. Joul, writing upon the subject, says, "It is an established fact that salmon and trout ova can be sent to the antipodes, and hatched there; but as I am not satisfied with only about 3,000 fry being hatched from about 30,000 living healthy ova that were placed in the breeding-ponds in Tasmania, and about 300 from 1,200 healthy ova in Melbourne, I wish to call the attention of Mr. Buckland, Mr. Francis, Mr. Buist, and other artificial breeders, to these numerous deaths of the ova, after having advanced so far in hatching as to have the eyes well developed, and when they ought to be considered safe, with the view to elicit from these gentlemen an opinion of the probable causes, and to suggest a remedy. My own experience is that out of 100 healthy ova taken from the moss, which have not been more than 100 days in ice, I can hatch eighty; and there appears, from what I know of the river-water and climate of Tasmania, no reason why similar results should not be obtained there. I am the more anxious to obtain the opinions of these gentlemen, because I learn that for years to come further attempts are to be made to carry ova in ice to that colony."

NEW METHOD OF EXTRACTING GOLD FROM ORES.

Mr. BRIGGS read a paper from Mr. F. C. Calvert, of Manchester, on a New Method of Extracting Gold from Auriferous Ores. At the present time when the auriferous ores of Great Britain are attracting public attention, it may be advantageous to persons interested in gold-mining, to be made acquainted with a new and simple method of extracting gold from such ores, which presents the advantages of not only dispensing with the costly use of mercury, but of also extracting the silver and copper which the ore may contain. Further, it may be stated that the process can be profitably adopted in cases where the amount of gold is small, and the expense of mercury consequently too great. Without entering here into all the details of the numerous (about one hundred) experiments which I made some years since, before I finally arrived at the new method of extracting gold, which I have now the honor of communicating, allow me to state a few facts which are necessary to give a complete view of the subject. If 2.2 parts of pure and finely divided gold, obtained by the reduction of a salt of that metal, be added to 100 parts of pure sand, and placed in a bottle with a saturated solution of chlorine gas for 24 hours, only 0.5 of gold is dissolved. If the same experiment be repeated, but instead of chlorine water, a mixture of chlorine water and hydrochloric acid be used, 0.6 of gold is dissolved. If, instead of employing hydrochloric acid and chlorine gas, a mixture of sand, reduced gold, and peroxide of manganese, with hydrochloric acid, are placed in a bottle, 1.4 of gold is dissolved ; so that it would appear that, under the influence of nascent chlorine, the gold is more readily dissolved than when the same gas is mixed in solution with hydrochloric acid, previously to being placed in contact with the auriferous sand. Still these processes leave a great deal to be desired in a commercial point of view, as more than a third of the gold remains undissolved. The same results are obtained if the chlorine gas be generated by another method, viz., by adding to the auriferous sand a mixture of chloride of sodium, sulphuric acid, and peroxide of manganese. Being convinced, therefore, that nascent chlorine gas was a fit and proper agent for cheaply extracting gold from ores, and that it was probably only necessary to modify the method of operating, I allowed the mixture of hydrochloric acid and peroxide of manganese, or of sulphuric acid, peroxide of manganese, and chloride of sodium, to remain for twelve hours in contact with the auriferous sand; and, then, instead of washing-out the solution of gold, I added a small quantity of water, which removed a part of the acting agent, and this was made to percolate several times through the sand; by which method I succeeded in extracting from the sand, within a fraction the whole of the gold. I then repeated the last experiments with natural auriferous quartz, and easily extracted the two ounces of gold per ton which it contained. I therefore propose the following plan for extracting the gold on a commercial scale:—The finely-reduced auriferous quartz should be intimately mixed with about one per cent of peroxide of manganese; and if common salt be used this material should be added at the same time as the manganese, in the proportion of three parts of salt to two of manganese. The whole should be then introduced into closed vats, having false bottoms, upon which is laid a quantity of small branches covered with straw, so as to prevent the reduced quartz from filling the holes in the false bottom. Muriatic acid should then be added if manganese alone is used, and diluted sulphuric acid if manganese and salt have been employed; and, after having left the whole in contact for twelve hours, water should be added so as to fill-up the whole space between the false and true bottoms with fluid. This fluid should then be pumped-up and allowed to percolate through the mass; and after this has been done several times, the fluid should be run off into separate vats for extracting the gold and copper that it may contain. To effect this, old iron is placed in it to precipitate the copper; and after this has been removed, the liquor is heated to drive away the excess of free chlorine, and a concentrated solution of sulphate of protoxide of iron, or green copperas, must be added, which, acting on the gold-solution, will precipitate the gold in a metallic form. By this method, both gold and copper are obtained in a marketable condition. If silver is present in the ore, a slight modification in the process will enable the operator to obtain this metal also. It is simply necessary to generate the chlorine of the vitriol, manganese, and chloride of sodium process, taking care to use an excess of salt, that is, six parts instead of three, as above directed. The purpose of this chloride of sodium being to hold in solution any chloride of silver that may have been formed by the action of chlorine on the silver-ore, and to extract the metal, the following alteration in the mode of precipitation is necessary. Blades of copper must be placed in the metallic solutions, to throw down the silver in a metallic form, then blades of iron to throw down the copper, the gold being then extracted as previously directed. I think the advantages of this process are, 1st, cheapness; 2nd, absence of injury to the health of the persons employed; 3rd, that not only is the metallic gold in the ore extracted (as is done by mercury), but it attacks and dissolves all gold which may be present in a combined state, besides enabling the miner also to extract what silver and copper the ore may contain. I cannot, however, conclude without reminding you of what is generally underrated; that is, the heavy expenses which attend the bringing of the ore to the surface of the ground, and crushing and preparing it for being acted upon by mercury or by any other agents.

MISCELLANEOUS.

ILLUSTRATION TO DR. DAWSON'S ARTICLE ON THE GENUS RUSOPHYCUS.



Rusichnites Acadicus.

For description, see *ante*, page 367.

CALLUNA VULGARIS IN NEWFOUNDLAND.—Mr. Murray, late of the Geological Survey of Canada, and now engaged in a survey of Newfoundland, has brought to Montreal specimens of this plant, which were collected by Judge Robinson on the east coast of Newfoundland, near Ferryland (lat. 47°, long. 52° 50′), and which are stated to be from a small patch of the plant not more than three yards square. The locality is in the same part of the island to which the specimens collected by a Mr. Cormack (or MacCormack), and formerly in the collection of the Linnæan Society, are referred, (American Journal of Science, vol. xxxviii, p. 122,) namely the south-east peninsula; and two additional localities in this peninsula are noticed in Cormack's label, namely, the head of St. Mary's Bay and Trepassy Bay or Harbor. It is supposed that the Cormack who collected these specimens is the well-known explorer of the interior of Newfoundland; but we do not find any notice of the plant in his published narrative, although it contains many botanical notes.

De la Pylaie was no doubt the first to collect the plant in Newfoundland, since, though it is not in his herbarium, Prof. Brunet informs us that it is mentioned in his MS. notes.

We now have certain knowledge of localities of heather in Massachusetts, in Cape Breton (see *ante*, page 378), and in Newfoundland, to which may be added Giesecke's testimony that it occurs in Greenland.

THE GOLD OF NOVA SCOTIA OF PRE-CARBONIFEROUS AGE.—At Corbitt's Mills, about four miles north of Gay's River, Colchester County, Nova Scotia, auriferous clay-slates of the same character as those of the other Gold districts of the Province, are overlaid unconformably by nearly horizontal beds of grey and red conglomerate, grit, and sandstone, of Lower Carboniferous, probably Lower-Coal-measures age. At the mills these last are only a few feet in thickness. They, in turn, are overlaid by a mass of drift, and by beds of stratified sand and clay of variable thickness.

The little brook supplying the water-power to the mills, has cut through the Post-tertiary and Carboniferous beds, and in some places has worn for itself a channel in the slates, so that in the numerous excavations on its banks very good sections are exposed.

As to the Carboniferous age of the conglomerate and sandstones there can be no doubt. They cannot be Silurian, for they overlie uncomformably rocks of this age. They are totally unlike any Devonian rocks occurring in the Province, while they agree perfectly with the Lower Carboniferous conglomerates and sandstones of the Carboniferous basin on the margin of which they lie. They contain a few ill-preserved fossil plants like those found in similar Carboniferous beds. Between the Carboniferous and Drift, the only formation occurring in Nova Scotia is the New-Red-Sandstone, to the rocks of which the beds under consideration bear no resemblance. They cannot be of drift-age, for their fragments form rounded boulders in that deposit. They show no sign of having suffered from metamorphism. The lower part of the beds of conglomerate or grit at their junction with the slates, is richly auriferous, the gold occurring principally in the form of flattened scales, sometimes a quarter of an inch in diameter, disseminated through the rock. I have seen many fragments of the conglomerate, not a cubic inch in size, on the surface of which twenty or thirty scales of gold could be counted with the naked eye. Levels are driven into the banks of the brook, at the junction of the two formations: a foot or more of the lower part of the conglomerated bed is removed and washed in the common miner's cradle and pan, yielding rich returns. It is from this source that the greater part of the gold mined at the locality is obtained.

A machine is being erected on the spot to crush the conglomerate, in order that the go'd may be more thoroughly extracted.

Gold has been washed from the drift overlying the conglomerate. The source whence the gold was derived, was, doubtless, quartz-veins in the clay-slates. Only one lead, about a quarter of an inch in thickness, has been discovered beneath the conglomerate. It is richly auriferous, and has a strike of about north and south, and a dip to the eastward of 70°. Non-auriferous quartz-veins are very numerous in the slate-hills of the vicinity. That this lead is older than the Carboniferous strata is plain from its ending abruptly at the junction with the slates.

From the above facts I think there can be no doubt that the gold of Corbitt's Mills is of Pre-Carboniferous origin; and since the gold of that locality was derived from strata precisely similar in character to those of the other gold-regions of Nova Scotia, and which strata are but the re-appearance northward of the gold-bearing rocks of the gold-fields of Renfrew and Oldham, and of the metamorphic band of the Atlantic coast, I think that the Pre-Carboniferous age of the gold of Nova Scotia is clearly indicated.

It is a very generally accepted theory, propounded by Sir Roderick Murchison, that, while gold is confined to Lower Silurian strata, it did not make its appearance therein until just before the time of the drift. As the gold of Nova Scotia was probably introduced into, or assumed its present form in the quartz-leads, at the time of the metamorphism of the Silurian rocks, which metamorphism was Pre-Carboniferous, I had doubted the correctness of this theory. The occurrence of gold in the Carboniferous rocks of Corbitt's Mills, shows that it is not to be applied to the Province of Nova Scotia.

G. Fred. Hartt.

Halifax, Oct. 27, 1864.

OBITUARY.

PROFESSOR BENJAMIN SILLIMAN.

Our honored associate, Professor Benjamin Silliman, the founder of this Journal (Silliman's Journal), whose name has appeared upon the title-page of every number, from the first until the present, is with us no more. He died at his residence in New Haven, early Thursday morning, November 24, 1864, (the day set apart for a national thanksgiving,) having reached the age of eighty-five years.

It becomes our duty to place on record in these pages, as an inscription to the monument which he has himself erected, an outline of his career and a tribute to his memory. Few men enter life with such promise as he; fewer still sustain themselves so evenly, and die so widely lamented.

Instruction in natural science has been his great work; and in it he was emphatically a man of the times. Beginning when almost nothing was known in this country of the departments to which he was especially devoted, he lived to see them carried forward to a high degree of progress, and their importance everywhere acknowledged. His life, which was one of few marked incidents, was passed in his native State, in connection with Yale College, the institution that early selected him as one of its faculty. Two or three times he was invited to become the president of colleges elsewhere, but New Haven continued his chosen home. Twice he visited Europe, first in 1805–6, in order to qualify himself for his work in life by attendance upon lectures in London and Edinburgh, and by observation of foreign institutions of learning; and again, near the close of his life, in 1851, when he was accompanied by his son, and made a more extended tour of observation and inquiry. Frequent journeys in his own country made him acquainted personally with the institutions and the men of every State, while his habits of prompt and friendly correspondence perpetuated the intimacies which he formed at home and abroad.

Without attempting a formal biography (which the late day of his decease renders impossible at this time), we propose to speak briefly of Professor Silliman's career as an officer of Yale College, and as a man of science, and then of his personal character and influence in the community.

The Silliman family has resided in Fairfield, Conn., since the early colonial days. Tradition says that Claudio Sillimandi, their earliest known ancestor, was driven, in 1517, from Lucca, Italy, to Switzerland, by religious persecution. The descendants resided in Berne, and afterwards in Geneva, whence they emigrated through Holland to this country about the middle of the seventeenth century. A worthy pastor of the name, living with his family near Neufchatel, was visited by Professor Silliman in 1851.

Ebenezer Silliman, the grandfather of Benjamin, graduated at Yale College in 1727, and Gold Selleck, the father, in 1752. The latter was a brigadier-general of militia in the Revolution, and was entrusted for a time with the defence of the Long Island coast. In 1775 he was married to Mary, the daughter of the Rev. Joseph Fish of Stonington, and the widow of the Rev. John Noyes. The two children of this marriage, Gold Selleck and Benjamin, became members of the same class in college, and have maintained through life an intimacy peculiarly fresh and cordial. The younger brother, Benjamin, was born in North Stratford, Conn., (now the town of Trumbull,) August 8, 1779. The elder, who was born in 1777, is still living in Brooklyn, N. Y.

Throughout his active life, Professor Silliman has been identified with Yale College. He entered the institution in 1792, graduated in 1796, became a tutor in 1799, was appointed professor of chemistry and natural history in 1804; and in 1853, having been relieved, at his own request, from further service as an instructor, he was designated, by the corporation, professor *emeritus*. Thus, during a period of nearly three-quarters of a century, his name has appeared as a student and a teacher successively on the catalogues of the college. He was a pupil of both Dr. Stiles and Dr. Dwight, and the colleague of the latter during eighteen years. With President Day and Professor Kingsley he was associated for half a century or more in the government of the institution.

In the capacity of a college-officer, he was pre-eminent as a teacher. The professor's chair, in the laboratory or in the lecture-room, was the place above all others in which his enthusiasm, his sympathy with useful aspirations, his varied acquisitions, his acquaintance with the world of nature and of art, and his graceful utterance, exerted their highest and most-enduring influence. The minds which he aroused to the study of nature have become investigators and teachers in every portion of the country; and all his pupils, whether devoted to science or to letters, will bear testimony to the interest which he awakened in these pursuits. They will never forget the admirable tact with which the manipulations of the laboratory were performed, or the brilliant experiments in chemistry which the lecturer seemed to enjoy, as if, like the class, he had never witnessed them before. The course in chemistry, in early years, extended through one hundred and twenty lectures. In later days it was not so long, but was followed by a course in mineralogy and another in geology. Here, too, Professor Silliman had the same magnetic influence on his students, sending them off on long walks about New Haven and at home to search for specimens, or to study the phenomena of geology. The third of these annual courses, that on geology, he gave with peculiar zest and eloquence. He delighted to depict the catastrophes of geological history, and to clothe the world with the plants and the animals of former days.

Professor Silliman was less concerned in the government of the students than some of his associates; but questions were continually arising in which his counsel was of weight. He was prompt in rebuking every form of youthful delinquency, yet was never harsh nor inconsiderate. No student ever left his presence feeling wronged or indignant. He would much rather sacrifice a rule than injure an offender. If he seemed sometimes to be lenient, it was the leniency of a father, for his mind regarded the improvement of his scholars rather than the enforcement of routine and discipline. His paternal lectures to the Freshman class on morals and manners were admirable in their influence; and many a graduate of the college will acknowledge that his habits for life were affected by the judicious hints which he received from his kind and sympathising teacher.

Mr. Silliman's labors began with instruction; but they did not end there. His active and versatile disposition led him to become interested in and to help forward whatever would contribute to the welfare of Yale College. When he went abroad, in 1805, to fit himself for the duties of his professorship, the purchase of books for the library was one of the duties with which he was especially charged. He was one of the library committee until his retirement. In his own departments, not only the Chemical Laboratory, but also the Cabinet of Minerals, owed its existence to his energy. This collection is indeed so important, that something more than the mere mention of it seems due. About the time when Mr. Silliman was appointed a professor, the entire mineralogical and geological collection of Yale College was transported to Philadelphia in one small box, that the specimens might be named by Dr. Adam Seybert, then fresh from Werner's School at Freiberg, the only man in this country who could be regarded as a mineralogist scientifically trained. From this small beginning grew the present cabinet. In 1810, owing to personal regard for Professor Silliman, Col. George Gibbs deposited with Yale College his valuable collection of minerals; and after it had remained open to the public fifteen years, various friends of the college, chiefly through the instrumentality of Professor Silliman, subscribed for its purchase the sum of $20,000. Other important accessions were also secured through his influence, not only from college graduates and other American gentlemen, but from various foreign collectors.

The Clark telescope is another of the donations to Yale College due to Professor Silliman. This excellent glass, the best in the country at the time of its purchase, was the means of exciting among the students of the college unusual attention to astronomical pursuits for many years after its reception. The liberal donor, a farmer near New Haven, by this and other more important gifts, placed himself foremost among all the benefactors of the college up to that time, and Prof. Silliman was the medium through whom his benefactions were bestowed. The Trumbull Gallery of Paintings, a collection of priceless value, not only as works of art, but also as illustrations of American history and biography, was secured to the college through the same enlightened instrumentality. The Medical Institution of Yale College and the Sheffield School of

Science, important branches of the University, were both greatly aided in their beginnings by the influential exertions put forth by Professor Silliman. He was one of the chief founders of the Alumni Association of the college; and at their anniversaries and on other occasions, he was, as another has said, "the standing 'orator' of the college; the principal medium between those who dwelt in the academic shade and the great public." Not unfrequently he was the college solicitor, asking funds for the expansion of the institution, and never asking in vain.

Although his services as a college-officer were great, Professor Silliman's strongest claim to the gratitude of men of science rests upon the establishment, and the maintenance, often under very discouraging circumstances, of the American Journal of Science. The history of this undertaking has already been given, in his own words, in the introduction to the fiftieth or index volume of the first series of the Journal; and it is for others, rather than for us, to give an estimate of his editorial services. It is but just, however, to call attention to a few circumstances, which all will regard as creditable to its founder.

He had the sagacity to foresee, as long ago as 1818, the scope which such a magazine should take. The prospectus which he then wrote is applicable almost exactly to our pages to-day. Experience has established the wisdom of the course which he marked out.

He maintained the Journal, from the beginning, at his own pecuniary risk. Its publication has often been a serious financial burden, and in its most prosperous days has not yielded a fair return for editorial labor. But it has been continued, at this personal inconvenience, for the sake of American science, that the labors of our countrymen might be made known abroad, and the labors of Europeans understood in this country.

The Journal has never been used for the benefit of any party or individual, but solely for the advancement and diffusion of scientific truth. Its pages have been always open to free scientific discussion, with truth as the single end in view.

The original investigations of Prof. Silliman are not numerous. In the early part of his career he began with energy some important experiments and researches. He undertook a geological survey of Connecticut; he published a paper in conjunction with Prof. Kingsley on the famous Weston meteorite; he applied the newly-invented blowpipe of his friend, Dr. Hare, to the fusion of a variety of bodies, which were before regarded as infusible; he demonstrated in the galvanic battery the transfer of particles of carbon from one charcoal-point to the other; he made scientific examinations of various localities interesting in their geological or mineralogical aspects. But he was too much needed elsewhere to be allowed to remain a close student in the laboratory, or to engage with constancy as an explorer in the field of geological research. He has probably been a more useful man in the wider spheres of influence to which he was called, than he could have been in a life devoted to scientific investigation.

During a considerable part of his life, he was one of the few men in the country who could hold a popular audience with a lecture on science. The public early knew of his capabilities; and for many years he yielded to invitations from various parts of the country to deliver lectures on Geology and on Chemistry. In 1833 he gave his first popular course on Geology at New Haven, which was repeated in 1834 at Hartford and Lowell, and in 1835 at Boston and Salem. At Boston, the audience desiring to attend was so much larger than the largest hall would hold, that each lecture was given twice, for the accommodation of the public. From 1840 to 1843 inclusive, he gave four successive courses of the Lowell Lectures in Boston. Besides various other engagements in the Northern and Eastern States, he went in 1847 by invitation to New Orleans, and on his way appeared before crowded audiences in other cities of the South; and five years after the resignation of his professorship in college, when he had passed his 75th year, he made the long journey to St. Louis, in obedience to a call for a course of lectures from the citizens of that place.

In lecturing, his language was simple; his flow of words easy, generous and appropriate; his style animated, abounding in life-like and well-adorned description, often eloquent, and sometimes varied with anecdote running occasionally into wide digressions. His manner was natural, and every feature spoke as well as his mouth. His noble countenance and commanding figure (he was nearly six feet in height, with a well-built frame) often called forth, as he entered the lecture-hall, the involuntary applause of his audience.

In his popular courses he often lectured on the subject of Geology and Genesis; and as he was widely known not only as a man of science, but also as a sincere believer in the sacred Scriptures, he greatly aided in removing from the religious world the apprehension that science and religion were hostile in their teachings.

Mr. Silliman found great pleasure in helping forward other men of science. He rejoiced heartily in their progress; his house and his laboratory were always open to receive them, and if a friendly word or letter from him could advance their interests, he was ever ready to bestow it. He also felt a deep concern for the advancement of scientific investigations in every part of the country; and whenever, in halls of legislation, or before the public, the name of Benjamin Silliman would advance a useful project, it was not withheld. In more than one instance, the foreigner or the exile remembers his kindness with almost filial devotion.

Prof. Silliman's scientific publications, apart from his contributions to this journal, were chiefly text-books. He edited Henry's Chemistry and Bakewell's Geology, for the use of his pupils; and also published a work on Chemistry, in two volumes.

His long labors for science brought him honors from all parts of the world. His name is on the roll of several of the principal scientific Academies or Societies of Europe, and of those of his own country. He was one of the original members of the National Academy of Sciences, and a Regent of the Smithsonian Institution.

Aside from Professor Silliman's influence as an officer of Yale College, and as a well-known man of science, his personal hold upon the community at large was remarkably strong. This was due somewhat to the favor with which his popular lectures were received, and to the wide circuit over which he had journeyed. It was also owing in part to the pleasure and instruction which were afforded by his books of travel. Twice, as we have stated, Professor Silliman visited Europe, the interval between his journeys being nearly fifty years. Both these visits led to the publication of his observations in volumes which were widely read. The narrative of his earlier journey especially was received by the public with great delight. Few Americans then went abroad; and hardly any had published narratives of what they had seen. Mr. Silliman's volumes were fascinating to young and old,—and many were the testimonials which he received of the interest thus awakened in European institutions and manners. His Journal of a Tour to Canada was another contribution to the literature of the day.

But the general influence of Mr. Silliman must be attributed to his personal character, rather than to any of what may be termed the accidental circumstances of his life. He was a man of vigorous understanding and sound judgment, led on, but never carried away, by an enthusiastic disposition, glowing and constant. With this was associated sterling integrity, which never harbored a selfish or dishonorable purpose, but rejoiced in doing and encouraging whatever was right. Every one could trust him. These fundamental traits were adorned by the outward qualities of affability and courtesy, or rather were expressed in manners at once so dignified and so kind that all with whom he came in contact were charmed at once, and on closer intercourse were bound to him as friends for life. Such friendships he never neglected or forgot. Even the sons and the grandsons of his early associates inherited a share in the regard which he had bestowed upon their parents. Blending with and ennobling all these virtues, was the child-like simplicity of his Christian faith.

A character like this shines the brighter the nearer it is seen. In his own family circle, Mr. Silliman has moved for years as a patriarch, surrounded by his descendants to the third and fourth generation. The very house which he occupied has become historic, reflecting in its arrangements, its family portraits, its interesting mementoes of absent friends, and its long shelves of books, the controlling mind which has dwelt there.

In the neighborhood and town where he resided, Mr. Silliman was peculiarly beloved and respected. "New Haven will not be New Haven without him," said more than one of his associates, as he heard of his death. His hand was always open to the needy; he was given to hospitality. He frequently took part in public meetings, and was actively concerned in all questions of local improvement. He rarely, if ever, failed to discharge his duties as a citizen at the polls, and was always ready to express his opinions on questions of public policy.

A whole-souled patriot, he viewed with the deepest interest the complications brought into the affairs of the country by the system of slavery. His general benevolence ever led him to sympathize with the oppressed, and the wrongs of the African touched him deeply.

As soon as the atrocities in Kansas revealed the determination of the advocates of slavery to perpetuate and extend that institution, even if they dissevered or destroyed the nation, Mr. Silliman came out with all his youthful ardor, and with the influence of his years and reputation, as the opponent of the slave-power. He thus became the object of personal defamation, even in the Senate-chamber at Washington; but he still remained firm, for he recognized in this war a slaveholder's rebellion. All the lofty sentiments of patriotism which were awakened in childhood as he witnessed the commencement of national life, were intensified by this struggle to maintain the Union. He was sure that the nation would be purified by the conflict, and liberty established throughout all the land.

Mr. Silliman has always been remarkable for uniform good health, and in his later years but slightly manifested the encroachments of age. To the last, his form was as erect, his brow as serene, and his features as full of life and cheerfulness, as in his earlier days; and his gait was only a little slower and more cautious.

He continued as usual until the middle of November just past, when he was for a few days quite unwell, probably as an immediate consequence of exposure to cold when attending an evening meeting in behalf of the Sanitary Commission. He had gradually, to appearance, regained nearly his former strength during the following week, and on Wednesday was intending to join the family Thanksgiving festival the next day at the house of his son-in-law, Prof. Dana. On the morning of that day (November 24), he awoke early, after a night of quiet rest, feeling stronger, as he said, than he had done for some days. He spoke with his wife of the many reasons there were for thankfulness, both public and private; dwelling at length upon the causes for national gratitude, especially in the recent re-election to the Presidency of a man who had proved himself so true, so honest, so upright in conducting the affairs of the government as Mr. Lincoln. As was his custom, he offered up, while still in his bed, a short prayer, and repeated a familiar hymn of praise. In resuming his conversation, before rising, he spoke of the possibility of his attending the public services of the day, of the happiness of his home, of the love of his children, and, in strong terms of endearment, of his wife. Just as these his last words of love were uttered, there was a sudden change of countenance, a slightly heavier breath, and he was gone. At the advanced age of eighty-five, life to him was still beautiful; and not less so was its close. His sun set in the blessedness of the Christian's faith, to rise on a brighter morrow.—*From Am. Jour. Sci.* [2], vol. xxxix, No. 115.

REVIEW.

The Boston Society of Natural History has issued the following circular:—

"On account of the gradual diminution of the number of subscribers, the increased cost of publication, and the limited income of the Boston Society of Natural History, it has been necessary to suspend the publication of its Journal and Proceedings.

"This suspension is a serious injury to the Society, as it cuts off the means of making its labors public, and deprives it of the material for exchange with other scientific bodies for the increase of the Library. The Publishing Committee, with the consent of the Council, have therefore deemed it advisable to invite its Patrons and Members, and the friends of Science, to subscribe for these works, so that their publication may at once be resumed.

"The Society has already published seven volumes in 8vo of the Journal, illustrated with many plates; and nearly nine volumes in 8vo of the Proceedings. The former will hereafter be issued in 4to, under the style of Memoirs; the latter will be published as heretofore, in monthly sheets, but will not any longer be furnished free of cost to members.

"Price.—The Memoirs will be furnished to members and patrons at $3.50 per number; to the public, at $4. A number, averaging 125 pages and four plates, will be published about once a year, four numbers completing a volume.

"The Proceedings will be furnished to members and patrons at $3 per volume; to the public, at $4. They will be issued in sheets of 16 pages each, averaging 24 sheets to a volume, the volume being completed in about two years. Payment—for Memoirs will be due on the presentation of each number; for the Proceedings, on the issue of the first sheet.

"Boston, December 1, 1864."

Signed by the Publishing Committee.

We are indebted to the author for the first part of the Memoirs above alluded to, being a "Revision of the Polyps of the Eastern Coast of the United States," by A. E. Verrill, and consisting of 45 pages of quarto letter-press, and one lithographic plate illustrating five species. The author, after noticing the imperfection of some and the inaccessibility of much of the available material necessary to the study of these animals, adds, "It was for the purpose of supplying in some measure the deficiency in these respects, and to establish a basis for future investigations, rather than to present anything new, that the present work was undertaken; but on account of the constant accessions of new materials, it has now become necessary to present quite a number of undescribed species, and it is very probable that many more remain to be hereafter discovered." The fringed actinia figured in this Journal, vol. iii, pages 401–2, as *Actinia dianthus*, is here named *Metridium marginatum* (of Milne-Edwards), and, though closely allied to the *M. dianthus* of Europe, is said to be a "perfectly distinct" species. Mr. Verrill says of it—"It is the most abundant species along the whole coast of New England and of the provinces of New Brunswick and Nova Scotia.* * * In the Bay of Fundy it is particularly abundant, and grows to a very large size. At Mount Desert, on the coast of Maine, I have seen, during a very low tide, a rocky bottom completely covered for acres with this species, from low-water mark to a depth of two fathoms or more." We have found it equally abundant on the north shore of the St. Lawrence a few miles below the Saguenay; the specimens in form and color agreeing exactly with Dr. Landsborough's figure of *A. dianthus*, save that the column was proportionally more slender than shown by him. We may add that we have found the Bell-anemone (*Lucernaria auricula*) plentiful at Metis on the south shore, where it occurs in rocky pools, adhering to the fronds of sea-weeds, and is easily found during low tide.

These Memoirs are from the Riverside Press, Cambridge, Mass., and are in the usual excellent style of that establishment.

W.

Published, Montreal, January 11, 1865.

ABSTRACT OF METEOROLOGICAL OBSERVATIONS,

Taken at the Montreal Observatory, Latitude 45° 31′ N. Longitude, 4h. 54m. 11s. W. of Greenwich. Height above level of the Sea 182 feet. For the month of October 1864

BY CHARLES SMALLWOOD, M.D., LL.D., D.C.L.

Day of Month.	Reading of the Barometer, corrected, and reduced to 32° F. Highest	Lowest.	Mean.	Reading of Thermometer. Max.	Min.	Mean	Mean Tension of Vapor.	Mean Humidity of the Atmosphere.	General direction of Wind.	Horizontal movement in 24 hours in miles.	Mean extent of Clouds in 10ths.	Depth of Rain in inches.	Depth of Snow in inches.	Ozone in 10ths.	Weather, &c.
	Inches.	Inches.	Inches												
1	30.200	30.139	30.179	66.1	36.7	52.5	.369	.869	W	152.10	3.6	....	....	1.0	
2	.100	.008	.069	54.6	50.2	51.8	.366	.935	N E	70.10	10.0	6.272	....	2.0	Rain.
3	.067	.023	.047	67.3	50.8	57.6	.450	.906	N E	91.08	9.6	....	....	2.6	
4	.000	29.929	29.968	67.9	47.8	59.9	.462	.893	W	11.52	5.3	....	....	2.0	"
5	29.930	.904	.920	78.2	43.5	61.6	.501	.853	W	31.61	1.3	....	....	1.6	Rain.
6	.622	.410	.546	56.2	54.0	58.2	.439	.903	W	29.64	10.0	0.076	....	1.6	Rain. [Snow
7	.334	.260	.334	69.3	50.0	59.8	.447	.861	S W	50.91	6.6	0.320	....	1.6	Rain — First
8	.362	.300	.300	43.4	19.1	39.8	.227	.870	N E	267.25	10.0	0.041	Inapp	2.3	Rain.
9	.491	.462	.475	43.0	29.2	39.1	.217	.852	N E	122.00	9.6	0.497	....	1.6	Rain.
10	.514	.479	.491	48.1	35.0	43.0	.256	.868	W by S	221.00	3.8	0.146	....	1.3	
11	.891	.759	.834	53.3	35.6	45.5	.279	.864	W by N	154.35	4.6	....	....	1.6	
12	.703	.649	.715	47.3	33.2	43.1	.270	.919	S W	47.26	10.0	0.046	....	2.0	Rain.
13	.519	.477	.504	45.2	37.4	42.3	.271	.981	N E	31.52	10.0	0.114	....	2.0	Rain.
14	.413	.391	.312	47.0	38.5	44.0	.297	.985	N E	107.98	10.0	0.210	....	2.3	Rain.
15	.653	.357	.442	48.1	42.4	46.0	.319	.969	N E	192.75	10.0	0.117	....	2.6	Rain.
16	.674	.598	.561	46.9	45.2	46.1	.315	.989	N E	64.00	10.0	0.052	....	2.0	Rain
17	.600	.523	.565	46.3	39.7	43.7	.273	.928	W by N	54.60	9.6	0.024	....	2.3	Rain.
18	.654	.627	.641	52.0	39.7	45.6	.285	.885	W	79.90	5.3	....	....	2.0	
19	.671	.663	.667	52.2	39.3	45.6	.293	.912	W	47.70	6.0	....	....	1.3	Au Borealis.
20	.597	.804	.537	49.8	33.1	44.2	.282	.918	W	57.49	7.6	0.018	....	2.0	Rain.
21	.767	.752	.759	58.1	35.3	46.8	.311	.910	N N W	191.69	2.6	....	....	1.6	
22	.759	.667	.685	54.0	36.4	47.7	.308	.891	W by N	97.60	8.0	Inapp	....	2.0	Rain.
23	.604	.597	.600	51.0	44.2	48.1	.310	.892	W	97.08	10.0	Inapp	....	1.0	Rain.
24	.724	.608	.658	53.0	38.7	47.2	.309	.893	N E	110.90	4.6	....	....	1.3	Au. Borealis.
25	.820	.809	.818	49.7	31.1	44.5	.272	.897	N N E	117.20	8.6	....	....	1.6	
26	.764	.506	.646	61.3	33.2	47.2	.308	.863	N W	185.90	1.3	....	....	1.6	
27	.784	.573	.700	48.0	32.0	41.5	.227	.812	N by W	116.29	8.0	....	....	1.6	Rain.
28	.369	.279	.325	42.1	33.6	39.0	.220	.900	N E	17.21	10.0	0.420	....	3.0	Rain.—Snow.
29	.651	.472	.557	49.7	28.5	40.3	.244	.900	W N W	407.42	1.3	0.941	....	3.6	
30	30.000	.724	.841	50.1	34.7	42.1	.243	.857	W	113.22	0.3	....	....	2.0	
31	29.847	.705	.753	50.9	31.2	41.4	.233	.870	N W	225.55	8.0	....	....	1.6	

Remarks for the Month.

Barometer ..
- Highest, the 1st day, 30.200 inches.
- Lowest, the 7th day, 29.260 "
- Monthly Mean, 29.534.
- Monthly Range, 0.940.

Thermometer
- Highest, the 5th day 78°.2.
- Lowest, the 29th day, 28°.5.
- Monthly Mean, 48°.24.
- Monthly Range, 46°.60.

Greatest intensity of the Sun's rays, 92°.2.
Lowest point of Terrestrial radiation, 24°.0.
Mean of Humidity, .894
Rain fell on 17 days, amounting to 3.794 inches.
Snow fell on 2 days, amounting to 0.10 inches.
Most prevalent wind, N. E.
Least prevalent wind, S. W.
Most windy day the 8th day, mean miles per hour, 11.13.
Least windy day, the 4th day, mean miles per hour, 0.7.
Amount of Evaporation 2.14 inches.
Aurora Borealis visible on 2 nights.

ABSTRACT OF METEOROLOGICAL OBSERVATIONS,

Taken at the Montreal Observatory, Latitude 45° 31′ N. Longitude, 4h. 54m. 11s. W. of Greenwich. Height above the level of the Sea 182 feet. For the month of November 1864.

BY CHARLES SMALLWOOD, M.D., LL.D., D.C.L.

Day of Month.	Reading of the Barometer, corrected, and reduced to 32° F.			Reading of Thermometer.			Mean Tension of Vapor.	Mean Humidity of the Atmosphere.	General direction of Wind.	Horizontal movement in 24 hours in miles.	Mean extent of Clouds in 10ths.	Depth of Rain in inches.	Depth of Snow in inches.	Ozone in 10ths.	Weather, &c.
	Highest	Lowest.	Mean.	Max.	Min.	Mean									
	Inches.	Inches.	Inches.												
1	30.005	29.609	29.867	44.8	25.5	36.0	.205	.881	W	96.81	4.0	....	....	1.6	
2	.051	30.018	30.038	38.0	26.0	32.5	.178	.879	W	125.11	5.3	....	....	1.0	
3	29.890	29.831	29.856	50.1	21.2	36.3	.217	.871	W	69.91	0.6	....	....	1.6	
4	.412	28.668	.383	39.2	23.9	35.2	.198	.901	N E	153.14	10.0	1.260	....	3.0	Rain.
5	.611	29.114	.019	59.4	30.4	32.6	.184	.903	W	87.60	9.6	..	....	1.6	
6	.914	.841	.837	51.3	31.1	41.1	.247	.885	W	184.24	0.0	....	....	2.3	
7	.948	.714	.853	58.4	39.4	48.0	.311	.889	S W	99.76	4.6	Inapp	....	2.6	Rain.
8	30.004	.863	.948	51.2	34.7	46.2	.292	.887	W by S	97.47	7.6	Inapp	....	2.6	Rain.
9	29.594	.347	.480	56.4	48.4	59.9	.472	.908	W b. S	86.67	10.0	0.902	....	3.0	Rain.
10	.279	.080	.183	50.2	50.1	50.9	.364	.889	W by S	217.44	8.0	0.210	....	2.6	Rain.
11	.449	.296	.362	43.0	35.7	39.9	.224	.858	W	146.89	6.6	....	....	2.0	
12	.547	.501	.520	43.4	29.7	38.9	.224	.895	W	179.70	3.3	....	....	1.3	
13	.674	.614	.631	40.9	29.4	35.3	.300	.899	N N E	179.40	6.6	....	....	1.3	
14	.994	.880	.931	51.8	23.0	36.5	.213	.890	N W	211.22	2.6	....	....	2.6	
15	.917	.771	.581	33.8	28.1	31.7	.177	.901	N E	110.00	10.0	....	....	3.0	
16	30.255	30.022	30.154	33.8	20.4	28.9	.130	.869	W	87.69	7.6	....	3.10	3.0	Snow.
17	.105	29.764	29.919	36.3	22.0	32.1	.179	.888	S E	46.27	9.6	....	....	2.3	
18	29.820	.764	.795	50.3	32.0	39.6	.236	.892	W	152.72	2.6	0.300	....	3.0	Rain.
19	.986	.916	.948	40.2	25.1	33.9	.191	.872	W	179.42	6.0	....	....	2.6	
20	.904	.709	.823	55.0	34.7	43.9	.269	.875	W	79.47	3.3	....	....	2.3	
21	.585	.377	.486	46.1	33.1	40.4	.244	.912	S by W	124.71	10.0	0.182	....	3.0	Rain.
22	.411	.090	.247	43.2	31.2	36.4	.222	.924	W by N	57.80	10.0	0.288	....	3.6	Rain.
23	.998	.447	.747	38.1	29.4	31.7	.180	.890	W	44.71	5.3	....	0.90	2.3	Snow,
24	30.267	30.228	30.218	31.4	9.8	23.8	.139	.865	W S W	71.46	7.6	....	...	2.0	
25	.300	.264	.285	35.5	30.4	33.2	.180	.871	W by S	94.72	10.0	....	Inapp	3.0	Snow.
26	.097	29.916	.018	41.8	31.4	35.7	.392	.867	S E	24.21	8.0	Inapp	....	3.6	Rain.
27	29.863	.800	29.835	36.0	33.4	34.8	.189	.881	N E	111.42	10.0	0.246	....	4.0	Rain.
28	.960	.504	.706	42.2	31.6	37.6	.221	.914	S E	22.19	10.0	Inapp	....	2.6	Rain.
29	.577	.397	.408	46.1	41.1	41.1	.281	.925	W S W	17.70	10.0	0.543	....	3.3	Rain.
30	.442	.414	.425	44.0	38.4	42.1	.255	.911	N E	13.49	10.0	0.600	....	3.3	Rain.

Remarks for the Month.

Barometer ... { Highest, the 25th day, 30.300 inches. Lowest, the 4th day, 28.668 " Monthly Mean, 29.720. " Monthly Range, 1.632. "

Thermometer { Highest, the 7th day, 58°.4. Lowest, the 24th day, 9°.8. Monthly Mean, 38°.11. Monthly Range, 48°.6.

Greatest intensity of the Sun's rays, 73°.1.

Lowest point of Terrestrial Radiation, 7°.4.

Mean of Humidity, .899.

Rain fell on 13 days, amounting to 2.360 inches.

Snow fell on 3 days, amounting to 4 inches.

Most prevalent wind, W.

Least prevalent wind, S. E.

Most windy day, the 10th day, mean miles per hour, 10.31.

Least windy day, the 30th day, mean miles per hour, 0.56.

Aurora Borealis visible on 2 nights.

Lunar Corona, visible on 1 night.

ABSTRACT OF METEOROLOGICAL OBSERVATIONS,

Taken at the Montreal Observatory, Latitude 45° 31′ N. Longitude, 4h 54m. 11s. W. of Greenwich. Height above the level of the Sea 182 feet. For the month of December 1864.

BY CHARLES SMALLWOOD, M.D., LL.D., D.C.L.

Day of Month.	Reading of the Barometer, corrected, and reduced to 32° F.			Reading of Thermometer.			Mean Tension of Vapor.	Mean Humidity of the Atmosphere.	General direction of Wind.	Horizontal movement in 24 hours in miles.	Mean extent of Clouds in 10ths.	Depth of Rain in Inches.	Depth of Snow in Inches.	Ozone in 10ths.	Weather, &c.
	Highest	Lowest.	Mean.	Max.	Min.	Mean									
	Inches.	Inches.	Inches.												
1	30.000	29.562	29 812	49.7	34.7	41.1	.245	882	W S W	104.40	6.0	0.060	....	2.0	Rain.
2	.134	.972	30.075	37.2	24.0	31.8	.174	.870	N E	84.26	6.6	....	0.70	2.6	Rain.
3	29.480	.894	29.385	44.5	35.2	40.5	.257	.900	N E	94.70	10.0	0.412	....	3.0	Rain.
4	.607	.451	.506	42.8	29.7	34.6	.195	.901	W	114.90	2.0	....	....	2.3	
5	800	.617	.753	31.4	19.0	27 3	.152	.899	W	232.40	7.6	Inapp	....	3.0	Rain.
6	.774	.495	.593	40.2	30.4	35.8	.205	.899	N E	47.70	10.0	0.441	....	3.0	Rain.
7	.682	28.918	.247	38.4	35.1	37.5	.308	.885	W	47.10	10 0	0.211	....	2 6	Rain.
8	29.874	29.342	29.579	32.0	18.9	25.3	.141	.889	W	272.40	6.0	....	Inapp	3.3	Snow.
9	30.492	30.262	30.410	29.5	8.2	18.6	.106	.863	W	371.14	0.0	....	....	2 3	Lunar Halo.
10	.231	29.900	.072	22.4	18.0	31.8	.109	.848	N E	51 74	10 0	....	0.64	3.0	Snow.
11	29.747	.279	29.524	26.0	18.4	23.0	.129	.894	N E	114.14	8 6	....	1.30	3.3	Snow.
12	.752	28 964	.362	22.4	2.5	11.9	.083	877	W	111.14	9.3	....	5.34	3.0	Snow.
13	30.142	29 799	30.011	9.0	-9.0	0.3	.045	.876	W by N	142.71	6.3	....	Inapp	3.0	Snow.
14	29.800	.334	29.670	20.5	10.6	13.9	.089	.864	N E	94 10	8.6	....	3.50	3.0	Snow.
15	30.101	30.024	30.061	17.0	-0.5	7.4	.065	.877	W	97.64	0.0	....	....	2.6	
16	29.994	29.987	29.990	22.1	9.5	17.1	.096	.895	N E	57.89	10.0	....	....	2.0	
17	.894	.797	.851	32.0	18.0	25.7	.144	.896	N E	47.70	6.6	....	...	2.6	
18	30.311	30 241	30.264	22.2	13.6	17.6	.101	.862	W	104.71	0.0	....	Inapp	3.0	Snow.
19	19.401	19.317	29.319	20.2	14.7	18.4	.103	.841	N E	74.44	3.3	....	3.14	3.0	Snow.
20	.797	.692	.711	16.8	8.1	12.5	.076	.853	W	87.64	0 0	....	....	2.0	
21	.416	.249	.311	13.4	9.8	11.6	.083	.885	N E	59.74	10.0	....	4.75	3.3	Snow.
22	29.304	29.304	29.511	16.0	-6.1	5.7	.058	.874	N E	117.11	4 0	....	1.20	3.0	Snow.
23	.847	.737	.795	-2.5	-14.9	-7.2	.031	.862	W by N	146.61	10.0	....	....	1.1	
24	.742	.644	.639	10.0	-4.6	4.02	.060	.911	N E	207.40	10.0	....	Inapp	2.0	Snow.
25	.861	.679	.795	36.6	24.0	31.0	.169	.885	W	133.10	8.0	....	....	2.0	
26	.671	.637	.650	40.2	33.0	34.4	.197	.904	W	71.11	6.6	....	Inapp	2.0	Snow.
27	.490	.379	.427	40.0	31.0	36.0	.192	.874	N E	79.10	10.0	Inapp	....	2.6	Rain.
28	.411	.407	.409	38.4	32.6	35.7	.199	.887	S W	49.90	8.6	0.197	....	3.0	Rain.
29	29.270	29.199	29.224	32.0	31.6	31.8	.184	.935	W	24.70	10.0	....	2.50	3.0	Snow.
30	.400	.279	.350	26.4	15.1	22.0	.126	.899	W	207.41	6.6	....	Inapp	2.0	Snow.
31	.817	.602	.737	20.2	3.5	13.9	.117	.867	W	74 60	8.6	...	....	3.0	

Remarks for the Month.

Barometer . . { Highest the 1st day, 30.311 inches.
Lowest the 12th day, 28.964 "
Monthly Mean, 29.934 "
Monthly Range, 1.357 "

Thermometer { Highest the 1st day, 49°7.
Lowest the 23rd day, -14°9.
Monthly Mean, 22°.28.
Monthly Range, 64°.6.

Greatest intensity of the Sun's rays, 69.7.
Lowest point of Terrestrial radiation, -16°.1.
Mean of Humidity, °.880.
Rain fell on 7 days, amounting to 1.301 inches.
Snow fell on 15 days, amounting to 22.97 inches.
Most prevalent wind, W.
Least prevalent wind, S. W.
Most windy day the 9th day, mean miles per hour, 15.47.
Least windy day, the 29th day, mean miles per hour, 1.02.
Aurora Borealis visible on 1 night.
Lunar Halo visible on 1 night.

INDEX.

JOHN LOVELL, PRINTER.