Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- ☐ Coloured covers/ Couverture de couleur
- ☐ Covers damaged/ Couverture endommagée
- ☐ Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- ☐ Cover title missing/ Le titre de couverture manque
- ☐ Coloured maps/ Cartes géographiques en couleur
- ☐ Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- ☐ Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- ☑ Bound with other material/ Relié avec d'autres documents
- ☑ Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure
- ☐ Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.

- ☐ Coloured pages/ Pages de couleur
- ☐ Pages damaged/ Pages endommagées
- ☐ Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- ☑ Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- ☐ Pages detached/ Pages détachées
- ☑ Showthrough/ Transparence
- ☑ Quality of print varies/ Qualité inégale de l'impression
- ☐ Continuous pagination/ Pagination continue
- ☐ Includes index(es)/ Comprend un (des) index

  Title on header taken from:/ Le titre de l'en-tête provient:

- ☐ Title page of issue/ Page de titre de la livraison
- ☑ Caption of issue/ Titre de départ de la livraison
- ☐ Masthead/ Générique (périodiques) de la livraison

☐ Additional comments:/ Commentaires supplémentaires:

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
						✓					

THE

CANADIAN

Naturalist and Geologist,

AND PROCEEDINGS OF THE

NATURAL HISTORY SOCIETY

OF MONTREAL.

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY.

VOLUME IV.

Montreal:
PUBLISHED BY B. DAWSON & SON, 23 GREAT ST. JAMES STREET.
1859.

This Magazine will appear bi-monthly, and be conducted by the following Committee, appointed by the Natural History Society of Montreal:—

J. W. Dawson, LL.D., F.G.S., *Principal of McGill College.*
T. Sterry Hunt, A.M., F.R.S., *Chemist to Geological Survey of Canada.*
E. Billings, *Palæontologist* " " "
David Allan Poe, Esq. Rev. A. F. Kemp.
A. N. Rennie, Esq.
W. H. Hingston, M.D., *Corresponding Secretary Nat. Hist. Society.*
John Leeming, Esq., *Recording Secretary* " "

Entered, according to the Act of the Provincial Parliament, in the year one thousand eight hundred and fifty-nine, by Benjamin Dawson & Son, in the Office of the Registrar of the Province of Canada.

CONTENTS.

MISCELLANEOUS.

REVIEWS AND NOTICES OF BOOKS.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOL. IV. FEBRUARY, 1859. No. 1.

ARTICLE I.—*Remarks on the Geographical Distribution of the Cruciferæ throughout the British Possessions in North America.* By GEORGE BARNSTON, Esq.

(Presented to the Montreal Natural History Society.)

In bringing CRUCIFERÆ forward immediately after FUMARIACEÆ, Torrey, with his usual acumen, has followed the surest indications of relationship. In these two orders the petals and stamens are equal in number, and the superior ovary is formed nearly on the same plan with Parietal Placentæ. In both the sepals are deciduous, and those of Fumariaceæ we might almost look upon as four, but united into two. The differences which do exist are not so great as to neutralize the above resemblances in characters so essential to the formation of a natural system. That profound observer Jussieu, also, at an earlier date, did not fail to allow their due weight to these decided marks of propinquity.

Of the species of CRUCIFERÆ to be found in North America, Torrey and Gray describe 113. Of these, there are probably ten that have been introduced, and perhaps nearly as many are common or indigenous to both North America and Europe. The nine or more tribes into which these cruciferæ are divided, derive their characters from the length or shortness of the silique, its dehiscence or indehiscence, the arrangement of the seeds with regard to the

placentæ, their margination, and the position of the cotyledon within the seed. The greater portion of these nine tribes have their species generally diffused, some on the western side of the Rocky Mountains, others on the eastern plateau, and the Atlantic board. The tribe Isatideæ is an exception, however, as it appears only in the far west, where six or seven species of *Thysanocarpi* occur.

Commencing with the ARABIDEÆ, the first tribe of the great siliquose division, we have three species of *Cheiranthus* in North America. The *C. capitatus* in California and Oregon, passing into British territory from Puget Sound, the *C. Pallasii* on the North West coast, and the *C. Hesperidoides*, in Pensylvania, Kentucky, Illinois and Arkansas. No locality in the British territories eastward of the Mountain, appears to be quoted by any author for American Wallflowers; and certainly I have not heard of them native in Canada. The fragrant and most grateful, the *Cheiranthus cheiri*, is only to be found in our gardens.

The *Nasturtiums* (Water-cresses) are well sprinkled over the country south of Canada, but more rarely elsewhere. We possess the *N. palustre*, however, in all quarters, wherever the ground is suitable for it, throughout the length and breadth of the land. The *N. natans*, a scarcer plant, is to be found in Canada and the United States, along the borders of small lakes, and may be distinguished by its immersed leaves being many-parted with capillary segments. The other Nasturtiums are distributed to the number of five in the United States, and of four in the Oregon and on the north west coast.

Barbarea præcox attains to a high latitude, say 68°, and we have it also along the banks of rivers in Canada. The *Barbarea vulgaris*, common in the Northern States, is also found in Oregon and on the north-west coast, running north to Sitka, within the Russian territories. There may be difference of opinion, whether this be an introduced plant or not, according to the quarter where it may be found. Occurring in settled districts in the States, one might pronounce it introduced, while in new or wilder situations another would at once say it was indigenous. It is the Yellow Rocket and Winter Cress of the English; the Cresse de Terre of the French; and Hierba de Santa Barbara of the Spanish.

Passing over the genus *Streptanthus*, of which three species occur in the United States, three in the rocky mountains, and six in California and Oregon, we arrive at the *Turritis* of Dillenius.

Of this genus the species most frequently seen is the *T. glabra*, common enough on the shores of Lake Superior and the banks of the streams running into Hudson's Bay; it extends northward as far as lat. 64°, and in the more northern latitudes is accompanied by the *T. patula*, and *T. retrofracta*, which are distinguished principally by their spreading and retrofract pods. Within the arctic circle the *T. mollis* and *T. diffusa* are joined to them, when the *T. retrofracta* drops off. The *T. patula*, although not reported as higher than 68° on the continent, has nevertheless a variety in Greenland, from which country Sir W. J. Hooker has received it. The *Turritis macrocarpa* and *T. striata* are western plants; the *T. brachycarpa* is confined to the Michigan territory.

The genus *Arabis* has 15 species now discovered in North America, of which five are natives of this province, the *A. petræa*, *hirsuta*, *lyrata*, *lævigata*, and *Canadensis*. The *A. hirsuta*, frequent near the coast of Hudson's Bay, extends to the Oregon, and along the shores of the Pacific as far as Sitka. The *A. petræa* is also marked by Chamisso as a plant of Unalashka. On the north shores of the St. Lawrence below Quebec, the *A. lævigata* is common, and is met with here and there throughout Canada. The two other Canadian species, the *A. lyrata* and *Canadensis*, like the last, travel southwards, and are seen scattered over the States as far as Virginia, Georgia, and the Arkansas. Two species, which appear to be confined to Labrador, the *A. Alpina* and *A. striata*, are amongst the cruciferæ of Europe. Of this rather extensive genus there are still 7 or 8 species to be found in North America, but to the southward of the boundary line. Four of these are the discovery of the indefatigable Nuttall amongst the Rocky Mountains and towards the Oregon.

The bitter cresses, or *Cardamines*, not so numerous in species as the last genus, and more seldom met with in the north than the genera, Turritis and Arabis have the leaves generally pinnately divided, which is a form little observed in the other two. *Cardamine rotundifolia*, and *C. bellidifolia*, have undivided leaves, and are extensively distributed, each in its chosen habitat. The former best known in the eastern and northern states, was also procured by Drummond in the Rocky Mountain defiles, from lat. 52° to 57°, which for one season, the summer of 1856, he took as the range for his botanical researches. Lake Superior and Hudson's Bay have also been quoted as affording this plant. The *C. bellidifolia* is a native of Arctic America, but, like some other plants of

that region, has its alpine residences in more southern latitudes. The summits of the Rocky Mountains in lat. 52°, and what is more remarkable and interesting, the White Mountains of New Hampshire, claim the *C. bellidifolia* as a native. *Sub Jove frigido!* we may exclaim, as we meet this errant stranger in its airy quarters, and imagine while we pluck it that we inhale the atmosphere of the arctic zone. A still more extraordinary place allotted for this plant is California, as testified by Douglas, whose observations were always so clear and so well authenticated, that we are scarcely at liberty to doubt them. The pinnately leaved *Cardamineæ* amount to seven, according to Torrey and Gray, three of which are Arctic plants. The *C. pratensis* of Linnæus is on the islands of the Arctic Ocean as well as in Behrings Straits, so that we may conclude with a considerable degree of certainty that it extends alongst the whole northern coast of this continent. Being a native also of Hudson's Bay, Canada, and the western part of the State of New York, it would appear that it accommodates itself to a breadth of climate equivalent to at least 30 degrees of latitude. The *C. hirsuta*, running less to the northward, (as far as has yet been observed,) is nevertheless found on the coasts bordering on the Arctic Sea, and on the north-west coast in high latitudes, having a distribution eastward and westward equal to the breadth of the continent in lat. 45°. The *C. Virginica* of U. States' botanists is a variation of the Cardamine we have just had under consideration. The *Cardamine digitata* is confined entirely to the north, and passes over Behring's Straits to form one of the Siberian Flora. Other three species are the *C. angulata*, and *C. oligosperma*, from the Oregon, and *C. Ludoviciana*, from Georgia, Kentucky, and the Arkansas, but they are foreign to the British possessions. *Cardamine purpurea* is a Siberian plant, and although by the celebrated voyage and discoveries of Captain, now Admiral Beechey, we know that it passes over to Kotzebue's Sound, yet it must still only be considered as foreign, as it has not yet been heard of beyond the Russian territories.

The *Dentaria*, near *Cardamine*, but having the roots toothed or tubercled, is a southern genus. *D. laciniata*, and *D. diphylla*, enter Canada, but do not, as far as I have observed, advance farther northward. The *D. tenella*, and *D. macro-carpa*, belong to the Oregon, and it is very probable may yet be discovered passing the boundary line of 49°, and so enter into our list of New Caledonia or Fraser River plants. Should Palliser's party cross

the Rocky Mountains, much information no doubt will be obtained regarding plants, and other subjects of natural history, from the able and zealous naturalists composing that scientific party. The Thompson's and Frazer's River countries display as fine a field for the enterprise of scientific and speculative minds as is to be found in North America.

Following the *Dentaria*, we have the genus *Parrya*, a name given by R. Brown to an Arctic plant or two, to commemorate the distinguished officer, who was amongst the foremost of the discoverers in the expeditions which were set on foot during the present century, to ascertain the reality of a North-West passage. As it is a northern plant, I may state that in it the pods are broader than in the genera hitherto mentioned, the valves are veiny, the seeds broadly margined, and the funiculi more or less adherent to the septum. On the Arctic coast, to the eastward of Mackenzie River, we have one species, the *Parrya arctica* of Brown; and to the westward of the same river, and on the north-west coast, the *Parrya macrocarpa*. By the late Sir John Franklin and his companion, now Sir George Back, the *P. macrocarpa* was brought home on their second voyage to and from the Arctic coast; but it must have been known before this to the Russians, Linnæus having described a variety of it under the name, *Arabis caule-nudo*.

The two genera with which Torrey closes the *Arabideæ* of North America are the *Phenicaulis* and *Leavenworthia;* but I pass them over, as the former occurs only to the westward of the Rocky Mountains, at the Forks of Lewis and Clark, on the high hills of the Wallawalla, and the other is confined to the Central and Southern States.

We are introduced to the tribe *Sisymbreæ* in the genus *Hesperis*, of which there are two of North America. The *Hesperis minima* is the same plant as the *H. pygmæa* of Hooker, and probably does not differ from the *Cherianthus Pallasii* of Pursh. It scarcely passes to the southward of the Arctic circle, but stretches from Behring's Straits eastward as far as Great Bear's Lake, where it was found by Sir John Richardson. The *H. Menziesii* is recognized as coming only from California.

The genus *Sisymbrium*, like that of *Arabis*, dispenses its species over Arctic as well as Sub-arctic America, and that too in not very unequal order. The *Sisymbrium officinale* is supposed to have been introduced from Europe into Canada and the

United States, but the *S. Sophia*, which appears in various localities in Lower Canada, may be a native; a point, however, not easy to be determined. Common to British America and the United States is the very generally diffused *Sisymbrium canescens*, which is also found on the Rocky Mountains, and westward to Oregon and California. This soft-looking, frequently hoary plant, is very hardy, bearing the rigours of the north as well as the heats of Georgia and Arkansas. The *S. Sophioides* of Fischer, found in high latitudes, extends from Hudson's Bay to the Arctic coast, stretching westward round the continent to the Pacific. It is remarkable amongst its kind by the flowers and pods being in umbelliform corymbs. The *S. junceum* is from dry stony grounds in the Oregon. Six or seven other species, the discoveries of Nuttall, are found on the hills of the great dividing ridge, south of 49°; but it is very probable that some if not all of these will be met with by Monsieur Bourgeau, the French botanist attached to Palliser's exploring party, which has been busy last season on the Bow River, and near the boundary line, where it crosses the back-bone of America. In that quarter, hitherto so dangerous, and therefore seldom or never approached by the foot of civilized man, there is a portion of both prairie and mountain yet unsearched, its geology and its botany only deducible from what is known of districts far removed from it. We may therefore anticipate a most interesting description of novelties, in the natural history of the region in question, when the surveying and exploring expeditions bring the fruits of their labors before the public. In concluding my remarks on the present genus, I may observe that the *S. humile*, a Siberian species, is also a production of the Rocky Mountains, but in the higher latitudes, from 52° to 68°. The *Sisymbrium Thalianum*, the *Arabis Thaliana* of Linnæus, has been introduced from Europe.

Passing the *Tropidocarpa* of Hooker, natives of California, we come upon the genus *Erysimum*, which contains some handsome species, shewing themselves on the plains, and on the dry grassy spots throughout the north. The *E. cheiranthoides*, known in Europe, is also gathered in Canada and the United States, and in the prairie country. We find it west of the Rocky Mountains in lat. 47°, as far as the Pacific; and Hooker gives it a place on the banks of the McKenzie, up to 67°. The *E. lanceolatum*, a handsome little plant, appears in the flora of Canada, and, proceeding northwards, reaches the Arctic Sea.

Torrey and Gray are silent as to its presence on the Pacific, although from Hooker's work we might conclude that it existed there. The *E. asperum*, a closely allied species, flourishes in the plains eastward and westward of the mountain ranges, attaining the latitude of 65° on the McKenzie. Strictly speaking, the interior of the continent is its peculiar ground, as it does not in any quarter appear to approach the sea-coast within a considerable number of degrees. Nuttall has five others of this genus, none of which have yet been noted as on British territory. One is from Arkansas and Texas, two are from the elevated plains of the Rocky Mountains, one from the banks of the Willamet, and the fifth from the neighbourhood of Monterey, Upper California.

The second great division of *Cruciferæ* is like that of the SILIQUOSÆ, very extensively distributed over all the temperate climes of the northern hemisphere, and British America has its portion of them. In the genus *Vesicaria*, the *V. arctica* extends from the island of Anticosti to the Arctic Regions, where it prevails most. The borders of the eastern prairies are probably the limit of its range westward, in the lat. of 52°. The *V. didymocarpa* is a very singular species, conspicuous by its strong corymb of flowers, and when in fruit remarkable for its evidently bilobed didymous silicle, which is orbicular or inflated. On the Rocky Mountains, from lat. 52° to 57°, and in all probability southwards to the sources of the Platte, it seeks the deep sand-banks and sand-beds, wherever its long fusiform roots may find easy lodgment.

Of all the genera of the Cruciferous order, *Draba* has in North America the greatest number of species. Thirty belong to this continent, and of those the greater part are Arctic and sub-Arctic plants. Confined to high northern latitudes, and scattered over the islands and shores of the Arctic Seas, we have the *D. algida*, *alpina*, *pauciflora*, *micropetala*, *oblongata*, *corymbosa*, *lapponica*, and *stellata*. In the extreme north is also found the *D. glacialis*; but this has likewise an Alpine residence southwardly, on the summits of the Rocky Mountains, to which the others apparently do not stray. The *Draba lævigata* has been seen as yet only at the extremity of North West America. Common to the sub-Arctic as well as Arctic regions are other Drabas more likely to be fallen in with by the Canadian botanist. The *D. muricella* exists in the north, and in Labrador. The *D. incana*, stretching along the coast of the Frozen Sea from Unalaschka to Labrador, can be

gathered plentifully on the north shores of the St. Lawrence. The *D. hirta*, is common on the rocky islands of Lake Superior; and the *D. glabella*, *lutea*, and *nemoralis*, approach the confines of Canada West. Hooker gives the island of Montreal as a habitat of the *Draba muralis* of Linnæus. The *Draba oligosperma*, a native of the banks of McKenzie's River, appears to have been collected by Nuttall on the summit of lofty hills near the sources of the Platte. The Rocky Mountains afford near their heights some Drabas peculiar to the range; the *D. densifolia* at the sources of Lewis's River, the *D. rupestris levipes*, *crassifolia* and *aurea*, on the same ridges, as far north as lat. 57°. The strictly southern species are fewer in number. *D. arabisans* is found near Lake Champlain, and in the States of New York and Michigan, crossing to the north shore of Lake Superior. Five or six others are dispersed only over the Central and Western States; but the *D. verna*, with bipartite petals, which may be reckoned among these, sometimes may be seen decking the hill-sides and fields of our province.

The fifth tribe of Cruciferæ, the *Alyssineæ*, commencing with *Vesicaria*, continued in *Draba*, will end with *Cochlearia*, a genus pre-eminently Polar, as encircling to a great extent the Great Polar Basin, representing the great flowering classes almost at the very limits of vegetation, and bearing the standard of Flora nearly to the axle of our sphere. Three *Cochleariæ* belong to Russian America, and four to our Arctic coast. These latter are the *C. Anglica*, *fenestralis*, *officinalis*, and *Danica*. *C. trydactylites* is said to occur in Labrador, and *C. Greenlandica* pertains to Greenland. Diffused laterally like a belt or girdle, this genus, assisted by other plants of a similar constitution, and the Mosses and Lichens, helps to produce an identity of vegetable growth and covering to the earth in the highest northern latitudes, on the European, Asiatic, and American shores.

The genus *Camelina*, from which the sixth tribe of Cruciferæ, the *Camelineæ*, takes name, has but one species native of North America, the *C. barbareæfolia*, which has been found only on the Russian territory on the north-west coast. The *C. sativa* must be an introduced plant, and is probably working its way westwards and northwards with the progress of civilization.

Braya, with the four following genera, has been placed by Torrey, with some degree of doubt, in the tribe *Camelineæ*. The *Braya alpina* is obtained on the Rocky Mountains, from

latitude 52° to 57°; and the *B. glabella* and *pilosa* are the discoveries of Sir John Richardson, on the shores of the Arctic Sea, the latter having been met with only at the outlet of McKenzie River.

Platypetalum purpurascens has a habitat extending from McKenzie River to Spitzbergen, and the *P. dubium* is a species of Melville Island.

Two *Eutremæ*, the *E. Edwardsii*, upon which R. Brown founded the genus, and the *E. arenicola*, are both Arctic plants. The former was discovered first on Parry's voyage to Melville Island, and was afterwards collected, along with the second, on the Arctic coast, on each side of the McKenzie, by the travellers Franklin and Richardson.

A single species of the genus *Platyspermum*, the *P. scapigerum* was the discovery of David Douglas, at the great Falls of the Oregon or Columbia River.

The *Subularia aquatica* of Linnæus has been procured from the borders of ponds in Maine by Nuttall.

Two tribes having the silicle compressed, contrary to the narrow septum, will now complete what has to be said regarding the Siliculosæ and their distribution. These are the *Thlaspidineæ* and *Lepedineæ*.

The *Thlaspi arvense* of Linnæus, as well as the *Thlaspi alpestre*, are commonly met with in old waste grounds in Canada. Both I believe to have been introduced, for neither of them occur to my knowledge in the newly-settled or the uncultivated and wilder parts of the country. The *Thlaspi alliaceum* is rare. The indigenous species *T. montanum* is found from Canada to the Arctic zone; and the *T. cochleariforma*, closely resembling it, occupies a western position, about the head waters of the Oregon. The *T. tuberosum*, remarkable for its tuberiferous roots, does not appear to have been met with in Canada or the North. It was discovered by Nuttall in Western Pennsylvania.

Hutchinsia, another genus of this tribe *Thlaspidiniæ*, has a species, the *H. calycina*, from the Rocky Mountains, in lat. 52° to 57°: a variety of it is noted as native in Kotzebue's Sound.

The *Lepidium ruderale* occurs frequently throughout the British Possessions from Hudson's Bay to the Pacific Ocean, preferring waste places like the Thlaspi. The *L. campestre*, common about fields and gardens, is a weed introduced from England. Species are met with passing the Rocky Mountains into the

Oregon Territory, such as the *L. integrifolium* and *L. montanum*. The *Lepidium Menziesii*, first known on the north-west coast, was also gathered by Drummond in the Rocky Mountains, afterwards by Nuttall on the same ranges farther south. We can merely name the Californian species, the *L. oxycarpum* and *L. latipes*, discovered by Douglas; the *L. Californicum, lasiocarpum*, and *nitidum*, by Nuttall.

The *Capsella bursa-pastoris*, or Shepherd's Purse of the old countryman, is well diffused over the whole country to the roots of the Rocky Mountains westward, and to Great Bear's Lake northwards. About this, our well-known old friend, there is never any mistake. The declared plague of the pasture, and detested by the industrious gardener, the *bursa-pastoris* nevertheless gladdens our eye with its homely and home-like look, reminding us of early days and all their associations, the country road, the cotter's kale-yard, and other long-forgotten scenes.

The third division of our order, the *Nucamentosæ*, containing the ninth tribe, the *Isatideæ* of Decandolle, furnishes us with but one genus on this continent, the *I. thysanocarpus* of Hooker, of which all the species lie west of the Rocky Mountains. The *I. curvipes*, upon which the genus was founded, was discovered by Douglas at the Great Falls of the Columbia; and the *I. oblongefolius* was first discovered by Nuttall as being native of the same country, but much lower down the river, at the junction of the Willamet. Four others are Californian, the *I. elegans* and *pulchellus* of Fischer and Meyer, and the *I. crenatus* and *laciniatus* of Nuttall.

In the fourth division *Lomentaceæ* is the tenth tribe, *Cakineæ*, in which we have the genus *Cakile*. The single species, *C. Americana*, is a strange-looking plant, known in English as the Sea Rocket. The pods are constricted, and have transverse separations, forming one celled, one seeded joints. It is not apparently a common plant, but occurs near the sea, and on the shores of the great lakes of Canada. I have seen it on sand along the north bank of the great St. Lawrence River, from the Gulf up as far as the Saguenay. Its fleshy leaves no doubt enable the Cakile, although on a smaller scale than the purely succulent orders, such as the Cacti, &c., to assimilate much of its sustenance from the air; nature thus, by wise modifications of structure, compensating liberally in one way, for what may be wanting or stinted in another. I have been sometimes surprised at the fresh-

ness of the Cakile in a dry sand, where most other plants of the same order would have withered and perished.

In taking leave of this most useful and interesting order, I may with propriety quote from Sir John Richardson's very able observations at the end of his "Journal of a Boat Voyage," published in 1851. Regarding Polar plants, he says:—"Of the Polar "plants, amounting to 91 species, which inhabit Melville Island, "the shore of Barrow's Straits to Lancaster's Sound, and the "north coast of Greenland, between the 73rd and 75th parallels "of latitude, about $\frac{7}{9}$ths range to Greenland, Lapland, or Northern "Asia. Of the remainder some have been gathered on the shores "of the Arctic Sea from Baffin's Bay to Behring's Straits, and it "is probable if these high latitudes were fully explored, the Flora "of the entire zone would be found to be uniform. Some of the "more local plants will perhaps be ascertained, on farther ac-"quaintance, to be mere varieties altered by peculiarities of "climate. That the Flora as well as the Fauna of the high "northern latitudes is nearly alike in the several meridians of "Europe, Asia and America, has long been known; and even "when to some distance south of the Arctic circle, we find that "this law is superior to the intrusion of high mountain chains, "and is but partially infringed upon." Further on he observes: "The families of Polar plants which are most rich in species are "the Cruciferæ, Gramineæ, Saxifrageæ, Caryophylleæ and Com-"positæ. Of these, the Saxifrageæ are most characteristic of "extreme northern vegetation. All of them that inhabit the 74th "parallel in America are found also in Spitzbergen, Lapland or "Siberia; and even the Polar species are twice as numerous as "those which exist in the wide district which 'Gray's Flora of "the Northern States' comprehends; and we may add, that the "plant which Humboldt traced highest in the Andes, was a "Saxifrage. The Caryophylleæ and Cruciferæ, which vie with "the Saxifrageæ in number on the 74th parallel, include many of "the doubtful species above alluded to."

There is no doubt every reason to believe that Sir John's words as to the unlucky multiplication of species through the separation of varieties will some time or other prove true, not only in the plants of the Arctic zone, but also in those further south. More extended acquaintance with both will correct our knowledge in that particular. Able monographs amongst American and European botanists will do this work, so much required.

With regard to Cruciferæ in particular, it appears to me that there exists in the species of this order an aptitude to reconcile themselves to the various peculiarities and changes of climate incident to countries under different meridians. In North America many European Cruciferæ have become naturalized. They frequently usurp a prevalence in our gardens and in cultivated grounds, so as to become weeds, reminding the old countryman at every step of scenes of his youthful home. *Nasturtium officinale*, *Barbarea vulgaris*, *Thlaspe arvense*, *Lepidium campestre*, and most frequent of all, the *Capsella bursa-pastoris*, are naturalized Americans and Canadians; and is not this in perfect accordance with the diffusive character of the order, as noted by botanists in those species which exist in the highest northern latitudes?

In those dismal regions where ice holds almost eternal empire, and where frost is arrested but for a few short weeks of the year, we still may please ourselves with discovering that wise provision is made, as far as possible under the circumstances, for the wants of man. The intense cold of winter and spring requires that the bodily functions of the Esquimaux should be fortified by a diet of pure animal food, and that too of the fattest and most oily description. The composition of the blood is thus preserved in a state fit for supporting the human frame, while the lungs are breathing freely an intensely cold condensed atmosphere. When the summer arrives, and the length of sunshine heats the air, the natives must have their systems surcharged. Nature then may be supposed as stepping in, and supplying from her stores the most cooling, aperient, and anti-scorbutic vegetables for their relief. The Esquimaux at this season, by having recourse to the productions of mother earth, may have his blood purified and his skin cleansed, as well as the inhabitant of the tropics can by the condiments around him have his languid appetite stimulated, and the incipient fever assuaged. In whatever quarter of the globe man may be placed, surely by searching he may find what is best calculated to benefit him. Let him only take the trouble and time to investigate, and turn to advantage what has been so liberally—nay, often so lavishly, we may say—spread out before him, and he will not fail to discover, that an unseen hand has been long since at work to anticipate his wishes, and supply his needs.

Montreal, January, 1859.

ARTICLE II.—*Fish Manures.* By T. Sterry Hunt. Extracted from the Report of the Geological Survey of Canada for 1857.

Before describing the results of some enquiries into the value of these manures, and the practicability of introducing their manufacture into Canada, it may be well to explain briefly certain principles which may serve to guide us in the appreciation of the subject. Modern investigations of the chemistry of vegetation have led to a more or less correct understanding of the laws of vegetable nutrition and the theory of manures, and we are all aware how many natural and artificial matters have been proposed as substitutes for the manure of the stable and farm-yard. Foremost among these ranks the Peruvian guano, composed for the most part of the exuviæ of sea-birds, and employed for centuries by the Peruvians as a powerful stimulant to vegetation. This substance owes its value to the phosphoric acid and ammonia which it is capable of affording to the growing plant; the former element being indispensable to the healthy development of vegetation and entering in large proportion into the mineral matter of the cereals; while ammonia furnishes in a form capable of assimilation, the nitrogen, which with the elements of water and carbonic acid, makes up the organic tissues of plants. Besides these essential principles, plants require sulphuric acid, silica, chlorine, potash, soda, lime, magnesia and oxyd of iron, all of which elements are found in their ashes, and are required for their healthy growth. In a fertile soil all of these ingredients are present, as well as phosphoric acid and ammonia, which last substance is constantly produced by the decay of animal and vegetable matters, and is either at once retained by the soil, which has the power of absorbing a certain portion of it, or is evolved into the air and afterwards dissolved and brought down by the rains to the earth.

Many of the mineral elements of a soil are present in it in an insoluble form, and are only set free by the slow chemical re-actions constantly going on under the influence of air and water. Such is the case with the alkalies, potash and soda, and to a certain extent with the phosphates. Now although there is probably no soil which does not yield by analysis quantities of all the mineral elements sufficient for many crops, yet by long and uninterrupted tillage the more soluble combinations of these elements may be all taken up, and the land will then require a certain time

of repose in order that a store of more soluble matters may be formed. Hence the utility of fallows.

In my analysis of the soils of the Richelieu valley, in the Report for 1850, pp. 79-90, I have shown, by comparing the virgin soils with those exhausted by continued crops of wheat during fifty years, that the proportions of phosphoric acid and magnesia, elements which are contained in large quantities in this grain, have been greatly diminished, but the soil still contains as much phosphate as it has lost, and this only requires to be rendered soluble in order to be available to vegetation.

In forests and untilled lands the conditions of a healthy vegetable growth are seldom wanting; the soil affords in sufficient quantity all the chemical elements required, while the leaves and seeds which annually fall and decay, give back to the earth a grea proportion of the elements which it has yielded. In this way the only loss of mineral matter is that which remains stored up in the growing wood or is removed by waters from the soil. Far different is the case in cultivated fields, since in the shape of corn, of fat cattle, and the products of the dairy, we remove from the soil its phosphates, alkalies and nitrogen, and send them to foreign markets. The effect of tillage becomes doubly exhaustive when by artificial means we stimulate vegetation without furnishing all the materials required for the growing plants. Such is the effect of many special manures, which while they supply certain elements, enable the plants to remove the others more rapidly from the soil. A partial exhaustion of the soil results likewise from repeated crops of the same kind; for the elements of which the cereals require the largest quantity are taken in smaller proportions by green crops, and reciprocally, so that by judicious alternations the balance between the different mineral ingredients of the soil is preserved.

One of the great problems in scientific agriculture is to supply to the soil the ammonia and the mineral matters necessary to support an abundant vegetation, and to obtain from various sources these different elements at prices which will permit of their being economically made use of. Nowhere but in the manure of the stable and farm-yard can we find combined all the fertilizing elements required, but several of them may be very cheaply procured. Thus lime and magnesia are abundant in the shape of marl and limestones; soda is readily obtained, together with chlorine, in common salt; while gypsum or plaster of Paris supplies at a low

price both sulphuric acid and lime. Potash when wanting may be supplied to the soil by wood-ashes, but phosphoric acid and ammonia are less easily obtained and command higher prices.

An abundant supply of phosphate of lime is found in bones, which when dried contain from 50·0 to 60·0 p. c. of mineral matter, consisting of phosphate of lime, with a little carbonate, and small portions of salts of magnesia and soda. The remainder is organic matter, which is destroyed when the bones are burned. This phosphate of lime of bones contains 46·0 per cent of phosphoric acid, and the refuse bone-black of the sugar-refiners usually affords about 32·0 per cent. of the acid. The different guanos also contain large amounts of phosphoric acid, and that known as Columbian guano is principally phosphate of lime. Various deposits of mineral phosphate of lime have of late attracted the attention of scientific agriculturists. I may mention in this connection the crystalline phosphate of lime or apatite of our Laurentian limestones, and the phosphatic nodules found in different parts of the Lower Silurian strata of Canada and described in previous Reports.

These mineral phosphates are in such a state of aggregation, that it is necessary to decompose them by sulphuric acid before applying them to the soil. The same process is also very often applied to bones; for this end the phosphate of lime in powder is to be mingled with nearly two-thirds its weight of sulphuric acid, which converts two-thirds of the lime into sulphate, and leaves the remainder combined with the phosphoric acid as a soluble super-phosphate. In this way, the phosphoric acid may be applied to the soil in a much more divided state, and its efficiency is thereby greatly increased. Even in its soluble form however, the phosphoric acid is at once neutralized by the basic oxyds in the soil, and Mr. Paul Thenard has lately shown that ordinary phosphate of lime, when dissolved in carbonic-acid water, is decomposed by digestion with earth, insoluble phosphates of iron and alumina being formed, which are again slowly decomposed by the somewhat soluble silicate of lime present in the soil and transformed into silicates with formation of phosphate of lime. It is probable that alkaline silicates may also play a similar part in the soil. These considerations show that the superior value of soluble phosphate of of lime as a manure, depends solely upon its greater subdivision. A portion of the phosphoric acid in Peruvian guano exists in a soluble condition as phosphate of ammonia.

With regard to the nitrogen in manures, it may exist in the form of ammoniacal salts, or combined in organic matters which evolve ammonia by their slow decay. The ammonia which the latter are capable of thus yielding, is designated as potential or possible ammonia, as distinguished from the ammonia of the ammoniacal salts, which is generally soluble in water, and is at once disengaged when these matters are mingled with potash or quicklime. Such is the sulphate of ammonia, which is prepared on a large scale from the alkaline liquid condensed in the manufacture of coal-gas. In Peruvian guano a large amount of the nitrogen is present as a salt of ammonia, and the remainder chiefly as uric acid, a substance which readily decomposes, and produces a great deal of ammonia. In fact, this decomposition takes place spontaneously, with so much rapidity, that the best guanos may, it is said, lose more than one-fifth of their nitrogen in the form of ammonia in a few months' time, if exposed to a moist atmosphere.

Other manures, however, contain nitrogen in combinations which undergo decomposition less readily than uric acid. Thus unburned bones yield from six to seven per cent. of ammonia, and dried blood, fifteen or sixteen per cent, while woollen rags and leather yield about as large a quantity. In estimating the value of such matters as manures, the difference in the facility with which they enter into decomposition, must be taken into account. Thus if too large quantities of guano are applied to the soil, a portion of the ammonia may be volatilized and lost, while with leather and wool the decay is so slow, that these materials have but little immediate effect as manures. The nitrogen of blood and flesh is converted into ammonia with so much ease, that it may be considered almost as available for the purpose of a manure as that which is contained in ammoniacal salts.

Attempts have been made to fix the money value of the ammonia and the phosphates in manures, and thus to enable us from the results of analysis, to estimate the value of any fertilizer containing these elements. This was I believe first suggested a few years since, by an eminent agricultural chemist of Saxony, Dr. Stockhardt, and has been adopted by the scientific agriculturists of Great Britain, France and the United States. These values vary of course very much for different countries; but I shall avail myself of the calculations made by Prof. S. W. Johnson of New Haven, Connecticut, which are based on the prices of manures in the United States in 1857. In order to fix the value of phosphoric

acid in its insoluble combinations, he has taken the market prices of Columbian guano, and the refuse bone-ash of the sugar refiners, which contain respectively about 40 and 32 per cent. of phosphoric acid, and from these he deduces as a mean 4½ cents the pound as the value of phosphoric acid when present in the form of phosphate of lime. This would give $1.44 as the value of 100 pounds of bone-ash, and $1.60 for the same amount of the guano, while they are sold for $30 and $35 the ton.

The value of soluble phosphoric acid has been fixed by Dr. Volcker in England, and by Stockhardt in Saxony, at 12½ cents the pound. This evaluation is based upon the market price of the commercial super-phosphates of lime. Mr. Way of the Royal Agricultural Society, however, estimates the value of phosphoric acid in its soluble combinations at only 10½ cents the pound; and Mr. Johnson, although adopting the higher price, regards it as above the true value.

In order to fix the real value of ammonia, Prof. Johnson deducts from the price of Peruvian guano, at $65 the ton, the value of the phosphoric acid which it contains, and thus arrives at 14 cents the pound for the price of the available ammonia present. This kind of guano, however, now commands a price considerably above that which serves for the basis of the above calculation; and both Volcker and Stockhardt fix the value of ammonia at 20 cents the pound. The price of potash as a manure is estimated by Mr. Johnson at 4 cents the pound; but this alkali rarely enters to any considerable extent into any concentrated manures, and may therefore be neglected in estimates of their value.

The use of fish as a manure has long been known; on the shores of Scotland, Cornwall, Brittany, some parts of the United States, and on our own sea-coasts, the offal from fisheries, as well as certain bony fishes of little value for food, are applied to the soil with great benefit. The idea of converting these materials into a portable manure was however I believe first carried into effect in France by Mr. Démolon, who seven or eight years since, erected establishments for this object on the coast of Brittany and in Newfoundland. For the details of this manufacture I am indebted to the *Chimie Industrielle* of Payen. Concarneau, in the department of Finisterre, is a small town whose inhabitants are employed in fishing for sardines, and it is the refuse of this fishery which is employed in the manufacture of manure. The offal is placed in large coppers and heated by steam until

thoroughly cooked, after which it is submitted to pressure, which extracts the water and oil. The pressed mass is then rasped, dried in a current of hot air, and ground to powder. 100 parts of the recent offal yield on an average 22 parts of the powder, besides from 2 to 2½ parts of oil. The manufactory of Concarneau employs six men and ten boys, and is able to work up daily eighteen or twenty tons of fish, and produce from four to five tons of the powdered manure.

This manure contains, according to an average of several analyses, 80.0 per cent. of organic matters, and 14.1 per cent. of phosphates of lime and magnesia, besides some common salt, a little carbonate of lime, small portions of sulphate and carbonate of ammonia, and only 1.0 per cent of water. The nitrogen of this manure, which is almost wholly in the form of organic matters, corresponds to 14.5 per cent of ammonia, and we may estimate the phosphoric acid, which is here present in an insoluble form, at 7.0 per cent. If we calculate the value of this manure according to the rules above laid down, we shall have as follows for 100 pounds:—

Ammonia,—14½ pounds, at 14 cents,.....	$2.03
Phosphoric Acid,—7 pounds, at 4½ cents.....	0.31½
	$2.34½

This is equal to $47 the ton of 2000 pounds; the manufactured product of Concarneau, however, according to Payen, is sold in the nearest shipping ports at 20 francs the 100 kilogrammes, (equal to 220 pounds), which, counting the franc at $0.20, is equivalent only to $1.81, the 100 pounds, or a little over $37 the ton. This however was in 1854, since which time the price of manures has probably increased.

Mr. Démolon in company with his brother, has also according to Payen, erected a large establishment for the manufacture of this manure on the coast of Newfoundland, at Kerpon, near the eastern entrance of the Strait of Bellisle, in a harbor which is greatly resorted to by the vessels engaged in the cod-fishery This manufactory, now in successful operation, is able to produce 8,000 or 10,000 tons of manure annually. Payen estimates the total yearly produce of the cod-fisheries of the North American coast to be equal to about 1,500,000 tons of fresh fish; of this, one-half is refuse, and is thrown into the sea or left to decay on the shore, while if treated by the process of Démolon, it would

yield more than 150,000 tons of a manure nearly equal in value to the guano of the Peruvian islands, which now furnish annually from 300,000 to 400,000 tons. If to the manure which might be obtained from the cod-fisheries of the Lower Provinces, we add that of many other great fisheries, we are surprised at the immense resources for agriculture now neglected, which may be drawn at a little expense from the sea, and even from the otherwise worthless refuse of another industry. To this may be added vast quantities of other fish, which at certain seasons and on some coasts are so abundant that they are even taken for the express purpose of spreading upon the adjacent lands, and which would greatly extend the resources of this new manufacture. The oil, whole extraction is made an object of economic importance in the fabrication of manure from sardines, in France, exists in but very small quantities in the cod, but in the herring it equals 10 per cent. of the recent fish, and in some other species rises to 3.0 and 4.0 per cent.

Mr. Duncan Bruce of Gaspé has lately been endeavoring to introduce the manufacture of fish-manure into Canada; but he has conceived the idea of combining the fish offal with a large amount of calcined shale, under the impression that the manure thus prepared will have the effect of driving away insects from the plants to which it is applied. He employs a black bituminous shale from Port Daniel, and distilling this at a red heat, passes the disengaged vapours into a vat containing the fish, which by a gentle and continued heat, have been reduced to a pulpy mass. The calcined shale is then ground to powder and mingled with the fish, and the whole dried. Experiments made with this manure appear to have given very satisfactory results, and it is said to have had the effect of driving away insects when applied to growing crops, a result which may be due to the small amount of bituminous matter in the products of the distillation of the shale, rather than to the admixture of the calcined residue. Coal-tar is known to be an efficient agent for the destruction of insects, and in a recent number of the journal, *Le Cosmos*, it is stated that simply painting the wood-work of the inside of green-houses with coal-tar has the effect of expelling from them all noxious insects. Mr. Bruce caused several analyses of this shale to be made by Dr. Reid of New York, from which it appears that differerent specimens contain from 2·0 to 26·0 per cent. of carbonate of lime, besides from 1·4 to 2·0 per

cent. of carbon remaining after distillation. The amount of volatile matter, described by Dr. Reid as consisting of water, naphtha and ammonia, was found by him in two different samples to equal only 3·5 per cent., of which a large proportion is probably water.

I have examined two specimens of manure prepared by Mr Bruce from the fish commonly known as the menhadden (*Alosa menhaddeu*). No. 1 was made with the Port Daniel shale, as before described; while for No. 2, this was replaced by a mixture of clay and saw-dust, which was distilled like the shale, the volatile products being added to the decomposing fish. The oil which rose to the surface of the liquid mass had been separated from the second preparation, but remained mingled with the first. both of these specimens were in the form of a black granular mass, moist, cohering under pressure, and having a very fishy odour. A proximate analysis of these manures was first effected by exposing a weighed portion to a temperature of 200° F. till it no longer lost weight, and then calcining the residue, from which the carbonaceous residue very readily burned away. The oil in the first specimen was obtained by digesting a second portion, previously dried, with either, so long as anything was taken up. The solution by evaporation left the oil, whose weight was deducted from the loss by ignition. The portion of oil remaining in the second sample was not determined.

	I.	II.
Animal matter and carbon,	23.7	21·0
Oil,	6·6	
Water,	13·5	21·8
Earthy matters,	56·2	57·2
	100·0	100·0

The residue of the calcination was digested with hydrochloric acid, which dissolved the phosphate of lime from the fish-bones, together with portions of lime, magnesia, alumina, and oxyd of iron, derived from the shale and clay. The solution from No. 1 contained, moreover, a considerable portion of sulphate from the gypsum of the shale. Small quantities of common salt were also removed by water from the calcined residues. The dissolved phosphoric acid, lime, and magnesia were separated by precipitating the phosphoric acid, in combination with peroxyd of iron, from a boiling acetic solution and were determined according to

the method of Fresenius. The nitrogen of the organic matter was estimated by the direct method of burning a portion of the dried substance with soda lime, and weighing the disengaged ammonia as ammonia-chlorid of platinum. The results were as follows for a hundred parts:—

	I.	II.
Phosphoric acid,	3·40	3·99
Sulphuric acid,	2.16	·15
Lime,	5·90	4·44
Magnesia,	1·20	1·15
Ammonia,	3 76	2·60

If we calculate the value of the first specimen according to the rules already laid down, we have as follows for 100 pounds:—

Phosphoric acid, 3 4 pounds at 4½ cents,	$0·153
Ammonia 3¾ pounds at 14 cents,	0·525
	$0·678

At 68 cents the 100 pounds, this manure would be worth $13.60 the ton. The sulphuric acid is of small value, corresponding to 80 pounds of plaster of Paris to the ton, and we do not take it into the calculation. The somewhat larger amount of phosphoric acid in the second specimen, is probably derived in part from the ashes of the saw-dust, and in part from the clay. The value of this manure would be $10·88 the ton.

In order to arrive at the real value of the animal portion of this manure after the removal of the oil, we may suppose, since Dr. Reid obtained from the shales from 4·5 to 7·6 per cent. of fixed carbon, that with the 56.2 parts of calcined residue, there were originally 3·7 parts of carbon derived from the shales. This deducted from 23·7 parts leaves 20·0 of nitrogenized animal matter in 100 parts of the manure, yielding 3·76 parts, or 18·8 per cent. of ammonia. This matter consists chiefly of muscular and gelatinous tissues, and Payen obtained from the dried muscle of the cod-fish, 16·8 per cent. of nitrogen, equal to 20·4 of ammonia. The 24·4 parts of phosphoric acid in the manure will correspond to 7·4 of bone-phosphate, and if to this we add for moisture, impurities, etc., 2·6 parts, = 3·00 in all, we should have for 100 pounds of

the fish when freed from oil and dried, the following quantities of ammonia and phosphoric acid :—

Ammonia,—12½ pounds at 14 cents,.....	$1.75
Phosphoric acid,—11½ pounds at 4½ cents,..	0·51
	$2·26

The matter thus prepared would have a value of $45.20 the ton, agreeing closely with that which we have calculated for the manure manufactured from sardines in France, in which the quantity of ammonia is somewhat greater, and the phosphoric acid less, giving it a value of $47 the ton.

Prof. George H. Cook of New Jersey, in an analysis of the menhadden, obtained from 100 parts of the dried fish, 16·7 parts of oil, besides 61·6 of azotized matters yielding 9·28 parts of ammonia, and 21·7 of inorganic matters, etc., containing 7·78 of phosphoric acid.* If we deduct the oil, we shall have for 100 parts of the fish, according to this analysis, 11.2 of ammonia, and 9·3 of phosphoric acid.

By comparing these figures with the results calculated for the animal portion of Mr. Bruce's manures, we find :

	Ammonia.	Phosphoric acid.
Manure from sardines (Payen),.....	14·5	7·0
Dried menhadden (Cooke),.....	11·2	9·3
Manures by Mr. Bruce.....	3·75	3·4
" " (excluding shale),.	12·5	11·3

The proportion of phosphates is of course greater in the more bony fishes. In the manure of Mr. Bruce there are doubtless small amounts of phosphoric acid and ammonia, derived from the shale and the products of its distillation ; but these do not however warrant the introduction of an inert material which reduces more than two-thirds the commercial value of the manure. The results which we have given clearly show that by the application of a process similar to that now applied in France and in Newfoundland, which consists in cooking the fish, pressing it to extract the oil and water, drying by artificial heat, and brinding it to powder, it is easy to prepare a concentrated manure, whose value, as a source of phosphoric acid and ammonia, will be in round numbers, about $40 the ton.

* Report of the Geological Survey of New Jersey for 1856, p. 93.

We can scarcely doubt that by the application of this process a new source of profit may be found in the fisheries of the Gulf, which will not only render us independent of foreign guano, now brought into the Province to some extent, but will enable us to export large quantities of a most valuable concentrated manure, at prices which will be found remunerative.

ARTICLE III.—*Additional Notes on the Post-Pliocene Deposits of the St. Lawrence Valley.* By J. W. Dawson, LL.D., F.G.S., &c.

(Read before the Natural History Society of Montreal.)

In a paper on the Newer Pliocene and Post Pliocene deposits of the vicinity of Montreal, communicated to the Natural History Society last winter, I promised to follow up the subject, especially in the direction of the more minute organisms of these deposits, and the comparison of the stratigraphical arrangements near Montreal with those in other parts of the Province. In fulfilment of this promise, I now proceed to state a number of facts which I have ascertained or which have been communicated to me in the past summer.

I. Foraminifera and Bryozoa.

The Foraminifera are creatures almost at the extreme limit of simplicity of structure in the animal kingdom. Generally microscopic in dimensions and consisting of a soft and apparently homogeneous jelly, they present no appreciable organs, except little thread-like extensions of their bodies, which appear to be their organs of prehension and locomotion. Such creatures might at first sight be supposed incapable of being preserved among the medals of creation. They have, however, the power of secreting for their protection delicate and beautiful calcareous cells, divided into a number of chambers which are added successively in the progress of growth, and communicate with each other and with the outer world by minute orifices; and as these creatures abound everywhere in the ocean, their shells are constantly accumulating on its bottom, so as in some cases so form thick beds of calcareous matter. The Bryozoa, equally minute in size, are far more complex in structure; presenting, with a general polyp form,

complicated digestive and muscular apparatus, which place them far in advance of the hydroid polyps, and have induced the majority of modern zoologists to arrange them with the mollusks. They occupy horny or calcareous cells, which usually have wide openings for the extension of the arms or tentacles which procure the food of the inmates. These cells are arranged in branching or flat and circular groups, which form a large proportion of the zoophytes of the older naturalists, and are to be found everywhere on submerged stones, shells, and sea-weeds.

I place these two tribes, in their structure so dissimilar, together, because they are found together in the drift deposits; and because, owing to this and to their microscopic size, they can be conveniently studied in connection.

Before proceeding to describe the species found, I may mention that though the minute dimensions of these objects may cause them to escape the notice of many collectors, they are, when studied with the aid of the microscope, not inferior in interest and beauty to any other fossils found in our tertiary plains. The Foraminifera may easily be detected by examining the clays in which fossil shells occur, and particularly those holding *Fusus tornatus* and the spicula of *Tethea Logani*,* with the aid of a pocket lens. When they are thus ascertained to be present, a quantity of the clay should be well dried, broken into small pieces, and stirred in a quantity of water, when the clay will subside and the little shells may be skimmed from the surface. When dry they may be spread on a tray or on dark-colored paper, and examined with the lens to ascertain what forms are present. They may then be picked up with a moist camel's-hair pencil, and placed separately in small boxes for more minute examination. For the microscope, they may be mounted either on a dark ground as opaque objects, or in Canada balsam as transparent objects; and should be studied in both of these ways. With the foraminifera, the collector will usually find valves of *Cytheridea*, some of the smaller univalves, and detached cells of *Lepralia*.

(1.) *Position of Foraminifera and Bryozoa in the Post Pliocene Deposits.*

Logan's Farm.—In the last volume of the Naturalist, I de-

* For notices of these and other fossils referred to in these pages, see my former paper, Canad. Nat. vol. 2.

scribed a number of species of fossils from Logan's farm, and stated what I believed to be their relative position. By the kindness of Mr. Logan, I have since been enabled to make an excavation in the spot where these remains are most abundant, and obtained the following section :—

	ft.	in.
Soil and sand,	1	9
Tough reddish clay,	0	0½
Gray sand, a few specimens of *Saxicava rugosa*, *Mytilus edulis*, *Tellina Grœnlandica*, and *Mya arenaria*, the valves generally united,	0	8
Tough reddish clay, a few shells of *Astarte Laurentiana*, and *Leda Portlandica*,	1	1
Gray sand, containing detached valves of *Saxicava rugosa*, *Mya truncata*, and *Tellina Grœnlandica*; also *Trichotropis borealis*, and *Balanus crenatus*: the shells in three thin layers	0	8
Sand and clay, with a few shells, principally *Saxicava* in detached valves	1	3
Band of sandy clay, full of *Natica clausa*, *Trichotropis borealis*, *Fusus tornatus*, *Buccinum undatum*, *Astarte Laurentiana*, *Balanus crenatus*, &c. &c., sponges and *Foraminifera*. Nearly all the rare and deep-sea shells of this locality occur in this band,	0	3
Sand and clay, a few shells of *Astarte* and *Saxicava*, and remains of sea-weeds with *Lepralia* attached; also *Foraminifera*,	2	0

Stony clay, boulder clay.

It thus appears that at Logan's farm we have littoral species at top, and that all the rare and deep-water fossils, as well as the *Lepraliæ* and *Foraminifera* occur in a comparatively thin band near the base of the deposit. This corresponds precisely with the order observed elsewhere in the vicinity of Montreal; though at Logan's Farm the arrangement is somewhat more complex than in other localities.

Tanneries.—At the brick-yards near the village of the Tanneries, near Montreal, the surface of the Leda clay is well stored with *Leda Portlandica*, *Astarte Laurentiana*, *Natica clausa Tellina Greenlandica*, and some other shells. It also contains sponge spicula and foraminifera. The shells at this place, though by no means so numerous as at Logan's farm, are remarkable for their excellent state of preservation.

Beauport.—I visited this celebrated deposit for the first time last autumn. At first sight it consists of a mass of stratified sand

and gravel, equivalent to the Saxicava sand of Montreal, and resting on boulder clay. The overlying mass is filled with *Saxicava Tellinæ*, &c.; and the underlying boulder clay as usual contains no fossils. My experience in the Montreal deposits, however, led me to expect a bed, however thin, representing the Leda clay, between these; and on searching at the junction of the two great beds above mentioned, I was gratified by finding a layer of sand about three inches in thickness, filled with the rarer shells of the deposit, characteristic of its deeper waters, such as *Fusus tornatus*, *Pecten Islandicus*, *Buccinum ciliatum*, *Modiolaria discors*, &c.* The *Rhynconella psittacea* occurs only in this layer, and in such a manner as to leave no doubt that it is buried here in situ, in the very spot where it lay anchored to the stones of the surface of the drift. On these stones, however, I found a new and interesting field for observation. In the thin layer above referred to, all the stones, as well as those that lay on the surface of the boulder clay or partly imbedded in it, were covered with the remains of marine creatures, especially *Balanus crenatus*, *Spirorbis sinistrorsa*, *Spirorbis spirillum*, *Lepralia* and *Hippothoa*. This layer, in short, evidently represented a time when the surface of the boulder clay, covered only by a thin layer of sand and stones, constituted the bottom of clear and deep water, before it became covered by the Saxicava sand. This bottom, although no clay has been deposited on it, represents the Leda clay at Montreal, and is exceedingly rich in the fossils usually found at the surface of that bed. *Foraminifera* occur in it, but they are comparatively rare, and, so far as I could find, only of species common at Montreal.

(2.) *Species of Foraminifera.*

In my paper of last year a few of these were figured, but the nomenclature of these creatures was in a state so unsettled that I hesitated to attach names to them or to identify them with described species. I am now relieved of the greater part of this difficulty by the appearance of Williamson's excellent monograph on the British Foraminifera, the nomenclature of which I shall follow in noticing our Canadian species.

---

* Sir C. Lyell notices the fact that these shells are more abundant in the lower part of the mass than above.

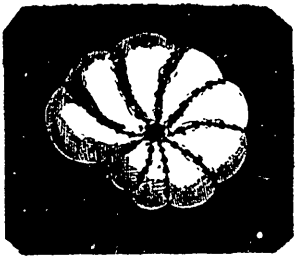


Fig. 1.

1. *Polystomella umbilicatula*, Walker (Fig. 1).*—Nine tenths of the foraminifera from the Montreal clays belong to this species, which also occurs at Beauport, and in equal proportionate abundance living in Gaspé Bay. The specimens all belong to the variety *incerta* of Williamson; and as among many hundreds of specimens I can find none that present the typical characters of the species, and as the general form is also less compressed than in the typical specimens as described and figured by Williamson, I should be inclined to believe this so-called variety in reality a distinct species, were it not for the fact, that, while these curious little creatures are almost indefinitely variable, there is a remarkable persistency of certain varieties in particular localities. The modern specimens from Gaspé correspond precisely with their ancient progenitors of the Post-Pliocene clays. The size of the fossil specimens is large for the species; the diameter of some individuals being $\frac{1}{30}$th of an inch.

Localities.—Logan's farm, Montreal; Brick-yards at Tanneries, Montreal; Beauport; also recent in Gaspé Bay.

2. *Nonionina crassula*, Walker.—Among the fossil specimens of the last species, there are many not distinguishable from it in external form, in which I cannot find, either when viewed as opaque or transparent objects, the characteristic septal apertures of Polystomella. These specimens are usually smaller, more hyaline, and smoother than those showing the apertures. If distinct, they must belong to the species above named. I found no individuals of this description among my recent specimens from Gaspé.

---

* See also paper in Can. Nat. Vol. 2, Fig. 17.

3. *Polymorphina lactea* (Figs. 2, 3, also paper in Canad. Nat. vol 2). This is perhaps the second species in relative importance, though much less plentiful than *Polystomella umbilicatula*. The greater number of the specimens belong to the variety "*typica*" of Williamson (Fig. 2). Others appear to be an exaggerated form of the variety "*oblonga*" (Fig. 3), and many others, especially the smaller examples, are of the variety "*communis*." A similar range of varieties exists in the modern specimens from Gaspé. Size $\frac{1}{30}$ to $\frac{1}{50}$.

Localities.—Logan's farm; Tanneries: recent in Gaspé.

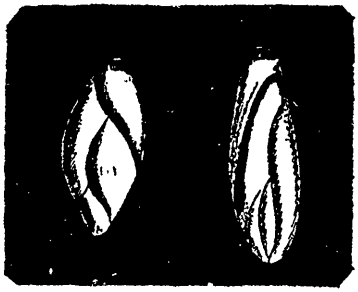


Fig. 2 Fig. 3.

4. *Miliolina seminulum* (Lin.)—(For figure, see paper in Can. Nat. Vol. 2, Fig. 18.) In my paper of last year this species was noticed as *Quinqueloculina occidentalis*, Bailey; and I still believe it to be identical with the shell so named; but I presume that it, as well as many other supposed species of the genus *Quinqueloculina* of D'Orbigny, must be included in *Miliolina Seminulum*, as extended by Williamson. This shell is not infrequent in the clays at Montreal, and it also occurs in Gaspé Bay. It approaches very nearly to the typical form of the species, but is usually of small size, not exceeding $\frac{1}{30}$th of an inch in length.

Locality.—Logan's farm.

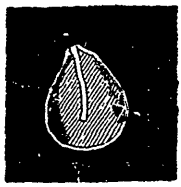


Fig. 4.

Fig. 5.

5. *Entosolenia globosa* (Figs. 4, 5).—This species is not uncommon in the clay at Montreal. Fig, 21 of my paper of last year is

referable to it, as I had not then observed the internal tube, and supposed it in consequence to be an Orbulina. Figs. 4 and 5 show this internal structure. This species is very small, scarcely exceeding $\frac{1}{100}$th of an inch, and is very smooth and translucent.

Locality.—Logan's farm; Tanneries.

288

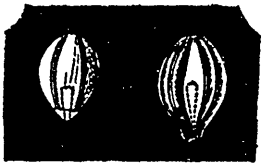
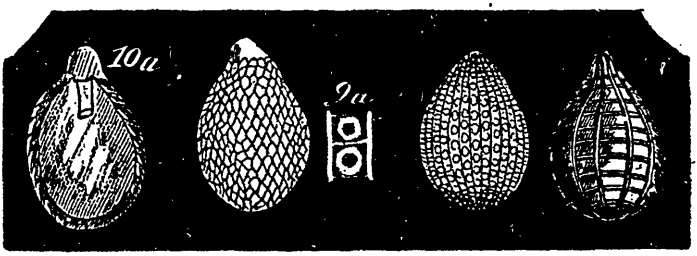


Fig. 6. Fig. 7.

6. *Entosolenia costata*, Williamson (Figs. 6, 7; also Fig. 22 in paper of last year.)—This beautiful little shell differs from that last described only in the possession of longitudinal narrow ribs. Williamson, who had seen only two or three examples, establishes it as a separate species with some doubt; and since in my specimens from the Montreal clays the number and distinctness of the ribs are very variable, I think it probable that this shell is only a variety of *E. globosa.*

Locality as above.



289

Fig. 10. Fig. 9. Fig. 8.

7. *Entosolenia Squamosa* (Figs. 8, 9, 10).—This, the most elegant of all our Post-Pliocene foraminifera, presents several beautifully ornamented varieties. In the last species the sides are marked by simple longitudinal ribs. In the simple varieties of this the ribs are crossed by more slender transverse bands In others the rectangular spaces thus formed appear to have circles inscribed in them. In others the distinction of longitudinal and transverse ribs disappears, and the whole surface be comes covered with a regular hexagonal network of raised lines of various degrees of fineness. I have endeavoured to represent

several of these forms in the figures; but there are many intermediate varieties, and my wood-cut representations fall far short of the exquisite beauty of the shells themselves, which appear under the microscope as if worked in pure translucent porcelain. Size $\frac{1}{100}$ to $\frac{1}{60}$.

Parker and Jones regard the three species last described as identical. Williamson also leans to this view; and since in my specimens there is a gradation from those that are smooth to those that are ribbed, and from these to those that are netted, I can scarcely hesitate to adopt the same conclusion, in which case the two last species must be regarded as varieties of *E. globosa.*

Fig. 11.

8. *Biloculina ringens*, D'Orb. (Fig. 11).—I have found only two specimens of this species, and neither revealed much of its real character until mounted as a transparent object. I have figured one of them as it appears in this way; and it well shows the manner in which the successive cells are added, the orifice being alternately at opposite ends of the shell. Size about $\frac{1}{50}$.

Locality.—Tanneries.

All the species of Foraminifera above noticed are found living as well as fossil. Three of them have been obtained by myself from Gaspé Bay, and the others may probably be found there. The species most abundant in the tertiary clays is also that which prevails in Gaspé Bay, and the conditions of life in both are the same. The Gaspé specimens were found in mud, in from 10 to 15 fathoms, and holding *Leda limatula*, *Tellina calcarea*, and *Astarte sulcata*, so that it may be regarded as strictly equivalent to our Montreal Leda clay, in or at the surface of which the Foraminifera chiefly occur. Two species found at Gaspé have not as yet been recognized in the tertiary clays. One is a globular shell, probably *Orbulina universa*, the other a rough, punctured, yellowish species, probably *Bulimina scabra.*

All the species found in the Canadian tertiary clays are widely distributed in the North Atlantic, and some of them still more extensively. *Polymorphina lactea* is found in the British crag,* and *Entosolenia globosa* in Miocene deposits at Petersburgh, U.S.† They afford little indication of climate, *Miliolina seminulum*, for instance, extending in the present seas from Greenland to Cuba. With respect to depth of water, their indications are probably more precise, though on this subject I can find little reliable information. One fact is certain, that in Gaspé, at present, a depth of 10 to 20 fathoms corresponds bathymetrically, in so far as these creatures are concerned, with that represented by the upper layers of the Leda clay, or brick-clay of Montreal. I have obtained, however, at least one indication that there are still lower depths, not represented as yet by the fossils of our tertiary deposits.

I owe to the kindness of Capt. Orlebar, R.N., two small specimens of fine clay, taken up by the sounding-lead from depths of 187 and 196 fathoms, off Mount Camille, near Bic Island, in the River St. Lawrence. On carefully levigating these specimens, I found in them three species of Foraminifera, all distinct from those of the tertiary clays and of Gaspé, and the silicious shields of a number of microscopic plants (*Diatomaceæ*). The Foraminifera I refer to the following species:—

Rotalina turgida, Williamson. (Fig. 20.)
Spiroloculina depressa, D'Orbigny. (Fig. 21.)
Bulimina auriculata, Bailey. (Fig. 22.)

Fig. 20.

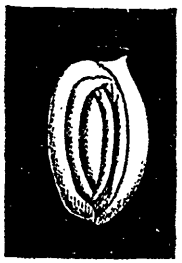


Fig. 21.

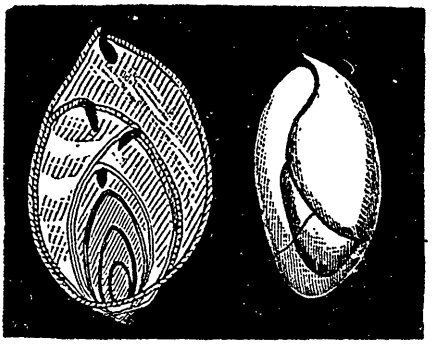


Fig. 22.

* Wood. † Bailey.

The Diatomaceæ associated with these shells include *Coscinodiscus lineatus* and species of *Gallionella, Eunotia, Cocconeis* and *Achnanthes*, most of them apparently identical with forms figured by Bailey. There are also minute acicular spicula of sponges.

Since the highest points at which raised beaches have been found in Canada scarcely reach an elevation of 80 fathoms above the sea level, we can scarcely expect to find on the present land evidence of depths equal to those represented by these soundings. Their containing distinct species from those in the tertiary clays is, however, an interesting fact, and I figure these as a guide to collectors who may be so fortunate as to find them in a fossil state.

(3.) *Species of Bryozoa.*

From the abundance of the remains of these creatures on stones at the surface of the boulder clay at Beauport, I have no doubt that a number of species might reward a diligent search. My time however at this locality was very limited, and although I brought thence single pebbles with as many as four or five species attached to them, I have no doubt that my collection includes only a small fraction of the species occurring there. The specimens are also in many instances in a defective state of preservation; and as collectors of these objects well know, even in recent specimens it is often very difficult to determine species from the dead cells alone. I am therefore able to name at present only a few species, but these, I trust, may be relied on with some certainty.

1. *Hippothoa catenularia*, Fleming. (Fig. 12.)—This pretty little organism spreads its chains of cells over the tertiary pebbles at Beauport, just as is now does in the Gulf of St. Lawrence; and being of a dense and strong texture, is remarkably well preserved. It belongs at present to the Laminarian and Coralline zones, and is found abundantly in Gaspé Bay in nine fathoms.

2. *Hippothoa divaricata*, Lamour. (Fig. 13.)—This smaller and more delicate species is very abundant at Beauport; but from its minuteness and its similarity in color to the grey, weathered pebbles, may easily escape observation. It differs from the typical form of the species in having the cells united to each other directly, instead of by a slender calcareous thread; but as Johnston* mentions this as sometimes occurring in recent specimens

295 296

Fig. 12.

Fig. 13.

Fig. 14.

it may be regarded as merely the characteristic of a variety*. I have not yet found this species living in the Gulf of St. Lawrence.

3. *Tubulipora flabellaris*, Fabricius. (Fig. 14.)—I refer—with some doubt—to this species the organism represented in fig. 14, which occurs sparingly and not in good preservation on stones at Beauport. Fabricius found this species in Greenland, and it occurs in various parts of the North Atlantic. I have not found it living, but it may be the same with the *T. divisa*, a species closely allied to *flabellaris*, found by Stimpson in the Bay of Fundy.

297 298

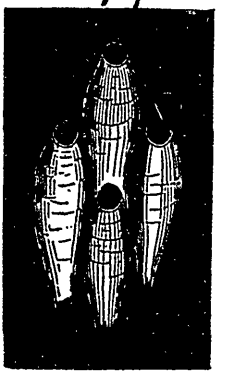


Fig. 15.

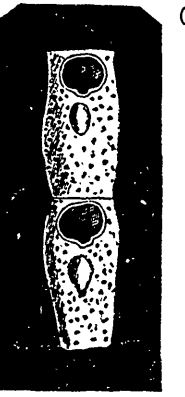


Fig. 16.

4. *Lepralia hyalina*, Lin. (Fig. 15.)—The organism represented in fig. 15 must, I think, be referred to this species. It is found sparingly on stones at Beauport, often nearly covered with the remains of its ovicapsules. It now lives in the Gulf of St. Lawrence and the Banks of Newfoundland.

5. *Lepralia pertusa*, Johnston. (Fig. 16.)—This species is

* British Zoophytes, page 292.

very abundant at Beauport, and, as usual with it, is very variable. The cells represented in fig. 16 belong to the most regular and beautiful variety, which occurs in a state of preservation quite equal to recent specimens. *L. pertusa* is still one of the most abundant forms on the American coast; and the study of the diverse forms of cells which occur in the same patch, is very instructive in relation to the errors likely to arise from basing specific distinctions in these creatures on minute differences in the forms of the cells.

The two last species appear to the naked eye on the stones of the drift, as flat, roundish, white patches, somewhat roughened, like shagreen; and under a lens of low power disclose the forms of their cells.

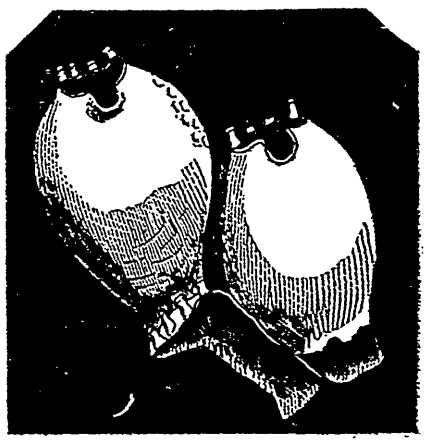


Fig. 17.

7. *Lepralia quadricornuta.* N. S. (Fig. 17.)—This is a large species, the cells being about $\frac{1}{23}$th of an inch in length. It is quite distinct from any species known to me. Its description is as follows:—Cells arranged alternately, ovate, ventricose, smooth on the greater part of the surface, but toward the lower end finely marked with radiating and transverse lines, and at the margins roughened with scaly projections; aperture narrowed, flattened at the distal margin, and armed with four hollow spines, those at the angles strongest; proximal margin deeply sinuated and projecting.

The specimens occur abundantly in the lowest part of the deposit at Logan's farm, and are arranged in such a manner as to

show that they were attached to fronds of algæ which have entirely disappeared. Being imbedded in soft clay, it is much more difficult to secure perfect specimens than in the case of the species attached to stones. From the position of this Lepralia in the deposit, I infer that it lived in very deep water; and it is possible that when we are better acquainted with the deeper parts of the Gulf of St. Lawrence, it may be found there. Having searched in vain for any described species corresponding with it, I propose for it the name of *L. quadricornuta*, founded on its most obvious distinctive character, which is of more importance here than in the case of a recent species, owing to the circumstance that the specimens in the clay usually split in such a manner as to show only the inside of the cells, on which the four horns generally remain sufficiently distinct.

Patches of this Lepralia one inch in length and half an inch in breadth were found at Logan's farm, and the cells were remarkably uniform in size and shape. If found in a living state, its large size and elegant vase-like form will render it one of our finest species. Its nearest allies appear to be *L. ventricosa*, Hassell, *L. trispinosa*, Johnston, and *L. crassispina*, Stimpson.

Before leaving the Bryozoa, it may be well to name the additional species known to me as living in the Gulf of St. Lawrence and likely to occur in the drift:—

Membranipora pilosa, Gaspé, Nova Scotia.
Membranipora, another species, Gaspé.
Flustra Murrayana, Gaspé, Metis, Miss Carey's collection.
Tubulipora patina, Gaspé, Metis, Nova Scotia.
T.——— penicellata, Gaspé.
Idmonea Atlantica, Gaspé.
Cellularia neritina, Miss Carey's collection.
Cellularia, another species, Gaspé.

Through the kindness of Andrew Dickson, Esq., I was lately favored with the inspection of a flat stone taken up by the hook of a fisherman on the Banks of Newfoundland, which wonderfully resembles, in its assemblage of species, the stones in the drift at Beauport. It has at one end a group of *Balanus crenatus* of the precise variety so common in the drift; and over various parts of the surface are abundant shells of *Spirorbis sinistrorsa*, with at few of another species not as yet found in the drift. Large portions of the surface are covered with *Lepralia variolosa* and

hyalina; and there is also a *Tubulipora* closely resembling that found at *Beauport.* The shell of a dead *Balanus* contained a little fine sand, among which were small and much rubbed specimens of a *Polystomella* or *Nonionina,* and fragments of spines of *Echini.* This stone is indeed almost a precise modern counterpart of those buried in the drift at Beauport; and they, like it, probably lay in the bottom of a sea loaded in spring with boulder-bearing ice.

I had almost omitted to mention that some of the stones from Beauport, with *Balanus, Bryozoa,* &c., bear on their surfaces distinct marks of glacial action, in their polish and striation; and that just as in exposed situations in modern seas, their animal tenants have evidently selected the re-entering angles and least exposed surfaces for their habitations.

II. Fresh-water Shells in the Post-pliocene Deposits.

I have on several occasions found specimens of *Limnea* in the Post-pliocene clays, but always suspected some accidental intermixture. I have been favoured in the past summer, by Andrew Dickson, Esq., with specimens of land and fresh-water shells from the bank of a brook emptying into the Mississippi, a tributary of the Ottawa, two miles below Pakenham Mills, and at an elevation of about 266 feet above Lake St. Peter. They were found in sand and gravel containing *Tellina Grœnlandica,* and which Mr. Dickson thinks is an undisturbed tertiary deposit. The specimens furnished to me afford many internal evidences which would lead me to the same conclusion. The species present are:—

Valvata tricarinata,	*Planorbis parvus,*
Planorbis bicarinata,	*Amnicola porata,*
Planorbis trivolvis,	*Helix striatella ?*

Lymnea elodes ?

As may be seen by reference to the paper by Mr. Billings in the first volume of this journal, all these shells now exist in the Ottawa valley. Proof of their existence there in the Post-pliocene era would be of great interest; and though I am fully aware of the many chances that may cause recent fresh-water shells to be mixed with older deposits, I am strongly inclined to believe that these deposits at Pakenham afford such evidence. Their occurrence is at least deserving of notice, that the attention of geologists may be attracted to the locality.

III. Land Plants.

I am indebted to Andrew Dickson, Esq., for the opportunity of studying a large number of nodules containing plants, collected by him at Green's Creek, on the Ottawa. They contain numerous vegetable fragments, which appear to have been originally distributed over the surface of a tract of clay and covered by similar material, a layer of calcareous nodules subsequently forming along the plane of deposition and imbedding and preserving the remains, which are very little changed, though some of them appear to have been in an advanced state of decomposition before being imbedded. Among them I can recognize leaves or fragments of leaves of the *Populus balsamifera*—which seems to be a very abundant plant at this locality—leaves and stems of grasses, needles of pines, and a moss apparently of the family *Fontinaleæ* or *Hypneæ*.* There is also a well preserved small *dicotyledonous* leaf, which I have not yet been able to identify.

The most curious point in connection with these remains is their association with what seem to be remains of *Algæ*, and with shells of *Leda Portlandica* having the valves cohering. They would thus appear to have been deposited in the sea and in deep water. I observed something of the same kind in Gaspé Bay, where, at the mouth of the North-west river, I found *Leda limatula* living in dark-coloured mud containing vegetable matter, much of it no doubt washed down by streams from the land.

IV. Miscellaneous Fossils.

Ophiocoma.—In my paper of last year I mentioned an organism in a nodule from Ottawa which seemed to be the remains of an ophiuroid star-fish. I have since found similar remains in the Leda clay at the Tanneries, near Montreal. The specimens are entirely disintegrated, but show the internal joints of the rays and also the external plates and spines. From their form I judge that they may have belonged to a small Ophiocoma, not very dissimilar from the *O. bellis* now found in the Gulf of St. Lawrence; but whether identical with that species, or with that found by Sir W. E. Logan at Ottawa, I cannot certainly determine. I figure some of the remains merely to direct the attention of other observers to these curious objects. (Figs. 18, 19.)

* Sullivant, in a note just received, says it is probably not far from *Hypnum riparium*,

Figs. 18 and 19.—*Joints of Ophiocoma, magnified.*

Modiola glandula.—A single valve of this pretty little shell has been found at Logan's farm. It now inhabits deep water in the Gulf of St. Lawrence. I may also mention that I have found perfect specimens of *Modiolaria discors* both at Logan's farm and Beauport, which quite confirm Dr. Gould's identification of my fragment of last year with that species.

Fusus (*Clavatula*) *turricula.*—Specimens of this shell have been found by Mr. R. Ramsay at the Brick-yards at the Tanneries. It occurs extensively in the North Atlantic, and fossil in the British Crag.

Rissoa.—Since the publication of my last paper, Mr. Bell of the Geological Survey, has shewn to me in that collection a *Rissoa* with five distinct revolving bands, separated by a flattish space from the suture. On comparison of this shell with my specimens referred last year to *R. minuta*, I am inclined to think that they are the same, but that the latter were worn, so as to present a smooth surface. It is not unlike *R. obsoleta* of Wood's Crag Mollusca. I have another little shell which closely resembles *Alvania ascaris* of the same author, but it is too incomplete for its certain identification.

Spirorbis spirillum.—This common species is found of small size, attached to pebbles, at Beauport.

V. General Remarks.

In so far as general conclusions in Geology are concerned, the observations of the past year do not in any way conflict with the conclusions stated in my former paper.

The arrangement of the deposits at Logan's farm and Beauport, confirms the subdivision which I have attempted to establish, of an underlying non-fossiliferous boulder clay, a deep-water bed of clay or sand (the Leda clay of Montreal), and overlying shallow-water sands and gravels, the Saxicava sand of my former paper. This arrangement shows a gradual upheaval of the land from its

state of depression in the boulder-clay period, corresponding with what has been deduced from similar appearances in the Old World. "The upheaval of the bed of the glacial sea," says Forbes, "was not sudden but gradual. The phenomena so well described by Prof. Forchhammer in his essays on the Danish drift, indicating a conversion of a muddy sea of some depth into one choked up with sand-banks, are, though not universal, equally evident in the British Isles, especially in Ireland and the Isle of Man."*

We now have in all, exclusive of doubtful forms, sixty-three species of Marine Invertebrates from the Post-Pliocene or Pleistocene clays of the St. Lawrence valley. All, except four or five species belonging to the older or deep-water part of the deposit, are known as living shells of the Arctic or Boreal regions of the Atlantic. About half of the species are fossil in the Pleistocene of Great Britain. A majority of the whole are now living in the Gulf of St. Lawrence and on the neighbouring coasts; and I have reason to believe that the dredging operations carried on by the officers of the Geological Survey in the past summer, will enable us to recognize all but a few as living Canadian species. In so far, then, as marine life is concerned, the modern period in this country is connected with that of the boulder clay by an unbroken chain of animal existence. These deposits in Lower Canada afford no indications of the terrestrial fauna; but the remains of *Elephas Primigenius* in beds of similar age in Upper Canada,† show that during the period in question great changes occurred among the animals of the land; and we may hope to find similar evidences in Lower Canada, especially in localities where, as on the Ottawa, the debris of land-plants and land-shells occur in the marine deposits.

* Memoirs of Geological Survey.

† Reports of Geol. Survey; Lyell's Travels.

ARTICLE IV.—*Report on the Fisheries of the Gulf of Saint Lawrence.* By M. H. PERLEY, Esq., Her Majesty's Emigration Officer at Saint John, N.B.*

Laid before the House of Assembly by command of His Excellency the Lieutenant Governor, and ordered to be printed 8th March, 1849.

There is probably no part of the world in which such extensive and valuable Fisheries are to be found, as within the Gulf of Saint Lawrence. Nature has bountifully provided within its waters, the utmost abundance of those fishes which are of the greatest importance to man, as affording not only nutritious and wholesome food, but also the means of profitable employment.

These Fisheries may be prosecuted as well in the open waters of the Gulf, as within every Bay, Harbour, Creek, Cove, and Inlet in connection with it. Whether on the bleak and sterile coast of Labrador; or on the western coasts of Newfoundland and Cape Breton; or along the eastern shores of Nova Scotia and New Brunswick; or within the Bay of Chaleur; or around Prince Edward Island, Anticosti, or the Magdalen Islands, the Fisherman may pursue his labours with nearly equal chances of success, and the full prospect of securing an ample reward for his toil.

With such valuable and unlimited Fisheries in close proximity to these Colonies, and as it may be said at the very doors of the inhabitants, it is no less strange than true, that they are prosecuted to the greatest extent, and with most profit, by citizens of France, and of the United States.

The French exercise an almost exclusive right of fishing upon the western coast of Newfoundland, the fertility and great mineral wealth of which have only recently become known, and are not yet fully appreciated.

From seven to eight hundred sail of America fishing vessels enter the Gulf of Saint Lawrence annually; and scattering over the whole of its wide extent, with little heed of the limits to which they are restricted by treaty, pursue their business unmolested, and but rarely leave their stations without full and valuable fares.

The Jersey merchants also prosecute these Fisheries with great zeal and assiduity, and, as it is believed, with much profit. They have permanent establishments and Fishing Stations in Gaspé,

* This Report although issued ten years ago, contains the best account of the Fisheries of the Gulf at present extant. Believing it to be important on account of the statistical and natural history information that may be gleaned from it, we republish it without abridgement.

E. B.

Labrador, and Newfoundland, and three or more establishments in New Brunswick; but they by no means confine themselves to any particular locality. They employ upwards of one hundred vessels almost exclusively in carrying the rich products of the deep to various foreign markets, besides the smaller craft required upon the coast. Two of the leading Jersey firms, Messieurs Robin and Company, and Nicolle Brothers, are supposed respectively to afford employment, directly or indirectly, to nearly one thousand persons.

The inhabitants of those shores of Cape Breton and Nova Scotia which are within the Gulf, pursue the Fisheries in their immediate neighbourhood to a moderate extent; and a few of their vessels visit the Magdalen Islands, and the Labrador coast, during the season. The people of Prince Edward Island, who are favourably placed for securing a goodly portion of the riches of the sea, make still more limited efforts; but their efforts can scarcely be described as more limited, or more feeble, than those of the people of New Brunswick, who dwell upon its shores, from Baie Verte to the western extremity of the Bay of Chaleur—those shores commanding as great an extent and variety of fishing ground, and as abundant supplies of valuable fish of every description, as can be found in any other part of the unrivalled Gulf of Saint Lawrence, while they possess equal, and perhaps superior, facilities for prosecuting its Fisheries, both extensively and profitably.

The most vaiuable Fisheries of the Gulf are those for Herring, Cod, and Mackerel. But before entering upon the question of their encouragement and extension, by increased facilities of communication, it will be proper to give some description of each. With this view they will be taken up in the order of the fishing season; after which, the secondary Fisheries of the Gulf will be briefly noticed.

THE HERRING.

The common Herring (*Clupea harengus*) appears in the Gulf of Saint Lawrence at the end of April, or early in May, and the fishing continues until about 10th June, when they retire to deep water, having deposited their spawn. These "Spring Herring," as they are termed, are taken in "set nets" along the whole eastern shore of New Brunswick, around Miscou Island, and within the Bay of Chaleur. Being caught while in the very act of spawning, they are thin and poor, of little value as an article of food, whether fresh or salted. Another Herring appears on the

coast about the 20th August, and remains in-shore for a month; these are fat and in good condition, furnishing excellent food, and a valuable commodity for export. It is admitted, that when first caught, these "Fall Herrings" are fully equal in every respect to the best Scotch Herrings; and if they were cured in the Dutch manner, this Fishery, from the increased price, and demand, would become one of the most important and valuable Fisheries of the Gulf.

The Herring is the animal delicacy of Holland, and there enjoys a very different reputation, from that of the common salt Herring of Britain or America; yet the fish of both Holland and Britain are the same, being caught on the same fishing grounds, and those of North America are in no respect inferior.

The Dutch mode of curing Herrings is thus described by Mr. Chambers, in his "Tour in Holland in 1838." "Immediately on being caught, the Herrings are *bled, gutted, cleaned, salted, and barrelled.* The bleeding is effected by cutting them across the back of the neck, and then hanging them up for a few seconds by the tail. By being thus relieved of the blood, the fish retain a certain sweetness of flavour, and delicacy of flesh *which unbled Herrings cannot possibly possess.* The rapidity of the process of curing, must likewise aid in preserving the native delicacy of the animal, for the Herring lies salted in the barrel, in a very few minutes after it has been swimming in the water. I was assured that the superiority of the Dutch Herrings is solely ascribable to this mode of curing."

The greater mercantile value of the Dutch Herrings, on the Continent of Europe, being found to arisesolely from this mode of curing, the Commissioners of the British Fisheries (in Scotland) were induced to devote great attention to it, and to urge its general adoption by every means in their power. Their officers and inspectors were directed to brand every barrel of Herring, cured according to the Dutch mode, with the figure of the Crown. In their official Report for 1844, the Commissioners state that—"the unprecedented demand from the Continent for Crown brand Herrings, is a sufficient proof of the care with which the integrity of the brand is preserved, as well as of the high value which is set upon it, in all the Continental markets. It was the strong conviction impressed upon the minds of the Commissioners, of the vital importance of preserving the integrity of the brand, which compelled them to exercise the painful duty of dismissing from the service, one of the Board's oldest officers. As he had branded a cargo of

Herrings, which afterwards went to Hamburg, where they were complained of, as having been found unworthy of the brand, the Board despatched the General Inspector of the East coast to that place, in order that he might rigidly examine the contents of all the barrels; and on receiving an unfavourable report as to the result of his investigation, the officer was immediately dismissed. The effect of this prompt measure has been, to raise the character of the brand even higher in the estimation of the Foreign Fish Merchants, to whom the circumstances were generally known. It is by the preservation of the purity of the official brand, that the produce of the British Herring Fishery is to be upheld in character abroad, and the demand for it largely extended in Foreign Markets."

As a proof of the gradually increasing confidence which the Crown brand received on the Continent, the Commissioners furnish a statement of the number of barrels exported to the Continent, during the preceding seven years, commencing with 57,388 barrels in 1837, and annually increasing to 181,583 barrels in 1843.

The Commissioners further say—"An extensive export Merchant has given it as his opinion, that if great care shall be continued in the selection, cure, and official Inspection of the Fish, the Continent of Europe would consume more British Herrings than are now caught in our fisheries. Although they have to contend with all the disadvantages of a duty levied on them of ten shillings per barrel, British Herrings are now brought into competition with Belgian Fish in their own markets, and are annually diminishing the sale of Dutch Herrings, by furnishing part of the supplies in markets formerly entirely dependant on them. By this means their price has been so reduced, that the number of "busses" fitted out for the deep sea Herring Fishery, has been already considerably diminished."

In their Report for 1845, the Commissioners say—"The increasing demand for British Herrings of late years in Germany, arises from their moderate price, their careful selection, their superior cure and quality, and above all, from the security which dealers have in the official brands. The general stipulation between sellers and buyers is, to deliver and receive "Crown" "and Full" branded Herrings; and Mr. Miller, the Inspector of the East Coast, states in a Report made to the Board, of the information gathered by him during a short tour of inquiry made by order of the Commissioners, that he has the authority of a firm at Stetting

for stating, that they sold about 40,000 barrels of Crown and Full branded Herrings last year, which were every where received without objection. The Inspector found British Herrings at Berlin, Wittemberg, Leipsic, Frankfort, Cologne, and Brussels; and he saw several parcels in transit for more distant parts; the barrels were all Crown and Full branded, and the Fish were in fine condition, all well meriting the official brand, and much approved by every one. He frequently inquired for Dutch Herrings, and was uniformerly shown British Herrings as Dutch; and when he stated that they were British, they always insisted that they were Dutch, and they sold them as Dutch. So general is the use of British Herrings on the Continent, that at Embden, where, a few, years ago, fifty vessels were annually fitted out for the Fishery, and a bounty of about £50 paid to each, the number of vessels was reduced to twelve, notwithstanding the continuation of that bounty. The Inspector General learned from the British Consul at Frankfort, that the navigation of the Rhine to Mayence, or Frankfort, has not been attempted by vessels laden with British Herrings, in consequence of the jealousy of the Dutch, who throw insuperable obstacles in the way. Those Herrings which have been sent thither, were transhipped at Rotterdam, when the charges levied in Holland, proved to be almost prohibitory. But as the prospect has arisen of immediate transport by a Canal connecting the Maine with the Danube, the Catholic countries of Bavaria, Hungary, and Austria, may be expected to afford new markets for our Herrings, when the navigation of the Rhine may be attempted, or when the Railway from Antwerp to Cologne may be employed."

These extracts from official reports of the highest character, show most clearly the increased value which the Dutch mode of curing gives to British Herrings; while the careful inspection, and the rigid measures adopted to preserve the integrity of the official brand, indicate in the strongest manner, the necessity for a similar inspection in New Brunswick. At present, from the entire absence of both skill and care, one of the most prolific and most valuable Fisheries of the Gulf is rendered of the least value, and there is a complete waste of the bounties of Providence. Herrings are taken in the largest quantities, at a season when they are almost unfit to be eaten, because they are then caught with the greatest ease, and at least expense, and thousands of barrels are found of so little worth, that they are used to manure the land, or are left to rot upon the beaches.

In the autumn, when the Herrings are in fine condition, they are taken during a few weeks only, because our fishermen are quite ignorant of the proper mode of curing to render them of value, and are not aware of the manner of using drift nets in deep water, which is so successfully practised by the Herring Fishers of Loch Fyne, and other noted stations in Scotland. By a similar manner of fishing, our fishermen could continue to catch Herrings until the latest period of the fishing season, and those taken last would be of the finest quality. The mode of fishing by drift nets, is thus described by Mr. Yarrell, in his admirable work on British Fishes:

"The net is suspended by its upper edge, from the drift rope, by various shorter and smaller ropes, called buoy ropes; and considerable practicable skill is required in the arrangement, that the net may hang with the meshes square, smooth, and even, in the water, and at the proper depth; for, according to the wind, tide, situation of their food, and other causes, the Herrings swim at various distances below the surface."

"The size of the boat depends on the distances from shore at which the fishery is carried on; but whether in deep or in shallow water, the nets are only in actual use during the night. It is found that the Fish strike the nets in much great numbers when it is dark, than while it is light; the darkest nights, therefore, and those in which the surface of the water is ruffled by a breeze, are considered the most favourable. It is supposed that nets stretched in the day time alarm the Fish, and cause them to quit the place where that practice is followed; it is, therefore, strictly forbidden."

Many thousands of barrels of the inferior "Spring Herring," are taken at the Magdalen Islands every season, at the period when they approach the shores of these Islands to deposit their spawn. They are then very poor, and as but little care is taken in curing them, they often prove unfit for human food. They are caught in large seines, which require 15 or 20, and sometimes 40 men to manage them; and they are capable of enclosing, and bringing to the shore, from 200 to 1000 barrels at a single haul. When taken from these seines, it is the common practice to put them in the holds of the vessels, without washing, bleeding, or divesting them of their offal. They are salted "in bulk," as it is termed, and so they remain until the vessel arrives at the Port whence she sailed, whether in the Colonies, or in the United States. They are then taken out and packed in barrels, sweltering in all their impurity; but whole cargoes frequently prove worthless as food, and are used for dressing grass land.

The number of barrels of Herrings exported from the several Ports in the Counties of Restigouche, Gloucester, Northumberland, and Kent, during the last eight years, is thus stated:—

Ports.	1841	1842	1843	1844	1845	1846	1847	1848	Totals.
Restigouche,	13	....	....	....	41	....	75	....	129
Bathurst,	....	....	....	20	52	....	....	280	352
Caraquette,	26	87	16	50	110	437	396	28	1150
Miramichi,	140	346	219	1080	3732	1192	1189	....	7898
Richibucto,	....	....	100	....	49	120	93	48	410
Totals,	179	433	335	1150	3984	1749	1753	356	9939

A large proportion of the Herrings exported from the Miramichi, are of the description best known as the Gaspereaux or Alewife, (*Clupea vernalis*) which leave the Sea, and ascend most of the Rivers of the Gulf, to spawn. They are a thin, dry fish, much inferior to the Sea Herring when salted; they find a market in the West Indies, as from their leanness, they are less liable to spoil in a hot climate than the fat Herring.*

From the preceding Table it appears clearly, that beyond furnishing some portion of the food of the inhabitants of the Northern Counties of New Brunswick, the magnificent and unlimited Herring Fishery of the Gulf of Saint Lawrence and Bay of Chaleur, barely furnishes a sufficient quantity for export to prevent Herrings being altogether omitted from the Returns.

Of all the Fisheries of the Gulf of Saint Lawrence, none could be increased to a greater extent, or would furnish a more valuable export, than the Herring Fishery, if placed under judicious regulations, and conducted with greater skill and care. The manner of taking Herrings by drift-nets in deep water, requires to be generally known and adopted. At present, these excellent and truly valuable Fish, which exist in the Gulf in myriads, during the latter part of the season, when they are in the finest condition, are only caught in sufficient quantities to furnish bait for Cod, and a supply for domestic use.

The Dutch mode of curing also requires to be introduced, in order that the full flavour and fine quality of the Fish may be preserved. If cured according to this approved mode, and properly packed in

* Note in 1850.—Since this Report was first published, it has been ascertained that Cuvier, and the American Naturalists, class the Alewife, not as a Herring, but as a species of Shad, and designate it *Alosa vernalis*.

barrels of hard wood, bearing an official brand, (on which full reliance could be placed,) to denote the quality of the Fish within, the Herrings of the Gulf of Saint Lawrence would find a ready market throughout the whole extent of Canada, and would find their way by inland navigation, and the Great Lakes, to the most Western States of the Union, where there exists a large and constantly increasing demand. To other parts of the United States, and to Foreign Ports elsewhere, they might be profitably exported, if they could reach Saint John, at all seasons, at a moderate charge.

The Herring Fishery of the Gulf would be more benefitted than any other, by the construction of Railways, and the increased facilities for communication which they would afford. No other description of Fish would probably furnish so large an amount of Railway traffic, as, if once properly established, this Fishery, which can now be scarcely said to exist, might be prosecuted to an almost unlimited extent.

THE COD.

The Cod Fishery commences from the 1st to the 10th June, and continues until the end of November; it may be prosecuted in every part of the Gulf of Saint Lawrence, to a greater or less extent. The principal Fish caught, differs but little from the *Gadus morrhua*, of Linnæus, or ash-colored Cod. There are besides, two varieties, known as *Gadus rupestris*, the Rock Cod, and *Gadus arenosus*, the Shoal Cod.

Near the Shores of New Brunswick, the best Fishing Grounds, or rather, those most frequented, are from Point Escuminac to Miscou, and thence along the Bay of Chaleur, to the Restigouche.

The inhabitants of the County of Gloucester prosecute the Shore Fishery to a greater extent than any others on the New Brunswick coast. Their principal stations are Miscou, Shippagan, Caraquet, and Grande Ance. They go out in boats, from one to fifteen miles from the land, in the morning, and when at the longer distance, do not return until the evening of the following day. The boats have two fore-and-aft sails, and a jib; each boat is managed by two men, and frequently there is with them a boy. Each man has two lines, from 30 to 48 fathoms in length, and they are also furnished with Mackerel lines, spare leads, and hooks. The boat has oars, an anchor and rope, compass, and small oven for cooking; the cost is about £18 for each boat, with complete outfit. The Fishermen generally build their own boats during the Winter: the

keel is of birch; the timbers of cedar; and the planks of pine or cedar. A boat will last from six to eight years, and so will the sails also, with care.

The quintal, by which Cod are always sold, is 112lb of dry fish. It is considered a good day's nshing, at Miscou, for one of these boats to take ten quintals of Fish, which they frequently do. When first caught, 112 of the small fish, and 30 of the large size, are reckoned to the quintal.

Nearly all the fishermen of Shippagan and the Bay of Chaleur, split, salt, and cure their own fish. When they do not, 252lb of green fish, salted and drained, are given to a curer, to return 112lb of merchantable dry fish.

The boats, as they return from the fishing banks, run alongside a stage built over the water, upon which the fish are thrown out. The first man that handles the fish cuts its throat with a single stroke of his knife, and slides it along a sort of table to another, who whips off the head, and throws it, with the entrails, through a hole in the table, into the water underneath, retaining only the liver, which is thrown into a tierce to make oil. The next man splits the fish, and takes out the back-bone; on the manner in which these operations are performed, the quality of the Fish for market, in a great degree depends. They are then washed, and rubbed with salt, in which they remain for six or eight days; then, being again well washed, they are placed in what is called a "horse pile," to drain. After draining twenty four hours, they are spread out to dry on long narrow wicker frames or stages, set up on purpose, called "flakes." They require to be frequently turned to prevent their being "sun-burnt," or salt-burnt;" and they cure in about three weeks. It is not well to cure them too fast; they are best when dried moderately.

After the Fish are sufficiently cured, they are collected and laid in small circles, with the tails outwards; these circles are continually built upon, each row being larger than the one below it, until the pile is about three feet high, when the circles begin to diminish so as to form a conical roof; this is covered with birch bark, and stones are placed upon it. The piles are thus rendered impervious to the heaviest rains; and in this position, the Fish are left to season before being packed for exportation.

The Bay of Chaleur Cod are more prized in the markets of the Mediterranean, and, will, at all times, sell there more readily, and at higher prices, than any other. They are beautifully white; and

being very dry, can better withstand the effects of a hot climate and long voyage, than a more moist Fish. The peculiarity of their being smaller than Cod caught elsewhere, is also of great importance as regards the South American market, for which they are packed in tubs of a peculiar shape, called "drums," and into which they are closely pressed by means of a powerful screw.

The usual baits for Cod on the New Brunswick Coast, and in the Bay of Chaleur, are—Capelin, in the early part of the season —and afterwards, Herring and Mackerel—when no other baits can be had, Clams are used.

The capelin (*Salmo grœnlandicus*)* is a beautiful little fish, from four to seven inches in length, the under jaw longer than the upper, the colour of the back greenish, the under surface of the body silvery. They usually appear about Miscou, and in the Bay of Chaleur, early in May; but sometimes not until near the end of that month. The Cod Fishery does not fairly commence until the arrival of the Capelin, which continue near the shores until the end of July.

There has been great complaint of late years, in the upper part of the Bay of Chaleur, of the falling off in the Cod Fishery, which is said to be every year decreasing. At Carleton, Maria, New Richmond, and other places on the Gaspé shore, the fishing establishments are deserted, and going to ruin. At these places there was formerly an abundant supply of fish; but the inhabitants now barely catch enough for their own winter store.

This decrease is also felt on the New Brunswick shore. The settlement of Petit Rocher sends out about 50 boats only, which average a catch of 50 quintals each, during the season. The Pockshaw coast sends out a few boats, but they only fish occasionally. The Caraquet and Shippagan boats, further down the Bay, take more than 100 quintals each during the season, which are of better quality than those taken off Petit Rocher. The decline of the Cod Fishery in the upper part of the Bay is attributed to the wanton destruction of the proper and natural food of the Cod—Herring and Capelin—which are taken in immense quantities; not for immediate eating, or for curing, or for bait—but for manuring the land!

In a representation made to the Canadian Legislature by a fisherman of Gaspé, it is stated, that this fisherman has seen five

* This is the *Mallotus villosus* which occurs so well preserved in the fossil state near Ottawa.

hundred barrels of Capelin taken in one tide, expressly for manure; and that he has also seen one thousand barrels of Herring caught at one time, and not taken away, but left to rot upon the beach.

It has been remarked in the Bay of Chaleur, that owing to this waste of the smaller fish, the Cod Fishery recedes, as agriculture advances. The lazy farmer, who thinks he can increase the fertility of his land by a single sweep of his seine, does so at the expense of the fisheries, although a bountiful Providence has furnished the shores with inexhaustible quantities of kelp and sea-weed, and other valuable manures, which really enrich the soil while it is admitted that the use of fish greatly deteriorates it.

The Legislature of Canada has been strongly urged to make it a misdemeanor, punishable by fine and imprisonment, for any person to use either Herring or Capelin as manure; and such a measure would seem to be highly desirable in New Brunswick. To be effective, there should be similar regulations on both sides of the Bay of Chaleur.

The deep-sea fishery for Cod is not prosecuted to any great extent in the Gulf by the people of New Brunswick. A few schooners proceed from the Fishing Stations in the County of Gloucester, already mentioned, to the Bradelle Bank, about fifty miles from Miscou. In the summer of 1839, H. M. S. Champion, in sailing from the East Cape of Prince Edward Island to the Bay of Chaleur, (crossing the Bradelle Bank) passed through a fleet of 600 to 700 sail of American fishing schooners, all engaged in Cod fishing.

The vessels of Gaspe frequently resort to Anticosti, off the eastern end of which Island, Cod are often taken in great abundance and of good quality.

The excellent fishery on the Labrador Coast is prosecuted almost wholly by the Americans, and by vessels from Newfoundland, Canada, and Nova Scotia. The vessels usually employed are schooners of 70 or 80 tons burthen, and they arrive on the coast about the end of May. Every part of the coast is frequented by fishing vessels during the season, from Mount Joli, at the southern boundary of Labrador, to the northern extremity of the Straits of Belleisle. On reaching the coast, the vessel enters some snug harbour, where she is moored, and there remains quietly at anchor, until a full fare, or the departure of the fish, requires the Master to seek another inlet, or return home.

The fishery is carried on entirely in boats, and the number found most useful is one for every thirty tons of the vessel; there

are two men to each boat. If fish are in plenty, and not too distant from the vessel, they are expected in good weather to get two loads each day. The return of the boats with fish is the signal for the dressing crew, who remain on board, to commence their operations. If it is intended that the vessel shall remain on the coast until the fish are ready for market, they are taken on shore as caught, and there dressed, salted, and dried, before being put on board the vessel. But it is the more common practice, especially with vessels from the United States, to salt the fish on board, and take their cargoes home in a green state, drying them after arrival.

The vessels from Nova Scotia and Canada, in general, carry their cargoes home in a green state.

About three hundred schooners from Newfoundland resort to the Labrador Coast every season, during which they usually make two voyages. When they first return from the coast, they take home a cargo of dry fish; but on the second return voyage, a considerable proportion of the fish in a "green" or pickled state, and is dried at Newfoundland.

The Labrador Coast is indented every where with excellent Harbours, which have been frequented for a very long period. From the security of these Harbours, and the general certainty of an ample supply of fish, this coast is preferred by many fishermen to any other Fishing Station within the Gulf.

The average produce of this fishery may be estimated at ten quintals of dry fish to every ton of the vessels employed; but the Masters of the American schooners are dissatisfied when they fail to catch 12 or 13 quintals per ton. The baits are principally the Capelin and the Herring, both of which abound on that coast. The Herrings taken at Labrador, in the latter part of the season, are considered very fine: yet they are not caught as a chief object of pursuit, but merely as an adjunct to the Cod Fishery.

The quantity of dried Cod exported from New Brunswick Ports, in the Gulf of St. Lawrence, during the last eight years, is thus stated in quintals:—

Ports.	1841	1842	1843	1844	1845	1846	1847	1848	Totals.
Dalhousie, ..	..	..	500	..	..	..	..	..	500
Bathurst, . . .	..	50	..	..	..	..	..	1,091	1,141
Caraquette, .	7770	9638	8670	8841	7456	11,673	8672	14,678	77,398
Miramichi, ..	..	486	300	150	70	272	1398	298	2,974
Richibucto ..	..	..	..	40	..	25	270	..	325
Totals,	7770	10,174	9470	9031	7526	11,970	10,340	16,067	82,438

From this Return it appears, that the export of dried Cod from the Northern Ports of New Brunswick, is chiefly from Caraquette. This export is made almost wholly by the Jersey Houses of Robin and Co., and Le Boutillier, Brothers, of Paspediac in Gaspé, and Alexandre and Co., of Shippagan, to Brazil, Spain, Portugal, Sicily, and the Italian States. The export of Cod from the Gulf of St. Lawrence to Foreign Markets, is a branch of business which the Merchants of New Brunswick have yet to learn.

The quantity of dried Cod exported to Foreign Countries from the District of Gaspé, during the past year (1848,) is thus stated from official Returns:—

Gaspé Basin,	41,269 Quintals.
New Carlisle,	46,523 do.
Total,	87,792 Quintals.

The whole quantity of Dried Cod exported from New Brunswick during the last eight years, is exceeded by the quantity exported from Gaspé during the year 1848 only, by 5,414 quintals.

There is reason to believe, that a considerable proportion of the Cod exported from New Carlisle, is caught on the south side of the Bay of Chaleur, and about Miscou, the fishing grounds being better near the New Brunswick Shores, than on the Gaspé side of the Bay.

The quantity of dried Cod exported from Newfoundland in 1845 was 1,000,333 quintals, of which one-sixth was the produce of the Fishery on the Labrador Coast.*

The whole line of the New Brunswick coast from Shediac to Escuminac, around the Bay of Miramichi, and thence along the shores from Tabusintac to Shippagan and Miscou, offers the greatest facility for prosecuting either the in-shore, deep-sea, or Labrador Cod Fishery. There are numerous harbours, creeks, coves, lagoons, for boats and vessels of every size and description; the beaches are admirable for drying Fish, and there is abundance of wood at

* The French employ 360 vessels, from 100 to 300 tons each, with crews amounting to 17,000 men, in the Newfoundland Fisheries. Their annual catch of Cod averages 1,200,000 quintals. The Government bounty is eleven francs per quintal, which is fully the value of the article itself. A French vessel for the Bank Fishery, of 300 tons, has a crew of at least 40 men, and from 7 to 9 heavy anchors, with 800 fathoms of hemp cable, and 4 or 5 large boats, capable of standing heavy weather.

hand for the construction of stages and "fish-flakes." The soil too, is generally excellent, and owing to the flatness of the coast, the shore is every where easy of approach. For the establishment of Fishing Stations by Merchants of capital and skill, or the organization of Fishing Colonies on an extensive scale, this coast offers rare advantages.

The Bay of Chaleur likewise possesses many advantages for the prosecution of the Fisheries. The whole Bay may be considered one great Harbour, as throughout its entire breadth and extent, there is not a single rock, reef, or shoal. During the summer, it literally swarms with fish of every description known on the shores of British North America; and its ancient Indian name of "Eck-etaun Nemaachi"—the Sea of Fish—well denotes its character.

The facilities for ship building are very great on the New Brunswick side of this Bay. The timber is of excellent quality, and noted for its durability, more especially the larch, which is accounted equal to any in the world. Mr. MacGregor, M. P. for Glasgow, late Secretary to the Board of Trade, in one of his official Reports to that Board, says—"The larch-built vessels of the Bay of Chaleur are remarkably durable. A vessel belonging to Robin and Co., which I saw at Paspediac in 1824, I went on board of again in 1839, in the port of Messina, where she was then discharging a cargo of dry Codfish, to feed the Sicilians. This vessel, then more than thirty years old, was perfectly sound."

The "bultow" mode of fishing for Cod, introduced by the French at Newfoundland, and now being adopted by the English residents there, might very probably be followed with advantage by the fishermen dwelling on the New Brunswick coast.

The "bultow" is described as a long line, with hooks fastened along its whole length, at regular distances, by shorter and smaller cords called *snoods*, which are six feet long, and are placed on the long line twelve feet apart, to prevent the hooks becoming entangled. Near the hooks, these shorter lines or *snoods*, are formed of separate threads, loosely fastened together, to guard against the teeth of the fish. Buoys, buoy ropes, and anchors or grapnels, are fixed to each end of the line; and the lines are always laid, or as it is termed "shot" across the tide; for if the tide runs upon the end of the line, the hooks will become entangled, and the fishing will be wholly lost. These "set-lines" have been some time in use on the coast of Cornwall, in England, and the mode is there

called "bulter" fishing.* A gentleman connected with the British Fishery Board, has suggested an improvement, in fixing a small piece of cork within about twelve inches of the hook, which will suspend and float the bait, when it will be more readily seen by the fish. If a bait rests upon the ground, it is sometimes covered with sea weed, and often devoured by Star fish, Crabs, and Echini.

In a petition from the inhabitants of Byrant's Cove, in Newfoundland, to the Legislature of that Colony, in 1846, it is stated, that the "bultow" mode of fishing had been introduced in that vicinity in the previous year, at first by a single line, or "fleet" as it is termed, of one hundred hooks; and this proved so successful, that before the end of the season, seventy five fleets were used, some of them three hundred fathoms long. The petitioners represent, that the set-line, or "bultow," is the best mode of fishing ever introduced in those waters, as being less expensive in outfit, and in keeping boats in repair. They state that a set-line will last three years, and with care even longer; that the total expense of fitting one out, with a gross of hooks, is only fifty shillings; and that it is not moved during the season, nor taken up, except for overhauling and baiting, until the fish move out in the deep water in the autumn. The petitioners add, that the fish taken by the "bultow" are larger than those taken by the hand line, as also superior in quality; and that it was a common thing, during the preceding season, for one and a half quintals of fish to be taken off a gross of hooks, in overhauling the line of a morning. It appears that the lines are overhauled, and fresh baits placed on the hooks every morning and evening; and it is set forth as an advantage of the "bultow," that if the fisherman leaves it properly baited in the morning, it is fishing for him while he is at work in his garden; whereas, by the other mode, if he was not on the ground, he could not expect fish. The petition then proceeds thus: "Your petitioners therefore pray your honorable House to cause the following rules, or something like them, to pass into law, as like all new inventions, the set-line, or "bultow," has to struggle against many hindrances, from ignorance, and bigotry to the old method, yet, as your Petitioners have endeavoured to show, the "bultow" has proved itself, what may be fully termed, "THE POOR MAN'S FRIEND.

* Mr. Wallop Brabanon, in his work on the Deep Sea Fisheries of Ireland, says this mode of fishing is much practised on the West Coast of Ireland, where it is called "spilliard," or "spillet" fishing.

The rules which the Petitioners pray may become law are simply that the fishing grounds may be divided into two parts, one for the "bultow," and one for hand-line Fishermen; that the "bultows" shall always be set parallel with each other, that they may not get foul, and may take up as little room as possible; and, lastly that a person conversant with this mode of fishing, may be appointed to enforce these rules, and to instruct those who are not acquainted with the method, in the proper manner of fitting out and setting the "bultow." The Petitioners conclude by stating their belief, that if their suggestions are carried out, the boats now used in the Shore Fishery will, in three years, give place to the "bultow" throughout Newfoundland, as they have already done in Byrant's Cove.

For the Deep-sea Fishery, the "bultow" is of great length. The French fishing vessels chiefly anchor on the Grand Bank of Newfoundland, in about 45 fathoms water, veer out one hundred fathoms of cable, and prepare to catch Cod, with 2 lines, each 3000 fathoms in length. The snoods are arranged as previously described, and the hooks being baited, the lines are neatly coiled in half bushel baskets, clear for running out. The baskets are placed in two strong built lug-sail boats, and at three o'clock in the afternoon, both make sail together, at right angles from the vessel, on opposite sides; when the lines are run out straight, they are sunk to within five feet of the bottom. At day break next morning, the boats proceed to trip the sinkers at the extremities of the lines, and while the crew of each boat are hauling in line and unhooking Fish, the men on board heave in the other end of the lines, with a winch. In this way, four hundred of the large Bank Cod are commonly taken in a night. The Fish are cleaned and salted on board, and stowed in the hold in bulk; the livers are boiled to oil, which is put in large casks secured on deck. The French vessels engaged in this Fishery, are from 150 to 300 tons burthen; they arrive on the Grand Bank early in June, and on the average, complete their cargoes in three months. In fine weather, the largest class of vessels frequently run out three or four "bultows" in different directions from the ship, and thus fish 10,000 fathoms of line, or more, at one time, with a proportionate number of hooks.

Should this mode of fishing be approved, measures might be devised for promoting its adoption near the shores of New Brunswick.

If circumstances should arise to induce the prosecution of the Cod Fisheries of the Gulf of Saint Lawrence, on a more extensive

scale, some regulations will be necessary for an efficient inspection of dried fish intended for exportation to Foreign markets, in order to give a character to the commodity, and prevent carelessness in curing. On this point, the Commissioners of the British Fisheries, in their Report for 1844, say—"It is very gratifying to observe, that there is a gradual increase in the annual export of dried Cod to Spain, where a most extensive market for the consumption of this description of fish, may be fairly looked for, in the course of some years. This can only be obtained by unremitting care on the part of the Board's officers, in their inspection and punching of the fish, the Spaniards being very particular in regard to the excellence of the article they purchase. The Commissioners have judged it right to order an improvement in the form of the official punch used for stamping the dried Cod and Ling, and instead of that lately used, which cut a square figure out of the tail of the fish, for which some private marks used by curers were liable to be mistaken, they have adopted a crown, which is less liable to be imitated."

Besides Cod, there are several species of fish of the same genus, caught in the Gulf, in the prosecution of the Cod Fishery. These are—the Haddock (*Gadus æglefinus*)—the Hake (*Gadus merlucius*)—and the Torsk, or Tusk, (*Gadus brosme.*) These fish are cured in the same manner as Cod, to which, however, they are inferior. They are known commercially as "Scale Fish;" and on the average, they sell at about half the price of Cod.

The Cod fishers in the Gulf often take the large flat-fish, known as the Halibut, (*Hippoglossus vulgaris* of Cuvier) which sometimes attains the weight of 300 lbs. The flesh, though white and firm, is dry, and the muscular fibre coarse. These fish are cut in slices, and pickled in barrels, in which state they sell at half the price of the best Herrings.

(*To be continued.*)

REVIEWS AND NOTICES OF BOOKS.

Proceedings of the Essex Institution, Salem, Mass. Vol. II., Part I. 1856 to 1857.

We have perused this volume with the greatest pleasure. The annual Report of this Society which it contains gives evidence of much life and energy in the prosecution of Natural Science and of History. The aggregate number of its members is three hundred

and seventy-eight. During the year it held thirteen evening meetings for the discussion of subjects connected with the objects of the Institute. These meetings commenced on the 8th Nov., and continued on the 2nd and 4th Mondays of each month. The interest manifested in them, we are informed, gave assurance of their utility. The Society possesses a liberary and museum of great value and interest. During the year a Horticultural Exhibition was held under its auspices. From the report of the Ornithological Committee, we find that the collection is in good condition and well arranged, comprising 209 mounted specimens of North American Birds, containing 148 species; 137 specimens of foreign birds, 12 of foreign bird's nests; 74 do. do. eggs, containing 41 species determined; also 23 species contained in 72 specimens not determined; 50 specimens, containing 32 specimens of American Bird's nests; 200 specimens of American bird's eggs, containing 81 species, not including about 27 species contained in 50 specimens of undetermined ones. This seems to be a favorite department. Large additions have been made to it by donations during the year.

In the Ichthyological section, we find the committee, while complaining somewhat, yet reporting the large number of 263 specimens of American fishes, embracing 26 families, 61 genera, and 80 species; of foreign fishes there in all 144 specimens, embracing 32 species. In Mammalia the collection is certainly very poor, containing only 48 specimens, exclusive of duplicates. In the department of Botany there appears to be a good Herbarium in excellent order, gradually expanding and increasing in value. We note these things to show what can be done by a few zealous students of Natural History.

We would notice as worthy of imitation by our own Society, the appointment by this Institute of curators, not only of special departments, but of sections of each department;—e. g. in the Historical department there are curators in Ethnology, in M.SS., and in the Fine Arts. In Natural History there are curators in Botany, Mammalia, Ornithology, Herpetology, Ichthyology, Comparative Anatomy, Articulata, Mollusca, and Radiata, for Mineralogy, Geology, Palæontology. This division of labour in the hands of real lovers of the magnificent and beautiful works of the Creator, is the true method of success and progress.

Another feature of this Institute which we deem well worthy of commendation, is that of its field meetings during the favourable seasons of the year. The record of one runs as follows:

"Field Meeting at Topsfield, an exploration of the ponds, streams and woods, such as the extreme heat would permit, having been made by several members in the forenoon, a session was held at 3 o'clock in the Hall of the Academy." Another runs. "Field Meeting at Danvers. A very warm day, ending in a thunder-shower and much rain. The morning was spent in examining the woods, near the residence of Wm. A. Lander, to whose hospitable reception and welcome to his grounds the party were greatly indebted." Why may we not have such meetings in Montreal? We surely do not lack either enthusiasm or scientific knowledge to render them both interesting and profitable? A day spent upon our Mountain by an intelligent band of explorers, such as we might muster, could not fail to be both healthful and profitable. Another on St. Helen's island, or at Isle Jesus, or Belœil, or among our quarries, or fifty other places, would be also delightful. To such excursions many merchants and professional men would we doubt not, be allured from the toils of their daily work. They would be sure to get their bodies refreshed, and their knowledge of places, persons and things greatly enlarged.

Many of these papers contained in the "Proceedings" of the Essex Institute are of much value. They are remarkably well edited. The style in which most of them are written is very pure and good; we say much when we say that it is English of a good type. We might expect this from Massachusetts, and from a city that lies under the literary shadows of Boston. It is so pleasant to find American writings free from national and provincial corruptions that we cannot avoid marking this excellency in these "Proceedings" and appending to it our note of admiration.

The Historical and Scientific lore which the volume contains is considerable. We would especially instance as valuable the Historical paper by S. P. Fowler of Danvers, embracing an elaborate and minute account of the life, character, &c. of the Rev. S. Parris of Salem village, and of his connection with the Witchcraft delusion of 1692. This Biography extends over nineteen closely printed pages, and is of deep interest. It portrays the character of a learned, laborious, and withal sagacious divine. It depicts also the characteristics of the people among whom he lived, and the rise of the curious delusion into which they were drawn by the crafty, the wicked and the credulous.

Another paper, of much botanical interest, was read before the Institute by the Rev. I. Russel, being a review of a book entitled:—

"New England's Varieties Discoverd, in Birds, Fishes, Serpents and Plants of that country. Together with the Physical and Chirurgical Remedies, wherewith the Natives constantly use to cure their Distempers, Wounds and Sores, &c. &c. By John Josselyn, Gent. Second Addition, London, 1675."

The Reviewer's object is, chiefly to identify the plants contained in the list, observed by Josselyn. These are classified (1) into such plants as are common to the two countries, England and America. (2) Such as are peculiar to America, and which had a name. (3) Such as belong to the country, but had no name. With few exceptions the plants described are identified with much interesting criticism and some valuable historical notes. As a specimen of this paper we quote from page 164 :—"Hollow-Leaved Lavender, (*Sarracenia purpurea*). The description of this fine plant, "proper to the country," and really worthy of being one of "New England's Varieties Discovered," is so unique that I shall transcribe it at length.—There is also a very good figure by which the plant in question was easily recognised, "Hollow-Leaved Lavender is a plant that grows in (Salt) Marshes, overgrown with moss,with one straight stalk about the bigness of an oat-straw,better than a cubit high ; upon the top standeth one fantastical flower ; the leaves grow close from the root in shape like a tankard, hollow, tough, and always full of water, the root is made up of many small strings, growing only in the moss and not in the earth ; the whole plant comes to its perfection in *August*, and then it has leaves stalks and flowers, as red as blood excepting the flower, which has some yellow admixt. I wonder where the knowledge of this flower has slept all this while *i. e.* above forty yeais ?"

"This the purple Side Saddle flower is one of the finest and most ornamental of our native plants, and well known for its singular beauty." "Parkinson's Theatre of Plants," was published in 1640, while John Josselyn Gent's Treatise was published in 1675, (the former contains a good figure and description of this plant,) so that our author seems to have "slept all this while in ignorance of the Hollow-Leaved Lavender, rather than as he supposes others about him had done. The term Lavender is probably expressive of the form of the leaf : *lavo lavendum*, to wash, &c. *Quere*—hence the derivation of pitcher plant, or forefather's pitcher, or Tankard and the like ?"

We would only further refer to a report by a committee of the Institute on the question of "Lightning conducting rods." This

paper we deem of so much practical value that we have transferred t entire to our pages, recommending it to the careful perusal of those of our readers, who are interested in the preservation of ships or houses from injury by lightning.

From this imperfect review of these Proceedings of the Essex Institute, it will be manifest that its labours during the year have been highly fruitful. Its original papers we hesitate not to say, are real contributions to knowledge, and worthy of a place in any scientific library. On reading them we have asked ourself, Why could not Montreal produce something of equal value and interest as this? It is not for the want of men that we do not. Science is represented among us by names of European celebrity, and we have several Amateurs of ability and zeal. There is therefore the material; of this fact no one can doubt—why is it then that we cannot as a Natural History Society occupy a higher place than we do? The reason obviously is that with but one or two honorable exceptions, our Scientific men whom we honor and of whose works we are proud, stand almost entirely aloof from our Society. We have men of liberal education and scientific culture, not a few in our good city, who if they would but associate themselves together to advance the cause of literature and Science would, we are persuaded, do incalculable service to the city and Province. Why should the Canadian Institute of Toronto be better off in this respect than we are? It embraces most, if not all the men of science and literature in the city, and the result is, that its light is shining with ever increasing brightness. If our Natural History Society is not suitable for the reception of our *savans* and *cognoscenti*, let it be reformed, or let a new one be instituted of a kind more suitable to promote the objects of science.

Let not the reproach hang upon us that we are little better than a nominal society. We have now erected a more suitable building for our Museum, Meetings and Lectures. We trust, that this will be the means of attracting many new members and of adding to the ranks of old workers many lovers of Science who will be something more than ornamental members of the time honored Natural History Society of Montreal.

Wild Flowers: how to see and how to gather them. With remarks on the economical and medicinal uses of our native plants. By SPENCER THOMSON, M.D. New edition, revised; with illustrations from designs by Noel Humphreys. London: G. Routledge & Co. Montreal: B. Dawson & Son.

This work is written by one who has a true love of nature and an intimate knowledge of her floral kingdom. Its chief design is to lead the mind to the study of the subject of which it treats in deeper and professedly more scientific works, and to present, in as interesting and comprehensible a form as possible, such a view of the vegetable kingdom as could be illustrated by the plants and flowers of Great Britain. The author has succeeded, we think, in writing a book that will be sure to interest young minds, and amateurs, in the observation of those lovely, and, at the same time, most accessible of God's created works—the wild flowers of the field. He says truly in his preface, and to this we cordially subscribe, "that the time is coming fast when no man or woman will be considered properly educated who is ignorant of the leading facts, at least, of the natural sciences, and when the knowledge and study of these natural revelations from God will rank second only to a knowledge of the higher revelation He has given as of Himself." After an interesting and lively introduction the author, in the *first* part of the book, enumerates and describes the various organs of a plant, their arrangements and development. In part *second* he gives a brief but lucid explanation, amply illustrated, of the Linnæan and Natural systems of classification. Part *third* contains a monthly illustration of British wild flowers, into which are introduced particulars of much interest to those who are entering upon the study of Botany. There are concluding chapters on the flowerless plants and on the economical and medicinal properties of those native to Britain. The book contains one hundred and seventy-one good wood-cut illustrations. It is one of Routledge's cheap series of publications and is an instance of what is doing at the present day by enterprising writers and publishers to bring the highest productions of science and literature within the reach of persons with limited incomes. We cordially recommend this work as one of great merit and deep interest. Its style is remarkably lively and clear and its aim highly commendable.

A Life of Linnæus. By Miss BRIGHTWELL, of Norwich. London: John Van Voorst. Montreal: B. Dawson & Son Pp. 191.

This little book gives a most interesting account of the life of the great Swedish Naturalist. It begins with his childhood and youth in the parsonage of Stenbrohult in Smœland, a province in

the south of Sweden, and carries the reader on in the most pleasing manner through the chief incidents that marked the life of Linnæus, to his final eminence. The story is told with great simplicity and elegance. The incidents are skilfully wrought into the narrative. The prominent excellences of this great man's character and genius are lovingly noted. There is no elaborate statement or discussion of his system to perplex young readers; enough, however, is related to excite admiration and awaken interest. The book is besides pervaded with a genuine, unaffected piety, and a true love of nature, which renders it very delightful reading for a winter's evening. To the young we would expressly recommend this Biography. It sets before them an example of perseverance in a chosen pursuit, and shows what may be done by a zealous devotion to any department of study which invites attention. The authoress concludes her pleasing task with a few words recommendatory of the study of Botany. As a mental exercise she particularly commends it, "What study," says she, "is calculated to afford more delightful instruction, at once gratifying a taste for beauty and training the youthful mind to thought and observation. Affording too the most healthful gratification and innocent enjoyment, its pleasures spring up beneath our feet, and as we pursue them, reward us with simple and pure joys." The book is beautifully printed and carefully got up, and will both recompense cost and perusal.

Geological Survey of Canada. Report of Progress for 1857.

As a branch of literature, Geological Reports are in some respects in a pitiable position. Necessarily dry in their details, and to many readers scarcely intelligible, they are too often thrown into dusty corners of libraries, where they lie unread and uncared for. Occasionally they fall into the hands of critics more witty than wise, who can see no advantage in the expenditure of public money in the investigation of fossil remains of shell-fish and such trifles; not considering that in thus despising the handiwork of their Maker, they would deprive us of an important aid to the discovery of those deposits of useful minerals in which all men, however little scientific, are interested. In these circumstances it becomes one of the duties of Journals such as this, to point out whatever of utility there may be in these somewhat forbidding documents.

The field-work of the present report belongs to the able assistants whom the head of the Survey has gathered around him, and for the selection of whom he merits all praise. Sir William Logan himself was chiefly employed in arranging the chaotic mass of specimens that had accumulated in the apartments of the Survey, and in securing to Canadian science whatever benefits could be obtained from the meeting of the American Association in Montreal; after which he managed to spend a few weeks in unravelling the tangled skein of those old Laurentian rocks to which of late he has so much devoted himself.

We are surprised that the arrangement of the Museum occupies so small a place in this Report. It has involved an amount of labour appreciable only by those who know the difficulty of arranging large collections. In its present state, the Museum of the Survey may, in its lucid and orderly arrangement, challenge comparison with any similar collection; and affords a systematic exhibition of the geology and of the mineral resources of Canada, which will be read with pleasure by thousands who derive little benefit from printed reports. It would be well in some future Report to give a description and a plan of the Museum, which might also be printed separately as a guide to visitors.

Mr. Murray was occupied with the Huronian formation of the North shore of Georgian Bay, the equivalent of the Cambrian of English geologists, and the chief seat of copper-mining in Canada. His explorations had reference principally to the distribution of a band of limestone, which was taken as a guide mark in tracing out the relations of these crumpled and shattered formations. This limestone has accordingly been traced over a considerable extent of ground, and, with the section which Mr. Murray has made across the country, gives a view of the general arrangement of those rocks which we did not previously possess, and which will materially aid in tracing out the mineral deposits in their continuation in new localities. The writer of this review spent a day or two, two years since, in puzzling over the intricate distribution of rocks and veins at the Bruce Mines, with the aid of the previous reports on the district and would have been thankful then to have had Mr. Murray's map and section for a companion. The general section of the Huronian rocks given by Mr. Murray will be of interest to the geologist, and ought to be in the hands of every one who "prospects" for mines on Lake Huron. It is as follows in ascending order:—

	Feet.
1. Green altered slates of a chloritic character,	1000
2. Greenstone,	400
3. Greenish silicious slates, interstratified with pale greenish quartzite,	1200
4. Slate conglomerate,	1000
5. Limestone,	250
6. Slate conglomerate,	800
7. Dark blue or blackish fine grained slates, with dark grey quartzite,	500
8. Whitish or whitish-grey quartzite, passing into quartzose conglomerate with blood-red jasper pebbles,	1000
9. Greenstone,	700
	6850

The copper veins appear to be confined, at least in their more productive portions, to the greenstone bands. The limestone occurs at the shore near the Bruce Mine, in the rear of the same location, and in a long band extending along the Thessalon River, and thence across Echo Lake and to the north shore of Little Lake George.

Mr. Richardson's work lay in the Peninsula of Gaspé, and had for its object the ascertaining of the precise boundaries of the Lower and Upper Silurian and Devonian rocks, with the view of accurately delineating these in the forthcoming geological map. The details of the coast sections on most parts of this peninsula were very carefully worked out many years ago by Sir William Logan, as we have had occasion to know by following his footsteps, bed by bed, over some parts of the coast. Mr. Richardson had to run lines of section across the country, and trace out the extension inland of the beds seen on the shore. His sections and map accordingly give a very clear idea of the general structure of the fossiliferous rocks of Gaspé. The Gaspé sandstones of Devonian age, which contain the remarkable fossil plants referred to in another page of this number, form a long trough extending through Gaspé Bay, and reaching, with few interruptions, nearly as far as the valley of the Magdalen, a distance of fifty miles. They rest on the great limestone of Cape Gaspé, probably Upper Silurian, and this again is placed unconformably on the edges of sandstones, conglomerate, limestone, and shale, belonging to the Middle and Lower Silurian, which form the long ranges of cliffs extending westward from Cape Rosier. The plant-bearing Gaspé sandstones thus rest on the limestone, exactly

like coal measures on the carboniferous or mountain limestone, and, were it not for the fossils and the relations of the sandstones to the southward, they might easily be mistaken for coal measures. Another portion of Mr. Richardson's Report is occupied with the record of a short reconnaissance of the Silurian limestone which appears at Lake St. John at the head of the Saguenay, accompanied as usual by fertile soil. The occurrence of these rocks here is interesting, as an indication of the recurrence of the fossiliferous formations in an outlying basin in the midst of the great area of Laurentian metamorphic rocks which bound cultivable Canada on the north.

The Palæontology of the Report is wrought out by Mr. Billings and Professor Hall of Albany. As we have already published in this Journal the greater part of both reports, it is unnecessary to refer to them here, except by way of general remark. Prof. Hall's paper on Graptolites is a valuable contribution to palæontology. These curious fossils are very characteristic of certain portions of the Lower Silurian series, and therefore important to geologists in classifying these rocks; but their true nature has been very obscure. The unusually perfect specimens obtained by Sir W. E. Logan have enabled Prof. Hall to represent for the first time their general forms and the arrangement of their parts, though he still expresses a doubt as to their affinities. It seems however almost certain that they were intended to float freely in the sea, bearing along the numerous little animals inhabiting the cells on the sides of their branches, and which were very probably allied to the Bryozoa.

Mr. Billings gives us an elaborate comparison of the fossils of the Black River limestone in Canada with those of the same formation in New York, confirming and extending the fact ascertained by Sir William Logan some time since,—that the fossils of this formation in Canada graduate into those of the Trenton limestone. Mr. Billings has also commenced the study and publication of the fossils of the Devonian series in Western Canada, and describes in this report a number of new species and some new genera of corals and mollusks from these and the Silurian rocks.

We are glad to see so much of the Report occupied with palæontology, and trust that this will be continued and increased. Until the engagement of Mr. Billings, this was the weak point of the Canadian Survey; and as our geological readers very well know, no reliable work can be done in geology without attention to fossils. Obvious though this is, however, we are inclined to

insist on it here; because, while every person knows the value of economical geology, comparatively few are aware of the intimate relation which palæontology bears even to this more utilitarian department. Fossils are in truth the readiest means for identifying rock formations, and are indispensable to any satisfactory comparison of Canadian geology with that of other countries. Does some speculator insist that the Gaspé or the Trenton limestone is the equivalent of the English mountain limestones, and the overlying sandstones and shales coal-measures, a comparison of the fossils at once convicts him of his error. Is a vein of lead-ore discovered in a Canadian formation, and is it important to ascertain if the bed containing it corresponds geologically with those of the lead regions of Missouri or Wisconsin, it may be quite impossible for the geological surveyor to trace its line of outcrop into those regions, but a few fossil shells may settle the point. Does a foreign geologist wish to compare the geology of Canada with that of his own country, he can have confidence in the identification of formations only if their fossils have been carefully and accurately examined. Independently of all this, there is the duty which lies on Canada as a civilized country to contribute her share to the elucidation of the records of creation, in so far as these have been inscribed on her own rocks. She is not asked to pay for explorations to discover a north-west passage or explore the Antarctic seas; but it will be a lasting disgrace if she cannot work out the natural history and physical geography of her own territory. Nor must the knowledge of fossils be confined to the officers of the survey and die with them. It must be published and illustrated by good figures, so that, once done, it may remain for future reference, and thus become a permanent addition to the scientific literature of the country. Times may change, and editorials and acts of Parliament may become waste paper; but rocks and fossils are permanent things, and work once well done in reference to them is sure to retain its value. Additions may be made to it, but the substratum will remain good. Nay, it will increase in value; for as a native Canadian literature arises, popular writers will take hold of it; and here, as in England, we shall have pleasant and instructive popular books growing out of what are now dry descriptions and lists of fossils. It may be said that the palæontology of the country would in time be explored and published by amateurs; but this would be an affair of centuries; and in the mean time even the industrial

interests of the country would suffer from lack of this kind of knowledge. There is besides a vast amount of drudgery to be done, which no amateurs will ever undertake, but the execution of which opens up the way for them. The writer has himself worked at some little points of Canadian geology, of which, but for the labours of the Survey, he would perhaps not have known the existence, and from which these labours had already removed the preliminary difficulties. A stimulus is thus given to original investigation by private persons; and there are not yet enough of labourers to occupy the openings already presented. Not to be tedious in this matter, we hope what Sir William Logan is now doing for Canadian palæontology will be appreciated in such a manner as to induce him still more extensively to prosecute this very important department of his work.

Prof. Hunt's portion of the Report is occupied with two distinct subjects;—one, a contribution to the solution of an intricate problem in theoretical geology which has more or less baffled previous enquirers; the other, an enquiry into the value of fish manures and the inducements to their manufacture in Canada. In the first part Mr. Hunt has summed up the principal facts in the history of dolomites or magnesian limestones, and has described with many analyses a great number of there rocks occurring in various formations in Canada. He then considers the theories which have been proposed to explain the formation of these rocks, and rejecting them all as untenable, maintains that the carbonate of magnesia was precipitated mixed with carbonate of lime, and finally united directly with it to form a dolomite. The conditions of this precipitation are illustrated by a series of experiments upon the action of solutions of bi-carbonate of soda on sea-water, and of bi-carbonate of lime upon waters holding sulphate of magnesia. In the latter case by an unexpected reaction there are formed under certain conditions, gypsum and bi-carbonate of magnesia. These researches form a part of a series of investigations in which Mr. Hunt is engaged on the chemical conditions of geological deposition and metamorphism, and which we hope he will one day combine in a systematic treatise on the subject.

Of the second subject, the fish manures, we shall attempt no summary, as the paper itself is reprinted in this number. It should be copied into all the agricultural journals, and extensively circulated. The three facts, that in all the old and run-out soils of Canada, phosphates and ammonia are urgently required; that

these substances are actually worth to the farmer for manure 10 and 20 cents per pound; and that immense quantities of fish garbage, capable of affording these valuable substances, are annually wasted in the fishing districts,—should lead to some practical action in the matter. Some years ago we strongly urged this subject on the attention of the farmers of one of the maritime provinces. A manufactory now exists in Newfoundland; and we hope the time is coming when the culture of wheat may be restored to old farms by the liberal application of this manure.

A new feature in this report is the appearance of Mr. Bell's observations on the living fauna of the Gulf of St. Lawrence. It has often been remarked, in the press and elsewhere, that without much increase of expense the Geological Survey might collect an immense amount of information on the zoology and botany of the province, and more especially on the geographical distribution of its animals and plants The introduction of the subject in the present report is a small step in this direction, and gives promise of useful work. Mr. Bell is a very young man, the son of the late Rev. Mr. Bell of L'Orignal, himself a geologist, whose collection, very ingeniously arranged, is now in Queen's College. He has in him the material of a good naturalist, and we hope to meet him in many succeeding reports laden with new facts on the distribution of the invertebrates of the Gulf of St. Lawrence.

On the importance of the observations of longitude, by Lieut. Ashe, it is unnecessary to say anything, except that they remind us of the forthcoming map, on which so much of the labour of the survey is at present concentrated. One part of the report, however, is zoological, and relates to certain recent animals of singular habits. "My past experience," says Lieutenant Ashe, "had taught me to avoid the tops of houses, and to select the solid earth and solid rock for the support of my transit instrument. Still I had another lesson to learn. This neighbourhood was infested with boys, who when they saw a light shining through the cracks of the boards, commenced throwing stones with a determination and precision worthy of a better cause; and some of the few clear nights that occurred in this month were lost in consequence of boys' love of mischief. I first tried mild entreaties, and then severe threatenings; they laughed at the former, and made faces at the latter. I then procured the service of the police, who partly succeeded in keeping the boys from further interference with my duties."

This narrative raises the question, which is applicable not only to the Kingston boys but to other assailants of the Survey, whether their ire was excited by the little light which they saw "through the cracks," or by their want of more light on the subject. This is, in some sense, an educational question; and leads to a remark on the circulation of scientific reports, which we think has throughout the United States and British Colonies been greatly mismanaged. Such reports, got up as attractively as possible, should be placed in the hands of the trade, with a fair commission on their sale; and the gratuitous distribution should be limited to public persons and institutions In this way a much greater and better circulation would be secured, the reports would be more extensively read and appreciated, and would be more accessible to those who really require them, and a large portion of the expense of printing might be saved. This course has been successfully pursued by the Geological Survey of Great Britain. It has also, we are glad to observe, been adopted in the case of the decades of Canadian fossils; and we can scarcely doubt that these will eventually be found even remunerative as a publishing speculation, though the sale may be too slow to enable them to be profitably issued by private enterprise.

J. W. D.

MISCELLANEOUS.

Geological Society of London.—The Meeting of this Society, on the 5th January, was occupied principally with Canadian subjects: a paper, by Principal Dawson, on the "Devonian Plants of Canada," and one by Mr. T. Sterry Hunt, on some points of Chemical Geology.

The paper on Devonian plants related chiefly to the observations made by the writer last summer in Gaspé, which enable him to describe two species of a new genus, to which he gives the name *Psilophyton*. They are lycopodiaceous plants, with many dichotomous branchlets and rudimentary leaves, allied in some respects to the modern genus *Psilotum*, but springing from a horizontal rhizome, similar to that of some ferns, and having the branchlets rolled up circinately in vernation. Plants of this kind in fragments, have been recognized previously in the Devonian rocks of Scotland and the continent of Europe, but were referred to sea-weeds, &c. The Gaspé specimens, for the first time, enable their true

nature and affinities to be made out. Two species, *P. princeps* and *P. robustius*, were described. A fossil conifer, first found in Gaspé by Sir W. E. Logan, was referred to the *Taxineæ*, and described under the name of *Prototaxites Logani*. A lepidodendron (*L. Gaspianum*) and two species of *Knorria*, one not distinguishable from *K. imbricata*, were added to the Devonian flora of Canada; as also a *Noeggerathia*, of which fragments only were obtained. The paper also described the mode of occurrence of the small Devonian coal seam, discovered by Sir W. E. Logan in Gaspé, probably the oldest true coal seam known. The occurrence of impressions of *rain-marks*, sun-cracks, &c., in these beds, was also noticed.

Professor Hunt's paper contained an elaborate exposition of those views of his on the mode of metamorphism of rocks by chemical changes in the presence of water and a moderate amount of heat, which are already in part known to our readers.

We hope, at some future time, to reprint both papers, or abstracts of them, in the Naturalist.

Canadian Institute of Toronto.—*New Trilobite.*—In the Number of the Canadian Journal for January, Professor Chapman describes a new Canadian trilobite, and the Hypostoma of his species, described in a former article, the Asaphus Canadensis. The new species is named after the Professor of Natural History in the University of Toronto, *A. Hincksii*. It is distinguished from the other Canadian species of Asaphus, as indicated in the following tabular summary of characters:—

Caudal shield with segment furrows	Head-angles terminating in long points.—*A. Canadensis.*
	Head-angles rounded.—*A. Halli.*
Caudal shield smooth.	Pleuræ curving forwards.—*A. platycephalus.*
	Pleuræ curving backwards.—*A. Hincksii.*
Or:— Pleuræ curving backwards.	Head-angles terminating in horns; pygidium furrowed.—*A. Canadensis.*
	Head-angles slightly rounded; pygidium smooth.—*A. Hincksii.*
Pleuræ curving forwards.	Pygidium furrowed.—*A. Halli.*
	Pygidium smooth.—*A. platycephalus.*

Entozoa.—The same number contains a long article on those remarkable creatures, the internal parasites, that infest man and other animals, by Lucius Oille, M.B. It professes to be mainly a summary of the results of Von Siebold and Kuchenmeister, but is well deserving of the study of medical students and young naturalists. The writer very properly scouts the idea of the *gene-*

ratio equivoca, attributed by old writers to these creatures; but which is so directly contradicted by their enormous reproductive powers and the curious metamorphoses which some of them are known to undergo. He also well maintains their use in nature, as physicians, rough it may be, but necessary to apply sharp remedies to unnatural modes of life. The cestoid entozoa or tape-worms are these of which the history is best known; and they are ascertained to be in their young state the little cystic entozoa that take up their abode in the flesh and other tissues of animals. What can be more strange than the transformation of the little microscopic entozoon of the liver of a mouse into the tape-worm of the cat, and the eggs of the tape-worm again finding their way into the food of the mouse, and thence into its flesh or liver; or what more curious than that the *Cysticercus cellulosæ*, which causes "measles" in hogs, rabbits, and sheep, is only the young state of the *Tænia solium* which infests the intestines of man, and that man and these domestic animals reciprocally supply each other with these pests.

"The scolex of the tænia solium and the cysticercus cellulosæ are identical. This is apparent from the similarity in anatomical structure and from experiment. It has now been determined beyond controversy that by feeding the hog, rabbit and sheep with the eggs of the tænia solium those animals became infested with the cysticercus cellulosæ, and by feeding the dog and man with those cystic worms, tape-worms were produced in their intestines. The abundance of cysticerci in the hog is well known. Statistics abundantly prove the frequent occurrence of tape-worm in butchers who are accustomed to handle raw meat and are not over careful or cleanly, but often by their hands or knives rubbed in their mouths introduce the cystic worms into their system. It is also common among those who eat in any manner raw or imperfectly cooked meat contaminated with the cysticerci. The Hottentots in the Caffir wars demonstrated the mode of translation of the cystic worms into the suitable nidus for the final stage of development, namely, the intestine. Those people in the invasion of the enemy's territory feasted according to their barbarous fashion upon the cattle and sheep that were captured, and became greatly infested with tape-worm, whilst previously they were mostly exempt."

The history of these creatures may be shortly stated as follows:—

1. The *Proglottis* or full-grown joint loaded with ova, passes

from the intestinal canal of the animal infested by tape-worm, and creeps to a little distance, depositing its eggs in grass, in water, &c.

2. The ova being devoured in the food of some animal, are hatched into *Embryos*, microscopic in size, and furnished with little hooks, by means of which they penetrate into the vessels and are carried to different parts of the system.

3. They become developed into the stage of the *resting scolex*, in which they are little sac-like objects, on which heads or scolices armed with hooks and suckers are developed.

4. The flesh of the animal infested by these scolices, now known as *Cysticerci*, is eaten by some carnivorous animal, in whose intestines the little parasites fasten themselves, and become developed into tape-worms, producing new proglottides.

Such are the strange provisions made by a beneficient Creator for the life and welfare of creatures, in themselves most loathsome to us; but like all other parasites and plagues, intended to teach us lessons, both physical and moral, which man has been too slow to learn, and, from neglect of which, both he and his domesticated animals must probably long continue to suffer. The subject is, in many respects, an uninviting one; but of great importance in natural science and hygiene, and, for this reason, we desire to give our mite of encouragement to any one who follows it up in the right spirit.

Agassiz on a Museum of Natural History.—A magnificent scheme, for the promotion of Natural History, is now under consideration in Boston. Prof. Agassiz, having declined the tempting offers made to him by the Emperor of the French, takes advantage of the opportunity to invite the attention of his adopted country to a scheme, by which the capital of Massachusetts may become the centre of Natural History education in America. The plan includes the erection of a museum on a magnificent scale, and the institution of curatorships to be eventually erected into chairs of Natural History. It is wise and far-seeing, and, we hope, will be warmly taken up by the Bostonians, who are alive to the importance of attracting to their city young men desirous of scientific education, and have already been, with this view, munificent patrons of their University. Our little attempts in Canada, in erecting museums and forming provincial and other collections, dwindle into small matters compared with the grand conception of the Swiss naturalist. We quote his own words, in a memorial to the Committee of the Lawrence Scientific School :—

"In its present condition, the museum hardly furnishes me the specimens I require for my courses of instruction, for, in consequence of the daily accessions which are heaped upon those already crowded in this narrow space, it is often impossible to find what is wanted at the time, and it is out of the question to allow free access to the museum in its present confused state, to any student not already trained in the manipulation of specimens. Had I six or eight rooms of the size of the two now at my disposition, I could at least make a fair beginning of a systematic arrangement, separate the duplicates from what is to constitute the collection proper, allow free access to the rooms for the public as well as the students, and thus create a more general interest for this establishment, while the students themselves would derive all the advantages which such a collection ought to afford them in their studies. At the same time, the separation of the duplicates from the collection proper would furnish ample materials for an extensive system of exchanges with other institutions of the same kind, by which the collection would at once be at least doubled in all its parts, and in some of its departments increased three or four times, and in some, even tenfold. The advantages of such a system of exchanges are very obvious, and my inability from want of room to separate the duplicates from the collection, has already been, for some years past, a check upon its increase. I hope, therefore, that as soon as it is fully understood, some remedy for this evil may be found.

"But even the possession of an appropriate building will not altogether put an end to our difficulties. The collection is already so large that it is impossible for me to take charge of it alone, even were I to give all my time to its care. For many years past I have already been under the necessity of having one or two, and at times even three assistants, who, at my private expense, have been, most of the time, engaged in taking care of the specimens. As I have nothing in the world but what I earn daily, such an expenditure has frequently been for me a source of unendurable anxiety, of which I wish to free myself, that I may hereafter devote whatever energy I may possess untrammelled to the higher interests of science. In this perplexity I have thought that a number of curatorships, corresponding to the scholarships now existing in the University, which enable young men, whose private means are insufficient for such an object, to receive a college education, might perhaps be founded by some of our wealthy citizens, which

would furnish a small income to students who have already taken their degree, and who, wishing to prosecute farther their studies under my direction, might thus earn the means of remaining in Cambridge by assisting in the arrangement and preservation of the collection, as well as in making the exchanges. The position of the Curators in the scientific school would thus be similar to that of the tutors in the undergraduate department. In a well-organized museum there should be as many curators as there are branches in zoology, including embryology, palæontology and zoological anthropology. In the course of time, these curatorships (to which should be attached the duty of delivering a certain number of lectures annually) may be endowed so as to afford the means of appointing special professors for each branch, and as soon as this is accomplished, our organization would be more perfect than that of either the British Museum or the Jardin des Plantes. Beside the curators, there should be one or two preparators, to mount specimens, and to make the necessary preparations required for the illustration of the specimens. It would also be desirable to have an artist attached to the establishment who would have to make magnified drawings of such specimens as are too small to be at once studied by the natural powers of the eye; these drawings would be appropriate ornaments for the corridors, and at the same time assist in the courses of lectures which it should be the duty of every curator to deliver annually upon the special branches entrusted to his care.

"Gigantic as this scheme may appear, I see nothing visionary or unpractical in it; for, while it cannot be expected that so many curatorships should be founded at once, it is plain that they are not all needed now, and that the same person may take charge of several departments simultaneously for several years to come, and a subdivision of labor may be introduced as it becomes necessary, and our means make it possible. It would, however, be desirable that the services of four or five curators should be obtained soon, —one to take charge of the vertebrates, one of the mollusks, one of the articulates, one of the radiates, and one for the embryological department; and I would add that the sooner the latter curatorship is permanently founded, the better for our institution, as I believe that the methods I am attempting to introduce in the study of animals by comparing their different stages of growth with the permanent forms of lower types, is likely to be a most original feature in this museum, and that which is likely to secure

for it a place among the institutions which shall contribute largely to the real advancement of science. Let me add, with respect to the lectures to be delivered by the curators, that, while they would be a means of progress for themselves in their studies, they would also learn the difficult art of teaching, and prepare themselves to occupy higher situations in this or other Universities.

"While we must wait until the means are secured for founding professorships in the different departments of zoology, I believe that it will be easy to enlist the sympathy and co-operation of all the men in the country, who have acquired for themselves a high position as original investigators in the various departments of Zoölogy. Honorary degrees are conferred, all the world over, by learned institutions on men distinguished for their attainments. It would be equally honorable to our university, and to the distinguished naturalists of the country, if it should please the corporation to grant to such men the title of honorary professors of this university. Until we can have a faculty of resident professors, we can at least have one of honorary professors; and I know those who, gratified by such an honorable distinction, would not hesitate to come to Cambridge annually for a short time, and give to our students the benefit of their knowledge, by delivering short courses of lectures in their respective departments."

TWENTY-EIGHTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—GEOLOGICAL SECTION.

The Ossiferous Cavern at Brixham.—A paper on this subject was read by Mr. W. Pengelly, but not published in the Athenæum from which our extracts are made. Fortunately W. A. Bovey Esq., Advocate of this city, has a letter from his father, who lives upon the spot in which the following passage occurs, which he has kindly permitted us to copy.

"I must not forget to mention a discovery recently made in our town, resulting from the Commons Inclosure Acts. We sold a portion of Windmill Rea Common, immediately over Mrs. Francis to a Mr. Philp for building purposes. On blowing out the rock for a foundation, they came in upon a cavern; the floor of which consisted principally of calcareous stalagmite, very solid and compact. On exploring it, a very large stag's antler was found imbedded in it, and several bones of the elk, fox, &c. &c.

A party of scientific gentlemen from Torquay subsequently explored it, and obtaining a grant of money from the Geological

Society, (London), they purchased the right of working the cavern from Mr. Philp, for £50. A person from the Isle of Wight has been now engaged in it for a considerable time, and upwards of 2000 specimens of bones of extinct mammalia have been found in the various deposits forming the bed of the cavern. Just imagine such remains, the teeth, jaws, femurs, &c. &c. of the Elephant, Rhinoceros, Hyæna, Bear, &c., being entombed within the mass of lime-rock forming the hill behind the spot over which you have played many a time. When first the cavern was opened, it was not more than from 2 to 3 feet in depth, from the stalactitic roof; but on removing the stalagmite that forms the floor, they found a deep deposit 15 or 16 feet deep. All this has been removed so that the cavern is very large."

The most curious circumstance connected with the exploration of this cavern, is the discovery of flint knives in the bone bed. No human relics ever having been hitherto found mingled with the bones of extinct carnivora. According to the present theory of Geology, or at least, the most generally received notices of Geological time, the human period did not commence until long after the extinction of those mammalia. Nothing has hitherto been found to shew the contemporanity of man with those animals. Hence the discovery of those knives has given rise to much discussion among the Geologists. Some assert that they must have been either placed there by some one on purpose, or have accidently been mingled with those bones by diluvial action &c. &c. Others again contend for a higher period of human antiquity.

After Mr. Pengelly's paper, Prof. Ramsay read a report from the Local Committee at Brixham, from which it appeared that Dr. Falkner had found amongst these ossiferous remains the bones of the rhinoceros, boa, horse, reindeer, cave-bear, and hyæna, and also several well-marked specimens of flint-knives, generally regarded as of Celtic manufacture.

Prof. Owen said he was glad that means had been taken for the frozen together into one contiguous transparent mass, although careful exploration of this cave, but it would be premature to raise any hypothesis until the whole of the parts were before them. He had not yet seen any of the bones, and indeed was entirely indebted for what he knew on the subject to the paper which Mr. Pengelly had read, and he should refrain, therefore, from expressing any opinion, but he wished to caution them against coming to any conclusions as to the antiquity of these remains which were really not warranted. He proceeded to show, from the remains

of tigers, elephants, and other animals found in this country, in Siberia and other parts of the world where the climate was much colder than was supposed to be compatible with their existence. That there was undoubted evidence that these animals could adapt themselves to cold and temperate climates as well as to torrid ones, and remarked that the conditions of animal life were not those of climate, but of food and geniet, wherever there was the prey undisturbed by man, there also would be the destroyer. They had evidence from the writings of Julius Cæsar, of the existence of England, 2000 years ago, of three distinct species of animals, including two gigantic species of ox, and one of the reindeer, and he was himself satisfied that they had once a native British lion, all of which however, were now extinct in this country, and he saw nothing in the remains which had been discovered at Brixham to lead him to suppose that the animals lived before the historic period, or which was inconsistent with the concurrent existence of a rude race of barbarians. At the same time he was open to conviction, and would be very glad to see a good fossil human being, which should prove that man had been much longer upon the earth than historical evidence led them to suppose.

President—W. Hopkins, Esq.

The President said the existence of mammalian life in its earlier stages on the surface of our planet, the condition of its existence, and the period of its introduction, have always furnished questions of the highest philosophical as well as palæontological interest. You will be aware that some geologists regard each new discovery of mammalian remains, in formations preceding the older tertiaries, as a fresh indication of the probable existence of mammalia in those earlier periods in which no positive proof of their existence has yet been obtained; while others regard such discoveries only as leading us to an ultimate limit, which will hereafter define a period of the introduction of mammalia on the surface of the earth, long posterior to that of the first introduction of animal life. Be this as it may, every new discovery of the former existence of this highest class of animals must be a matter of great geological interest. An important discovery of this kind has recently been made, principally by the persevering exertions of Mr. Beckles, who has detected in the Purbeck beds a considerable number of the remains of small mammals. The whole of them are, I believe, in the hands of our President, Prof.

Owen, for the determination of their generic and specific characters; but Dr. Falconer seems already to have recognized among them seven or eight distinct genera, some of them marsupial, and others probably placental, of the insectivorous order. I may also notice, as a matter of great palæontological interest, the recent discovery of a new Ossiferous Cave, near Brixham, in Devonshire, of which some account is to be brought before us during this meeting. The past year has been fruitful in palæontological researches.

The subject of the motion of glaciers is one of interest to geologists, for unless we understand the causes of such motion, it will be impossible for us to assign to former glaciers their proper degree of efficiency in the transport of erratic blocks, and to distinguish between the effects of glacial and of floating ice, and those of powerful currents. An important step has recently been made in this subject by the application of a discovery made by Faraday, a few years ago, that if one lump of ice be laid upon another, the contiguous surfaces being sufficiently smooth to insure perfect contact, the two pieces in a short time will become firmly the temperature of the atmosphere in which they are placed be many degrees above the freezing temperature. Dr. Tyndall has the merit of applying this fact to the explanation of certain glacial phenomena. There are two recognized ways in which the motion of a glacier takes place: one by the sliding of the whole glacial mass over the bed of the valley in which it exists; and the other by the whole mass changing its form in consequence of the pressure and tension to which it is subjected. The former mode of progression is that recognized by the sliding theory; the second is that recognized by what has been termed the viscous theory of Prof. Forbes. The viscous theory appeared to be generally recognized. Still, to many persons it seemed difficult to reconcile the property of viscosity with the fragility and apparent inflexibility and inextensibility of ice itself. On the other hand, if this property of viscosity, or something of the kind, were denied, how could we account for the fact of the different fragments, into which a glacier is frequently broken, becoming again united into one continuous mass? Dr. Tyndall has, I conceive, solved the difficulty. Glacial ice, unlike a viscous mass, will bear very little extension. It breaks and cracks suddenly at the separate pieces when subsequently squeezed together again become by regelation (as it is termed) one continuous mass. After some general re-

marks on the cause of the laminous structure of glaciers, during which he remarked that there was no doubt Dr. Tyndall was right in supposing the laminæ of blue and white ice to be perpendicular to the directions of maximum pressure, he said that it remained to be decided whether the explanations which had been offered were correct; but the actual perpendicularity of the laminæ of ice to the directions of maximum pressure within a glacier, and the probable perpendicularity to those directions of the laminæ in rock masses of laminated structure, would seem to establish some relation between these structures in rocks and glacial ice, giving an interest to this peculiar structure in the latter case, which it might not otherwise appear to possess for one who should regard it merely as a geologist.

SECTION OF ECONOMIC SCIENCE AND STATISTICS.

President—E. BAINES, ESQ.

The President said—If the British Association were a theatre for intellectual display, I should shrink from occupying a chair in which I have had such distinguished predecessors. But if I understand the spirit of this Association, it is the simple, honest, earnest pursuit of truth—first, of truth in facts, and secondly, of truth in principles; and it would be quite foreign to that spirit either to attempt anything of display or to apologize for its absence. I shall be permitted, however, to welcome the disciples of economical and statistical science on their visit to this important centre of industry where practical illustrations may be found of many branches of their subject, and where, I hope, there are many who can value their inquiries. After the remarks made last night by the President of he Association, it may seem superfluous to say anything further on the claims of that science which he pronounced to "bear more immediately than any others on the prosperity of nations and the well-being of mankind." We must all have felt how unanswerably the President proved the value of economical and statistical science, when he referred to the department of vital statistics, and showed what terrific losses had been sustained by our army and navy and the army of France from the neglect of sanitary rules. But I may just remark that what gave to the recent report of Mr. Sidney Herbert's Commission on the health of our troops in barracks its resistless force was, the certainty and precision with which statistical researches enabled it to measure the amount of loss sustained, by comparison with the mortality in other classes of the population at the same

ages. The report might have dwelt on sickness, on injudicious diet, on defective ventilation, on want of drainage, and so forth, and all such statements would have been pronounced to be exaggerations or errors: but when it applied the ascertained scale of mortality, so as to prove that there were so many deaths in the thousand when there ought only to have been half that number, the definiteness of the figures and facts defied evasion, fastened on the public mind and conscience, and compelled immediate measures of reform. Those persons who have ignorantly charged upon political economy and statistics a disregard of moral considerations and of humanity may now see how egregiously they were mistaken, and how the arithmetic which they thought so heartless is rising up as the most powerful advocate of the value of human life, of health, of domestic comfort, of temperance, of virtue, of proper leisure, of education, and of all that can purify and elevate society. I am glad to know that we shall have one or more papers on important points of vital statistics laid before this Meeting. May I for a moment refer to another reproach thrown upon statistics, namely, that they may be so used as to prove anything? I hardly need say that it is unfair to argue from the abuse of a thing against its proper use. But it may be admitted, that there is sufficient ground for this reproach, in the negligent or dishonest use sometimes made of statistics, to call upon us for the exercise of great caution, so that in the first place we may be sure we have got all the facts that are essential, and in the next place that we draw from them sound and accurate conclusions. I cannot refrain from expressing my conviction that as the science we cultivate has been shown to be favourable to humanity, so it is no less favourable to freedom. Within the last quarter of a century how busy has it been in knocking off all sorts of fetters from human energies!

The note on the cover of the December number of the *Naturalist*, in reference to Art. XXX. of our last volume, has, we find, been misunderstood. It was intended merely to remedy an omission of our own. In copying the article in question from the *Canadian Journal*, we omitted to copy with it the acknowledgment to the Smithsonian Institution for the use of the wood-cuts, which were originally prepared for that institution; and also to state that the article was based on that in the report of the Smithsonian Institution for 1856, but brought up to 1858 for the *Canadian Journal*. We regard this more full statement as due to both the bodies to which we have been indebted in this matter.

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF OCTOBER, 1858.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

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

Day of Month.	Barometer, corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	9 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 a. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	29·607	29·612	29·700	43·6	62·7	45·9	·209	·422	·221	·75	·75	·72	N. E. by E.	N. E. by E.	N. W. by N.	0·00	0·32	5·70	.....	.....	C. Str. 9. Clear.	C. Str. 10. Clear.	C. Str. 4. Clear.
2	815	734	779	36·0	57·2	41·8	·177	·216	·206	·85	·46	·78	N. W.	W. S. W.	S. W. by S.	9·40	11·43	3·06	.....	.....			C. Str. 10.
3	519	453	314	41·2	56·0	48·2	212	363	310	82	81	92	E. S. E.	S. E.	S. E.	1·72	2·30	0·22	0·200	.....	C. Str. 10. " 6.	C. Str. 9.	Str. 4.
4	419	461	597	50·0	57·9	50·4	290	288	283	82	61	78	W. S. W.	W.	W.	12·51	22·82	11·06	.....	.....	Clear.	Clear.	Clear.
5	694	800	947	44·9	56·8	38·3	218	179	186	76	40	81	W. S. W.	W. S. W.	W. by N.	6·03	18·41	9·10	.....	.....	"	"	"
6	998	914	901	36·6	57·2	41·0	191	216	197	90	46	78	W. S. W.	W. S. W.	W. S. W.	3·57	7·81	2·15	.....	.....	Str. 8.	Rain.	Rain.
7	619	322	361	30·2	45·5	45·0	149	275	282	90	92	96	E. N. E.	N. E. by E.	S.	0·09	2·08	3·40	0·770	.....	C. Str. 10.	C. Str. 6. " 10.	C. Str. 6. " 6.
8	211	219	270	37·2	44·6	40·4	178	218	182	81	76	73	S. W. by W.	W. S. W.	S. W. by S.	10·96	14·67	4·40	0·175	.....	Rain.	" 14.	Clear. Aurora Borealis.
9	247	371	626	39·0	45·1	43·7	223	204	224	96	68	79	S. W. by W.	W. by N.	W.	8·71	27·43	2·85	0·400	.....	C. Str. 2.	Clear.	C. Str. 10.
10	819	879	30·005	40·2	53·2	42·1	183	219	222	73	54	83	W.	W.	W. S. W.	11·05	13·34	1·80	.....	.....	C. C. Str. 6.	C. C. Str. 4.	C. Str. 6. Aur. Bor.
11	30·014	30·099	118	34·0	57·2	39·6	175	316	188	89	67	77	N. W.	S. W.	N. E. by E.	0·21	1·11	2·90	.....	.....	Clear.	Rain.	" 10.
12	010	060	29·990	31·1	55·8	45·7	149	236	236	84	53	92	N. E.	E. N. E.	S. E. by E.	4·47	4·23	1·75	.....	.....	Rain.	C. Str. 8.	Clear.
13	29·903	29·860	699	42·7	49·7	57·6	257	322	436	87	92	94	S. E.	S. E. by E.	S. S. E.	0·00	11·93	6·77	1·040	.....	C. Str. 10.	" 6.	C. Str. 4.
14	616	573	713	49·0	54·5	46·2	329	243	262	95	56	84	W. S. W.	S. W. by S.	S. S. W.	7·80	9·05	0·75	0·103	.....	C. C. Str. 6.	C. C. Str. 8.	" 6.
15	756	908	30·018	42·4	51·7	42·5	244	264	237	91	69	87	W. by S.	W.	W.	3·97	2·32	14·26	.....	.....	Clear.	C. Str. 6.	C. C. Str. 6.
16	30·252	30·254	276	30·5	51·4	42·0	142	245	235	84	65	91	S. W. by W.	S. by W.	S. E.	2·27	0·49	0·00	.....	.....	C. Str. 7.	" 4.	Clear. Aurora Borealis.
17	238	198	204	40·2	49·6	44·2	210	299	256	86	85	89	N. E. by E.	N. E. by E.	N. N. E.	2·27	5·71	5·31	1·110	.....	Fog.	Clear.	Cirr. Cum. 4.
18	243	063	050	35·8	70·6	56·0	197	482	398	95	66	90	S.	S. W.	S. S. W.	0·11	0·73	4·22	.....	.....	Clear.	C. Str. 6.	Clear.
19	001	010	017	47·1	64·0	60·2	298	373	433	92	62	85	S. S. E.	S. S. E.	W. S. W.	1·42	1·10	2·22	.....	.....	C. Str. 2.	Clear.	"
20	036	100	116	52·0	63·0	41·0	328	256	219	83	62	87	W. S. W.	E. S. E.	E. S. E.	0·12	3·71	6·43	.....	.....	Clear.	C. Str. 2.	C. Str. 10.
21	242	124	080	35·0	56·0	43·6	169	288	231	84	65	83	N. E.	E. N. E.	E. N. E.	5·75	9·36	5·40	.....	.....	C. Str. 10.	" 10.	Rain.
22	004	29·910	29·898	45·7	59·0	51·0	265	242	348	92	48	93	E. by S.	S. E.	W.	0·13	3·81	0·05	Inapp.	.....	" 6.	" 4.	Clear.
23	29·852	806	910	42·7	54·0	48·2	244	355	310	91	84	92	N. by E.	N. by E.	N. by E.	0·53	0·63	10·00	Inapp.	.....	Rain.	" 2.	Clear.
24	852	989	30·121	41·0	45·0	57·0	241	198	178	95	65	81	N. E. by E.	S. E. by E.	N. E. by E.	23·53	19·00	7·12	2·530	.....	Clear.	Str. 5.	Clear.
25	30·204	30·200	242	30·9	43·0	31·0	136	127	161	83	47	96	N. E. by E.	E. N. E.	N. E. by E.	9·92	8·32	2·87	.....	.....	Str. 2.	Clear.	Clear.
26	234	214	197	24·2	53·2	36·0	111	269	170	86	67	80	N. E.	S. W. by S.	S. W. by S.	0·46	1·22	0·09	.....	.....	Clear.	"	Clear. Aurora Borealis.
27	159	154	146	29·0	59·1	41·5	147	323	325	94	65	91	W.	W.	W.	0·14	0·51	0·11	.....	.....	Light Cirri.	Clear.	Clear. Aurora Borealis.
28	167	210	283	32·0	53·0	34·3	168	166	162	95	43	84	W. by S.	N. E.	S. E. by S.	7·90	6·00	4·01	0·200	.....	Str. 4.	C. Str. 6.	Rain.
29	231	001	29·994	28·9	43·0	44·7	147	237	280	94	87	96	N. E. by E.	E. N. E.	S. E. by S.	7·90	6·00	4·01	0·200	.....	C. Str. 6.	" 8.	C. Str. 8.
30	29·810	29·712	738	49·6	68·9	49·6	241	156	329	95	53	96	S. S. E.	S. E. by S.	N. E.	4·49	5·01	0·11	0·103	.....	" 10.	C. C. Str. 5.	" 10.
31	170	690	985	47·9	58·1	47·0	310	282	232	94	58	73	S. W.	W. by S.	N. E. by E.	0·73	5·86	1·52	.....	.....			

REPORT FOR THE MONTH OF NOVEMBER, 1858.

	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	29·963	30·126	30·239	44·1	45·8	38·1	·282	·182	·157	·96	·61	·71	N. E. by E.	N. E. by E.	N. N. E.	5·30	6·52	6·81	Inapp.	.....	C. Str. 10.	C. Str. 2.	Str. 2.
2	30·305	254	201	30·0	43·1	34·0	·137	·171	·155	·74	·62	·79	N. E. by E.	N. E. by E.	N. E. by E.	3·25	8·27	6·56	.....	.....	Clear.	Light Cirri. 2.	Clear.
3	231	116	29·929	29·9	40·1	38·0	142	139	136	88	58	81	N. E. by E.	N. E. by E.	N. E. by E.	8·27	5·61	1·55	.....	.....	"	C. Str. 4.	C. Str. 6.
4	29·871	29·954	932	35·4	36·1	35·2	206	191	183	93	90	90	N. E. by E.	E. S. E.	N. E. by E.	9·09	1·19	2·83	0·510	Inapp.	C. Str. 10.	Sleet, snow.	Rain.
5	900	852	885	34·0	44·0	41·0	162	248	219	84	88	87	S. E. by E.	W. by N.	N. N. W.	0·47	2·00	0·22	.....	.....	" 10.	C. Str. 10.	C. Str. 10.
6	848	828	681	36·0	41·0	36·8	191	190	170	90	74	89	N. N. E.	N. E. by E.	N. E. by E.	2·30	8·76	12·20	Inapp.	.....	" 9.	" 9.	" 10.
7	570	520	600	33·5	35·6	32·7	175	183	173	94	90	94	S. E. by E.	S. E. by E.	N. N. W.	18·13	7·37	1·06	2·550	0·40	Rain.	Rain.	Sleet.
8	550	497	729	32·5	40·5	29·5	173	143	174	94	60	94	W. S. W.	W.	W. N. W.	0·00	1·40	5·40	Inapp.	.....	C. Str. 10.	C. Str. 10.	Str. 4.
9	746	761	770	33·0	38·9	31·0	176	195	155	94	82	89	W. by N.	S.	S.	1·83	0·00	0·00	.....	.....	" 9.	" 9.	C. Str. 10.
10	761	719	924	26·3	31·7	24·5	123	124	111	87	73	86	N. N. E.	W. N. W.	W. N. W.	2·26	6·78	9·96	.....	0·40	" 10.	" 9.	" 10.
11	30·004	30·002	30·097	20·8	25·0	25·1	085	105	094	78	80	68	W. N. W.	W. S. W.	S. W.	17·62	5·83	1·13	.....	.....	" 8.	" 8.	" 10.
12	29·970	29·892	29·927	19·1	32·2	25·0	077	137	117	76	74	87	E. by S.	S. E.	S. E.	0·02	0·02	0·22	.....	.....	" 10.	Snow.	Snow.
13	871	830	520	24·1	30·7	30·0	123	142	148	87	85	89	E. N. E.	S. S. E.	E.	1·73	7·17	2·10	.....	2·55	Snow.	C. Str. 4.	Clear.
14	792	740	820	13·3	31·7	16·0	057	149	074	72	84	83	W.	W. by N.	N. W.	23·65	14·00	8·62	.....	0·70	Clear.	" 8.	Clear.
15	792	700	691	6·0	25·0	18·6	043	100	077	75	74	76	W. S. W.	W.	W. by N.	1·90	1·19	5·70	.....	.....	C. Str. 10.	Snow.	C. Str. 10.
16	449	450	512	16·0	26·7	25·1	074	117	117	82	80	86	W.	N. E.	N. N. E.	11·83	16·00	18·44	.....	Inapp.	" 8.	" 8.	Clear.
17	517	597	714	23·1	50·9	29·0	106	142	128	86	84	77	N. W.	W.	W.	29·75	25·02	12·20	.....	.....	" 10.	C. Str. 6.	C. Str. 8.
18	624	519	670	31·5	38·1	36·0	149	165	191	84	73	90	W. S. W.	W. S. W.	W. S. W.	7·01	11·15	8·33	.....	.....	" 7.	" 10.	C. Str. 2. Lunar Halo.
19	677	735	852	26·5	21·4	18·9	117	058	071	82	50	70	W. N. W.	W. N. W.	W.	19·90	22·22	14·22	.....	Inapp.	" 6.	" 6.	Clear.
20	832	717	801	19·2	36·4	27·3	077	107	123	71	80	82	W.	W. S. W.	W. S. W.	9·35	3·00	8·13	.....	.....	Cirr. 2.	Clear.	C. Str. 2.
21	757	761	782	22·4	37·4	26·2	095	193	126	79	85	87	S. E.	S. E.	N. E. by E.	0·01	0·00	0·35	.....	.....	C. Str. 10.	C. Str. 10.	" 9.
22	893	890	980	19·1	35·2	28·6	072	162	135	78	80	88	N. by E.	E.	N. E.	0·07	0·12	1·33	.....	.....	Snow.	Snow.	" 10.
23	681	578	562	20·1	27·0	26·2	081	129	185	79	88	93	N. E. by E.	N. E. by E.	N. E. by E.	3·75	15·63	9·61	.....	0·90	C. Str. 4.	C. Str. 2.	" 10.
24	567	559	627	27·2	51·9	22·3	129	135	095	88	79	79	N. E. by E.	N.	W. by N.	24·81	7·63	0·42	.....	0·30	" 10.	" 10.	" 10.
25	681	640	716	19·1	23·0	23·1	087	120	128	84	82	82	W.	W. N. W.	W. S. W.	11·10	10·90	10·50	.....	.....	" 9.	" 10.	" 9.
26	761	809	914	26·0	28·0	26·7	123	117	117	87	76	82	W.	W. N. W.	W. N. W.	7·70	9·43	9·85	.....	.....	" 9.	" 10.	" 9.
27	952	910	942	25·1	30·0	28·2	111	130	129	86	78	84	W. N. W.	S. W.	S. W.	10·83	3·45	2·70	.....	.....	" 9.	" 9.	" 9.
28	670	681	687	20·4	29·2	21·9	088	133	088	78	77	78	W.	S. S. W.	S. E. by S.	5·92	0·08	0·01	.....	.....	C. C. Str. 8.	" 6.	" 8.
29	644	660	677	18·1	26·2	20·9	081	111	085	83	80	78	N. E. by E.	S. E.	S. by W.	1·12	1·77	0·00	.....	.....	C. Str. 8.	" 10.	" 8.
30	424	475	914	18·7	29·0	12·0	077	123	054	96	77	71	S. E. by S.	W.	W. N. W.	1·20	5·95	19·13	.....	1·10	C. Str. 10.	" 6.	Clear.

REMARKS FOR OCTOBER, 1858.

Barometer..... Highest, the 18th day, 30·243 inches. Lowest, " 8th " 29·211 " Monthly Mean, 29·982 inches. Monthly Range, 1·032 "

Thermometer... Highest, the 18th day, 70°6. Lowest, the 26th day, 24°2. Monthly Mean, 46°48. Monthly Range, 46°4.

Greatest intensity of the Sun's rays, 81°4.

Lowest point of terrestrial radiation, 21°4.

Rain fell on 12 days, amounting to 3·629 inches; it was raining 53 hours and 10 minutes, and was accompanied by thunder and lightning on 2 days.

Most prevalent wind, N. E. by E. Least prevalent wind, S.

Most windy day, the 24th day; mean miles per hour, 16·48.

Least windy day, the 1st day; mean miles per hour, 2·00.

Aurora Borealis visible on 5 nights.

Comet visible to the naked eye till the 18th day.

The Electrical state of the atmosphere has indicated moderate intensity.

Ozone was present in large quantity.

REMARKS FOR DECEMBER, 1858.

Barometer..... Highest, the 2nd day, 30·305 inches. Lowest, " 16th " 29·449 " Monthly Mean, 29·779 inches. Monthly Range, ·856 "

Thermometer. Highest, the 1st day, 46°2. Lowest, " 18th " 4°8. Monthly Mean, 26°78. Monthly Range, 41°4.

Greatest intensity of the Sun's rays, 58°9.

Lowest point of terrestrial radiation, 4°8.

Rain fell on 6 days, amounting to 3·090 inches; it was raining

Mean of humidity, ·809.

Snow fell on 10 days, amounting to 6·41 inches; it was snowing 46 hours and 35 minutes.

First Snow of the season fell on the 4th day.

Most prevalent wind, N. E. by E. Least prevalent wind, E.

Most windy day, the 17th day; mean miles per hour, 2·249.

Least windy day, the 21st day; mean miles per hour, 0·11.

Lunar Halo visible on 1 night.

The Electrical state of the atmosphere has indicated moderate intensity.

Ozone was present in large quantity.