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THE

# CANADIAN NATURALIST

## AND GEOLOGIST:

### A Bi-Monthly Journal of Natural Science,

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

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(WITH TWO MAPS.)



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# CONTENTS.


PAGE

Botanical Science—Record of Progress; By GEORGE LAWSON, Ph. D., LL.D. .......... 1

Cave in Limestone near Montreal; By Mr. H. G. VENNOR .......... 14

Contributions to Lithology; By DR. T. STERRY HUNT, F.R.S. .......... 16

On Ocean Drifts and Currents, and their effects on Islands far removed from Continents; By J. MATTHEW JONES, F.L.S. .......... 37

Notes on the Silicification of Fossils; By DR. T. STERRY HUNT, F.R.S. 46

Notes on the Geology and Botany of New Brunswick; By Professor L. W. BAILEY .......... 81

On Pisciculture .......... 124

Contributions to Lithology; By DR. T. STERRY HUNT, F.R.S. .......... 161

On the Chemistry of Manures .......... 97, 189

Elementary Views of the Classification of Animals; By J. W. DAWSON, LL.D., F.R.S .......... 241

On the Occurrence of *Picris Rapæ* in Canada; By G. J BOWLES... 258

Synopsis of Canadian Ferns and Filicoid Plants; By GEORGE LAWSON, Ph. D., LL.D .......... 262

Observations on supposed Glacial Drift in the Labrador Peninsula; By HENRY YOULE HIND, M.A., F.R.G.S .......... 300

Description of two American Sponges; By DR. J. S. BOWERBANK, F.R.S .......... 304

Michaux and his Journey in Canada; By the Abbé OVIDE BRUNET... 325

Reminiscences of Amherst College; By EDWARD HITCHCOCK, D.D., LL.D. (Reviewed) .......... 337

Notes on the Habitats and Varieties of some Canadian Ferns; By DAVID R. McCORD, B.A .......... 354

On the Geology of Eastern New York; By Professor JAMES HALL and SIR WILLIAM E. LOGAN .......... 368

On the Fossils of the Genus Rusophycus; By J. W. DAWSON, LL.D., F.R.S .......... 363, 458

Observations on Canadian Geographical Botany; By A. T. DRUMMOND, B.A., LL.B .......... 405

On the Geology of the Ottawa Valley; By J. A. GRANT, M.D., F.G.S. 419

On Peat and its Uses; By DR. T. STERRY HUNT, F.R.S .......... 426

PAGE

NATURAL HISTORY SOCIETY.

Annual Conversazione .......... 50
The Maple-Leaf Cutter .......... 64
Annual Meeting .......... 218
Monthly Meetings .......... 234, 370, 272, 441
Annual Meeting, *continued* .......... 308

ENTOMOLOGICAL SOCIETY.

Proceedings of. .......... 374
Couper on *Attacus polyphemus* .......... 376
" on a gall from *Triticum repens* .......... 444

BRITISH ASSOCIATION.

Profs. Balfour and Rolleston's Addresses .......... 75
Jones and Parker on Foraminifera .......... 79
Geography and Ethnology (President's Address) .......... 153
Lecture by Dr. Livingstone .......... 279
Extracts from the Address of Sir Charles Lyell, D.C.L. .......... 389
Observations on the Salmonidæ; by Dr. J. Davy .......... 446
Transport of Salmon Ova to Australia; by T. Johnson .......... 452
New Method of Extracting Gold from Ores; by F. C. Calvert. 456

REVIEWS AND BOOK-NOTICES.

Geological Survey of Canada; Report of Progress .......... 65
Review of a Criticism of Renan on Languages .......... 146
Geological Magazine .......... 378
Verrill on the Polyps of the United States .......... 470

MISCELLANEOUS.

On Organic Remains in the Laurentian Rocks .......... 152
The Earthquake of April 1864 .......... 158
On Bivalved Entomostraca .......... 236
Hail-Storm in Pontiac .......... 307
Calluna Vulgaris .......... 378, 459
Illustration to Dr. Dawson's article on the Genus Rusophycus. 458
The gold of Nova Scotia of Pre-Carboniferous Age .......... 459

OBITUARY.

Principal Leitch of Queen's College, Kingston .......... 237
Professor Silliman of New Haven .......... 461

METEOROLOGICAL TABLES.

January and February .......... 239
March to August .......... 321
September .......... 404
October to December .......... 472

THE

# CANADIAN NATURALIST.

SECOND SERIES.

## BOTANICAL SCIENCE—RECORD OF PROGRESS.

By George Lawson, LL.D., Professor of Chemistry, Dalhousie College, Halifax, Nova Scotia.

1. Flora of Canada.—Canadian botanists will be pleased to learn that the series of "Colonial Floras," now being published under authority of the Home Government, is rapidly progressing; and that Sir William Hooker is now desirous of receiving contributions to the projected Flora of Canada and other British American Provinces, of which Dr. Joseph Hooker is to be the author. As to the nature of materials desired, it may be stated generally that information respecting the occurrence in Canada of plants not hitherto recorded as Canadian, when accompanied by authenticated specimens, will be most useful. In a letter from Sir William, he observes: "Our own materials [at Kew] are very ample for the object in question; nevertheless I am far from discouraging any from sending to us well-prepared specimens, among which it is probable we should find some new things, and more still which would be useful as showing the geographical distribution of species. Most of all we desire, as far as Canada is concerned, that specimens be collected largely in the *most southern districts*, as there would probably be found *United States species* not yet recorded as Canadian. The oaks, the pines, and in general the forest-trees and shrubs, particularly of the South, require a careful study. You define clearly the plants we most desire to have, viz.,

*such as are not already published as Canadian, or as are of critical interest.*"

2. Canadian Ginseng.—My friend and former pupil, Dr. John C. Schültz, the active Secretary of the Scientific Institute of Rupert's Land, called attention some time ago to the trade which was then being carried on in exporting ginseng *Aralia quinquefolia* from Minnesota to China. In western Minnesota the root is collected by Indians, and sold to traders in St. Paul's for a dollar a pound, to be carried to New York for export. Dr. Schültz, seeing several barrels of it at St. Paul's, wisely suggested to Canadians the propriety of taking up this lucrative branch of industry. In a letter which I have received from Sir William Hooker, that veteran botanist observes: "I am glad to see the subject of the American ginseng alluded to. Is it the fact that it is still largely exported to China? and what are the statistics? Now would appear to be the time to send it. I can assure you, that, old botanist as I am, and with correspondents all over the world, with two collectors I have had in Manchuria, intimate with all the Russian botanists, I have never been able to procure even a dried specimen of the Chinese ginseng. With great difficulty Dr. Bunge obtained for me a single dried root, for which three guineas was paid in the country. I have no doubt your ginseng is every bit as good as that of Manchuria, and certainly the Chinese once thought so."

3. Canadian Nuts and Gooseberries.—I find that the common hazel-nut of central Canada is *Corylus rostrata*; that of the Northern States and of the plains west from Canada, *C. Americana*, which in Canada is local, occurring abundantly in some places however, as at Belleville, where it was pointed out to me by Mr. J. McCoun. The common smooth gooseberry of Upper Canada is *Ribes rotundifolium*. The more prevalent one in the New England States is, according to Prof. Gray, *R. hirtellum*.

4. Canadian Habitats *of Diplostachyum apodum*.—Mr. Josiah Jones Bell, of Carleton Place, one of my former pupils, has given me specimens of this very interesting lycopod, collected by him at Dickson's Point, Mississippi Lake, C. W., August, 1863. The only Canadian localities previously known were Detroit River, C. W., where it was found by Dr. P. W. Maclagan; and Belleville, C. W., where Mr. McCoun pointed it out to me last summer. I have since found it in a fertile state in the grass by the

margin of Mill-Creek, a few hundred yards below the village of Odessa, which is some thirteen or fourteen miles from Kingston, C. W. This is the *Lycopodium apodum*, Linn., Pursh, etc., *Selaginella apus*, Gray, Eaton, etc. I have it from Schooley's Mountain, (Mr. A. O. Brodie,) but it is rare in the United States. Being a minute moss-like species, it may be sometimes overlooked. It is admirably adapted for cultivation in a Ward's case, as it covers the soil with a very dense carpet of a most beautiful light green hue.

5. Gulf-Weed at Cape Sable.—The Nova Scotia newspapers contain accounts of great quantities of the gulf-weed (*Sargassum bacciferum*) having been thrown upon the shore at Cape Sable, by the gales of December, 1863; the Gulf-stream, it is alleged, being much nearer the land than usual.

6. Poa laxa, Hænke.—This rare alpine grass was found on the White Mountains by Principal Dawson, to whom I am indebted for specimens.

7. Flora of Anticosti and the Mingan Islands.—Mr. A. E. Verrill has published in the Boston Natural History Society's Proceedings a list of the plants collected at Anticosti and the Mingan Islands, by himself, Mr. A. Hyatt, and Mr. N. S. Shaler, who formed a party from the Museum of Comparative Zoology for the investigation of the geology, etc., of Anticosti, in 1861. The list contains 209 named species of flowering plants. I note some of the more interesting: *Anemone parviflora*, S. W. Point; *Thalictrum alpinum*, *Ranunculus Cymbalaria; Dryas integrifolia*, Vahl., Mingan, and Anticosti, abundant; (*D. Drummondii*, attributed to Anticosti by Pursh was not met with;) *Rubus Chamæmorus*, abundant; *R. arcticus; Saxifraga Grœnlandica*, L., very abundant at Mingan Islands. A very large number of specimens of this species collected at Mingan, proves, according to Prof. Gray, that *S. Grœnlandica*, *S. cæspitosa*, L., and *S. exarata*, Vill., are only forms of one species; *S. aizoides*, large variety, abundant at Anticosti, about limestone cliffs; *S. aizoon*, Niapisca Island; *Ligusticum Scoticum; Erigeron acre*, (*E. alpinum*, Hook.,) narrow-leaved form, abundant on grassy banks near the mouth of Jupiter River; *Rhodora Canadensis*, L.*; Loiseleuria procumbens*, *Primula farinosa*, and *P. Mistassinica; Mertensia maritima*, a fern with glabrous leaves, was occasionally met with; *Taxus Canadensis; Calypso borealis; Hierochloa borealis*,

&c. Nineteen Orchids are enumerated, yet only two Carices, two grasses, and no Cryptogamia, so that there is still room for useful work at Anticosti and Mingan. The *Kalmia latifolia* of Mr. Billings's Anticosti list is no doubt *K. Angustifolia*, as Mr. Verrill suggests.

8. WOODSIA ALPINA (W. HYPERBOREA), A CANADIAN PLANT. —I am happy to be able to state definitely that this very rare fern is a native of Canada. Last winter several specimens of Woodsia were brought to me by my former pupil, Mr. Robt. Bell, B. A., who had gathered them in Gaspé in the previous year. One of these could not be satisfactorily identified; and through Prof. Torrey, I forwarded it to Mr. Daniel C. Eaton, who has made the American ferns a special study. He kindly took the trouble to compare it with authentic specimens in his rich herbarium of ferns, and with published figures and descriptions that were inaccessible at Kingston. He writes to me that he has now no doubt of the identity of the Gaspé fern with *Woodsia hyperborea* (*W. alpina*, S. F. Gr.). He adds: "it is the first American specimen I have seen." Thus Pursh's record of the fern as occurring "in clefts of rocks, Canada," is confirmed. Mr. Eaton further points out that Major Raines's Oregon specimens referred to *W. hyperborea* by Sir William Hooker, in his recent work on British ferns, do not really belong to that species; "they have not jointed stripes, nor a cilliate-cleft involucre, and belong to the *Physematium* section. I may state that my own specimens of *W. alpina*, from Norway, (Thos. Anderson, M.D.,) and Ben Lawers, Perthshire, (J. T. Syme, F.L.S.,) are very small fertile fronds, remarkably different in aspect from the comparatively large lax fronds from Gaspé (measuring nine inches in length). I therefore propose that the Gaspé plant should be distinguished as var. *Belli*, as I had described it in the "Synopsis of Canadian Ferns and Filicoid Plants"; but it must now be referred to *W. alpina*, not to *W. glabella*, as formerly. Although the latter species (*W. glabella*) is admitted by all authors as a Canadian fern, I know of no strictly Canadian habitat for it. Mr. Charles H. H chcock tells me that he collected *W. glabella* sometime ago at Willoughby Mountain, Vermont, where it has become extremely scarce.

9. THE COMPASS PLANT OR POLAR PLANT.—It is a misfortune of botany that more time is required to clear up doubts and point out errors than for the pleasanter task of making

new discoveries. Yet it is work that must be done, and it is usually in fact by this very process that discoveries are eliminated. Lately some attention has been given by a phenomenon said to be exhibited by *Silphium laciniatum* on the prairies, and the most contradictory observations have been recorded. In 1862 Mr. W. Gorrie called the attention of the Botanical Society of Edinburgh to various notices of this plant, such for example as the following:—

"But we had a guide to our direction unerring as the magnetic needle. We were traversing the region of the Polar Plant, the planes of whose leaves, at almost every step, pointed out our meridian. It grew upon our track, and was crushed under the hoof of our horses, as we rode onwards."—*The Scalp Hunters, by Capt. Mayne Reid*, p. 206.

"Whilst in the damper ground appeared the Polar Plant; that prairie compass, the plane of whose leaf ever turns towards the magnetic meridian."—*The City of the Saints, by R. F. Burton*, p. 60.

"Fortunately none go to the prairie for the first time without being shown, in case of such mishaps, the groups of compass-weed which abound all over the plains, the broad flat leaves of which point due north and south with an accuracy as unvarying as that of the magnetic needle itself."—*The Prince of Wales in Canada, &c., by the Times's Special Correspondent*, p. 300.

"On the uplands the grass is luxuriant, and occasionally is found the wild tea (*Amorpha canescens*) and the Pilot Weed, *Silphium laciniatum*."—*Emory's Notes with the Advance Guard*, p. 11.

"It is said that the planes of the leaves of this plant are coincident with the plane of the meridian; but those I have noticed must have been influenced by some local attraction that deranged their polarity."—*Lieut. Albert's Notes in the same work.*

"Patience," the Priest would say; "have faith, and thy prayer will be answered.
Look at this delicate plant that lifts its head from the meadow;
See how its leaves all point to the north, as true as the magnet.
It is the compass-flower, that the finger of God has suspended
Here on its fragile stock, to direct the traveller's journey
Over the sea-like, pathless, limitless waste of desert."

*Longfellow's Evangeline.*

What every body says must be true. The combined testimony of Mayne Reid, Burton, the Times's Special, and Longfellow, added to the common belief of prairie men, cannot be gainsayed. Yet a cautious botanist will suspect that after all, the concurrent testimony may resolve itself into a snow-ball fancy, that has gathered as it rolled from book to book, and that the popular authors quoted did not trouble themselves much about the accuracy of the fact. Prof. Asa Gray, our chief American botanist, does not confirm the exhibition of polarity by his observation of the plant in the Cambridge garden. In the same way, I could not make it out by observation of the plant for two years, although certainly in the single plant to which my observations were limited the *stem-leaves* did show a tendency towards a north and south direction. However in an "extra" from the American Journal of Science, given to me when on a recent visit to Prof. Gray at Cambridge, I find a communication from Mr. T. Hill, with observations made on the wild plants near Chicago,—Aug. 8, 1863. Only one plant, bearing four old leaves, gave an average angle with the meridian of more than 34°; their mean was 18° west. Of twenty-nine plants, bearing ninety-one leaves, the angles with the meridian were as follows: seven made angles greater than 35°; fifteen, angles between 35° and 20°; sixteen, angles between 20° and 8°; twenty-eight, angles between 8° and 1°; and twenty-five, angles less than 1°. Of the sixty-nine angles less than 20°, the mean is N. 0° 33′ E., i. e. about half a degree east of the meridian. The error of observation may have been as much as three times this quantity. One half of the leaves bear within about half a point of north, two-thirds within a point. In the Kingston specimen the first flower looked to the north, the others chiefly south.

10. Buxbaumia aphylla in Nova Scotia.—This rare and most remarkable of all the mosses grows on the hills three miles in the rear of the city of Halifax, Nova Scotia. It was found with perfectly formed but green capsules on December 26, 1863.

11. Parochetus communis.—A herbaceous leguminous plant, new to gardens, and bearing the above name, was exhibited at the November (1863) meeting of the Edinburgh Botanical Society. It resembles the common white clover, but has blue flowers, and is said to be very pretty. This plant was introduced to Canada last year, a fine crop having been raised from seeds received from Dr. Thomas Anderson, who obtained them at a high elevation on the Himalayas.

12. Acer Negundo, foliis variegatis.—In the *Verzeichniss* of our friend Mr. J. N. Haage, of Erfurt in Prussia, we observe a drawing and description of a beautiful variegated or silver-leaved variety of the *Acer Negundo*,—or as it ought rather to be called, *Negundo aceroides.* This elegant variety will form a welcome addition to the list of American ornamental trees. It is for sale in the European nurseries.

13. Canadian species of Equisetum.—The following are described in Trans. Bot. Soc. Ed.: *E. sylvaticum; E. umbrosum; E. arvense; E. arvense, var. granlatum;* (a new and remarkable form from the Trent, near Trenton); *E. Telmateja; E. limosum; E. hyemale; E. variegatum; E. scirpoides;* and *E. scirpoides, var. minor*, the last from Gaspé (Mr. Robt. Bell). *E. palustre* is understood to grow in the northern parts of Canada.

14. Sequoia Lawsoniana.—Messrs P. Lawson & Son of Edinburgh have raised a new Conifer from California seeds, which has been named *Sequoia Lawsoniana*.

15. Yucca filamentosa.—This fine southern plant is quite hardy in Canada. Its specific name refers to the numerous threads or filaments which hang from the margins of the leaves.

16. Clerodendron Thomsonæ, Balfour, (Mrs. Thompson's Clerodendron). This handsome plant was transmitted by the Rev. W. C. Thompson from Old Calabar, on the west coast of Africa, and flowered at the Botanic Garden of Edinburgh, in December, 1861. It is a shrubby twining plant, producing showy flowers, and will soon be seen in all our hot-houses. Prof. Balfour gave a full description of it some time ago, accompanied by a beautiful drawing from the pencil of Dr. Greville. (Trans. Bot. Soc. Edin., vol. vii, p. 2.) It had not then shown fruit, which however has been subsequently produced, and is now described, with elegant drawings. Prof. Balfour states that the fruit consists of four achens, which when ripe assume a shining black color externally. Between the achens, and attached to their surface, but not appearing on the peripheral side, there is a bright red cellular coat, which enlarges as the fruit ripens, separating the achens, which ultimately appear as four distinct seed-vessels, covered on their upper surface (commissure), with a succulent rugose mass of cells of a bright scarlet color. The surface oil-globule-bearing cells are described as of a glandular nature. We have here apparently a beautiful example of glan-

dular structure, presenting in an exogenous plant a perfect homology with the glandular structures of the fruits of monocotyledons, so well described by Brongniart, and serving to illustrate the theory (see Trans. Bot. Soc. Ed., v, p. 213), that all vegetable glands are epidermal structures. In several points of view then this is an interesting plant, and Dr. Balfour has done it ample justice in his admirable description.

17. PHYSOSTIGMA VENENOSUM, Balfour.—The Poison Bean or Ordeal Bean of Calabar, *Physostigma venenosum*, Balfour, which is used in Africa as a state poison, a supposed means of discovering crime, and a certain method of punishing it, is likely to yield, in the hands of medical men, some return for all the evil it has done in the hands of the ignorant and superstitious Africans. Dr. Thomas R. Fraser finds that the bean acts as follows:

1. The kernel acts on the spinal cord by destroying its power of conducting impressions. 2. This destruction may result in two well-marked and distinct effects, either in muscular paralysis, extending gradually to the respiratory apparatus, and producing death by asphyxia; or in rapid paralysis of the heart, probably due to an extension of this action to the sympathetic system, thus causing death by syncope. 3. A difference in dose accompanies the difference in effect. 4. The functions of the brain may be affected secondarily. 5. It produces paralysis of muscular fibre, striped and non-striped. 6. It excites secretions, and especially the action of the alimentary mucous membrane. 7. Topical effects follow the local application of the watery emulsion and alcoholic extract; these are destruction of the contractibility of muscular fibre, and contraction of the pupil when applied to the eye-ball or eye-lids.

18. NEW IRISH LICHENS AND HEPATICÆ.—Dr. Benjamin Carrington, F.L.S., has described (Trans. B. Soc., vii, p. 3) the following new lichens: *Ephebe Moorii*, Carrington, a delicate little species found at Glena, Killarney, growing in shallow depressed patches, an inch or more in extent, on *Frullania tamarisci*, var. *microphylla*; *Lecidea scapanaria*, Carrington, Killarney, parasitic on the stem and leaves of *Scapania undulata*, var. *major*, and *S. æquiloba*. The same indefatigable botanist has given an elaboration of the Killarney Hepaticæ well worthy of study. Cryptogamic botany used to be a pleasant pastime; but

it now requires an exercise of the observing powers that none but genuine botanists can endure.

19. The Toot Poison of New Zealand.—Dr. W. Lauder Lindsay, F.R.S.E., has published a paper (read to the British Association) on the Toot Poison of New Zealand, a poison which has of late years committed great ravages among the flocks and herds of the settlers. It belongs to the class of *narcotico-irritants.* The poisonous parts of the plant to man are usually the seed contained in a beautiful dark purple luscious berry, resembling the blackberry, which clusters closely in rich pendant racemes, and is most tempting to children. The young shoots, which are tender and succulent, resembling asparagus in appearance and taste, are eaten by cattle and sheep. Robust cattle habituated to its use do not seem to be affected; but animals suddenly making a large meal of it after long fasting, or after long feeding on drier or less palatable materials, or after exhaustion by hard labour, hot dry weather, or a fatiguing sea-voyage, are sure to suffer from its use. It causes vertigo, stupor, delirium, and convulsions, curious staggerings and gyrations, frantic kicking and racing or coursing, and tremors. In man the symptoms are coma, with or without delirium, sometimes great muscular excitement or convulsions. During convalescence there is loss of memory, with or without vertigo. Dr. Lindsay states that in many cases of loss of cattle by individual settlers, the amount of loss from toot-poisoning alone had been from twenty-five to seventy-five per cent.

The destructive plant in question is named *Coriaria Tutu*, Lindsay. It is *C. ruscifolia* of Linnæus, *C. sarmentosa*, Forst., etc., names to which the author objects as inapplicable. The whole genus needs revision; most of the species are more or less poisonous. The New Zealand settlers owe a debt of gratitude to Dr. Lindsay for the trouble he has taken to investigate the Toot poison.

20. The Chinese Green Dye.—From a report of the Agri-Horticultural Society of the Punjab, just received from L. A. Stapley, Esq., it appears that that institution is in a thriving and active condition. At the Society's meeting on 22nd July, 1863, plants of *Rhamnus utilis*, which yields the celebrated Chinese green dye, were shown. It was resolved, with reference to the facility with which this plant appears to be propagated in the

Punjab, and to the great advisability of obtaining satisfactory information as to the second species of *Rhamnus*, necessary to the complete adaptation of the former plant to the purposes of dyeing as practised in China, that an application be made through the Punjab government, to obtain from the British Consular authorities in China, further and authentic particulars (also seeds) of the several species of *Rhamnus*, without which the dye cannot be prepared, as shown in the papers translated for the Agri-Horticultural Society of India, by Mr. Cope, and published in their journal. It is remarked with satisfaction that the seedlings before the meeting are the produce of seeds from plants grown in the Society's Badamee Garden.

21. LAKH DYE.—In the same report, D. F. McLeod, Esq., calls attention to the valuable insect producing the lakh and lakh dye of commerce. He states that it is indigenous to various parts of the Punjab, especially to the N. W. extremity of the Baree Doab, zillah Goordaspoor, and the S. W. parts of the Kangra zillah. There is some reason to believe that, at one time, the insect covered a larger space than it now occupies. There is a popular rumor that the Sikh government derived a revenue of one lakh of rupees from the farm of the exclusive privilege to gather the lakh; but this is probably an exaggeration. The subject is however one full of interest, and should draw the special attention of the Society. In the central provinces, where the insect exists in great abundance, it is propagated by artificial means, and grafted as it were on the tree. It feeds chiefly, down there, on the Dhak (*Butea frondosa*); but in the Punjab it is exclusively found on the Ber (*Rhamnus jujuba*). Two years ago Mr. McLeod had observed the insect to be spreading on Ber trees and bushes in his neighborhood. This year (1863) the insect has shown itself in large quantities, considerable enough to make it worth the notice of parties to purchase the right to cut the branches on which the insects are found. Reference to the exports of Bengal show that thousands of maunds are sent to Europe, either as lakh or dye, and its preparation is carried on in large establishments. The lower province insect feeds chiefly on the Dhak. Why should experiments not be made for grafting it on this tree, of which whole forests exist? His Highness the Rajah of Kupoorthulla has devoted some attention to the subject, and introduced the insect from Oudh into his Dhak forest lands near Phugwara. Experiments are likewise in progress

in the Punjab in raising silk and hops. Wild mushrooms are abundant in the rains at Shahpoor; of which, according to Dr. G. Henderson, there are two edible sorts,—one globular, and the other exactly like an English mushroom.

22. Improvement of Cotton in India.—Dr. Henderson reports that his experiments with the finer kinds of cotton, of which seeds have been imported, have been very successful. His remarks throw a welcome light upon the present aspect of cotton culture in India. He says that the cotton seed sent to him was sown in April, and succeeded wonderfully: many of the plants are over three feet high, and six feet in circumference round the bush. Some sea-island cotton sown a few days before has been giving an early crop for some time. The New Orleans seemed to thrive best: it has been in flower for a few days. The reason of the sea-island giving an early crop is believed to be that after frequent and regular watering, it was passed over once or twice, and the check thus caused during the hot winds made it flower. An early crop might in this way be got from all second year's plants before the rains come on, if it would not weaken the plants too much. Dr. H. visited some wells where Egyptian seed had been distributed, and found that very little had germinated, and also that the plants were mixed with native cotton. The Zeminders say what is very true, that they cannot afford to try experiments: they know exactly the value of country cotton, but had no experience of the American sorts. It seems that the best mode of securing a fair trial of American cotton by the Zeminders would be for government or local committees to adopt the same method as Mr. Wightman does,—to supply seed known to be good, to stipulate for its being sown in a particular way, and to guarantee a certain amount per beegah, so that if the crop failed, the Zeminder would not lose by it. If in each district eight or ten beegahs were thus grown, the natives would be able to judge for themselves as to the advantage of growing foreign cotton. Dr. H. sowed some New Orleans seed near a road leading to the Cutchery, and, as expected, the Zeminders often came to look at the plants, and asked questions about the new cotton.

23. Indian Bamboos.—Efforts are being made to extend the growth of the bamboo as widely as possible throughout the Punjab. The kinds of which seeds are being collected for distribution are these:

1. The hollow bamboo of the plains.

2. Solid bamboo of the lower hills, of which spear handles and clubs are usually made.

3. The Nirgali, or small bamboo of the hills, growing at elevations from 5,000 to 8,000 feet.

4. The Garroo, or still smaller hill bamboo, growing at higher elevations, probably up to 12,000 feet.

Enquiries have been set on foot to ascertain, if possible, from the people, the intervals which elapse between the seasons of flowering of the several varieties, a point on which the more observant ought to be able readily to furnish information; as after flowering and yielding seed, the entire tract of bamboo which has seeded simultaneously dries up and perishes, fresh plantations springing up from the seeds which have been scattered by the old stock.

24. Box wood and Olive wood for the Engraver.—The following remarks by Dr. Cleghorn, the chief botanist in India, accompanied samples of wood-engraving received from Dr. Hunter of the Madras School of Arts:—

"Some months ago I sent small logs of box and olive from Kooloo, and, as you perceive, both of these woods answer well for engraving. They show that the wood cuts smoothly, and has working qualities adapted for the graver to print from.

"The enclosed twig of box (*Buxus sempervirens*) is taken from a tree in Mr. McLeod's *arboretum* at Dharmsalla, a spot well worthy of a visit, containing many introduced Himalayan trees of great interest, as well as many European fruit-trees adapted to this hill station. It is perhaps the only collection of indigenous Alpine trees in the Punjab; the nearest approach to it being that of Mr. Berkeley at Kotghur. I hope the day is not far distant when the Punjab Agri-Horticultural Society may have a Hill garden affiliated with it, at one of the *Sanitaria* of the province.

"The Himalayan box appears to be identical with the tree common all over southern Europe, from Gibraltar to Constantinople, and extending into Persia. It is found chiefly in valleys at an elevation of from 3,000 to 6,000 feet. I have met with it from Mount Tira near Jhelum, to Wangtu Bridge on the Sutlej. It is variable in size, being generally seven to eight feet high, and the stem only a few inches thick, but attaining sometimes a height of fifteen to seventeen feet, as at Mannikarn in Kullu, and a girth of twenty-two inches as a maximum. The wood of the smaller trees is often the best for the turner and the wood-engraver. It is made by the villagers into little boxes for holding ghee, honey, snuff, and tinder. At the medical stores in Sealkote it is turned into pill-boxes; and it appears to be adapted for plugs, trenails, and wedges. The wood is very heavy, and does not float; it is liable to split in the hot weather, and should be seasoned, and then stored under cover.

"The Olive *Zaitoon*, which has also been tested for wood-engraving at the Madras School of Arts, is another plant of the Mediterranean Flora which range from the coast of the Levant to the Himalaya. It varies a good deal in the shape of its leaves and in the amount of ferruginescence; hence the synonyms *cuspidata* and *ferruginea*: but it does not appear to differ specifically from the *Olea Europea* of the Mount of Olives,—the emblem of peace and plenty. The finest specimens I have seen are in the Kaghan and Peshawur valleys, where the fruit resembles that of rocky sites in Palestine or Gibraltar. The wood is much used for combs and beads, and is found to answer for the teeth of wheels at the Madhopore workshops."

25. Nettle Fibre.—It is perhaps not generally known in Canada that the exquisitely beautiful fibre known as China grass-cloth, and so much in favor for the best kinds of ladies' handkerchiefs, is obtained from an Indian nettle. No doubt the American *Urtica gracilis*, which grows abundantly about the Falls of Niagara and elsewhere in Canada, might be turned to good account, were our Agricultural Associations to direct attention that way. Dr. Cleghorn tells us that the *Urtica heterophylla* (the species cultivated by Mr. McIver at Ootakamund) is plentiful in Simla, having followed man to the summit of Jako, attracted by moisture to an elevation unusual for any member of the family. It is found within the stations of Dalhousie and Dharmsalla, and at many intermediate points. The quantity is surprising, wherever the soil has become enriched by the encamping of cattle. The growth at this season also is luxuriant in shady ravines near houses, where there is abundance of black mould; but the sting being virulent, the plants are habitually cut down as a nuisance, both by private persons and municipal committees.

There are other plants of the nettle tribe, particularly *Bohmeria salicifolia*, "siharu," used for making ropes (to which attention has been directed by Dr. Jameson). This plant does not sting, and is abundant at low elevations.

Large prizes were to be given for quantities of the nettle fibres to be delivered at Lahore in October 1863. The fibre brings from £16 to £18 sterling per ton in London.

26. Diatoms of the South Pacific.—Dr. Greville has described, with exquisite figures, (Trans. Bot. Soc. Ed.,) numerous new species of diatoms obtained from dredgings in the South Pacific. There are two new genera, viz.: *Stictodesmis*, Grev., and *Omphalopsis*, Grev., and thirty-one new species.

Halifax, N. S. Jan. 7, 1864.

*(To be Continued.)*

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## CAVE IN LIMESTONE NEAR MONTREAL.

By H. G. Vennor.

Under a similar heading to the above, this cave is noticed in the Canadian Naturalist and Geologist, Vol. III, page 192. To that article we would refer those interested, for the exact position of this cave. The party or parties, who then visited this curiosity—if I may so call it—found it filled with several feet of water, and were unable to give it any satisfactory examination. On the 11th of November last I visited the cave, and had no difficulty whatever in finding it. Of late years, the entrance has been considerably enlarged. Formerly, the opening was situated between the roots of a tree, which is yet standing in the vicinity; but some time since, the earth was slightly cut away, exposing the surface of the rock, and greatly enlarging the means of access to this cavern. From the outside, the limestone has a very rusty and weather-worn appearance, and is of a shaly texture. The whole surface is filled with the fossil shells and corals peculiar to the Trenton limestone. The mouth of the caves is about four feet high, by six feet in width. On entering, I was agreeably surprised to find that the water had entirely subsided into a narrow well, or fissure in the floor, some twenty feet distant from the mouth of the cave. Standing by this well, the room was about thirteen feet high by eight feet in width. The walls jutted out irregularly on either side, but gave the average width of eight feet. The ceiling was also of limestone rock, and coated over with stalactitic carbonate of lime, from which hung a few small stalactites. In the sides of the chamber were numerous deep fissures, hardly large enough to admit an arm, and lined with the same mineral.

In these fissures could be seen very perfectly the formation of satalactites and stalagmites,—the former meeting the latter half way. Some of the stalactites were of a beautiful needle-like shape, and about four or five inches long. These we could not procure, as they were beyond our reach; but they may be plainly seen by holding a candle in the crevice. Before passing farther into the cave, let us for a moment examine the well. It is affirmed by the people in the neighborhood that no bottom has yet been found to it. But on questioning them, we found that their bottomless measure was two pairs of reins tied together. It is however a difficult depth to measure, as it runs down very irregularly, and at angles. The water is clear, and very cold, and has a strange greasy touch. It is surprising to see its transparency, when it has this thick and oily touch; it yet remains to determine whether this well is fed by springs, or by the drippings from the roof of the cavern. Leaving the well, we push on, and after ascending a few feet, come to two passages, one leading to the right, the other to the left. The entrance to the one on the right is about two feet square, and leads into a small room or passage running into the rock. This passage is about thirty feet long, and two or three broad, ending in a narrow fissure which seems to run deep into the limestone. This fissure is too small for one to enter with any comfort, though I believe it widens some few feet farther in. Turning with difficulty, we retraced our steps, and came before the passage running to the left.

This at the entrance was two feet high and six feet wide; but on entering, we found ourselves in a small room, about eight feet high, and six wide. At its extremity another fissure ran down into the rock, which looked as if it had at one time been a pretty large passage. Indeed, so shaly and loose are these rocks, that by the action of water and the frosts, this cave may be, ere long, entirely blocked up. The *habitans* state that it was at one time much larger than it is now. In the first, or entrance-chamber, were found sticking to the roof, and sparkling with moisture, six beautiful species of moths: two of these, are now in the Society's collection. These moths were snugly ensconced in the cracks of the rock, sleeping quietly, until the genial breath of spring and the songs of returning birds should rouse them again to their out-door employments. Besides moths, bats also had taken up their quarters in this cave, and flew around, sadly disconcerted by our intrusion. In the paper alluded to in the beginning of this article, it was stated that if the water could be pumped out of this cave, bones might be found at the bottom. I may just mention, before concluding this brief description, that the cave is now entirely free from water, and that no bones have been found as yet; but a search into and amongst the loose soil at the bottom, may be, and I think would be, well worth attempting.

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## CONTRIBUTIONS TO LITHOLOGY.*

By T. Sterry Hunt, M.A. F.R.S.; of the Geological Survey of Canada.

### Introduction.

In a recent paper on *The Chemical and Mineralogical Relations of Metamorphic Rocks* (Silliman's Journal [2], xxxvi, 214),† an attempt was made to define the principles which have presided over the formation of sedimentary rocks, and to explain the nature and conditions of their alteration or metamorphism. That paper may be considered as to a certain extent introductory to the present one, which will contain, in the first part, some theoretical considerations which it is conceived should serve as a basis to lithological studies. In the second part will be given a few definitions which may serve to render more intelligible the classification and nomenclature of crystalline rocks; while a third part will contain the results of the chemical and mineralogical examination of some of the eruptive rocks of Canada; and a fourth, some examples of local metamorphism. The most of the results appear in the recent published Geology of Canada.

### I. Theoretical Notions.

I have already, in other places, expressed the opinion that the various eruptive rocks have had no other origin than the softening and displacement of sedimentary deposits; and have thus their source within the lower portions of the earth's stratified covering, and not beneath it. The theory which conceives them to have been derived from a portion of the interior of the earth still retaining its supposed primitive condition of igneous fluidity, is in my

* From *Silliman's Journal* Vol. xxxvii, page 248.

† *Canadian Naturalist*, Vol. viii, page 195.

opinion untenable. It is not here the place to discuss the more or less ingenious speculations of Phillips, Durocher, and Bunsen as to the constitution of this supposed fluid centre, nor the more elaborate hypothesis of Sartorius von Waltershausen as to the composition and arrangement of the matters in this imaginary reservoir of plutonic rocks. The immense variety presented in the composition of eruptive masses presents a strong argument against the notion that they are derived, as these writers have supposed, from two or more zones of molten matter, differing in composition and density, and lying everywhere beneath the solid crust of the earth; which, in opposition to the views of many modern mathematicians and physicists, the school of geologists just referred to regard as a shell of very limited thickness.

The view which I adopt is one the merit of which belongs, I believe, to Christian Keferstein, who, in his *Naturgeschichte des Erdkörpers*, published in 1834, maintained that all the unstratified rocks, from granite to lava, are products of the transformation of sedimentary strata, in part very recent; and that there is no well-defined line to be drawn between neptunian and volcanic rocks, since they pass into each other (vol. i, p. 109.) This view was subsequently, and it would seem, independently brought forward in 1836 by Sir John Herschel, who sought to explain the origin of metamorphism and of volcanic phenomena by the action of the internal heat of the earth upon deeply buried sediments impregnated with water. (Proc. Geol. Soc. of London, vol. ii, pp. 548, 596.) See also my papers in the Canadian Journal, 1858, p. 206; Quar. Jour. Geol. Soc. 1859, p. 488; Can. Naturalist, Dec. 1859; and Silliman's Journal [2], vol. xxx, p. 135.

The presence of water in igneous rocks, and the part which it may play in giving liquidity to all volcanic and plutonic rocks, was insisted upon by Poulett Scrope, so long ago as 1824, in his *Considerations on Volcanoes.* (See also Quar. Jour. Geol. Soc. London, xii, 341.) This view has since been ably supported by Scheerer in his discussion with Durocher. (Bul. Soc. Geol. France [2], iv, 468, 1018; vi, 644; vii, 276; viii, 500.) See also Elie de Beaumont, ibid., iv, 1312. The admirable investigations of Sorby on the microscopic structure of crystals (Quar. Jour. Geol. Soc., xiv, 453) have since demonstrated that water has intervened in the crystallization of almost all plutonic rocks. He has shown that the quartz both of granites and crystalline schists contains great numbers of small cavities partially filled with water, or with concentrated aqueous solutions of chlorids and sulphates of potassium, sodium, calcium, and magnesium, sometimes with free hydrochloric acid. Similar fluid-cavities were found by him in most crystals artificially formed in aqueous solutions; and were also observed in the minerals from the limestones of Vesuvius, where they occur in nepheline, idocrase, hornblende, and feldspar; the liquid in the latter crystals containing, besides chlorids and sulphates, alkaline carbonates. Mr. Sorby has also described the cavities filled with vitreous and with stony matters which he has observed in quartz, in the feldspar of pitchstones, in augite, leucite, and nepheline; and which are sometimes found associated with fluid-cavities in the same mineral. As these fluid-cavities enclosed the liquid at an elevated temperature, its subsequent cooling has produced a partial vacuum, which is again filled on heating the crystal; so that the temperature of the crystals at the time of their formation may be approximatively determined. Mr. Sorby concludes that every peculiarity in the structure of the quartz of the veins in Cornwall, "may be most completely explained by supposing that this mineral was deposited from water holding various salts and acids in solution, at temperatures varying from 200° C. to a dull red heat visible in the dark" (about 340° C.). At this highest temperature he conceives that other minerals, such as mica, feldspar, and tinstone were deposited; the latter mineral containing numerous small fluid-cavities. In like manner, he deduces from the fluid-cavities in the Vesuvian minerals just noticed, a temperature of from 360° to 380° C. The presence at the same time of bubbles or vapor-cavities, and of glass and stone cavities in these crystals shows them to have been formed "at a dull red heat under a pressure equal to several thousand feet of rock, when water containing a large quantity of alkaline salts in solution was present, along with melted rock, and various gases and vapors. * * * * I therefore think that we must conclude provisionally, that at a great depth from the surface, at the foci of volcanic activity, liquid water is present along with the melted rocks, and that it produces results which would not otherwise occur." (Loc. cit., p. 483.)

Mr. Sorby has, as we have just seen, determined the temperature requisite to expand the liquid so as to fill the fluid-cavities, provided they were formed under a pressure not greater than the elastic force of the vapor. This of course represents the lowest temperature at which the consolidation could have taken place, and varies from 340° to 380° in the Vesuvian minerals, and 356° in the quartz of the trachyte of Ponza, to a mean of 216° in the Cornish granites, to 99° in those of the Scottish Highlands, and even descends to 89° in some parts of the granite of Aberdeen. But this low temperature is improbable, and inasmuch as water and aqueous solutions are compressible, their volume would be considerably reduced under a great pressure of superincumbent rock. Mr. Sorby has therefore calculated the pressure in feet of rock which would be required to compress the liquid so much that it would just fill the cavities at 360° C. The numbers thus obtained will therefore represent the actual pressure, provided the rock was in each case consolidated at that temperature. It would thus appear that the trachyte of Ponza was solidified near the surface, or beneath a pressure of only 4000 feet of rock; while for the Aberdeen granite the pressure was equal to not less than 78,000 feet, and for the mean of the Highland granites 76,000. The Cornish granites vary from 32,400 to 63,600, and give as a mean 50,000 feet of pressure. In this connection Mr. Sorby remarks that from Mr. Robert Hunt's observations on the mean increase of temperature in the mines of Cornwall, a heat of 360° C. would be attained at a depth of 53,500 feet.

The observations upon the metamorphic crystalline schists in the vicinity of these various granites show that their constituent minerals must have crystallized at about the same temperature as the granite itself; affording, as Mr. Sorby observes, "a strong argument in favor of the supposition that the temperature concerned in the normal metamorphism of gneissoid rocks was due to their having been at a sufficiently great depth beneath superincumbent strata"; and he concludes that with regard to rocks and minerals formed at high temperatures, we have "at one end of the chain erupted lavas, indicating as perfect and complete fusion as the slags of furnaces, and at the other end simple quartz-veins, having a structure precisely analogous to that of crystals deposited from water. Between these there is every connecting link, and the central link is granite." When the water, which at great depths was associated with the melted rock, was given off as vapor while the mass remained fused, slag-like lavas resulted. If however the water could not escape in vapor, it remained, as we have seen, to take its part in the crystallization, in some cases forming hydrated minerals; and the excess of it, as Mr. Sorby suggests, passed up as a highly heated liquid, holding dissolved materials, which would afterwards be deposited in the form of mineral veins in the fissures of superincumbent rocks.

I have thought it well to give at some length the remarkable results and conclusions by Mr. Sorby, because I conceive that they have not as yet received the full degree of consideration to which they are entitled, and are perhaps little known to some of my readers.* The temperature deduced by him from the examination of the crystals of hornblende and feldspar from Vesuvius is curiously supported by the experiments of Daubrée; who obtained crystallized pyroxene, feldspar, and quartz, in presence of alkaline solutions, at a temperature of low redness; while De Senarmont crystallized quartz, fluor-spar, and sulphate of barytes in presence of water, at temperatures between 200° and 300° C. At the same time the deposits from the thermal waters at Plombières show that crystalline hydrous silicates, such as apophyllite, harmotome, and chabazite, have formed at temperatures but little above 80° C.

We conceive that the deeply buried sedimentary strata, under the combined action of heat and water, have, according to their composition, been rendered more or less plastic, and in many cases have lost to a greater or less degree the marks of their sedimentary origin, although still retaining their original stratigraphical position. In other cases they have been displaced, and by pressure forced among disrupted strata, thus assuming the form of eruptive rocks; which, becoming consolidated under a sufficient pressure, retain the same mineral characters as in the parent beds. It is only those rocks which, like lavas, have solidified at or near the surface of the earth, and consequently under feeble pressure, which present mineralogical characters dissimilar to those of the undisturbed crystalline sediments. With this exception, the only distinction which can be drawn between stratified and unstratified masses must in most cases be based upon their attitude, and their relation to the adjacent rocks.

In view of these considerations I have, in previous papers, adopted for geological purposes a division of crystalline rocks into

* See further the late observations of Zirkel confirming those of Sorby. Proc. Imp. Acad. Vienna, March 12, 1863; in abstract in Quar. Jour. Geol. Soc., vol. xix.

indigenous rocks, or sediments altered *in situ*, and exotic rocks, or sediments displaced and translated, forming eruptive and intrusive masses. Under the head of exotic rocks is however to be included another class of crystalline aggregates, which are for the most part distinguished by their structure from injected or intrusive masses. I refer to the accumulations which fill mineral veins, and which doubtless have been deposited from aqueous solutions. While their peculiar arrangement, with the predominance of quartz and non-silicated species, generally serves to distinguish the contents of these veins from those of injected plutonic rocks, there are not wanting cases in which the predominance of feldspar and mica gives rise to aggregates which have a certain resemblance to dykes of intrusive granite. From these however, true veins are generally distinguished by the presence of minerals containing boron, fluorine, phosphorus, cœsium, rubidium, lithium, glucinum, zirconium, tin, columbium, etc.; elements which are rare, or found only in minute quantities in the great mass of sediments, but are here accumulated by deposition from waters, which have removed these elements from the sedimentary rocks, and deposited them subsequently in fissures.

No one at the present day will probably be found to deny the plutonic origin of most non-stratified rocks, so that the once vexed questions of the neptunists and plutonists may be regarded as settled. If however we go back but a few years in the history of geology, it will be found that an eruptive origin was then claimed for many rocks which are now admitted to be indigenous. It is scarcely necessary to refer to the views of those who have maintained the exotic character of many quartzites and crystalline limestones, when a majority of writers, even to the present day, class serpentines, euphotides, and hyperites among eruptive rocks; although the experience of every field-geologist is accumulating, from year to year, a great mass of evidence in favor of the indigenous nature of all these rocks. The sedimentary and indigenous character of very many granites, syenites, and diorites will now no longer be questioned. Thus we find, for example, that the melaphyres of the Tyrol, which, in Von Buch's too-famous theory of dolomitization, were supposed to have been erupted together with magnesian vapors which effected the alteration of the adjacent limestones, have been shown by Fournet to be sediments of Carboniferous age, metamorphosed *in situ*,—indigenous rocks, which were altered before the Jurassic dolomites were deposited. (Bul. Soc. Geol. France [2], vi, 506–516). In like manner we find Scipion Gras concluding from his researches on the anthracitic rocks of the Alps, that the serpentines, euphotides, porphyries, and spilites, which are there found associated with crystalline schists, are all of sedimentary origin, but have been so profoundly altered *in situ* as to have lost nearly all traces of sedimentary origin. (Ann. des Mines [5], v, 475.) We might add that the tendency of recent investigations has been to show that the protogines, or granites of the summit of the Alps, are Tertiary strata altered in place; thus confirming the bold assertion made by Keferstein in 1834, that these granites are altered strata of *flysch.* (This Journal [2], xxix, 123, 124.) Lesley's recent investigations of the granites of the White Mountains of New Hampshire, show them to be clearly stratified sedimentary deposits in nearly horizontal layers. (American Mining Journal, 1861,page 99; Silliman's Journal [2], xxxi, 403.) The ophites (amphibolites) of the Pyrenees, which by Dufrenoy and other French geologists have been regarded as eruptive, and were by the former imagined to be in some mysterious manner related to the rock-salt and gypsum of the region, which he supposed to be, like the ophites, of posterior origin to the enclosing strata (Explic. de la Carte Geol. de France, i, 95), are according to a recent note by Virlet, not eruptive, but altered indigenous rocks; belonging, together with the associated gypsum and saliferous strata, to the Triassic series. (Comptes Rendus de l'Acad., Aug. 1863, p. 232).

It would be easy to multiply examples of this kind, which show that a careful study of very many of the crystalline rocks hitherto regarded as eruptive, leads to the conclusion that they are really indigenous rocks. At the same time, many of these indigenous rocks appear to have been at one time in a soft semi-fluid condition, which permitted movements obliterating the marks of sedimentary origin, and producing other results which show the passage into eruptive rocks. Thus the crystalline limestones of the Laurentian series in Canada are frequently interstratified with thin beds of gneiss and quartzite, both of which are often found broken, contorted, and even twisted spirally, in a manner which indicates great flexibility of the silicious layers, as well as violent movements in the calcareous rock. The latter is in some cases found in the form of thin seams or considerable dykes among the adjacent broken silicious strata; thus assuming for small distances, the characters of an intrusive rock. For some figures and descriptions illustrating these broken and distorted strata, see Geology of Canada, pp. 27, 28. We may also allude in this connection to the observations of Dr. Hitchcock among the altered strata of the Green Mountains, which seem to show that the pebbles of gneiss and of quartz in certain conglomerate beds have been so softened as to have been flattened, laminated, and bent around each other. (Silliman's Journal [2], xxxi, 372.) Hence, while the tendency of the various observations above cited is in favor of the indigenous character of many rocks hitherto regarded as eruptive, we have at the same time evidence that these rocks are occasionally displaced. We should not therefore on *a-priori* grounds reject the assertion that any metamorphic sediment may sometimes occur in an exotic or intrusive form. A given rock, like limestone or diorite, may occur both as an indigenous and exotic rock; and different portions of the same mass may be seen by different observers under such unlike conditions that one may regard it as indigenous, and the other, with equal reason, may set it down as intrusive. It is evident then that to the lithologist, who examines rocks without reference to their geological relations, the question of the exotic or indigenous character of a given rock is, in most cases, one altogether foreign; and one which can frequently be decided only by the geologist in the field. Hence, although generally made a fundamental distinction in classification, it will be disregarded in the following sketch of the nomenclature of crystalline rocks.

I may here allude to a fact which I have already noticed, and tried to explain, (Silliman's Journal [2], xxxi, 414, and xxxvi, 220, *note*,) that throughout the great metamorphic belt which constitutes the Appalachian chain, exotic rocks are comparatively rare (at least in New England and Canada); but abound, on the contrary, among the unaltered strata on either side. Illustrations of this are seen in the valley of Lake Champlain, and in its northward continuation toward Montreal, in those of the Hudson and Connecticut, and in the northeastward continuation of the latter valley by Lake Memphramagog to the Bay of Chaleurs, which is marked throughout by intrusive granites. In accordance with the reasons already assigned for this distribution of exotic rocks, it is probable that a similar condition of things will be found to exist in other regions; and that eruptive rocks will, as a general rule, be found among unaltered, rather than among metamorphic strata. It is of course possible that a crystallization of the sediments may in some cases take place subsequent to the eruption of foreign rocks into their midst. The rarity of intrusive rocks among crystalline strata, not less than the unaltered condition of sediments which are traversed by abundant intrusive masses, is a strong proof of the fallacy of the still generally received notion which connects metamorphism with the contiguity of eruptive rocks.

## II. Classification and Nomenclature.

It is proposed in this second part, to describe briefly the composition, structure, and nomenclature of the various crystalline silicated rocks, considered without reference to the distinction between indigenous and intrusive masses. Comparatively few of these rocks are homogeneous, or consist of a single mineral species, and the names which have been applied to varying mixtures of different species are of course arbitrary; and as they have often been given without any previous mineralogical study, it sometimes happens, that, as in the case of the rocks composed of anorthic feldspars and pyroxene, different names have been proposed for varieties very closely related, or differing from one another only in texture or in structure.

The minerals essential to the composition of the rocks under consideration are few in number, and are as follows: quartz, orthoclase; a triclinic feldspar which may be albite, oligoclase, andesine, labradorite, or anorthite; scapolite, leucite, nepheline, sodalite; natrolite, or some allied zeolite; iolite, garnet, epidote, wollastonite, hornblende, pyroxene, olivine, chloritoid, serpentine, diallage; muscovite, phlogopite, and some other micas; chlorite, and talc. To these may be added as accidental ingredients, the carbonates of lime, magnesia, and protoxyd of iron, together with magnetite, ilmenite, and sphene. The silicates which, like tourmaline, beryl, zircon, spodumene, and lepidolite, contain considerable portions of the rarer elements, and often occur with quartz and feldspar in granitic veins, whose origin has already been alluded to, enter at most in very small quantity into great rock-masses.

The varieties of structure in crystalline rocks are the more deserving of notice as they have led to a great multiplication of names. We may note first the granitoid structure, in which the mineral elements are distinctly crystalline, as in granite. From this, there is a gradual passage through granular into compact varieties of rock. Most of these are simply finely granular, and are rightly entitled to the distinction of crypto-crystalline; but others, like the pitchstones, obsidians, and lavas, are apparently amorphous, and are natural glasses. In some cases the constituent minerals may be so arranged as to give a schistose or a gneissoid form to a rock. This arrangement is generally to be looked upon as an evidence of stratification; but something similar is occasionally observed in eruptive masses. In the latter case it generally seems to arise from the arrangement of crystals during the movement of the half-liquid crystalline mass; but it may in some instances arise from the subsequent formation of crystals arranged in parallel planes.

See on this point Naumann *On the Probable Eruptive Origin of Several Kinds of Gneiss, etc.*; Leonhard and Bronn, Neues Jahrbuch for 1847, and Poulett Scrope, Geol. Journal, xii, 345. I consider however that their views are to be adopted with great reserve, and admitted only in a very few cases. The ribbanded structure of some porphyries and clinkstones, as noticed by Scrope, is undoubtedly the result of movements in the liquid mass, and the same is true of some of the granitoid dolerites to be described in the third part of this paper; but the eruptive origin assumed by Darwin, Naumann, and some others for great areas of gneiss and gneissoid granite, seems to a student of the crystalline rocks of this continent utterly untenable. As has been already remarked, the progress of each year's investigation restores to the category of indigenous rocks many of those previously regarded as eruptive, and will, I am convinced, confirm the principle which I have laid down of the comparative rarity of exotic rocks in crystalline and in metamorphic regions.

Occasionally the crystallization of a rock takes places around certain centres, giving rise to rounded masses which have a radiated or a concentric structure, and constitute the so-called globular or orbicular rocks. Distinct crystals of some mineral, generally feldspar, augite, or olivine, are often found imbedded in rocks having a compact base. To such rocks the name of porphyry is given, and by analogy a rock with a granular base enclosing distinct crystals is designated as porphyritic or porphyroid. Amorphous or vitreous rocks, as pitchstones, are in like manner sometimes porphyritic. The name of porphyry, at first given to a peculiar type of feldspathic rocks, has now become so extended that it is to be regarded as only indicating an accident of structure. The title of amygdaloid is given to various rocks having rounded cavities which are wholly or partially filled with various crystalline minerals. The base of these rocks is generally granular or crypto-crystalline; but is sometimes amorphous, resembling a scoria or vesicular lava, the cavities of which have been filled by infiltration. Such is doubtless the origin of some amygdaloids. In more cases however these cavities have probably been formed like those often found in dolomites, and in some other rocks, by a contraction during solidification. Porphyroid rocks, in which quartz, orthoclase, and other minerals are arranged in orbicular masses, are also sometimes designated as amygdaloids, and may be confounded with the two previous classes in which the imbedded minerals are the result of subsequent infiltration. Allied in strucure and origin to the last are what are named variolites or variolitic rocks. (See Geology of Canada, pp. 606, 607.)

The masses into which some aluminous minerals enter as a prominent element constitute by far the greater part of the rocks now under consideration. These are naturally divided into two classes, whose origin we have pointed out in a recent paper already referred to. (Silliman's Journal [2], xxxvi, 218.) The first of these is characterized by containing an excess of silica, with a portion of alumina, much potash, and small portions only of lime, magnesia, and oxyd of iron. The second class contains a smaller amount of silica, and larger proportions of alumina, lime, magnesia, and oxyd of iron, with soda, and but little potash. These chemical differences are made apparent in the more coarsely crystalline rocks, by the nature of the constituent minerals; and in the compact varieties, by differences in color, specific gravity, and hardness. Thus in the rocks of the first class the predominant mineral is orthoclase, generally associated with quartz, and the composite rocks of this class seldom have a density much above that of these species; or from 2.6 to 2.7. In the second class, the characteristic mineral is a triclinic feldspar, with pyroxene or hornblende, the feldspar sometimes predominant; while in other cases the pyroxene or hornblende makes up the principal part of the rock. The presence of these latter minerals generally gives to the fine-grained rocks of this class a dark color, a hardness somewhat inferior to the more silicious class, and a density which may vary from 2.7 to more than 3.0. It will however be found that the line between the two classes cannot always be distinctly drawn; inasmuch as rocks containing orthoclase and quartz often include triclinic feldspars such as albite and oligoclase, and by an admixture of hornblende offer a transition to rocks of the second class. On the other hand, quartz is sometimes found with triclinic feldspars and hornblende in the rocks of the second class. Besides these two feldspathic classes, there is a third small but interesting group, in which an aluminous silicate of high specific gravity, such as garnet, epidote, or zoisite replaces the feldspar wholly or in part. These minerals being basic silicates rich in alumina, the relations of this group are naturally with those of the second class, although varieties of these species are found in rocks which belong to the first class.

The silico-aluminous crystalline rocks may thus be conveniently divided into three families. The first of these includes those rocks in which the aluminous mineral is orthoclase (orthose), from which they may be conveniently designated by the name of the *orthosite* family. The second includes those in which the aluminous element is an anorthic or triclinic feldspar, and may be designated as the *anorthosite* family: chemically related to this are those rocks holding as one of their elements nepheline, leucite, or scapolite. The third family includes those rocks which contain an aluminous silicate of high density, as epidote, zoisite, garnet, andalusite, or kyanite, in place of a feldspathide. Iolite or dichroite, which enters into the composition of some orthosite rocks, appears from its atomic volume to be related to the feldspars, and should take its place along-side of anorthit and scapolite as a magnesian feldspathide, while beryl in like manner appears to be a glucinic feldspathide.

It is worthy of notice, that some feldspars having the crystallization and density of orthoclase, nevertheless contain large proportions of soda. The loxoclase of Breithaupt appears from the analyses of Smith and Brush to be a true soda-orthoclase (Silliman's Journal [2], xvi, 43); while the sanidine or glassy feldspar of many trachytes contains potash and soda in nearly equal proportions. The name of potash-albite has been given to some feldspars of this composition; but the trachytic rocks hereafter to be described contain feldspars, which, without being glassy, have the composition of sanidine, together with a cleavage and specific gravity which show them to belong to orthoclase, rather than to albite. The anorthic feldspars offer in their composition such gradations from albite to anorthite, that the various intermediate species which have been distinguished seem to pass into each other. (Silliman's Journal [2], xviii, 270, Phil. Mag. [4], ix, 262.)

Next to the feldspars in lithological importance are the two species, pyroxene and hornblende. These are sometimes found associated in the same rock, and the varieties of pyroxene known as diallage and smaragdite are frequently surrounded or penetrated by hornblende. This association of the two species should be kept in mind, inasmuch as the substitution of pyroxene for hornblende in anorthosites, has been made the basis of a subdivision in classification. (Silliman's Journal [2], xxvii, 339.) Among the micas found in silicated rocks, besides muscovite and a magnesian mica (phlogopite or biotite), are to be included the hydrated micas observed by Haughton in many of the Irish granites. Of these the one is margarodite, and the other a uniaxial black mica, also hydrated, which he has referred to lepidomelane. (Trans. Royal Irish Acad., xxiii, 593.) The presence of from four to six hundredths of water in the micas of these granites is important in connection with the evidence already given of the intervention of water in the formation of granitic rocks. These two hydrous micas were often found by Haughton to be united in the same crystal; and Rose has remarked a similar association of potash-mica and magnesian mica in certain granites. (Senft, die Felsarten, p. 206.)

A scientific nomenclature for compound rocks presents such great difficulties that we must be content for the most part with trivial names which have from time to time imposed. In the case of simple rocks, the terms quartzite, pyroxenite, anorthosite, and orthoclasite are sufficiently definite, or they may be farther characterized as normal orthoclasite, etc.; while quartzose, micaceous, and quartzo-micaceo-hornblendic orthoclasite would designate various compound rocks of which orthoclase is the base. Such names, however descriptive, will never replace the older terms granite, syenite, etc., which are employed to designate certain forms of orthosite rocks. The frequent association of a triclinic feldspar (oligoclase) with orthoclase in granite rocks, and the partial or total replacement of the micas generally present in these, by hornblende, by chlorite, or by talc, giving rise in the latter case to what is called protogine, are well known. Nepheline (elæolite), natrolite, iolite, and magnetite are sometimes found as elements in granitic, gneissic, and syenitic rocks. The name of miascite is given to a granitic minature of orthoclase and black mica with elæolite, sometimes with hornblende, albite, and quartz.

The structure of these orthosite rocks gives rise also to a great variety of names; thus to coarsely lamellar granites the name of pegmatite is sometimes given, while fine-grained mixtures of orthoclase and quartz have received the names of granulite, leptinite, and eurite, or when apparently homogeneous and crypto-crystalline are called petrosilex. These latter forms often become porphyritic from the presence of crystals of orthoclase, giving rise to orthoclase-porphyry, or orthophyre. In some of these porphyries, as in those of Grenville, to be described in the third part of this paper, quartz is also present in distinct grains or crystals; while in some of the red antique porphyries the feldspathic base contains no excess of silica, and occasionally encloses crystals of oligoclase or of hornblende. In many cases the granites, syenites, orthophyres, and other orthosite rocks just mentioned are intrusive; while in other instances, rocks lithologically indistinguishable from these are indigenous, and becoming schistose pass into gneiss and mica-schist.

The rocks to which the name of trachyte has been given are generally composed in great part of orthoclase (sanidine). The typical varieties of these rocks are white or of pale colors, granular or finely crystalline, and frequently porous or cellular. They appear to consist of grains, crystals, or lamellæ of orthoclase, aggregated without any cementing medium, and to this seems to be due that roughness to which the rock owes its name. Oligoclase, quartz, hornblende, and mica are also met with in this rock, which becoming coarsely granular, passes into granite. Such is the case with the trachytes of the Sierra of Carthagena in Spain, described by Fournet as passing from a dull rough grayish feldspathic mass, into a highly crystalline aggregate of feldspar and mica, with or without hyaline quartz, enclosing hornblende, red garnet, and fine blue iolite. (Comptes Rendus, xliv, p. 1834.)

The trachytic texture is not confined to orthosite rocks. Abich has described under the name of trachy-dolerites a group of trachytoid anorthosites (dolerites). The cone of the Soufrière of Guadaloupe is described by Deville as a rough granular rock having the external characters of trachyte, from which it is distinguished by its somewhat greater density (2·75). It consists essentially of labradorite, with a little quartz, pyroxene, olivine, and magnetite. (Bul. Soc. Geol. de France [2], viii, 425.) Humboldt designates the trachy-dolerites of Etna and of the Peak of Teneriffe as trachytes (Comptes Rendus, xliv, 1067); so that this word, like porphyry, comes to indicate nothing more than a peculiarity of structure, which may be assumed by various feldspathic rocks. The trachytic orthosites, as we have seen, pass into granites, from which they do not differ in chemical composition; and their differences in texture probably depend upon the fact that the one was solidified under great pressure, and the other near the surface, trachytes passing in fact into lavas. The observations of Sorby on the fluid-cavities in the crystals of granites and of trachytes are in point.

Among the intrusive rocks of Canada to be described are granitoid, compact, and earthy varieties of trachytic orthosites, besides trachytic porphyries. These rocks often contain disseminated earthy carbonates, sometimes in considerable amount; as Deville had already shown for some of the trachytes of Hungary, and as I have also observed for those of the Siebengebirge on the Rhine. Trachytes also hold in some cases disseminated portions of a zeolite, apparently natrolite; and through this mixture pass into phonolites, of which a characteristic variety will be noticed in this paper. Obsidian and pumice-stone, which are often associated with orthoclase trachytes, are related to them in composition; and pitchstone and perlite are similar rocks, differing however in containing some combined water. Rocks resembling pitchstone, and sometimes porphyritic from the presence of distinct crystals of feldspar, occur in the south side of Michipicoten Island, Lake Superior, but have not yet been examined. (Analyses by Jackson and by Whitney of the pitchstones of Isle Royale will be found in Silliman's Journal [2], xi, 401; xvii, 128.)

The presence of an anorthic feldspar, generally oligoclase, in many granites and trachytes, not less than the admixture of orthoclase crystals in some of the trachytic dolerites of Etna, serves to connect the orthosite with the anorthosite family. Great masses of indigenous rock in the Labrador series in Canada, are made up of almost pure granular labradorite, or related triclinic feldspars, and might be termed normal anorthosites. (Silliman's Journal [2], xxxvi, 224; Geol. of Canada, 588.) In most cases however, these feldspars are intermingled with some other mineral, commonly hornblende or pyroxene.

The name of diorite is by good authorities restricted to rocks whose predominant elements are triclinic feldspars with hornblende; while the names of diabase and dolerite distinguish those rocks in which pyroxene takes the place of hornblende. In some anorthosite rocks however, pyroxene and hornblende are intimately associated, so that a passage is established from diorite to diabase. The feldspar of diorites varies in composition from albite to anorthite, and is occasionally accompanied by quartz. This, though most frequent with the more silicious feldspars, is sometimes met with in diorites which contain feldspars approaching to anorthite in composition. Sometimes the two constituent minerals are distinct and well crystallized, constituting a granitoid rock: fine examples of this, hereafter to be described, occur in the intrusive hills of Yamaska and Mount Johnson. At other times the diorite is finely granular or compact, when its color is generally of a green more or less dark from the disseminated hornblende, and it takes the name of greenstone. The greenstones of the Huronian series are in part at least diorites, and probably indigenous; but a great number of the so-called greenstone-traps are pyroxenic, and belong to the class of diabase or dolerite. Diorite not unfrequently contains a mica, which is generally brown or black in color. Chlorite, magnetite, ilmenite, and sphene often occur as disseminated minerals, as also carbonates of lime, magnesia, and oxyd of iron. The finer-grained diorites are frequently porphyritic from the presence of crystals of feldspar or of hornblende. Occasionally this rock is concretionary in its structure, as in the orbicular diorite or napoleonite of Corsica; which contains a feldspar allied to anorthite, with hornblende, and some quartz. The norite from Sweden is a granular mixture of a similar kind, containing also mica; and the ophite of some writers is a diorite in which hornblende greatly predominates.

The rocks which are essentially composed of anorthic feldspar and pyroxene, present still greater diversities than the diorites, and have received various names based upon differences in texture and in the form of the pyroxenic element. It is here proposed to restrict the name of dolerite to such of these rocks as contain the black augitic variety of pyroxene, and to include the mixtures of triclinic feldspars with all the other varieties of this species under the head of diabase. The finer-grained and impalpable varieties of diabase have received the name of aphanite; which is often indistinguishable from the corresponding forms of diorite, and like these may become porphyritic, giving rise to the augite-porphyry of some authors. Different varieties of this porphyry have received the name of labradophyre, oligophyre, and albitophyre, according to the composition of the imbedded feldspar crystals. These are sometimes accompanied by crystals of augite, or are altogether replaced by them.

The name of hyperite or hypersthenite has been given to those varieties of diabase which contain hypersthene or diallage. These rocks occur abundantly in the Labrador series, where the hypersthene in them sometimes, takes the form of a green diallage, or passes into a finely granular pyroxene, and is associated with red garnet, ilmenite, and a little brown mica; in addition to which epidote is said to occur in the hyperites of the same series in New York, and olivine is mentioned as being found in the hyperites of Sweden, and of the Island of Skye. Hornblende is also in some localities associated with the hypersthene. The hyperites, although indigenous rocks in the Labrador series in Canada, are described as forming in other regions intrusive masses.

Those varieties of diabase or hyperite which contain diallage, have, by the Italian lithologists been called granitone, but by Rose and others have been described under the name of gabbro. This rock sometimes contains hornblende, mica, and an admixture of epidote. A compact white or greenish-white epidote, or zoisite, which has the hardness of quartz and a density of 3.3 to 3.4, is the mineral named saussurite. This with smaragdite, which is an emerald-green pyroxene, often minged with hornblende, and passing into diallage, forms the euphotide of Hauy. Compact varieties of labradorite and of other triclinic feldspars have by most of the modern lithologists been confounded with saussurite, and hence the name of euphotide is frequently given to the so-called granitone or gabbro, which is only a diallagic variety of diabase. The true euphotide often contains a portion of talc, and sometimes encloses crystals of a triclinic feldspar, apparently labradorite, thus offering a transition to diabase. See farther my researches on euphotide, and saussurite; Silliman's Journal [2], xxvii, 339, and xxxvii, 426.

Under the name of dolerite, as already remarked, it is proposed to class such anorthosite rocks as contain a black ferruginous pyroxene or augite. These rocks, which are sometimes coarsely granular or granitoid in their structure, pass into fine-grained or compact varieties, which are distinguished by the names of anamesite and basalt. To these latter varieties belong a great part of the greenstone-traps, although in rocks of this texture it is often impossible to determine whether it is hornblende or pyroxene which is mingled with the feldspar. Olivine in grains or crystals frequently occurs both in the fine-grained basaltic dolerites and the granitoid varieties, giving rise by its predominance to what is called peridotite. Some fine-grained dolerites are porphyritic from the presence of black cleavable augite crystals, forming an augite-porphyry. Finely disseminated carbonates of lime and oxyd of iron are occasionally present in these rocks to the extent of twenty per cent., and even more. In like manner, magnetite and ilmenite, which are often associated, may constitute several hundredths of the mass. Many fine-grained greenstones contain, like phonolite, large portions of some zeolitic mineral, and they often abound in chlorite. The pyroxene in these rocks is sometimes replaced by a highly basic silicate. Some varieties of what has been called diallage may be represented as an aluminiferous pyroxene *plus* a hydrate of magnesia. At other times a mineral approaching in composition to a ferruginous chlorite (frequently amorphous) enters into the composition of these anorthosites, and even in some cases appears to replace altogether the pyroxene or the hornblende, constituting an aberrant form of diorite or of diabase, which is not uncommon among greenstones, and for which a distinctive name is needed. See on this point Geology of Canada, pp. 469, 605, and the remarks on melaphyre below.

The finer-grained dolerites are often cellular, giving rise to amygdaloids, whose cavities are generally filled with calcite, quartz, or some zeolitic minerals. To these amygdaloids the name of spilite is sometimes given. Earthy varieties of basalt, which are frequently the result of partial decomposition, constitute the wacke of some writers. It is doubtful how far many of these spilites and wackes have a claim to be considered as crystalline rocks, inasmuch as they appear in very many cases to be nothing more than aqueous sediments accumulated under ordinary conditions, or perhaps in some cases derived from volcanic ash or volcanic mud. As the other extreme of this series of rocks we may notice that dolerites often assume a trachytic form,—the trachy-dolerites already mentioned,—or constitute the lavas from modern volcanoes.

Among the compound rocks which are related to the preceding group by the presence of augite, may be noticed nepheline-dolerite, in which nepheline replaces the feldspar; and analcimite, a variety into which analcime enters in large amount. Scapolite also in some cases replaces feldspar, and forms with green pyroxene, a peculiar aggregate associated with the Laurentian limestones. Leucite enters as an important element in some dolerites, and even replaces wholly the feldspathic element, giving rise to what has been called leucitophyre or leucilite.

[Leucite is generally regarded as an exclusively volcanic mineral; but according to Fournet, it occurs like other feldspars in mineral veins, forming the gangue of certain auriferous veins in Mexico (Géologie Lyonnaise, page 261). According to Scheerer, leucite also occurs in drusy cavities with zeolites and quartz at Arendal in Norway; although it would seem to be rare in this locality since Durocher was not able to detect it. (Annales des Mines [4], i, 218). The conditions required for the formation of this feldspathide must be peculiar, since the volcanic rocks which afford it are confined to a few localities; and since while it contains a large amount of potash it is a basic silicate, and found among highly basic rocks, in which potash compounds are generally present only in very small quantities. The agalmatolite rocks, including dyssyntribite and parophite (Geology of Canada, page 484), are however basic aluminous silicates in which potash predominates, and might be supposed under certain conditions of metamorphism to yield leucitic rocks.]

The name of melaphyre, which is employed by many writers on lithology requires a notice in this connection. It was proposed by Brongniart as a synonym for black porphyry (mela-porphyre), and defined by him in 1827 as a porphyry holding crystals of feldspar in a base "of black petrosilicious hornblende." (Classif. des Roches, page 106.) Subsequent researches showed that some of these porphyries were really augitic; and Von Buch employed the name of melaphyre as synonymous with augite-porphyry, in which he was followed by D'Halloy. (Des Roches, p. 75.) In consequence of this confusion, and of the vague manner in which the term is used to include rocks which are sometimes diorites and sometimes varieties of dolerite or basalt, Cotta seems disposed to reject the name of melaphyre as a useless synonym, in which I agree with him. (Gesteinslehre, page 48.) More recently however, Senft (Die Felsarten, page 263) has endeavored to give a new signification to the term, and defines melaphyre as a reddish-gray or greenish-brown colored rock, passing into black, and containing neither hornblende nor pyroxene. The melaphyres of Thuringia and of the Hartz, according to him, consist of labradorite with iron-chlorite (delessite), carbonates of iron and lime, and a considerable portion of titaniferous magnetic iron. Hornblende and mica are present only as rare and accidental minerals. We have already alluded to this class of anorthosite rocks, as requiring a distinctive name; but from the historical relations of the word melaphyre, it seems to be an unfortunate appellation for rocks which are not black in color, and from which both hornblende and pyroxene are absent.

We now come to consider that third group of silicated rocks, in which the feldspathides are replaced by the denser double silicates of the grenatide family, garnet, epidote, zoisite, and perhaps idocrase. Red garnet enters into many gneissic rocks, and even forms with a little admixture of quartz, rock-masses. In some of these, as in the Laurentian series, there appears an admixture of pyroxene, forming a passage into omphazite or eclogite; which consists of smaragdite (pyroxene) and red garnet, sometimes mixed with mica, quartz, and kyanite, and passes through an increase of the latter into disthenite or kyanite rock. An aggregate of hornblende and red garnet forms beds in the Green Mountains, and an admixture of red garnet with lievrite and a little mica makes up a rock in the Laurentian series. This is evidently related to eulysite, a rock forming strata in gneiss in Sweden, and consisting of garnet, pyroxene, and a mineral having the composition of an olivine in which the greater part of the magnesia is replaced by ferrous and manganous oxyds. Related to this is an apparently undescribed rock from the Tyrol, of which a specimen is before me, consisting of red garnet, green pyroxene, and yellowish-green olivine, the latter greatly predominating; and also a coarsely crystalline rock from Central France, recently described by the name of cameleonite, and composed of olivine, with pyroxene, and enstatite, a magnesian augite; these minerals being accompanied by spinel, sphene, and ilmenite. I have already alluded to the true euphotides, in which a compact zoisite (jade or saussurite) takes the place of feldspar in a rock the other element of which is pyroxene, and have shown how the occasional presence of a triclinic feldspar connects euphotide with diabase. (Silliman's Journal [2], xxvii, 336.) In the same paper are described rocks made up of a white compact garnet with and without hornblende and feldspar, and also an epidosite, composed of epidote and quartz.

By the disappearance of the aluminous silicate from the rocks of the second and third groups, a passage is established to the amphibolites and pyroxenites; and these, through diallage rock, offer a transition to the ophiolites or serpentines. These relations are well exhibited in Eastern Canada, where the diorites or greenstones, which are sometimes highly feldspathic, pass into actinolite rock and hornblende slate on the one hand, and into diallagic diabase and diallagic ophiolite on the other.

These greenstones, which contain a chloritic mineral, and are often epidotic, pass gradually into compact or schistose chloritic rocks, frequently enclosing modules or layers of epidote, either pure or mingled with quartz. The relations between these various rocks are such that after a prolonged study of them I find it difficult to resist the conclusion that the whole series, from diorites, diallages, and serpentines, to chlorites, epidosites, and steatites, has been formed under similar conditions, and that they are all indigenous rocks. (Geology of Canada, pp. 606, 612, 652.) I have elsewhere expressed the opinion that these silicates are probably of chemical origin, and have been deposited from solutions at the earth's surface. The sepiolite or hydrous silicate of magnesia, which occurs in beds in tertiary rocks, the neolite of Scheerer, the silicates of lime, magnesia, and iron-oxyd deposited during the evaporation of many natural waters; and the silicates of alumina like halloysite, allophane, and collyrite, and that deposited by the thermal waters of Plombières, all show the formation and deposition at the earth's surface of silicates, whose subsequent alteration has probably given rise to many minerals and rocks. (Silliman's Journal [2], xxxii, 286; and Geology of Canada, pp. 559, 577, 581). At the same time the phenomena of local metamorphism furnish evidences that similar compounds have resulted from the action of heat upon mechanical mixtures in sedimentary deposits. (Ibid., p. 581.) A further consideration of this subject, and of the two-fold origin of many silicious minerals, is reserved for another place.

*(To be Continued.)*

# ON OCEAN DRIFTS AND CURRENTS.

By J. Matthew Jones, F.L.S.

The currents of the ocean may well be classed among the wonders of the world; and the most inattentive observer of the great truths of nature, can hardly fail to be struck with admiration on contemplating their magnitude, and considering the benefits derived from such movements.

Throughout the Atlantic, Pacific, Arctic, Antarctic, and Indian Oceans, these currents pass in particular directions, and with greater or less force, purifying the mass of fluid, and rendering it habitable to thousands of marine forms, which would otherwise languish and die for want of suitable nourishment. Great are the struggles which take place between currents and counter currents, especially those of large extent, and many are the instances on record of vessels being carried by their influence far out of their destined courses, to be cast away upon shores supposed to be many leagues distant. Of late years, more attention has been paid to these phenomena, and the works of Rennel, Smyth, Maury, and others have gained them a notoriety they well deserve, for assuredly to their power may be attributed the positive existence of many islands now colonized by animal and vegetable life.

If we take up a hydrographical chart of the world, we shall at once perceive the course of the various currents which are known to navigators at the present day. *First*—we have the Gulf Stream, issuing from the narrow strait between the southern extreme of Florida and the Bahamas, passing, at some distance from land, the coast of the American States, and gradually expanding its limits as it progresses, until about the latitude of Cape Cod, it diverges to the northeast, and proceeding onwards to the northern limits of the Banks of Newfoundland, meets the cold waters of the great Arctic current, which comes down from Davis Straits. Its rate is here lessened; but although the course is slow from this point, it steadily advances until it reaches the shores of Great Britain and Northern Europe. *Secondly*—we have the North African current, which sets from the latitude of the Azores, and taking the coast-line of Western Africa, proceeds along the shores of that country to the Gulf of Guinea, and even farther north. This stream, however, appears to divide its waters about the region of the Canaries, and sends a westerly branch towards the West Indies. *Thirdly*—we have the South Atlantic current setting from the Arctic Ocean, pouring its volumes between St. Helena and the main, until arriving at the northern edge of the North African current at the equator, it diverges to the westward, and flows into the Equatorial current which advances in a similar direction to the northern coast of Brazil, and sweeping past the coasts of Cayenne and Guiana, bends round the Gulf of Mexico, and heated in that vast cauldron to a high degree of temperature, rushes with great velocity through the Florida passage, and becomes the celebrated Gulf Stream. *Fourthly*—The main current of the Pacific is that known as the Peruvian current, which originates in the Antarctic drift current, and runs parallel with the South American coast from about the fortieth degree of south latitude to the northern shores of Mexico, whence it deviates, and rushes on to the westward across the Pacific, laving the shores of the whole intertropical islands until it arrives at New Guinea, and Australia, where it meets the counter currents from the Indian Ocean. *Lastly*—We have the Arctic current of the Atlantic, which sets from Baffin's Bay on the west, and Spitzbergen on the east side of Greenland, joining its parts at the northern extremes of the latter country, and as one vast stream, running its course to the Banks of Newfoundland, where it meets a barrier to its farther progress in the heated waters of the Gulf Stream.

Although the currents just enumerated include all the greater passages, yet there are divers others of less magnitude and extent which render service in disseminating around reproductive matter for the colonization of distant positions. In the Indian Ocean, for example, we have two currents running parallel with the continent of India, and another between the island of Madagascar and the adjoining coast of Mozambique, each exerting an influence on the country they pass. These, with the connecting and contra currents occurring in several positions, may be supposed to represent in some degree that progressive motion which agitates the wide expanse of ocean in different quarters of the globe.

Having thus far given a brief account of the positions and courses of these currents, let us consider their effect upon islands lying in or near their course, but far removed from any continent: but as it would extend this paper to an unusual length if we were to enumerate the many islands in each ocean which may be classed in the list, it will perhaps be advisable to select the more interesting localities where such effect is rendered more apparent, and where occurrences periodically take place, proving by clearest evidence the real existence of such positions, and the animal and vegetable life found upon them.

Probably we could not select a more perfect example of current-formed islands than the Bermudas, and as we have made their natural history our particular study, perhaps we may be allowed to express our opinion, founded upon fact and the clearest evidence, as to the origin of that remarkable group, which, with the exception of St. Helena, is supposed to be the most remote from land or island of any other in the world.

It will be well in the first place to explain the situation and nature of this group, in order that subsequent allusions to the same may be clearly understood.

The Bermudas, or Somer's Islands, consisting of four principal, and several smaller islands, lie off the coast of Carolina (the nearest land) at a distance of about six hundred miles; from Cape Sable, the northern extreme of Nova Scotia, about seven hundred and twenty miles; and in a northeast direction from Atwood's Keys, Bahamas, six hundred and fifty miles. They are of low elevation; the highest land, on which the light-house is built, being only two hundred and fifty feet above the sea level. The formation is entirely of calcareous sandstone, derived from broken shells, and corals, which varies in consistency in different parts of the islands. On surveying the group, we find the whole more or less clothed with cedar, save here and there, where cultivation occupies the ground, or the drift sand blown from the shore, has overwhelmed both cedar grove and arable land, and continues its way, as is the case in Payet's Parish, nearly across the island from side to side. The group is contained in an area of about twenty miles by three, and a bird's-eye view of the whole, gives it the appearance, as says an old author, "of a shepherd's crook." A belt of coral reefs extends all around the islands; on the north, to a distance of ten miles or more from shore; to the westward, about five miles, taking in Long Bar and the Chub Heads; while to the southward and eastward the open sea meets with no barrier until within a few hundred yards of land.

Having thus shortly described the situation and appearance of the Bermudas, we will now consider their origin.

A submerged rock, series of rocks, or any inequality which tends to raise the usual line of bed near the water level, whether in ocean, lake, or river, situate within the influence of a current, cannot fail to present an obstruction to the free passage of material; as you may glean in a minor form, from observation in any brook or water-course, however small it be. The moving waters impeded on their way, whirl and eddy around the obstacle, sticks and leaves are collected together, sand and earthy matter wherewith the water is impregnated, add their mite to the general mass, until a small island is formed; aside, or in mid-stream, which, if undisturbed, will gradually increase until strong enough to resist the force of the element in which it is situated; seeds are conveyed thither either by currents or foreign aid, and upon the accumulation of sand, stick, and earth, generate vegetable productions, which in their turn decay and become vegetable mould, serving to enrich the deposit, and afford nourishment to other plants in rotation.

If we perceive currents in lake, river, or brook forming deposits of matter, on their sides or in their midst, why may we not grant the same power to currents in the ocean? And if this power be granted, which is clear it should, we have only to recognize, in the first place, the presence of some inequality of the ocean bed under the spot now occupied by the Bermudas, whether owing to volcanic action or otherwise it matters not; secondly, a vast accumulation of sand and drift matter thereupon; and thirdly, the presence of the coral zoophyte to complete a solid fabric to within a few inches of low-water mark. Drift timber and gulf weed (*Fucus natans*) then arrested on their course, the latter material by thousands of loads monthly in certain seasons, would help to raise the whole above high-water mark, until sand and shell cast ashore by the waves and blown along the surface, forming rounded hills; sea birds making guano deposits; plants and shrubs springing up from seeds either brought by migratory birds* or carried on the current, would give a stable foundation and a

* The transportation of seeds by migratory birds has long engaged the attention of naturalists. The case may occur in two ways, either by undigested seeds passing through the body of the bird, or by earth containing seeds adhering to the feet. A wader has been shot in Nova Scotia, having in its crop undigested seeds of the rice of the Southern States of America.

resting-place for animal life. The surface of the land would gradually change as increased masses of sand became drifted in various positions, the underlying body of loose particles would harden by natural process, and in time form solid rock, while the accumulations of vegetable matter buried beneath such hardened rock would decompose, and form red earth; and where these deposits become liable to the action of the tides from below, the earthy composition would be cleared away, and caverns form in the place, all of which conditions occur in the Bermudas at the present day.

The Bermudas, although not placed within the full force of the Gulf Stream, are nevertheless close enough to be affected by its current, which, after a continuance of southwest winds, affords, by the occurrence of drift seeds and other matter from the Carribean Sea, ample evidence of its contact with, or very near approach to the group; and if facts of this import should not be considered sufficient to establish a clear case, the whole marine fauna, which is true West Indian, may be brought forward in support of the assertion.

But to give the process of formation of a group of islands of current origin more in detail, let us consider the remarkable process carried on in the building of reefs by the coral zoophyte. It is to this organism, low in the scale of nature, that the Bermudas are indebted for the position they hold in the midst of an ocean at all times and seasons liable to great commotion. A mass of simple sand-banks would assuredly be swept away, or at all events would never afford sufficient protection to tropical and boreal plants as they do at present. No cedar groves could exist so near the shore as they do, unless a barrier was made to the forward progress of those huge rolling seas, which, in severe weather, may be seen dashing on the outer reefs of the south shore, and spending their fury in casting high in mid air their columns of whitened foam.

The coral zoophyte, which has done so much for the islands of the Pacific, has conferred an equal, if not greater, benefit upon the Bermudas, building up around the whole coast huge walls of calcareous matter formed by the decease of countless generations of madrepores with their ever-accompanying mollusca and serpulæ, welded together, from which basis springs another generation of the same forms, to die in their order, and present a further ground work for the labors of future families.

To show more clearly the beneficial effects of these barrier-reefs in preventing the total annihilation of all vegetable productions, we have only to draw your attention to the present state of the district known as "The Sand Hills" in Payet's parish, about the centre of the main island, where the barrier reef is close in shore, and does not present a sufficient breakwater to prevent the full force of the waves throwing up vast quantities of sand upon the shore, which, acted upon, by the heavy gales from the southward, is blown in clouds to the top of the hill, some hundred and fifty feet above high-water mark, and burying whole groves of cedar and cottages, is rapidly extending its limits, and will ere long commit still greater damage by covering land now under cultivation. This present fact is sufficient to prove the use of barrier-reefs to oceanic islands, and also more clearly the use of oceanic currents in bringing to such positions animal life capable of effecting so much good by preserving a luxuriant vegetation from utter destruction.

As we have in considering our question touched upon the formation of coral reefs, perhaps it would not be uninteresting to state a few particulars in regard to the growth and habits of the coral zoophytes, and the different forms which are found inhabiting the same reef in the Bermuda waters.

There are five species of coral growing on the reefs, while in the sheltered sounds and harbors two or three more are found. The finger-coral (*Madrepora palmata*) appears to be the most abundant, crowding its palmate processes in every direction under water, and before it has been cleaned, it has a buff color, and when touched by the hand has the peculiar slimy feel common to all corals, and formed by the presence of the animal which secretes the hard calcareous mass. Some specimens of this species are extremely beautiful, presenting every shape and form which palmate processes can exhibit. At the extremities, digits of all lengths crown the ridge, while from the flattened sides arise in many cases extra palms digitated in like manner. The whole structure is remarkably porous. A species of *Madrepora* known as the star-coral (*M. oculina*) is also found on the outer reefs, though by no means so abundant as the former. It is by far the prettiest-formed coral in the Bermudas, and when cleaned, presents a series of the most exquisite white branches covered with elevated cells. In the water it has a green appearance, and is coated with the usual slime. In some situations it grows short and bushy, while in others its stems are elongated to some extent. There are three varieties of this species: (1,) with the cells greatly protruding; (2,) with the cells nearly even; and (3,) having them strongly depressed. There are two species of *Meandrina* found on these reefs,—*M. cerebra*, commonly known as brainstone from its singular appearance, and another species clearly different from the preceding, and allied to *M. Dædalea* of the Indian Ocean. The *Madrepora cerebra* grows to a large size, sometimes three feet in diameter, and is usually rounded in form; while the latter is rarely found more than six inches across, and growing in some cases within a foot of the surface on reefs, and in rock-pools even less. Two species of *Astræa* occur, sometimes covering the rock like a mass of sponge. These astroid corals are frequently found in a semi-fossil state, imbedded in the reef, and forming the base of masses of living madrepores.

On breaking into one of the reefs left dry at lowest tide, you find it composed of the following: the hard compact interior of calcareous rock, exhibiting under the lens a mass of minute portions of shell, sand, and broken coral, mixed with particles of pink-colored nullipores; the exterior presenting an irregular honeycombed appearance, some of the recesses containing sea-water and dotted with small specimens of the frilled *Meandrina* and small eyed *Astræa*, and adhering to the sides of these miniature pools several species of corallines and *algæ* shooting out from beds of scarlet, and sober-colored sponges and ascidians, over which crawl the slug-like forms of the many-spotted *Doris* and sea-hare (*Aplysia*), and the massive shell-bearing *Purpura deltoidea;* while in the crannies and sinuous passages are snugly ensconced numbers of purple *Echini* and hair-clad annelides; the whole more or less covered with a mantle of iridescent sea-weeds.

Such is the state of affairs on the reef: now let us proceed to take a survey of the productions, animal and vegetable, brought thither by the current of the Gulf Stream.

As before remarked, the marine fauna of the Bermudas is almost wholly West Indian. The first, if we except a few transient visitors, are all found in the Carribean Sea. The mollusks, with one exception only, according to Tristram, are all inhabitants of the same district, while the remaining invertebrata of all orders present a similar state. Many fishes are brought to the group, sheltering and feeding amid the vast fields of gulf-weed (*Fucus* *natans*), and several species of crustaceans reach the islands by the same source. Myriads of the Portuguese man-of-war (*Physalia pelagica*), the oblique-crested *Velella* (*V. vulgaris*), and two species of *Ianthina* (*I. fragilis* and *I. globosa ?*), with their bubble-like rafts, are cast ashore, while hundreds of the pearly *Spirula* (*S. Peronii*) float about untenanted by their rightful owners. These are all from the southward. Then ashore we find the land-crab (*Gecarcinus ruricola*) burrowing in the sand-hills; and running along the shore-rocks, the nimble and prettily marked *Grapsus pictus*, both West Indian forms. To these may be added many others all evidently descendants of an original stock brought thither by the current of the Gulf Stream.

As regards the botanical features of the islands, several trees, shrubs, and plants occur of West Indian character, some of which, springing as they do from positions close to high-water mark, denote their current origin. We may notice the calabash (*Crescentia cujete*), the sea-side grape (*Coccoloba uvifera*), the Prickly Lantana (*L. aculeata*), the Locust (*Hymenæa coubaril*), the Cochineal plant (*Cactus cochinillifer*); and many other species may be enumerated in support of the probable influence of the Gulf Stream. Two or three kinds of large beans are frequently found cast upon the beach: one called pin-box by the inhabitants, is the seed of a large species of trailing-vine (*Entada gigantea*), bearing huge scymitar-shaped pods; and is common in some of the West Indian islands, especially Jamaica, where Colonel S. Heath of the Royal Engineers informs us he has observed it growing in the mountains near the military station at Maroon Town, some two thousand feet above the sea level. Drift trees, sometimes of large size, with the roots attached, are also floated ashore; and some few years ago, according to the observant naturalist Hurdis, who resided several years in the Bermudas, two or three cedar trees of dimensions far exceeding those of any specimens to be seen on the islands, were found at some depth below the surface of a marsh which had been reclaimed from the sea, and which from their appearance were of foreign origin, and had doubtless been carried by the current from some part of the adjacent continent. These drift trees are in many instances the means of introducing pebbles and small portions of rock adhering to their roots; and it was with no little surprise that during our wanderings along the shores of the island we found these stones, of entirely different consistence to that of the sandstone in which they lay imbedded, in the shore-rock about high-water mark; nor could we at all account for such a singular circumstance, until we were informed by a geological friend that stones had been found among the roots of trees cast away on other oceanic islands, when a clue to the mystery was at once afforded us.

Thus we see in some measure the effect of ocean currents upon islands like those of the Bermudas, far removed from continents; and the case is the same in other parts of the world. Take for example the Keeling or Cocoa Islands, which are situate in the Indian Ocean at a distance of about six hundred miles from the coast of Sumatra, which owe their vegetation to seeds transported by currents from that island, Java, and Australia, and on whose shores are found stones and pebbles as in the Bermudas. Canoes of undoubted Javanese construction have also been found cast ashore; and many other instances are adduced by Chamisso, Darwin, and others, of the effect of currents upon these islands.

If such cases can be adduced of the introduction to distant islands of the ocean of whole faunas and floras, why may we not infer that in many cases islands like those of the Pacific have been peopled by the human race in a similar manner? We too frequently hear of sad cases of the survivors of abandoned vessels remaining on the ocean in open boats for a fortnight, or three weeks, or even longer, drifted along by the winds and currents in various directions. Canoes laden with people have been drifted from island to island in the Pacific, although hundreds of miles from each other, as is well known; while, according to Robertson, the fresh bodies of two men, of a race unknown to Europeans, were cast ashore, after a series of westerly gales, upon the Azores, doubtless from North or South America, proving that they had nearly completed their long drift voyage in their canoe before some untoward accident befel them and prevented their arriving alive.

We cannot therefore see, if human life can be prolonged under such circumstances, why we may not grant the drift and currents of the ocean a still greater usefulness in that of carrying to other lands a precious burden of human souls, to populate in process of time whole continents as well as islands; and, instead of looking for different centres of creation, to grant that one alone was made in conformity with the statements of holy writ.

*(Read before a meeting of the Nat. Hist. Society of N. Brunswick, 29th January* 1864.)

# NOTES ON THE SILICIFICATION OF FOSSILS.

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

Fossils replaced by silica are very abundant among the paleozoic limestones of Canada. Some portions of the Corniferous limestone are little more than layers of silicified shells and corals, with a small amount of intermingled carbonate of lime; and beautiful examples of silicification are also found in various localities throughout the limestones of the Trenton and Quebec groups. The silicified fossils are confined to certain planes; unaltered calcareous shells and corals being often found in the same limestone bed, half an inch above or below a layer holding silicified fossils; and even in these the replacement is sometimes confined to a portion of the shell or coral. A careful study of a series of these silicified specimens shows the operation of three distinct processes. First, the replacement of the fossil, giving rise to an exact copy of it in chalcedonic quartz; second, the incrusting by chalcedony of a fossil thus replaced; and third, in some cases the filling up of the cavity of the replaced fossil, with chalcedony or with crystalline quartz. The corals from the Corniferous limestone present examples of the first process, and are besides often filled or lined with crystals of quartz. The same thing is to be seen in various gasteropods from the Birdseye formation. Of these, the silicified shells, from which the limestone has been removed by an acid, preserve all their superficial markings; but are often lined with crystalline quartz, although at other times filled with the sedimentary limestone. In two instances, where these shells had been fractured, the fissure has been filled up with a tissue of chalcedony identical with that replacing the shell. This chalcedony is generally found to have a botryoidal surface, and a concentric structure, which however in some cases can only be discovered by the aid of a glass. Specimens of orthoceratites from the same formation show the exterior, as well as the septa and the siphuncle beautifully replaced by silica. In some silicified gasteropods it is seen, after removing the calcareous matter by an acid, that the silicification is chiefly confined to the two walls of the shell, which are completely replaced, while the middle portion remains calcareous, or is but partially penetrated by silica. The exterior of these silicified shells is sometimes incrusted with mammillary masses of chalcedony a tenth of an inch or more in diameter. This is an example of the second process, which is well illustrated by a fine specimen of a large and as yet undescribed species of Metoptoma from the Birdseye formation, to which my attention has been called by Mr. Billings. It was found reposing on its base, and filled with the sedimentary limestone, which was removed by an acid, showing the interior of the shell with some small adhering Serpulæ, which are also silicified. The exterior of the shell was completely covered with a rough warty coating of chalcedony, which has evidently spread in concentric circles from certain points, and is from five to ten hundredths of an inch in thickness. This crust, which readily separates, has been detached from a portion of the surface of the shell; which is found to have been completely replaced by chalcedony, and retains all its delicate markings. From the more frequent absence of this exterior coating of chalcedony from silicified fossils, we are inclined to look upon its deposition as a process subsequent to the replacement. In some cases however it takes place upon non-silicified specimens. Thus a Stromatopora having been cut in two, and submitted to the action of an acid, it was found that the silica was confined to an exterior crust, and to occasional grains and portions disseminated through the calcareous mass of the fossil. It is further to be remarked, that the limestone strata which contain the silicified fossils are associated with beds or masses of hornstone, in which these fossils are sometimes partially imbedded.

The facts detailed above (a part of which will be found in the Geology of Canada, p. 629) point to the conclusion that the replacement of the fossils, as well as their incrustation and filling-up with silica, took place before they were imbedded in the calcareous sediments, and that it was dependent on the presence of silica dissolved in the waters of the time. The mode in which the first process, or that of replacement, has been effected is however still obscure. In vegetable structures, which are very often silicified, such a replacement is comparatively rare. The pores of the wood become filled with silicious matter, while the woody fibre, in a more or less altered state, remains, and may be extracted, as Goeppert has shown, by dissolving the silica with hydrofluoric acid. This organic matter is often changed into coal, or even, according to Dr. Dawson, in some Devonian woods into a graphitic substance;

while Goeppert mentions its change into bitumen, and also observed a resinous matter in the pores of silicified conifers. He found that in some cases, as in certain agatized woods from Hungary, the organic matter had almost, or altogether, disappeared, leaving spaces which were empty, or filled only with water. Bead-like drops of silica were occasionally found by him upon the bundles of ligneous fibres. He also observed in some cases an incrustation of hyalite on the exterior of some specimens of silicified wood. (Goeppert, Plantes Fossiles, livr. 1, part 3.)

The silicified woods from Antigua, unlike any of these described by Goeppert, exhibit a replacement of the woody tissue by silica; some of them however still retaining portions of organic matter. In a specimen of exogenous wood from that locality, which I have lately examined with Dr. Dawson, the medullary rays are filled with silica showing traces of cells, and the ducts are also filled with silica. The whole of the woody fibre has more over disappeared, and its place is occupied by silica, which is distinguished by a slight difference in color from that filling the place of the vessels. In this case, it would appear that the process of silicification consisted of two stages; the first being the filling up of the pores by silica, followed by a removal, by decay, of the organic matter, leaving a silicious skeleton like that of the Hungarian woods noticed above, after which the empty spaces in this were filled by a further deposition of silica. It is probable that processes similar to those connected with silicification take place in the so-called petrifaction of organic remains by carbonate and sulphate of lime, sulphate of barytes, oxyd of iron, and metallic sulphurets.

In this connection, may be mentioned the observations and experiments of Pengelly, Church, and others on the so-called Beekite. This name has been given to mammillary chalcedonic concretions around a nucleus of coral, sponge, shells, or even of limestone, which occur in the Triassic conglomerates of Torbay in England. This nucleus in some cases has disappeared, but in others remains in greater or less part unchanged, or has been partially silicified. These concretions apparently result from a similar incrusting process to that which I have described in Stromatopora and Metoptoma. Mr. Church has examined these bodies with care both chemically and microscopically, and in the L. E. & D. Phil. Magazine for February 1862 ([4], xxiii, 95) has given his own and others' observations, with a number of figures. He has also described in this paper the results of some experiments on the process of silicification; for further details of which see The Chemical News, vol. v, 95. Mr. Church prepared a solution of silica in water by dialysis, according to Graham's method (L. E. & D. Phil. Mag. [4], xxiii, 295), and found that when this solution, containing about one two-hundredths of silica, and impregnated with a little carbonic acid, was filtered through fragments of coral, a large portion of carbonate of lime was dissolved, and the whole of the silica removed. Similar results, though to a less extent, were obtained with shells. In another experiment, a fragment of a recent coral was fitted into the neck of a funnel, and a solution prepared as above, with a little carbonic acid, and containing one hundredth of silica, was allowed to drop on the coral, and after slowly filtering through, was found, as in the previous experiment, to have abandoned the whole of its silica, while the coral had lost nearly all its lime, although retaining its structure in a great measure. It was however covered with a thick film of gelatinous silica." Mr. Church farther observed that the addition of small portions of the solid carbonate of lime, barytes, or strontia to a strong solution of pure silica, caused it to gelatinize immediately; and according to Graham, solutions of these carbonates have the same effect. The concentric structure which is characteristic of chalcedony, was observed by Mr. Church in the silicious deposits from the Geysers of Iceland, and from the hot springs of Luzon in the Philippine Islands, as well as in menilite; and Mr. J. H. Gladstone, in a note to Mr. Church, in the paper already cited from the Philos. Magazine, refers to a similar structure as having been observed by Mr. Rainey in carbonate of lime formed in animal tissues: it is also artificially obtained when carbonate of lime is slowly deposited in the presence of gum or albumen. Mr. Church has since described (Chem. News, vi, 306) a curious example of the deposition of silica. A basket of eggs was recently found in a chalk-pit near Winchester, where it had been buried beneath the broken rock for, it is supposed, four or five centuries. The organic matter and the calcareous shell of the eggs had both disappeared, their places being occupied by chalcedony; "which seemed farther to have been deposited upon the willow twigs composing the basket, incrusting it so well that the real nature of the latter is evident to this day."

I have thought it well to bring together these observations since, for although they do not explain all the phenomena of silicification, they go far towards showing the conditions under which silica can be precipitated from its solutions in natural waters, and deposited either upon or within organic bodies, or in the forms of opal, chalcedony, and hornstone. See farther Silliman's Journal [2], xxviii, pp. 377, 381; and Bischof, Lehrbuch, ii, 1241.

Montreal March 25, 1864.

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## NATURAL HISTORY SOCIETY.

### ANNUAL CONVERSAZIONE.

" The Second Annual Conversazione of the Montreal Natural History Society was held in the rooms of the Society on the 2nd instant, and was, we are happy to say, highly successful. We learn with pleasure that since the last annual social meeting the Society has made very steady progress, the year not having been excelled, or even equalled, by any other in its history for the amount of scientific work done, and the successful introduction of new and valuable features, which it is believed will be sources of permanent benefit to the Society. But while the Society congratulates itself on this satisfactory state of affairs, there is of course room for still further prosperity, were the members and the friends of the cause to come forward more readily and evince greater interest in its advancement. At the regular meetings a number of interesting papers have been read, of which mention has been made at various times in these columns; and many elaborate articles, representing great scientific research, and having an important bearing on the arts of life, and on the material improvements of the country, have been contributed to the Canadian Naturalist. The Geology of our own country, in which every one must feel more or less interested, has received a large share of attention; and on points of the geology of the United States connected with Canadian geology, important contributions have also been received. In fact, in all the branches of study embraced by the Society, many new facts have been made known, which looked at merely in a scientific aspect, should be highly esteemed; but the pursuits of the naturalist are also of great utility to the country in their economical applications, thus giving the Society a strong claim to the support and consideration of the public, independently of the purely scientific discoveries, or of the pleasures to be derived from the collections and lectures. A committee of the Society has, for instance, been engaged in promoting measures for the more effectual protection of the smaller insectivorous birds which protect us against insect ravages; whilst another committee has been investigating the causes of the decay of the apple-orchards, for which the island of Montreal was once celebrated. Discussions have also arisen at the meetings respecting the use of Canadian fibres in the manufacture of fabrics and of paper. Nor should we omit to mention another important part of the work of this Society, namely that of popularizing natural science, thus rendering it more attractive, and causing its results to be more extensively known. This end is sought to be attained by the popular course of Somerville lectures, free to the public, and by throwing the Museum open on easy terms. One of the new features worthy of special attention is the engagement of a scientific curator, Mr. Whiteaves, under whose care large portions of the collections have been arranged in such a manner as to assist very materially in the study of natural history. There have been added to the Museum within a short time, many valuable contributions of marine shells, and some interesting specimens to the collections of birds and fishes.

"Many of the gratifying features which we have here briefly noticed, in order to show the work that the Society is engaged in, and what has been done, are attributed to the favorable impression made by the first Conversazione, held last year; one direct result of which was that a member liberally offered to commence a list with $200 to pay off the remaining indebtedness of the Society."

The chair was taken at eight o'clock by Dr. Dawson, President of the Society; there being seated on the platform the Lord Bishop of Montreal, Metropolitan, Rev. Mr. Ellegood, Rev. Mr. Kemp, Rev. Dr. DeSola, Hon. Mr. Sheppard, Prof. Miles, Stanley Bagg, Esq., W. H. A. Davies, Esq., John Leeming, Esq., and others. The Hall was crowded throughout, many being unable to obtain seats. The fine band of the Royal Artillery was present, by the kind permission of Col. Dunlop, R.A.

The introductory address was delivered by the President of the Society, Principal Dawson, LL.D., who said: "Ladies and Gentlemen, the members of the Natural History Society again welcome you to their annual conversazione, and trust that on this as on former occasions, you will sympathize with our pursuits and enjoy the entertainment which we have provided. I have no doubt that many of you regard us as very simple though harmless enthusiasts, pleased with a butterfly or a flower, delighted with a new shell or coral, going into ecstacies over the discovery of some unheard-of worm or microscopic animalcule smaller than a grain of dust. But admitting all this, and that our pursuits may not be worthy of comparison with the grave and weighty matters which engage your attention, we have still something to say for ourselves. If enthusiasts, we are not selfish; indeed I may say that we are somewhat amiable. A great authority in such matters has said that a true naturalist is never an ill-natured man; and we show our good nature by gathering here all our precious treasures, and exposing them to your inspection, and by providing in our Museum a refuge for every destitute specimen, that might otherwise go to waste or be neglected in some obscure corner. Indeed, I fear that we sometimes carry this to an extreme, and even render ourselves troublesome by insisting that you should look through our microscopes or examine our choice specimens, when you would rather be engaged about something else. We further, in these artificial days, keep up a testimony in behalf of nature. We maintain its pre-eminent loveliness, standing up for the lily of the field, even against all the glory of modern art. We invite attention to the plan and order, to the design and contrivance, which exist in nature, and thus do what little we can to magnify the works of God. Further, we are always ready to inform you as to any little practical matter that lies in our way. If you are puzzled by any strange bird or beast, or by any unaccountable phenomenon in air or earth, we are always ready to do our best to explain it. If any impertinent insect or fungus ravages your farm, garden, or orchard, we can tell you all about its habits, and how to get rid of it. We can, with the aid of our friends of the Geological Survey, inform you as to the mineral resources of the country, and can guard you against that perversion of mining enterprise, whereby some simple persons contrive to bury their money under ground without any rational hope of ever extracting it again. Besides all this, in our lectures, our monthly meetings, our published proceedings, and our museum, we provide you with many sources of pleasing and profitable recreation. Doing all this and more, in a quiet unobtrusive way, we think ourselves entitled to ask your kind countenance and aid in this our annual celebration. I have only to add, that a committee of members of the Society has labored to make our rooms and programme as attractive as possible, and that we have to thank many kind friends for contributions to your entertainment this evening."

Dr. Dawson introduced to the audience one of the pioneers of Natural History in this country—

HON. MR. SHEPPARD, who said: "On this occasion, the anniversary of the Natural History Society of Montreal, it has fallen to my lot to address to this goodly assemblage of the patrons of science, a few remarks and remembrances of the state of natural history and of its progress in Canada during the preceding half century, which it has been supposed my long standing as a student of nature enables me to submit to your patient hearing. These observations must necessarily be short, seeing the varied programme provided for the evening. In order to do this subject justice it will be necessary to go back to the early settlement of the country, when the Jesuit missionaries visited the wilds of America with the intention of Christianizing the natives. These missionaries were a learned and observant class of men; and their opportunities of becoming acquainted with the natural productions of the country, were greatly facilitated by their close intercourse with the Indians, following them in their periodical migrations, and sojourning with them in their encampments. They collected a vast amount of information from their native friends about the animals, and especially about the plants, many of which were known to possess healing properties, and to be useful in the few arts that the Indians were acquainted with. The results of these researches were, at a later period, collected and embodied by Charlevoix in his History of Canada. They are well worthy of being consulted. Towards the end of the last century Canada was visited by André Michaux the elder, coming from the north through Hudson's Bay, across the country by lakes Mistisions and St. John, down the Saguenay and up the north shores of the St. Lawrence, disappearing southward at some point unknown to us. It must have been very interesting to him to note the gradual change of the vegetable productions in his progress south from the barren grounds of the stunted birch, the vast collections of lichens and mosses which cover the surface of those dreary regions, to the noble oaks and maples on the shores of the St. Lawrence.

Michaux published the result of his observations in a Flora of America; but it is very meagre, compared with later works on that subject. Michaux the younger never visited Canada that I am aware of, but derived his information respecting our trees from his father. Francis Masson, that celebrated collector for the Royal Gardens at Kew, who introduced so many of the floral beauties of the Cape of Good Hope, visited Canada about the beginning of the present century. He passed a good portion of his time in Montreal; and oh how I did yearn for the benefit of his acquaintance, with a view to information on plants of the country, but all my sighing and yearning were doomed to end in disappointment. He died here about the year 1804, at the house of Mr. John Gray, at Côte St. Catherine, a benevolent and much respected merchant. The mention of John Gray reminds me that he kindly fostered the Rev. James Somerville while in a state of mental aberration. With Mr. Somerville I was much acquainted; he was devoted to the study of natural history. It will be recollected that this gentleman was a patron and benefactor of this Society. We now come to the name of Frederick Pursh, the celebrated botanist, who made his appearance in Canada in 1815. I became acquainted with him, and derived much valuable information from him about plants. He visited Anticosti in 1817, and brought back a large collection of living plants, rare in other parts of the country, some of which I cultivated in my garden; but the greater portion of them perished in the packages in which they were brought up. Among those which survived were *Ligusticum Scoticum*, a beautiful *Thalictrum*, which he named *T. purpurascens*, and an *Allium*, identified with *A. schœnoprasum*. Pursh's Flora of North America is a carefully got-up book, and was the standard text-book till Gray's appeared. Pursh died here about 1821, at the house of Robert Cleghorn, Blink Bonny, a nurseryman, and a good botanist,—a contemporary of Loudon. Poor Pursh was thriftless; in his declining years living mainly on the hospitality of his friends. Colonel Hamilton Smith, the learned historian of the natural history of man, visited Canada in 1817, seeking information in science generally. I became acquainted with him, but his sojourn here was very short.

Now, ladies, allow me to say a word of encouragement for you. What will you not succeed on attaining when you set your hearts on its accomplishment, as the example of the Countess Dalhousie will show. This lady became an accomplished botanist, and was an indefatigable collector of plants. She presented to this Society a large herbarium of Canadian plants, beautifully preserved; she collected many living plants, and sent them home to ornament the gardens and grounds of Dalhousie Castle; and she succeeded in imbuing her lady friends with a love of botany; some of whom made marked advances in this branch of natural history, particularly one, who subsequently sent many specimens of Canadian plants to Sir Jackson Hooker, to assist him in the compilation of his great work the Plants of British North America, in which her name is duly recorded as a contributor. The example of Lady Dalhousie is well worthy of imitation by those having leisure for study.

And now permit me by desire to endeavor to throw some light on the origin and progress of the Literary and Historical Society of Quebec, the elder sister of the Society. Strange to say, its formation was brought about indirectly, by a political movement, in this wise. It is no doubt known to many of you that the late John Neilson was the owner of the Quebec Gazette, established in 1764, now in its hundredth year. In virtue of an Act of Parliament, it possessed the privilege of publishing all official documents as they occurred. Neilson was a great politician, and was opposed to Lord Dalhousie in some points of government. This opposition Lord Dalhousie could not tolerate, and he came to the determination of establishing a paper which he could control, calling it the Quebec Gazette by authority, and he caused Dr. Fisher, a co-editor of the New York Albion, to come and take charge of it. Dr. Fisher had been a member of the Literary and Historical Society of NewYork; he persuaded Lord Dalhousie to get up a society with similar title and objects in Quebec. This was done, Chief Justice Sewell becoming the first President, and W. Green, a native of this city, the secretary. The Society was in the first instance composed of high officials and courtiers, and the fee was fixed at a high rate, for some end which can only be guessed at. Papers were read before the Society. The President gave his " Dark Days of Canada"; Captains Bayfield and Baddely read valuable papers on the Geology of Canada, and Mr. Green presented his papers on Textile Plants, and on the plants used in dyeing by the Indians. Shortly after the formation of that Society, some of the younger inhabitants of Quebec, perhaps thinking that they had been slighted, formed themselves into a society under the name of the " Society for the Promotion of Arts and Science in Canada." Lord Dalhousie refused his countenance to this new institution. Several papers were read, and a successful progress became manifest. After a while, a disposition on the part of the Literary and Historical Society to conciliate the new one, and even to advocate a fusion of the two, became apparent. This was ultimately effected, retaining the original title. The union of the two societies was productive of good, the working members becoming more numerous. Some of their labors appear in the transactions of the Society. On the accession of Sir James Kemp to the government of the Province, he very liberally bestowed to the Society a copy of that splendid work of art, Claude's *Liber Veritatis;* also a transit instrument, and an excellent telescope. Here it may be mentioned that M. Chasseur, a naturalist of Quebec, had formed a museum as a matter of speculation, principally composed of birds; but finding that it did not answer his expectation in point of revenue, he persuaded the Legislature to purchase the collection; and it was placed under the care of the Literary and Historical Society, in addition to their own museum, which had assumed a respectable condition. When in 1838 Lord Durham was sent out to conciliate the people, and restore Canada to a state of peace, he did at least one good thing. Led by the title of the Society to suppose that literature and history were its sole aim, he brought out a large and select collection of the ancient Greek and Latin historians, and presented it to the Society, for which he is entitled to praise. This valuable addition to the library was received thankfully, and it furnished the means for several reviews and criticisms by that very learned and esteemed member of the Society, Dr. Wilkie. At later periods that Society has been very unfortunate, having been no less than three times burnt out; losing much of its accumulation of objects of natural history, books, and apparatus, thus receiving a severe check in scientific pursuits; but it is now gradually recovering from its losses, and again rising into a state of activity. Before concluding, a word of commendation must be said on the Geological Survey of the Province, now for so many years so well and so efficiently conducted by its learned and amiable head, assisted by an active and scientific staff. Their joint labors have been eminently successful, as is abundantly shown by the very complete Geological Museum in this city; by their periodical reports of work done, now consolidated into one large volume, which, of course, will be studied by all scientific devotees, a monument of the industry of the Commission of Survey, and an evidence to the civilized world of the varied labors and scientific capabilities of the surveyors, well meriting the applause and gratitude of the Province, to which they are fully entitled. Shall I say a word on the subject of this Society? If permitted, it must be but a word, for you are all better acquainted with its formation and operations than I can pretend to be. The Society was formed shortly after that of the L. and H. Society; at the instance, I believe, of the late Dr. Holmes and some congenial spirits. In the first few years of its existence its progress was not very rapid, all up-hill work, as the Doctor informed me, the work resting on a few of the members; but if so, that languor has been sucessfully shaken off; its progress and prosperity have been of the most satisfactory nature. As a contrast to the difficulties for the acquirement of scientific information met with at a remote former period, already alluded to, allow me to state some of the great facilities which are now offered to the student of Natural History. In many parts of the Province there have been established Colleges for the education of youth, in which the Natural Sciences are taught by learned professors, with the advantage of extensive museums. I will only mention some of them, without entering into particulars. Beginning in the lower part of the province and proceeding upwards, we have Laval, McGill, Lennoxville, Queen's, Toronto, and others. As regards this city, let me mention with commendation McGill College. Here for the professed student every facility exists: regular lectures are delivered on all branches of Natural Science, aided by a very complete museum, with a library of books of reference. To the occasional student, this Society possesses all the advantages required; an extensive and well-arranged museum, regular stated meetings, attended by all the scientific men of the city, a well-conducted magazine, open to contributors generally, a courteous and scientific curator, a large and commodious building fit for all the purposes of the Society; and if I may judge by the extent of the present goodly assemblage of patrons, there seems great reason to look forward to further satisfactory progress necessitating the extension of accommodation, bespeaking the approbation of future dwellers in this growing and beautiful city, followed by the respect of the scientific world at large."

The President then announced that instead of the chemical experiments by Professor Robins following here, as set down on the programme, an address would be given by Prof. Miles of

Bishops' College, Lennoxville; since the gases emitted in the performance of the experiments might not tend to improve the ventilation of the room. PROF. MILES then spoke as follows:

"Mr. President, it has afforded me great pleasure to receive an invitation to join in this gathering of the members, friends, and visitors of the Natural History Society.

"As one of its numerous guests this evening, I beg to express my sincere thanks for the privilege of participating in a treat so richly and so variously furnished,—one which, while it appeals to the understanding, delights the imagination and the senses. But in endeavoring to respond, at a brief notice, to a request that I should address you, I should begin, if the plea were good for anything, or if it were judged to be in good taste, by asking you to remember how formidable a thing to some is the prospect of being required to make a speech. In place of that, however, I find it more natural, as it is doubtless more becoming, to obey the stimulus arising from a hearty sense of sympathy as regards the objects of the Natural History Society—to look to the feelings which must animate all who are assembled here to-night—cultivators, lovers, and patrons of science—gathered together here socially for the purpose of testifying an appreciation of those objects—for the purpose, in fact, of testifying *respect for science*, and an admiration of the useful and beautiful arts and improvements in art which science is continually furnishing.

"To these considerations I think, sir, I cannot be in error, when I add the mention of another motive in influencing us all who have come to participate in this evening's recreation; namely, a desire to express our recognition of those services which have rendered the Natural History Society what it is—whether of those who have given without stint, time, labor, and skill to its advancement, or of those other promoters who have, in various ways, contributed to the same end, by donations of money, of books, of works of art, and of specimens for the enrichment of the Society's collections.

"Encouraged by reflections of this kind calculated to loosen the tongue, and to place even an unpractised speaker at his ease, I am thankful for the opportunity of expressing my own gratification at what I see and hear to-night, and should rejoice indeed if, it may be at a fitting moment, I could be so fortunate as to say only a few useful words in furtherance of a cause we all desire to promote.

"There are established here societies—quite a goodly number of them—embarked in the execution of projects of benevolence, education, religious, mental and bodily welfare, and I have understood that Montreal is in this behalf not one whit behind other notable cities in her Majesty's dominions. But I do think, sir, without any disparagement of the aim and work of those other combinations of effort which have been alluded to, that one of the very chief ornaments of this city, and one of the most efficient promoters of progress, is the Natural History Society. Embracing in its list of members, living and deceased, a good number of persons of high reputation that extends far beyond the immediate scene of their labors, it can and does command that sort and degree of respect which gives weight to its proceedings, and which could not attend the efforts of any number of merely local magnates. The domain of the Society's researches being the boundless field of nature, and in a comparatively new country where almost every day new developments strengthen the confidence that is entertained in the magnitude of its natural resources, the Society may be expected in the success of its work to render services of the greatest value to the whole community by being instrumental in bringing those resources more and more into notice. I ought, perhaps, to apologize for presuming on your indulgence when I venture to make remarks of this kind—when I suggest that the expectations of the public may possibly extend much further than some would at first sight admit to be legitimate as regards the labors of one society. But I shall be pardoned, I think, when it is borne in mind how few and slender as yet, and as compared with older countries, are our organized means for the promotion of various special branches of science. The day to us has not yet dawned for venturing to take in hand the organization of distinct societies, to promote astronomy, chemistry, botany, meteorology, entomology, and a number of other leading branches upon which the progress of natural history is more or less essentially dependent. It must be obvious that the friends of science in this country are naturally led, through the force of circumstances, to depend upon such a body as the Natural History Society of Montreal for fostering and keeping alive amongst us a general scientific spirit, and a tone of natural science in all its branches and operations to take up work which elsewhere would be allotted to other associations. For these and like reasons it must be gratifying to the members of this society to feel that whatever they can do in behalf of science generally, even in cases where there is apparently only an indirect connection with the particular branches they combine to prosecute, is necessarily of advantage to the community: and that their labors, of whatever kind, are sensibly appreciated is amply demonstrated in the large and interested circle of friends whom the attractions of this annual conversazione have brought together this evening.

"Sir, I hope I shall not be found unmindful of the nature of this social occasion upon which I feel it would be unfitting to claim the attention of the audience for a long time. It would be no less inappropriate or unprofitable I believe for me to attempt to engage that attention, even for a short time, by the discussion of any purely technical matters appertaining to the several branches of natúral history. My further remarks shall, therefore, be brief, and shall be devoted to one of the most important and interesting of the Society's undertakings,—*its collection of specimens, illustrative of facts and phenomena of natural history.* In this department almost every person is able to put his hand to the work, and to further its progress; and I might add, that in such collections there is almost always a place waiting to be filled up by contributions such as would entail upon the individual friends of science, in most cases, at least, but a small sacrifice. It is perhaps needless to observe that specimens of objects of natural history subserve the purposes of attracting attention, exciting interest, and impressing the memory in a manner that corresponds with the effects produced by suitable experiments devised and executed in illustration of any law of nature or natural phenomena. As it would be unreasonable to expect a student of chemistry to comprehend, realize, and retain in his memory through mere words of description the phenomena attendant upon the mutual action of alkalies and acids, so would it be too much to presume upon attaining a rational knowledge of the peculiarities of an owl or of the substance india-rubber in the absence of visible examples of these objects. Drawings and models, if well executed, may to some extent supply the deficiency. But as we all know the work of the artist cannot attain to the perfection realized in nature; and it may be safely asserted that the impressions producible by verbal description, even when accompanied by good drawings, is neither so vivid nor so permanent as that which is created by the sight and handling of the objects. In fact, one common result of an accurate description or drawing of a natural object is to make us wish to *see*, if possible, the object itself. Again, if the sight of a specimen in a collection—be it a stuffed bird, or a mineral, or a valuable natural product in any one of its stages of conversion to the use of man—be found to augment the beholder's previous knowledge of it, or to set him right in regard to any erroneous impression he may have entertained; if it serve to support or confute any theory, or to suggest any idea that is afterwards worked out into useful results; or in fine, if it excite a spark in the mind which kindles into the desire to go forth and study the works of nature in any portion of her realm, there is one of the chief ends of such a collection attained.

" It is well worthy of note, that the variety of trains of thought and of associations roused by the sight of an object presented as a specimen is as great as that which exists in the mental qualities, bias, and occupation in life of those who examine it. In this connection I am tempted to quote the language of Sir John Herschel. Commenting upon the different ideas attached by different persons *even to the name* of a common substance, he says: 'Take for instance iron. One who has never heard of magnetism has a widely different notion of iron from one in the contrary predicament. The vulgar, who regard this metal as incombustible, and the chemist, who sees it burn with the utmost fury, and who has other reasons for regarding it as one of the most combustible bodies in nature;—the poet, who uses it as an emblem of rigidity; and the smith and engineer, in whose hands it is plastic and moulded like wax into every form;—the jailor, who prizes it as an obstruction, and the electrician who sees in it only a channel of open communication by which that most impassible of obstacles, the air, may be traversed by his imprisoned fluid, have all different notions of the same word. The meaning of such a term is like a rainbow,—every body sees a different one, and all maintain it to be the same.'

" The only or principal effect upon some minds derived from inspecting a collection of specimens appropriately arranged, is believed by many to be a sort of passive gratification traceable rather to the influence of a tasteful artistic display, than to the recognition of any positive result of useful knowledge. It may be so: with pre-occupied minds, or through habitual indifference to what passes, some persons may agreeably though cursorily inspect a museum without carrying away any new information. Still the effect, so far as it goes is good—they suffer no harm; and seeing that what is thus to their notice presented is not displeasing, there is the hope that on some future occasion they may be induced even to contribute to that which so much pleases and instructs others. But the number of such persons—who can go through, perhaps, an extensive museum without deriving any benefit whatever, is probably very small; and if there be any, he or she is at least in no worse position than a certain eminent navigator who minded exclusively his own nautical business, and returned home from his voyages in child-like ignorance of the artful ways of mankind—so that his friends jokingly said of him, 'he has been all round the world, but never in it.'

"I am sure, sir, that it would be tedious to listen to details of the advantages proposed and expected to be realized by a society or institution that embraces among its purposes the making of a collection of specimens. In most of the older museums very small attention was commonly paid to the points I have alluded to, what have been callen industrial and economic purposes. The beauty, the richness, the rarity, and curious nature of the objects illustrated, were commonly the main agencies by which the attention and admiration of visitors were moved. No one could say justly that these attributes are not perfectly legitimate, and worthy of especial provision in a public museum, viewed as a repository of what is considered valuable on account of its rarity, or because suggestive of interesting or important historical incidents. The majority of people for a very long time to come will probably regard with deep interest such objects as the spurs of King Henry the Fifth, the watch used by Oliver Cromwell, the snuff-box of Napoleon Bonaparte, the sword of General Wolf, and the relics of personal effects belonging to Sir John Franklin and his followers, recovered some years after their lamented owners had succumbed to their fate amid the arctic snows. The bare sight of these things rouses in most of us very strong emotions. As long as the world endures, human nature will ever cherish the preservation of articles of this kind. But it is much less common now than formerly to allot a large share of space in a museum to their preservation and exhibition: a more utilitarian disposition is everywhere prevalent—and collections of specimens are expected to be composed of something more than what may be denominated curiosities.

"But a brief visit to the Museum of this Society, which I may be permitted to say I have now the opportunity of seeing for the first time in the more extensive and appropriate building provided for it, has afforded me so much pleasure that I cannot help saying a few words on what appears to me on this occasion worthy of mention, a very important principle for governing the making of such collections—and it must be very gratifying to all lovers of natural history to see the principle adhered to in the structure of this Museum so far as it has progressed. The principle I allude to is that of utilizing the objects of a collection strictly with a view to the purposes aimed at—exhibiting only specimens as perfect as possible of their several kinds, not neglecting artistic display, but at the same time sacrificing even that (when necessary) to the conditions of order in a series, position, and other requirements for rendering illustrative objects of natural history really useful. Most modern collections made under favorable auspices are known to follow this out in a degree that was deemed useless, or which, perhaps, was not even thought of in former times. I could name, sir, I think more than one old-established museum where no expense has been spared, and yet where attention to this feature has been sadly neglected, occasioning injury to science, and exciting wonder in the minds of intelligent and scientific visitors, who go into them, perhaps, anticipating instructive information. Doubtless this is sometimes the result of sheer neglect; but more frequently it must arise from the too great liberality and abundance with which particular classes of specimens have been contributed. It is not so much the extent of a museum that renders it useful in the cause of science, as attention to unity of purpose, and to natural conditions. A bird, for example, poorly stuffed, mounted in an unnatural position, placed in a bad light, or thrown amongst others without heed of its species, however remarkable its prototype in nature may be, is but ill-suited to encourage the study of ornithology, or to illustrate the collateral facts of science which students of natural science are usually anxious to verify. The grand rule so valuable, and carried out by careful people in their ordinary arrangements, 'a place for everything, and everything in its place,' is eminently of consequence in the disposition of the objects of a museum.

"For reasons such as are feebly indicated in the above remarks, it is remarkable that people who are partial to ornithology are sometimes heard to declare that they derive more real benefit and more pleasure from inspecting a comparatively small collection judiciously arranged, and well mounted—as for example the birds in the University of Edinburgh College Collection—than from the examples in the great British Museum itself.

"In the nucleus of a future extensive museum embraced by the geological collection, the examples of animals, of birds, reptiles, and fishes, and in the herbarium belonging to this Society, I feel sure, Sir, there are offered opportunities which must furnish on all points most valuable helps to students of natural history in this country; and thus positive utility as well as the cause of theoretical science cannot fail to be subserved."

General chemical experiments, of an interesting description, were then performed by Professor Robins, accompanied with appropriate explanations.

During the remainder of the evening the entertainment was contributed to by Mr. Hearn, optician, who exhibited a series of dissolving views; and by the band, who gave several other choice selections. The visitors also examined with much pleasure the various interesting objects in the Society's collection, and a number of microscopes and other scientific instruments displayed in the library.

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## THE MAPLE-LEAF CUTTER.

At a late meeting of the Natural History Society, a communication was read from Rev. Mr. Constabell of Clarenceville, describing the ravages of an insect whose larva burrows in the maple leaves, cutting out circular pieces, which are used as coverings to protect the larva while eating the parenchyma of the leaf.

From the specimens exhibited, it appeared that the insect is a little moth, *Ornix acerifoliella* of Fitch, well known in the State of New York, though apparently not hitherto recorded in Canada. Fitch states that it is not ordinarily very destructive, but that in some seasons it appears in great numbers, and inflicts considerable ravages, especially on detached maple groves. He recommends that cattle should be turned into the affected groves in autumn, in the hope that their treading would destroy the pupæ, which at that season are lying on the ground, wrapped in their coverlets of cut leaves.

J. W. D.

# REVIEW.

Geological Survey of Canada. Report of Progress from its Commencement to 1863. Lovell, Montreal.

This large octavo, of 983 pages, illustrated with 498 wood-cuts, and to be accompanied by an atlas of maps and sections, presents a condensed view of the work of the Canadian Survey from its commencement in 1843. It gives the results of the combined labors of Sir W. E. Logan, Mr. Murray, Dr. Hunt, and Mr. Billings, a staff not to be surpassed either in ability or energy, and aided also by several able assistants, of whom Mr. Richardson and Mr. Bell stand first. It is also to be observed that the generous and liberal disposition of the Director of the Survey has kept him in friendly relations with every one of any note as an unofficial observer on Canadian Geology; and that in his Preface he enumerates and frankly acknowledges all the services, large or small, rendered by such persons before the institution of the Survey or during its progress.

The work commences with an account of the Physical Geography of Canada, presenting in few but well-chosen words the general features of the country. A few pages are then devoted to the nomenclature of the geological formations; after which begins the main portion of the work, devoted to a detailed description of the formations occurring in Canada, beginning with the Laurentian, the oldest of them all, and ending with the Devonian; the superficial geology being given in a separate chapter at the end. The fossils are carefully noticed under each formation, with illustrations of characteristic species.

The second leading division of the work is a description of Canadian minerals, embracing many new facts of interest, ascertained by the Chemist of the survey. Then follows by the same hand what may be regarded as a treatise on rocks, which is probably the most valuable and reliable memoir on this important subject in our language.

This part of the Report ends at page 670; and beyond this, as becomes a public survey, the remainder is occupied principally with economical geology. Every useful rock or mineral occurring in the country is noticed; with details as to the places and conditions in which it is found, and the extent to which it is worked;

and much useful information is given as to the modes of rendering such deposits useful elsewhere.

The value of this work to Canada can scarcely be over-estimated. It must be regarded as of vast importance, whether we consider readers abroad or at home, whether we consider scientific objects purely or those which are practical. Its mechanical execution is an evidence of the progress of the arts among us. Its publication to the world is a proof of the interest taken in science in this country, and of the enlightened patronage afforded by the Government to such investigations, and at the same time, of the immense value of our mineral resources, as well as of the extent to which they have already been made available. It gives for the first time to geologists abroad the means of making themselves thoroughly acquainted with the geology of this country; and it thus places Canada on a level with those older countries whose structure has been explored, and the knowledge of it made the common property of the world. In some departments of geology, it even makes Canadian rock-formations rank as types to which those of other countries will be referred. This is especially the case with regard to those oldest of known rocks, the Laurentian series, whose intricacies have for the first time been unravelled by the Canadian survey, their mineral character explained, and the earliest known traces of animal life obtained from them; so that the term *Laurentian* is applied as the general designation for the most ancient formations of Europe as well as of America. To the people of Canada, the publication of this Report must mark an era both in science and practical mining. Any one desirous of studying geology, has here to aid him a detailed account of the structure of his own country; an advantage not hitherto enjoyed by our self-taught geologists, and one which in a reading country like this, must bear good fruit. The practical man has all that is known of what our country produces in every description of mineral wealth; and has thus a reliable guide to mining enterprise, and a protection against imposture. Even in the case of new discoveries of useful minerals which may be made, or may be claimed to be made, after the publication of this Report, it gives the means of testing their probable nature and value, as compared with those previously known.

No one, in short, need henceforth have any excuse for professing ignorance of the labors of the Geological Survey, or for representing it as a useless expenditure of the public money. Persons not interested in science or in practical mining might heretofore have been excused for not having read the annual reports of progress, with their dry details and want of suitable illustrations; but after the publication of this attractive volume, such want of knowledge can no longer be tolerated; and it is to be hoped that no public speaker or writer will venture so to proclaim his own ignorance as to pretend that Canadian Geology is one of those little matters which have, in the midst of more important affairs, escaped his attention, or to underrate the labors of those who have devoted themselves to this great work.

We do not propose to give any summary of the Report, or to give extracts from it. It should be in the hands of every reading man in Canada; and as a further inducement to this, we close with the following extracts from the Preface, in relation to the arrangement of the Museum of the Survey, which is one of its most creditable and useful achievements:

"One of the duties imposed by the Government upon the Survey, at the time of its institution, was the formation of a Provincial Museum, which should illustrate the geology and the mineral resources of the country. This object has been constantly kept in view; and since a suitable building has been placed at the disposal of the Survey, the Museum has gradually assumed a value and importance which at the present time render it second to few on the continent for the special purpose to which it is devoted. The Museum is separated into two parts. One of these is devoted to Economic Geology, and in it are displayed specimens of such rocks and mineral substances as can be applied to the useful purposes of life. These are subdivided into two classes; one of them containing the more important metals and their ores, and the other what may be termed the non-metalliferous mineral substances. These various materials are again classified technically, pretty much in the way in which they are described in the twenty-first chapter of this volume; each specimen being placed under a label giving its locality, and the geological formation to which it belongs. The various substances are as much as possible reduced to forms showing their uses, thus at once making the design of the arrangement intelligible. In this division of the Museum there is a classified collection of all our mineral species; and another of our rocks, more particularly those of a metamorphic or of an intrusive character. This part of the Museum it is proposed to illustrate further by geological maps, sections, and models.

" The geographical distribution of any series of formations can scarcely be followed out correctly over a large area without a preliminary knowledge of the true geological superposition, or the natural order in which these formations have been deposited. It is now well established that throughout a very large proportion of the whole series of rocks composing the earth's crust, the best means of determining their succession is by their fossils; it being a fundamental principle of geology that different formations are characterized by different groups of organic remains. The study and determination of fossils thus becomes an indispensable part of a geological survey. But these organic forms are so many and so various, and pass into one another by such insensible gradations, that to make them truly available requires the special attention of a person versed in natural history, and indeed of one who pursues an uninterrupted study of that department of natural history which is devoted to these ancient forms. Hence the necessity of attaching a palæontologist to every important geological survey; and hence no geological museum can be complete without a full and properly classified collection of described organic remains from the fossiliferous rocks of the area which it is designed to illustrate.

" The second division of the Museum is thus devoted to the palæontology of our formations. In this division the fossils are displayed in groups, which succeed one another in the order of the formations, beginning with the most ancient. In each group the specimens are arranged in a natural-history order, commencing with the simplest or lowest forms, and rising to the highest; and to each specimen there is attached a label giving the generic and specific names of the fossil, with its geological formation and its locality. In order that there may be no mistake as to the fossil indicated by the label, the specimens are freed as much as possible from all other fossils. In order at the same time to save space, the specimens have been as much as possible reduced in size. In this operation the services of Mr. T. C. Weston, a lapidary, have been made available; and his skill has also been applied to slitting many of the cephalopods and other fossils, and rocks, for the purpose of showing their internal structure. By this reduction in the size of the specimens we have been able to arrange a much greater number in our limited space than would otherwise have been possible.

"The number of species of fossils displayed in the Museum is about 1500. Figures engraved on wood of 543 of the more characteristic of these, are given in the present volume. These are chiefly by Mr. J. H. Walker of Montreal, with a few by Mr. A. W. Graham and Mr. G. G. Vasey; the whole from excellent drawings by Mr. H. S. Smith. With a few exceptions, the species here figured are distinct from those which have already been given in the Decades of Canadian Organic Remains, published by the Survey. Of these, I, III, and IV have appeared, and it is expected that Decade II, already referred to, will shortly be published. For the descriptions of Decade I we are indebted to Mr. J. W. Salter, palæontologist to the Geological Survey of the United Kingdom. It contains twenty-one species from the Birdseye and Black River formation, the figures of which are drawn by Mr. C. R. Bone, and engraved by Mr. W. Sowerby. Decade II will contain fifty-one species of graptolitidæ, by Prof. James Hall of Albany. Decade III contains twenty-nine species of Lower Silurian cystideæ and asteridæ, described by Mr. Billings, and one species of cyclocystoides, by Messrs. Salter and Billings; with fourteen species of Lower Silurian bivalved entomostraca, by Mr. T. Rupert Jones, of the Geological Society of London. The figures are drawn on stone by Messrs. C. R. Bone, J. Dinkle, Tuffen West, G. West, and H. S. Smith. Decade IV contains forty-three species of Lower Silurian crinoidea, described by Mr. Billings; the figures drawn on stone by Mr. H. S. Smith, and printed by Mr. G. Matthews of Montreal. As already stated, Mr. Billings has described altogether 526 species of fossils. Those not included in the Decades have been published in the Canadian Journal of Toronto; the Canadian Naturalist and Geologist of Montreal; in the Annual Reports, and in the volume entitled Palæozoic Fossils of Canada, published by the Survey.

"In the collection of the Survey there are probably at the present time about 500 species of fossils still remaining undescribed. The publication of these will be an additional contribution to the general fund of palæontological knowledge; to which, as it has been of great utility in our own investigations, we are bound to add what we can for the benefit of others. But independent of the instruction derived from fossils as guides to ourselves, and proofs to others in regard to the succession of our rocks, there is a higher consideration attached to them than their mere utilitarian application. For, as remarked by Conybeare, they bring us supplementary information of numerous species which have long vanished from the actual order of things; and by their resurrection they unexpectedly extend our views of the various combinations of organic forms. In many instances they supply links otherwise wanting, in uniting the different terms of the series in an unbroken chain, and thus aid in the elucidation of those general laws of natural history, the investigation of which is always of so much interest to enlightened minds."

The maps and sections required to complete the work will be published in the course of this year. Through the kindness of Sir W. E. Logan, we have been permitted to examine the portions of them already prepared. One of them is an exquisite miniature geological map of Canada and the neighboring regions, giving a wonderful amount of detail in small space. Others are maps of special districts and formations; as, for instance, of the remarkable convolutions of the Laurentian rocks in the region of the Ottawa, and of the distribution and subdivisions of the Huronian system. There are also sections on several of the most important lines, which are of especial value and interest in consequence of their being drawn to a true scale, so as to present an accurate view of the actual relations of the rocks. These will of course, when completed, greatly enhance the value of the work.

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## MEETING OF BRITISH ASSOCIATION.

### Zoology and Botany.

Professor Balfour, in his opening address, after stating that the subjects to be discussed in this Section were biological ones, proceeded to remark: "Although our Section is separated for convenience from that of geology, nevertheless they have important bearings on each other. The study of Palæontology cannot be presented without a thorough knowledge of the anatomy, mode of growth, and geographical distribution of the plants and animals of the present epoch. In fact, the study of fossil plants and animals ought to constitute a part of every course of Botany and Zoology. Geology, in place of being reckoned a distinct science, may be considered as the means by which the departments of Mineralogy, Botany, and Zoology are combined in one harmonious system, embracing the natural history of the globe. Rash geological statements and conclusions often arise from imperfect knowledge of the sciences included in our Section. Fronds of ferns of different external forms have been described as distinct fossil species or even *genera*, the geologist not knowing that very different forms of frond are exhibited by the same species of fern in the present day. Again, another error has arisen from the same form of frond being considered as indicating the same species, whereas the same form does occur in different *genera* in the present flora—and these can only be distinguished by the fructification, which in fossil ferns is rarely seen. So also the same forms of shell may belong to different *genera*, the only distinction being founded on the teeth, or on some other character of the *animal* inhabiting the shell; and such characters are, of course, totally lost in the fossil. Again, the presence of a palm-leaf might be considered by the geologist as indicative of a very hot climate, from his not knowing that some palms occur at high latitudes, and others are met with in mountains associated with cool forms of coniferæ. These and numerous instances might be adduced to show the necessity of a perfect acquaintance with the present fauna and flora in all their details before the geologist can determine fossils, or the character of the climate of Palæontological epochs. There is a mutual bearing of all the natural sciences on each other, and the student of nature must take a comprehensive grasp of all. The natural sciences have always occupied a prominent place in the proceedings of the British Association. The subject is in itself popular, and is interesting to all classes. Much has been said in this Section to advance the sciences of Zoology and Botany, and to stimulate naturalists in their investigations. A great feature of the association which require special notice, is the procuring of reports in different departments of science, and the aiding and encouraging of naturalists in carrying on researches which require much labor and experience for their prosecution. Many a deserving young naturalist has thus been enabled to advance science, and lay the foundation for future fame and promotion. Another important feature of the Association is the bringing together men of science and promoting free personal intercourse. Perhaps more good has been done by this than even by the reading of papers. Interchange of thought by oral communication, and the opportunity of frankly stating difficulties and of asking questions, are most valuable to men of science, especially when they are congregated from various parts of the world. Friendships, too, are cemented, and asperities are softened by coming into contact with fellow-laborers in the same great field. No doubt there have been occasioned unpleasant altercations at our meetings; but even these have been ultimately turned to good account. Explanations are made, opinions are canvassed, and truth is finally elicited. For, as iron sharpeneth iron, so the countenance of a man his friend. But iron does not sharpen iron unless it is brought into contact with its fellow, and one be made to act sharply and keenly on the other. In former days keen disputes took place among geologists in reference to the formation of rocks. The igneous view, propounded by my distinguished relative, Dr. James Hutton, was supported warmly by some, while the aqueous view was espoused by others. At length, truth was elicited, and the minds of geologists now, to a certain extent, correspond. The relations and positions of rocks, the continuity of formations, Cambrian and Silurian rocks, coal and shales, glacial motions, the definition of species, their permanence or versaltility, and their origin, embryogenesis in plants and animals, flint hatchets, the age of man, and many other points, structural and physiological, have been, and now are, still discussed with great keenness and even with accuracy. But, out of all this, as in former cases, truth will at length come forth. The storms which now and then agitate the natural history atmosphere will purify it. Like the mists on the mountain, which bring out in bold relief the noble rocks and ravines of the craggy summit, so these disputes, even while they are carried on, bring out some phenomena of interest which had been previously invisible. The lightning's flash in the dark cloud may discern to us some prominent object which had been invisible in the calm sunshine. But ere long the storm will cease, the mists will be dissipated, and then the unclouded summit will appear in all its majestic clearness. So when the obscurity cast around science by the disputes of combatants shall have passed away, the truth will shine forth to the calm eye of the philosophic observer in all its beauty. In such polemics we are not to fight merely for victory, or for the advancement of our own fame, but for the great cause of truth, which alone will prevail at last. No studies are better calculated to promote friendly intercourse. The investigation of God's works is well fitted to calm unruly passions, and to promote humility and harmony. In speaking of the effects of the practical prosecution of Botany, the late Dr. Johnston of Berwick remarks: 'There is a pre-arranged and beneficial influence of external nature over the constitution and mind of man. He who made nature all beauty to the eye, implanted at the same time in His rational creatures an instinctive perception of that beauty, and has joined with it a pleasure and enjoyment that operate through life. We are all the better for our botanical walks, when undertaken in a right spirit: they soothe, soften, or exhilarate. The landscape around us becomes our teacher, and from its lesson there is no escape; we are wooed to peace by the impress of nature's beauty, and the very air we breathe becomes a source of gratification and pleasure. The companionship of those who are prosecuting with zeal and enthusiasm the same path of science is a delightful feature of such excursions. The feelings excited on these occasions are by no means evanescent: they last during life, and are recalled by the sight of the specimens which were collected. These apparent insignificent remnants of vegetation recall many tales of adventure, and are associated with the delightful recollection of many a friend. Many a time, while carrying on our botanical researches in the wide field of nature, and visiting the Alpine districts of this and other lands, have I felt the force of these remarks. On the last occasion that I presided over Section D at Liverpool, in 1854, I was associated with my late deeply-lamented colleague, Edward Forbes, who was President of Section C.; and, on looking back to his career, I feel, that I cannot give a better example of a true naturalist—one who took a wide and expanded view of nature in all her departments, and at the same time exhibited such a genial spirit as endeared him to all. I have elsewhere remarked that with all his knowledge, he combined an affability, a modesty, a kindness, which endeared him to every one. No student of nature was beneath his notice; no feat recorded by a pupil, however humble, was passed with neglect. He was ready at all times to be questioned, and was prompt to point out any spark of merit in others. He had no jealousy, and never indulged in attacks upon others. He gave full credit to all; and he was more ready to see the bright than the dark spots in their character.

Even to those who criticised him severely he bore no ill-will, and he certainly did not return railing for railing. Over and again was I associated with him in scientific rambles and in meetings of naturalists; and I have seen the tact with which he subdued the *perfervidum ingenium* when misdirected, and calmed the turbulent spirit when self-esteem prevailed over the due acknowledgment of another's merits. He was truly unselfish, and never failed to recognize and encourage merit wherever he could detect it. He had a truly generous spirit, and was totally devoid of narrow bigotry. He was desirous of promoting science, independently of all selfish views. He loved it for its own sake. Would that his example was more followed by all of us! When we look at the changes which are constantly taking place in the views of naturalists as science advances, we cannot but feel the need of modesty in the statement of our opinions. While we give our views and the reasons for adopting them, let this be done without dogmatism or asperity. Let us remember that our conclusions may be modified or altered by future discoveries. Such anticipations, however, should not paralyze our efforts. Science is advancing, facts are being accumulated, and, year after year, a noble structure is being reared on a sound foundation. It requires now and then a master-mind to bring out great generalizations, and to give a decided impetus to the work. Facts must be carefully weighed, and knowledge must be accurate and extensive; otherwise a genius in science is apt to bring forward rash generalizations, and to indulge in unfounded speculations. The imagination is disposed to run riot when a grand vista seems to open before it, and it flies on heedlessly to the terminus without surveying the intermediate ground. We do not ignore speculation; but we recommend, at the same time, cautious induction—a sifting of facts and of their relations to each other. Natural History sciences are now assuming an important place in education. They are not confined, as formerly, chiefly to medical men, but they enter more or less into the preliminary studies of every one. While Classics and Mathematics ought to have an important place in our schools and colleges, Natural History cannot now be neglected. Universities which formerly ignored it, are now remedying their error in this respect; and we may ere long hope to find it occupying a still more important position in educational institutions. The possession of university honors is now connected, to a certain degree, with a knowledge of nature; and a master of arts, as well as a doctor of medicine, is supposed to know something of the objects in the material world with which he is surrounded. The establishment, also, of special degrees in science is a step in advance, for which we are indebted to the University of London. Natural sciences are particularly valuable in mental training. They promote accuracy of observation and of description. They teach the student to look at the objects around him, not with an idle gaze, but with an intelligent discrimination. They ensure correctness of diagnosis, and encourage orderly and systematic habits. The British association, in its perambulation, does much good by bringing such subjects prominently under the notice of directors of educational institutions in various parts of the country. It stirs up many to see the value of this kind of knowledge, and gives practical illustrations of its bearing on the ordinary business of life. Thus the Association has an important influence on the town in which it meets, not merely by what it does during its sittings, but also by its after-efforts on the population. The very preparations made in the locality for the meeting have often been productive of much permanent good. They have been instrumental in bringing together collections which have formed the nucleus of a local museum. And they have been the means occasionally of introducing sanitary measures of the highest benefit to the inhabitants." In conclusion, the President remarked upon the reciprocal relations of science and theology.

### Physiology.

Prof. Rolleston, in opening the proceedings of this section, remarked that last year Dr. Sharpey delivered an address on the progress which physiology had made during the previous twenty years; and before the British Association last year, moreover, Professor Huxley delivered an address on the divisions and departments of the science, with its methods and prospects. His own aim would therefore be to avoid the territories which had thus been occupied; and he proposed to pass in review such writers as had written works to which reference was likely to be made in the section, and such publications as might probably become the subject of discussion. First, he would mention works intended for the general public; and secondly, specify works of a more strictly scientific character in the three departments of experimental physiology, structural and comparative anatomy, and the microscope, and then he intended to make a few observations upon the general and upon the educational value of physiological study. Of physiological and anatomical works intended for the general public, there were happily now a considerable number. Among those of a popular character he might specify *The Intellectual Observer*, *The Popular Science Review*, *The Natural History Review*, and *The Annals and Magazine of Natural History;* the three first of recent date, but the last a long established and still excellent publication. The scientific societies publish so many proceedings in octavo, with illustrations, that there did not exist the same necessity in England as on the Continent—a fact which their foreign friends would do well to remember, while the physiologists of England were free to acknowledge the many and valuable services rendered by German and other Continental works. He thought he ought, also, to mention American literary contributions, and to specify *The Smithsonian* and *The Philadelphian Journal of Science*, the French *Annales des Sciences Naturelles*, and the Würtzburg and Berlin *Archives*. Physiology and scientific zoology had been expounded with singular clearness and accuracy to the general public by Mr. Lewes; and anatomy was largely introduced into the pleasing fishermen's book, *The Angler-Naturalist*, by Mr. Cholmondeley Pennell. A short sketch, such as Mr. Pennell's, of the economy of the Bird, would be a most valuable addition to our ordinary ornithologies and oologies. He said oologies, for even in the egg of the bird the special needs of the forthcoming bird seemed to be more especially provided for than in the eggs of other families much higher in the scale. Passing from works of general to works of more strictly and severely scientific interest, he must observe that a high place was due to the lectures of Professor Huxley on the Classification of Animals; and it spoke well for the enlightenment of the readers of the *Medical Times* and of the *Lancet* that the editors of those journals had felt it desirable to cater for their tastes by publishing those lectures on pure science. Turning to works on Experimental Physiology, he was reminded of vivisection; a word which had been rendered familiar to the ears of the public during the last few weeks by the letters and discussions that had appeared in the *Times* and other papers. Addressing himself to one of the questions it suggests, he would ask—Is it possible that a want of humanity is a common fault of physiologists? He was not by any means so sure that "want of decency is want of sense"—as Pope had said—as that a want of humanity is a want of culture. Rudeness, ignorance, want of education, were much more surely connected with cruelty than was cowardice. All children pretty nearly were cruel—that is to say, they were capable of performing acts which adults, at least of the upper classes, shrink from. Most, if not all, persons in the lower order of society concerned in the capture of animals were pretty nearly invariably cruel; and, if reproved for cruelty, they would often be unable to understand what was meant. Gamekeepers, again, killed anything which possesses life, unless they knew they could be prosecuted for so doing, or were paid for preserving it. Cruelty, then, usually flowed from want of thought, want of culture, and want of refinement. Was it probable, then, that men of a science demanding much thought, much culture, and not a little education, should resemble persons lacking all these things in the very points most directly characteristic of such deficiencies? Let him state, too, great facts against which no amount of writing or of demonstration could be of any avail, except by ignoring them. The facts were—first, experiments on living animals very frequently cause their death instantaneously; secondly, when this is not the case, there was chloroform, which was almost invariably employed. In vivisection, as it was called, frequently the first step was the destruction of life, and that in a way as speedy, to say the least, as by the ordinary methods of destruction at the command of either the sportsman or the butcher. Now, surely a life might as well be sacrificed for increasing knowledge as for the production of flesh-food, or for what was called sport. Experiment, too, was tedious and toilsome, and was, therefore, rarely undertaken out of wantonness, or for the gratification of malignity. Undertaken for the ends of science, it had as good a claim to our sympathy as the practices of the "gentle craft" of anglers, to say nothing of those of the destroyers of warm-blooded animals. Vegetarians, it was true, but they alone, could meet this argument on principle. They could say, "Your 'Tu quoque' has no gagging force when used to us; we deny that two blacks make one white. You cannot experiment as you choose—find out how to create life; and nothing can justify you in taking it away." He did not see how this could be met, at least on vegetarian principles. But from what he had already seen in Newcastle, he judged that the vegetarian members of this Association were not many. In the other case, chloroform obliterated the sense of pain, and the use of chloroform was now rarely omitted. The utility of vivisection had been strikingly proved in two classes of diseases—diabetes and epilepsy. The latter, frightful to witness, was yet more frightful to suffer—violence and danger for the moment, and dreariness of prospect for the future, and of the way to meet it vivisection had given us at last a hopeful, because a rational, foreshadowing. To diabetes—an equally terrible if less shocking malady—the applicability of vivisectional results was even more direct than in reference to epelipsy, thanks to the studies of Dr. Pavy. He would just say further, that, when vivisection was being denounced as causing pain and suffering in a world already so full of both, it would be well to consider that, in this question, as well as in all other human questions, we had to deal with complex considerations, and to weigh them one against the other. Absolute certainty was not looked for in morals, absolute demonstration was not given us in religious questions, and absolute freedom from evil was not given to us in any course of practical action we adopt. Vivisection produces a certain amount of pain; but is this pain voluntarily and of deliberate purpose produced in a few laboratories, greater in amount, in intensity, in duration, than the mental pain, moral distress, and bodily agony endured in many a cottage, many a palace, by the victims of the very two diseases which, in these last years, vivisection has most assisted medicine to combat? He felt it to be his duty to make this apology for vivisection. Having done so, he passed on to the subject of structural anatomy, and specified the names of numerous writers upon it—both English and Continental. He next dwelt upon the professional and popular advantages of physiological study, and of a biological training—observing that a thorough scientific training tends, necessarily, to engender modesty and distrust of one's self. He believed he had the authority of their own elder Stephenson for saying that to worldly success there is no gift so necessary as the gift of something quite different. The bar, the senate, and the hustings delight in verbal antithesis, sharp distinctions, and sweeping assertions, which nature abhors. She knows little of antithesis—she works by gradations; and he who has studied her truthfully knows that the universality of assertion is generally in the inverse ratio of knowledge. For success, then, in the brilliant lines of life, the study of nature did not constitute the best possible training; but for success in the scientific careers he had specified, it would be wasting words to say how necessary a biological training is. After referring to Baron Liebig's new book, "The Natural History of Husbandry," and expressing the assured conviction that the popular dogmas of Phrenology would be shown to be radically false by the advancement of physiological knowledge, he then went on to show that profusion not parsimony was the law of nature, and concluded by saying that many causes could be working together to one result. Referring to the possibility of persons considering "the struggle for existence" to be a principle antagonistic to that of "special providence," he said that the incompatibility of the two agencies had no truer foundation than could be laid in the arbitrary teaching and unsupported hypothesis of ages skilled in the piecing together of word mosaics, but wholly devoid of scientific method. We have wider knowledge, we ought to have truer philosophy, than our forefathers; it would be an anachronism indeed to suffer the figments of the schoolmen to prejudice us against the work of the modern physiologist.

## On some Fossil and recent Foraminifera collected in Jamaica, by the late Mr. Lucas Barrett, F.G.S.

By Professor T. Rupert Jones, F.G.S., and W. K. Parker, Esq.

In 1862 Mr. L. Barrett, F.G.S., late Director of the Geological Survey of the West Indies, gave Messrs. Jones and Parker some fossil and recent foraminifera from Jamaica, comprising a few new forms; some that were previously but little known, and some in finer condition of growth than usual. The recent specimens, from their ascertained habitats, illustrate, to some extent, the conditions under which the fossil forms were deposited.

One sample of these fossil Jamaican foraminifera consisted of several specimens of *Amphistegina vulgaris;* and another of a few of the same species, with one *Textularia Barrettii* (a new variety of *Textularia*). No locality nor geological horizon was indicated for these. A third sample, from "South Hall Cliff," consisted of two large specimens of *Vaginulina legumen.* Fourthly, a much larger series of Foraminifera, from the "Pteropod-marl" of Jamaica, affords *Nodosaria Raphanistrum*, *Dentalina acicula*, *Vaginulina striata*, *Frondicularia complanata*, *Cristellaria Calcar*, *C. cultrata*, *C. rotulata*, *C. Italica*, *Orbito-*

*lina vesicularis*, *Bulimina ovata*, *Cuneolina pavonia*, *Vertebralina striata*, and *Lituola Soldanii*. These, however, can be regarded only as an incomplete Rhizopodal fauna.

From the recent foraminifera obtained by the late Mr. Barrett from different sea-zones, between 15 and 250 fathoms, on the Jamaica cost, we learn that *Amphistegina vulgaris*, *Textularia Barrettii*, *Dentulina acicula*, *Frondicularia complanata*, *Cristellariæ* and *Lituola Soldanii* indicate at least 100 fathoms, and probably more, as the depth at which the Pteropod-marl and the Amphistegina-beds were deposited in that region. Pteropods are found in some sea-muds at similar depths.

Of the recent Jamaican specimens (evidently only the larger and more conspicuous members of a rich Rhizopodal fauna), some were taken at from 15 to 20 fathoms, namely, *Quinqueloculina agglutinans*. *Q. pulchella*, *Orbiculina compressa*, and *O. adunca*; some at from 50 to 100 fathoms, namely, *Orbiculina compressa*, *Dentalina acicula*, and *Orbitolina vesicularis*; and several others at from 100 to 250 fathoms, namely, *Dentalina acicula*, *D. communis*, *Cristellaria rotulata*, *C. cultrata*, *C. Calcar*, *Frondicularia complanata*, *Amphistegina vulgaris*, *Palytrema miniacea*, *Bigenerina nodosaria*, *Verneuilina tricarinata*, *Textularia Trochus*, *T. Barrettii*, *Cuneolina pavonia*, *Lituola Scorpiurus*, and *C. Soldanii*.

*Cuneolina*, a rare form, hitherto known only by figures and description given by d'Orbigny, proves (as suspected) to be a modification of *Textularia*; and *T. Barrettii* is intermediate between it and *Textularia* proper. The *Frondicularia* are remarkably large and beautiful; and the *Cristellariæ* and *Dentalinæ* are also large and relatively abundant.

This fauna is almost identical with the fossil foraminifera of the Tertiary "Pteropod-marl" of Jamaica, above mentioned, specimens from which also were given by the late Mr. Barrett in 1862 to the authors of this notice.

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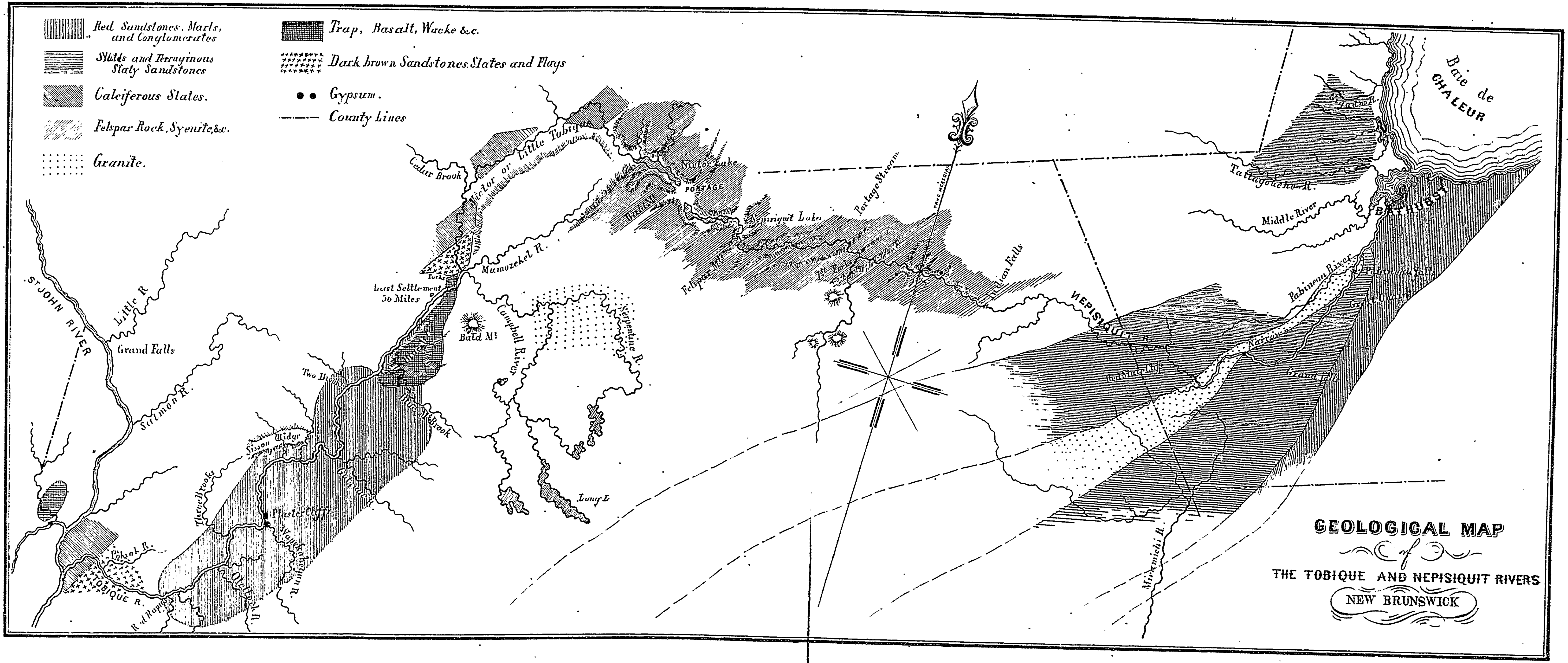
GEOLOGICAL MAP
of
THE TOBIQUE AND NEPISIQUIT RIVERS
NEW BRUNSWICK
Red Sandstones, Marls, and Conglomerates
Slates and Ferruginous Slaty Sandstones
Calciferous Slates.
Felspar Rock, Syenite, &c.
Granite.
Trap, Basalt, Wacke &c.
Dark brown Sandstones, Slates and Flags
Gypsum.
County Lines
Baie de CHALEUR
BATHURST
Middle River
NEPISIQUIT R.
ST JOHN RIVER
Little R.
Grand Falls
Salmon R.
TOBIQUE R.
Campbell River
Serpentine R.
Mamozekel R.
Cedar Brook
Last Settlement 56 Miles
Bald Mt
Long L
Plaster Cliff
Nepisiquit Lake
PORTAGE
Portage Stream
Felspar Mt
Indian Falls
Pabineau River
Grand Falls
Miramichi R.
Gypsum
Tattagouche R.
Sisson Ridge
Red Rapids