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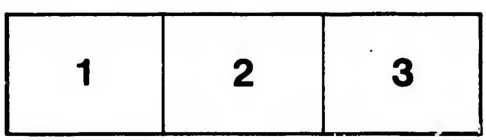
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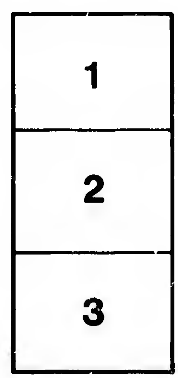
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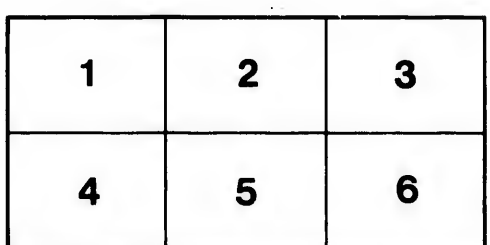
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Organic Siliceous Remains in the Lake Deposits of Nova Scotia.

By A. H. MACKAY.

[From the Canadian Record of Science. Vol. I, No. 4, Oct., 1885.]

VII. Organic Siliceous Remains in the Lake Deposits of Nova Scotia.

By A. H. MacKay, Pictou Academy, N. S.

The siliceous deposits in the lakes referred to are, first, and most abundantly, of vegetable origin, consisting of the exquisitely sculptured cell-walls of the unicellular plants, constituting the order *Diatomaceæ*; and, secondly, of animal origin, consisting of the spicules which form the skeletons of that group of the fresh-water sponges known as *Spongillina*.

The investigation of the character of the lake deposits of Nova Scotia has only been commenced and much is yet expected to be brought to light. The explorations made during the last two summers include a large number of lakes throughout the province, varying from five miles in length to less than one half of a mile, and from 160 feet in depth of water to that of only six or seven. Deposits of some of the larger lakes have been examined, but no systematic survey of them has yet been made.

These deposits may be roughly classified as follows:—

First, earthy muds.

Secondly, black or brownish slimy muds.

Thirdly, whitish siliceous muds, consisting nearly entirely of the cell walls of the diatomaceæ and the spicules of fresh-water sponges, which are found to be present in classes *first* and *second* also, although in less comparative abundance.

These three classes, of course, shade off into each other without any distinct line of demarkation.

In the first class there is a variable quantity of fine sand or clay introduced in times of freshets when the water becomes discolored from the earthy matter borne into it. Deposits of this class abound in lakes into which large streams that readily become turbid flow; and they form more rapidly, it is presumed, than those of the other classes. Soundings in the upper portions of the Lochaber, Garden of Eden, Forbes, Ainslie and Grand Lakes, for instance, bring up material of this class, all abounding to some extent with diatom valves and sponge spicules. The depths of these accumulations our primitive boring apparatus would not allow us to fathom.

The second class of deposits is found in abundance in lakes fed by small streams in the forest. In Calder and MacKay Lakes, Pictou County, the former being a full mile in length, the water in no place appears to be over 9 or 10 feet in depth, the average being 5 or 6 feet. In the central portions of these ponds a pole was driven down by the hand from a raft to the depth of 20 feet without striking hard bottom. Nearer the margin, the borer after passing through this deposit, generally took up a stiff clay, which has also been found underlying some peat swamps in the neighborhood. In some of these swamps analysis has shown a large percentage of the incombustible residue to be composed of diatomaceous and sponge remains, thus demonstrating their lacustrine origin. When the hard bottom of the above-named and other lakes was found to be undulating, the light slimy diatomaceous mud was found to be deepest in the depressions,—the mud surface being more conformable to the surface of the water than to the surface of its bed. In MacLean Lake, less extensive but nearly 30 feet deep, the same characters of the bed of the deposit were observed. In most of the other lakes, soundings, but no borings through the deposits, were made. The typical mud of this class is generally of some shade of a dark grey-brown color, having sometimes nearly the consistence of a very tremulous jelly, but pasty to the touch. Some specimens of this, dried so as to be so firm as to retain a moulded form, contracted to one tenth of its volume when perfectly dried, nearly 50 per cent. of which was estimated to be organic silica. While pieces of decaying wood, leaves, mosses, etc., are found in this material, its carbonaceous organic matter appears to have been to a great extent of algoid origin. The waters of these lakes are generally colored by the presence of organic matter in solution.

The third class of deposits has not been observed in such abundance as the other classes. In many cases it may have been formed from material of the second class, as is suggested by the deposits often shading off into each other in the same body of water. For instance, in Macintosh Lake, some of the purest white material did not come from the greatest depth of the water, but from the vicinity of shallows, between an island and the mainland. A gentle motion of the water from an exposed side of the lake is produced by the wind over this flat, and the deposit alluded to is immediately to the windward of the said flat. This suggests the hypothesis that the change from the slimy mud to the purer siliceous deposit may have been, at least partly, due to the solvent action of the water on the decaying vegetable material. This solvent action has been plainly demonstrated to exist by the analysis of the waters of the lakes which supply the city of Halifax with water, made by George Lawson, professor of Chemistry in Dalhousie College and University. The waters of Long Lake, the largest and highest of the series, was conducted for a time through the lower Chain Lakes, in which there is a large deposit of diatomaceous slime. The analysis gave 2.13 grains of organic matter per gallon in the water of Long Lake, and 2.68 in that of the lower Chain Lake. This shows that each gallon of water may have dissolved out of the Chain Lakes about half a grain of vegetable matter.

Those lakes, so far as observed, which lie in the midst of granite drift, and have clear water, have also purer silicious deposits, the percentage of silica in the dried material approximating in some ases to between 90 and 100. Folly Lake is an instance in which much material of this kind is submerged, and near an affluent of Barney River is a good example of a deposit which is now left high and dry.

The greater proportion of this siliceous material is made up of the frustules or epiderms of about one hundred species of the diatomaceæ. The following have been provisionally determined by comparison with the mounted types of Möller, the plates of Schmidt's Atlas, Van Heurck's Atlas with 3,000 figures of Belgian forms, figures and descriptions by Brun of Geneva in his "Diatomées des Alpes et du Jura," and the descriptions of Rabenhorst in his "Flora Europæa Algarum Aquæ Dulcis et Submarinæ."

1. Cocconeis pediculus, *Ehr.*
2. C. placentula, *Ehr.*
3. Gomphonema acuminatum, *Ehr.*
4. " " *var.* coronatum, *Ktz.*
5. " " *var.* laticeps, *Ehr.*
6. G. cristatum, *Ralfs.*
7. G. gracile *var.* naviculoides, *Grun.*
8. G. abbreviatum, *Ag.*
9. G. capitatum, *Ehr.*
10. G. intricatum, *Ktz.*
11. G. cistula, *Hemper.*
12. Epithemia turgida, *Ehr.*
13. E. gibba, *Ehr.*
14. " " *var.* parallela, *Grun.*
15. E. argus, *Ehr.*
16. Himantidium arcus, *Ehr.*
17. " " *var.* majus, *W. Sm.*
18. " " *var.* tenellum, *Grun.*
19. H. formica, *Ehr.*
20. H. pectinale, *Ktz.*
21. " " *var.* ventricosum, *Grun.*
22. " " *var.* minus, *Ktz.*
23. " " *var.* undulatum, *Ralfs.*
24. H. soleirolii, *Ktz.*
25. H. bidens, *W. Sm.*
26. " " *var.* diodon, *Ehr.*
27. H. præruptum *var.* inflatum, *Grun.*
28. H. polyodon, *Brun.*
29. H. polydentulum, *Brun.*
30. Amphora ovalis, *Ktz.*
31. A. affinis, *Ktz.*

32. Cymbella gastroides, *Ktz.*
33. C. cuspidata, *Ktz.*
34. C. ehrenbergii, *Ktz.*
35. C. lanceolata, *Ehr.*
36. C. delicta, *A. Sch.*
37. C. cistula, *Hemper.*
38. C. heterophylla, *Ralfs.*
39. C. tumida, *Breb.*
40. Navicula crassinervis, *Breb.*
41. N. gracilis, *Ehr.*
42. N. cuspidata, *Ktz.*
43. N. ambigua, *Ehr.*
44. N. appendiculata, *Ktz.*
45. N. affinis *var.* amphirhyncus, *Ehr.*
46. N. transversa, *A. Sch.*
47. N. amphigomphus, *Ehr.*
48. " " *var.*.......... ?
49. N. limosa, *Ktz.*
50. N. firma, *Grun.*
51. " " *var.* hit(s)cheockii, *Ehr.*
52. N. legumen, *Ehr.*
53. N. dicephala, *Ktz.*
54. N. elliptica, *Ktz.*
55. N. radiosa, *Ktz.*
56. N. scutellum, *O'Meara.*
57. Pinnularia oblonga, *Rab.*
58. P. viridis, *Rab.*
59. " " *var.* hemiptera, *Rab.*
60. P. perigrina, *Ehr.*
61. P. nobilis, *Ehr.*
62. P. major, *Rab.*
63. P. dactylus, *Ktz.*
64. P. gibba, *Ehr.*
65. P. divergens, *W. Sm.*
66. P. interrupta, *W. Sm.*
67. P. mesolepta, *Ehr.*
68. P. nodosa, *Ehr.*
69. Stauroneis phœnicenteron, *Ehr.*
70. St. gracilis, *W. Sm.*
71. St. anceps, *Ehr.*
72. St. fulmen, *Breb.*
73. St. punctata, *Ktz.*
74. St. stauropheria, *Ehr.*
75. Surirella robusta, *Ehr.*
76. S. splendida, *Ehr.*

77. S. biseriata, *Breb.*
78. S. bifrons, *Ktz.*
79. S. turgida *W. Sm.*
80. S. linearis *var.* constricta, *W. Sm.*
81. S. slevicensis, *Grun.*
82. S. elegans, *Ehr.*
83. S tenera, *Greg.*
84. S. cardinalis, *Kitton.*
85. Nitzschia amphioxys, *Ehr.*
86. N. elongata, *Grun.*
87. N. spectabilis, *Ralfs* (?)
88. N. sigmoidea, *Nitzsch.*
89. Stenopterobia anceps, *Breb.*
90. Fragillaria construens, *Grun.*
91. " " *var.* binodis, *Grun.*
92. F. capucina, *Desm.*
93. F. undata, *W. Sm.*
94. Synedra ulna, *Ehr.*
95. Meridion circulare, *Ag.*
96. Tabellaria floculosa, *Roth.*
97. T. fenestrata, *Lyngb.*
98. Cyclotella operculata, *Ag.*
99. C. comta *var.* affinis, *Grun.*
100. Melosira distans, *Ehr.*
101. M. arenaria, *Moor.*
102. M. orichalcea, *Mertens.*
103. M. granulata, *Ehr.*
104. M. crenulata *var.* valida, *Grun.*

This list is not exhaustive of all the forms found in any given locality, much less of all the species in the lacustrine deposits of the province. Until the species have been more fully determined in the whole range of deposits there will be little use in attempting to compare the forms of the lower deposits with those of the upper or more modern. Great variations are observed in many species of the diatomaceæ, concomitant with their stage of development, and also probably with their different environments. The conditions of environment also affect their distribution. It is remarkable in the Nova Scotian species, so far as observed, that while most of the forms determined are also found in the distant waters of the Alps and the Jura, some of the deposits taken from lakes but a few miles apart can be distinguished by the presence or absence of certain forms or by their relative abundance.

This induction is as yet based on too few a number of observations to be of any scientific value. But such instances as the following have been observed: *Melosira arenaria* (Moor) is abundant in the Earltown Lakes near the summit of the Cobequid range of mountains; while Gulley Lake, a few miles on the other side of the watershed, is distinguished by the presence of *Stenopterobia anceps* (Lewis) Bréb., and Mackintosh Lake, separated only by a few miles of mountain ridge and forest from both, contains, apparently neither this species of *Melosira* nor *Stenopterobia*; and the deposits of Lochaber lake are characterized by the relative abundance of *Cyclotella*. Of course these lake deposits contain, not only the organisms which live in their own waters, but those which are swept into them by their tributary streams.

In addition to the remains of the diatomaceæ, the siliceous spicules of sponges abound in all these deposits, especially the long skeletal spicules. In some few places, the silica from this source is in excess of that from the diatomaceæ. A search for the origin of these having been made last summer no less than *nine* species in *four* genera have been found, and two of these are considered as new to science. These fresh-water sponges grow on submerged wood, plants, stones and even on sand. They are all of some hue of green when living and exposed to the influence of light. They vary in size from very small up to a specimen of *Meyenia fluviatilis*, growing in Garden-of-Eden Lake, which measured twenty-seven inches in length by four inches in diameter, surrounding a small branch as a core. In the winter season the flesh of these generally decays, and most of the skeletal spicules scatter and accumulate in the adjacent deposits. The reproductive gemmules with their characteristic spicules, also, in the course of time float away, or germinate next spring on the original site. The following are the species of siliceous sponges which have been identified as living in the lakes at present, and whose spicules abound in the deposits under consideration. These sponges, like the diatoms, have certain species characteristic of certain waters, while others are more generally distributed.

1. Spongilla fragilis, *Leidy*.
2. S. lacustris *var*. dawsoni, *Bk*.
3. S. mackayi, *Carter*.
4. Meyenia fluviatilis, *Carter*.

5. M. everetti, *Potts* and *Mills.*
6. Heteromeyenia ryderi, *Potts.*
7. H. argyrosperma, *Potts.*
8. H. pictovensis, *Potts.*
9. Tubella pennsylvanica, *Potts.*

The first of these was described by Bowerbank as *S. lordii.* The specimen came from British Columbia. It was first discovered in England last summer, according to Carter. It turned out on examination, that Leidy, of Philadelphia, first described it as *S. fragilis.* No. 2 was described by Bowerbank over twenty years ago as *S. dawsoni;* next, by Potts as *S. lacustroides.* I called Mr. Potts' attention to Bowerbank's description, and it has been generally conceded since to be an American variety of the European *S. lacustris.* No. 3 was described by Carter, of England, in the January number of the "Annals and Magazine of Natural History," London. Potts claims that it is the same as his *S. iglooiformis,* a description of which, we think, has not yet been published. No. 5 is remarkable, as the species has never been observed before except in a pond upon Mt. Everett in Mass., U.S.A., at an elevation of 1,800 or 2,000 feet above the sea. It appears to be plentiful in Nova Scotia. No. 8, provisionally named, is remarkable for the paucity of its statoblasts, which for some time prevented its classification, although its skeletal spicules are very distinctive. Further investigation is necessary for the elucidation of the character and life-history of this species. This classification and nomenclature has the approval of H. J. Carter, the greatest living English writer on sponges.

E. Potts of Philadelphia, our best American authority, has observed that the spicules of sponges undergo variations within a very considerable limit, and that these variations are generally concomitant with the variation of the altitude of their habitat. The spicules of several of these Nova Scotian sponges he considers as varying from the usual type, but considers them as conforming to his hypothesis. The extensive deposits of these siliceous remains must have come proximately from silica in solution in the water. The analysis of the waters of Halifax lakes by Prof. Lawson shows the presence of soluble silica as well as of alumina, lime and iron, all of which have been found to exist in diatomaceous earths analysed by Zeigler, Hoffman, and

Lossier. No less than from 2.13 grains to 2.44 per gallon of these inorganic substances were found in solution in the waters of these lakes.*

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* This paper was written in answer to a request for the Author's observations on the diatomaceous deposits of Nova Scotia. It was simply given as a report of the progress of the Author's own work, which has since been extended to other portions of the Province, to New Brunswick, and Newfoundland. "Silliman's Journal," April, 1845, contains a list of twelve fossil infusoria determined by Professor Bailey in material sent from Earlton Lake by Sir J. W. Dawson. Of these, ten are now known as diatoms, and two as sponge spicules.

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