TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—ADDITIONAL NOTES ON GLACIAL ACTION IN HALIFAX HARBOUR, NORTH-WEST ARM, AND BEDFORD BASIN. — BY REV. DR. HONEYMAN, D. C. L., F. R. S. C., F. S. Sc., &c.

(Read November 9, 1885.)

EXAMINATION in detail reveals many interesting and important points that have not been noticed in preceding papers. To some of these I now propose to direct attention.

BEDFORD BASIN.

Having now resided a year and a half about half way up Bedford Basin, I have had favourable opportunities for studying the geology of this beautiful and picturesque region. Again and again I have referred to Navy Island, on the east side of the Basin, as having a glacial deposit of the "Cow Bay Type," replete with triassic and archaean boulders. To the north and south of this, from Bedford to the Narrows, expanses of drift have been examined of similar constitution.

The greatest breadth as well as depth of the Basin is between the Navy Island side and Birch Cove. The breadth here is two miles, and one of the Admiralty soundings, about midway, is 84 fathoms—(*Vide* Chart). As might be expected, its marine zoology is very interesting. This year its mackerel fishery has been very productive, and many singular fishes, especially *scomberesox saurus*, have been found in its waters.

The mollusca of Halifax harbor are decidedly Arctic and Boreal.—(*Vide* below.)

The Intercolonial Railway traverses its western side and south as far as the Narrows and Richmond. On its south side a branch line from Richmond extends to the cotton factory. This passes below Rockhead—the city prison. The cotton factory siding runs up a hollow to the west of Rockhead. Through this passes the short roads from Bedford to Halifax. Still further west is a deeper hollow. Through this passes the road to Dutch Village. It connects also the Bedford Basin with the North-West Arm. South of Rockhead, lies Fort Needham. I indicate these as they are connected with our investigations.

Along the west and south sides of the Basin are large accumulations of drift. On the west these are well exposed in roads and railway sections. They consist of rock masses, large and small stones in great abundance. There are quartzites imbedded generally in quartzite debris which is used for road material. I have searched diligently in this drift for triassic and archaean boulders, such as those found on Navy Island, without success. I have been equally unsuccessful in finding such boulders in the drift in the road cuttings towards Halifax and Dutch Village.

On the south side of the Basin I examined the sections on the shore, and also on the railway and cotton factory branch, without success.

Great caution had to be exercised in this investigation from the circumstance, that we have here railway *versus* glacial transportation. A great proportion of the railway ballast was brought from Truro, from the banks of glacial drift, through which the Intercolonial railway passes. This drift is largely derived fram Archæan rocks of the Cobequid Mountains. Out of this ballast stray boulders of syenites, gneisses, diorites, etc., are found on the shore and at the bottom of the drift cuttings. We have therefore to observe well, and reject all boulders that are not in the undisturbed drift.

We consider that all the drift under examination is either of local origin or at the farthest can only have come from a distance of 20 miles, the north side of the Cambrian quartzite band

of rocks, while that on the opposite side of the Basin was derived from the geological formation of the Cobequids and all the intervening formations.—(*Vide* Geological Map and Papers read before the Institute.)

Lumber Yard.

I would add to the accumulations of the "Cow Bay type" an elevation in the Lumber Yard. On this are the remains of one of the "old forts."

Connecting Lines.

A passes from Navy Island along the east side of the Basin to the Narrows, near Dartmouth Railway Bridge. It then crosses over to Richmond to Fort Needham. Proceeding it reaches the Queen's Dock Yard, at the late Observatory Hill. It then extends to the east side of the Citadel Hill. Thence it goes to the Lumber Yard, and then it passes to the Fort at the east side of entrance to the N. W. Arm.

B begins at the west side of George's Island, which lies in the harbour opposite the Lumber Yard. Thence it goes southerly to the west side of Cornwallis Island (McNab's). Proceeding along this Island it connects Thrum Cap and Shoal.

C may commence at the drift at the corner of Preston and Lawrencetown roads. Thence it passes to the accumulation at the top of Dartmouth Cove It then extends along the shore to the neighbourhood of Fort Clarence at the Eastern Passage.

D may be called the Terminal Line. This may begin at the accumulation at the old fort (of *A* line), and pass across the mouth of harbour to Thrum Cap. Thence it proceeds N. E. to the eastern side of the Passage. It then extends along the shore, to Cow Bay and Osborne Point. From this it extends to Lawrencetown Head; from this to Half Island, and then to Three Fathom Harbour.

The Triassic Amygdaloids from Blomidon and Partridge Island which I regard as the prime characteristic of the drift of the accumulation, etc., which I have thus connected, have their extreme easterly points of occurrence at—

1. Three Fathom Harbour, on the Atlantic Coast.
2. Preston.
3. Goff's, on Old Guysboro' Road, or rather ½ mile beyond.
4. Enfield, on the Intercolonial Railway. *Trans.* I. N. S.

E. Connecting these points we have a line which may be regarded as the eastern boundary of Amygdaloidal drift distribution, while A line may be regarded as the western boundary. We may thus have the approximate form and width of the moraine of which the accumulations formed a part. The width from N. W. Arm to Three Fathom Harbour is about 16 miles, from Navy Island to Preston it is 9 miles. Enfield is 23 miles nearer Blomidon and Partridge Island than Three Fathom Harbour.

Col. Akers directed my attention to a scooped out ledge on the site of the Old Chain Battery at the North-West Arm. I have pointed out the *roche moutonnee*, containing what is supposed to be a relic of the Chain Battery, with a scooping of argillites, on the entrance to the road that leads to the Prince of Wales Tower.

These indicate the scooping power of the agency which seems at least to have aided in the formation of the North-West Arm. At the top of the Arm, on its western side, I also shewed another scooping, when I was engaged making observations on the glaciation of the Halifax Peninsula.

Breccia.

It is upwards of 20 years since my attention was directed to a formation of this kind overlying the tilted argillites. This conglomerate was observed at the east side of the North-West Arm, at its top, and also on the west side of the Harbour between Richmond and H. M. Dockyard. Considering this to be like other conglomerates, formed by the action of sea agency, I was disposed to regard our conglomerate as the remains of an ancient formation, *e. g.*, Carboniferous. Good examples of this may be seen at the west side of the North Street I. C. R. Station and opposite the late Observatory Hill, and at the north-end of Dutch Village. I am persuaded that the rock is a glacial debris

cemented together by the oxide of iron derived from the pyrite of the argillites which chiefly constitute the Breccia. Sections indicated the Breccia filling the hollows of the underlying argillites.

Purcell's Cove.

Here we have an island at its entrance which has a very ferruginous aspect. To all appearances it is composed of debris. Its position near the entrance to the N. West Arm, suggests its origin. It seems to have been formed from the scooped material of the N. West Arm. Masses detached show that it is largely conglomerate cemented with oxide of Iron.

These show that glacial agency may also form conglomerates, and Breccias as well as marine agencies which have been chiefly employed in this work.

In my Paper, Session 1886-7, I gave a list of characteristic boulders of the "Amygdaloidal Drift" exhibited at the Centennial Exhibition, Philadelphia. I would now give the same with subsequent additions.

Archæan.

1. Granites.
   — hornblendic.
   Syenites.
   Diorites.
   — magnetitic.
   Gneisses.
   — magnetitic.
   Porphyrites.

Silurian.

2. Quartzite, olive-coloured with crinoids.

Carboniferous.

3. Limestones.
   Bituminous.
   Fossiliferous *(fauna)* Brachiopoda, &c.
   Sandstones (yellow.)

Flora.

Stigmaria.
Lepidodendron.
Calamites.

TRIASSIC.

Basalts. Blomidon or Parrsboro.
" with olivine, " "
Amygdaloids, with Heulandite, Stilbites, Chalcedony, &c.
Agates.
Jaspers.

GLACIAL HIGHWAY.

We propose now to go northward in the direction of our main glacial line, N. 40° W., to notice its Geology and to indicate the formations that have produced the drift material already referred to. From Halifax Harbour Mouth, a distance of 33 miles, (Mackinlays' Map) we have the Lower Cambrian Formation with its Quartzites and Argillites and associated Granites, west side of the Harbour and Mount Uniacke. On our way we have passed through the County of Halifax and entered the County of Hants. We now enter the Carboniferous Formation with its Sandstones, Limestones and Gypsums. The Limestones are sometimes fossiliferous (Fauna) the Sandstones, &c., having Flora. Passing through these 21 miles we reach the "Mines Basin," Reaching the other side we have gone 18 miles. The Formation lying under the water is the Triassic. (New Red Sandstone.) At 12 miles distance we passed Blomidon with its Basalts and Amygdaloids and Sandstones. On the north side of the Basin we have Partridge Island similarly constituted. We are now in Cumberland County at the junction of the Triassic with the Carboniferous Formation. Proceeding through Parrsboro' we traverse its Carboniferous to a distance of 4 miles. We have reached the Cobequid Mountains with (a) its Upper Silurian Formation (metamorphic.) This is the band that contains the Londonderry Iron Mines, about 40 miles to the eastward. After going ten miles and a half we reach Crystalline, Metamor-

phic, rocks of Archæan or Pre-Cambrian age, with Granites, Syenites, Gneisses, &c. About 5 miles of these bring us to the Carboniferous, without any other Formation intervening. We are now in the Cumberland Coal Field, with Springhill Mines and the South Joggins, celebrated in geology on account of its marvellous shore section. *Vide* Dawson's Acadian Geology, Lyell's Elements, Dana's Manual, &c.

We have thus crossed Nova Scotia from Halifax Harbour to the Chiegnecto Channel, which separates it from New Brunswick.

Sequence of Formations.

Lower Cambrian with Granites, Carboniferous, Triassic, with igneous rocks, Carboniferous, Silurian, Archæan, Carboniferous.

I have referred to the Mollusca of Halifax Harbour and Bedford Basin.

From Catalogue of J. M. JONES, F. L. S. TRANS. 1877.

CLASS CONCHIFERA.

Fam. SOLENIDÆ.

1. Solenomya borealis, Tott. Halifax harbour. (Verrill.)
2. Panopœa arctica, Gould. Halifax harbour.

Fam. MYADÆ.

3. Mya truncata, L. Halifax harbour.

Fam. ANATINIDÆ.

4. Lyonsia arenosa, Morch. Halifax harbour.
5. Thracia myopsis, Beck. Halifax harbour. (Smith and Harger.)

Fam. GASTROCHÆNIDÆ.

6. Saxicava arctica, Desh. Museum. Halifax harbour.

Fam. TELLINIDÆ.

7. Macoma fusca, Gould. Halifax harbour.
8. M. sabulosa, Morch. Halifax harbour. (Smith and Harger.)

Fam. CYPRINIDÆ.

9. Astarte castanea, Say. Halifax harbour. (Willis.)
10. A. crebricostata, Forbes and Hanley. Halifax harbour.
11. A. sulcata, Flem. Halifax harbour.
12. A. semisulcata, Gray. Halifax harbour.
13. Cyprina Islandica. Halifax harbour.

Fam. VENERIDÆ.

14. Callista convexa. Halifax harbour. (Willis.)

Fam. CARDIADÆ.

15. Cardium Islandicum. Halifax harbour.
16. Serripes Grönlandicus, Beck. Halifax harbour. (Willis.)

Fam. ARCADÆ.

17. Yoldia obesa. Halifax harbour.
18. Y. thraciæformis. Halifax harbour.
19. Y. sapotilla. Halifax harbour.
20. Leda tenuisulcata. Halifax harbour.
21. L. minuta, Mol. Halifax harbour.
22. L. caudata, Loven.

Fam. MYTILIDÆ.

23. Modiolaria nigra, Loven. Halifax harbour.
24. M. discors, Beck. Halifax harbour.
25. M. corrugata, Morch. Halifax harbour.
26. Crenella glandula. Halifax harbour.

Fam. OSTRÆIDÆ.

27. Anomia glabra, Verrill. Halifax harbour.

CLASS BRACHIOPODA.

Fam. TEREBRATULIDÆ.

28. Terebratulina septentrionalis, Couth. Halifax harbour.

Fam. RHYNCONELLIDÆ.

29. Rhynconella psittacea, Owen. Halifax harbour.

CLASS GASTEROPODA.

Fam. TRITONIDÆ.

30. Dendronotus arborescens, Ald. and Han. Halifax harbour.

31. Eolis nana ? Ald. and Han. Halifax harbour. (Verrill.)

Fam. TROCHIDÆ.

32. Margarita helicina, St. Halifax harbour.

Fam. SCALARIDÆ.

33. Scalaria gracenlandica, Sow. Halifax harbour.

Fam. TURRITELLIDÆ.

34. Turritella reticulata. Halifax harbour.

35. T. acicula, St. Halifax harbour.

Fam. CERITHIDÆ.

36. Apporhais occidentalis. Halifax harbour.

Fam. VELUTINIDÆ.

37. Velutina zonata, Gd. Halifax harbour.

Fam. NATICIDÆ.

37ª. Lunatia groenlandica.

38. Natica clausa. Halifax harbour.

Fam. PURPURIDÆ.

39. Buccinum undatum.

40. Neptunea decemcostatus. Halifax harbour.

Fam. CANCELLARIDÆ.

41. Trichotropis borealis, Sow. Halifax harbour.

In this list of 42 we have 12 arctic and 30 boreal. In Woodworth's Distribution Chart, *vide Manual of Mollusca*, Nova Scotia is included in the "Boreal Region."

These zoological observations are suggestive of certain geological and palæntological investigations which I reported to the Institute in my Paper read Nov. 9, 1874, "A Month among the Geological Formations of New Brunswick." Trans. Vol. IV, Page 19 *Extract.*

Post Pliocene.

"I have already in passing referred to a deep cutting on the north side of the new bridge of the Nepisiguit. This is in the deep drift overlying the granite. That this is glacial drift is evident from the great coarseness of the material, the massiveness of the enclosed boulders, the want of stratification and the absence of marine relics (fossils.)

I also noticed the first cutting across the Teteagauche.

This is of a different character from the preceding. The material here is stratified. It is of marine origin. The abundance of shells to be found in the beds unmistakably indicate the origin of the deposits. The Rev. C. H. Paisley, of Bathurst, has described the various beds as they appeared when the cutting was fresh, giving the measurements and characteristics of each,"

At Jacquet River were found cuttings in the Intercolonial Railway, having the same fossils as at Teteagauche. Here was found embedded a skeleton of a Beluga. The greater part of this is in the Provincial Museum. It was described by Dr. Gilpin in a paper communicated to the Institute. Trans. vol. iii. page 400.

At the Fisheries Exhibition of London, 1883, I exhibited characteristic portions of this skeleton with associated shells. This was considered as interesting in connection with the exhibition of the white whale (Beluga) from River St. Lawrence. The two exhibits showed that the Beluga frequented this river from the Champlain period to the present time.

Our observations on the Mollusca of Halifax Harbour seem to show that the mollusca of the present period of Halifax are essentially the same as the Postpliocene *Mollusca* of the northern part of New Brunswick, and also of eastern Canada.

The glacial drift of the I.C.R. and the Teteagauche and Jacquet river beds at Nepisiguit River, lies between our two glacial parallels—Chart of Glacial Problem—or in an intermediate parallel drawn from Beaver Harbour, which lies 58 miles east of Halifax Harbour.