

ON THE AGE OF THE CONGLOMERATE CAPPING THE CAMBRIAN
ROCKS OF NOVA SCOTIA.—BY HENRY S. POOLE, D. SC.,
ASSOC. R. S. M., F. R. S. C., *Halifax.*

(Read 16th November, 1903.)

Patches of a compact conglomerate, in places exceedingly hard to excavate, occur resting on Cambrian strata at various heights, in the neighborhood of Halifax. As the surface soil is generally thin, it is easily seen that the exposures are of detached masses, outliers of a deposit that originally must have extended to a considerable elevation. How wide was the range of the deposit has yet to be determined, but the variation in height cannot have been less than two hundred feet, counting from points well up on the peninsula to discoveries under water at Richmond shipping wharves. This range in elevation and location agrees with the investigations made by Mr. Walter H. Prest, ⁽¹⁾ at Bridgewater on the LaHave river; and the deposit bears, in some points, similarity to one found under like conditions, well away from the coast at Gay's River.⁽²⁾ This conglomerate early attracted attention for the gold which it contained, and it was shown by Mr. C. F. Hartt in 1864 to underlie the limestones and plaster of the Lower Carboniferous age.

Dr. D. Honeyman, speaking of the Digby shore near the border line of Yarmouth County, says: "I recognized the strata at Cape Cove as a counterpart of the Carboniferous auriferous conglomerate and breccia of Gay's river in Colchester County," (*Trans. N. S. Inst. Nat. Sc.*, vol. v., p. 240); while Dr. Bailey, referring to the same deposit, calls it post glacial⁽³⁾

(1) *Trans. N. S. Inst. Nat. Sc.*, vol. v., p. 240.

(2) *Ib.*, vol. vii., pp. 42 and 44.
" vol. v., p. 328 refers to the Grand Lake "prehistoric pottery" showing modern concretions.

(3) *Bailey Rep. Geol. Sur. Can.*, vol. ix, M., 74.

On September 24th, 1878, this Institute had an outing of its members⁽¹⁾ and the secretary reported that on following the shore from Purcell's Cove towards Falkland village, on the western side of Halifax Harbour, "attention was directed by Dr. Honeyman to a conglomerate recently formed by the accumulated debris of granite, gneiss and slate cemented with oxide of iron derived from pyritous gneissoid rocks."

In volume vii of our *Transactions* for 1886, p. 44, Dr. Honeyman refers to a remnant of Lower Carboniferous conglomerate, resembling that of Gay's river, occurring near Grand Lake station, that reaches within a short distance of the railway. The glaciation of the argillite surfaces around, shows, he says, the nature of the agency that has been at work in the isolation of this remnant of the Carboniferous period.

These views of Dr. Honeyman were written subsequent to his paper of November, 1885, on Glacial Action, wherein, on page 254 of the *Transactions*, vol. vi, he treats of the breccia at the head of the North West Arm, east side; and that lying between Richmond and H. M. Dockyard on the west side of Halifax Harbour. This he considered to be like other conglomerates, formed by the action of sea agency, and which he was disposed to regard as the remains of an ancient formation, *e. g.*, Carboniferous. Now he says he is persuaded that the rock is a glacial debris, cemented together by oxide of iron. Sections indicated the breccia filling the hollows of the underlying argillites.

On putting these various references together, it would appear that while Dr. Honeyman notes the strong similarity of the isolated and lowest of the deposits which directly rest on Cambrian strata, he classes some as belonging to the Lower Carboniferous period and others as of the Pleistocene, but how he distinguishes between them he does not explain.

(1) *Trans. N. S. Inst. Nat. Sc.*, vol. iv, p. 491

No detailed consideration has been given to this basal deposit in the writings of Dawson and Belt or in the reports of Professor Bailey and Mr. Faribault for the Geological Survey of Canada, and the only paper we have had bearing more than superficially on the matter is one by Mr. W. H. Prest on the Glacial Succession of Central Lunenburg; a paper that shows careful examination of certain deposits met with in the actual course of prospecting for gold leads under the guidance of experience and a study of the latest literature on glacial phenomena.

Mr. Prest correlates the Halifax rock with the Bridgewater conglomerate which he classes as the most ancient, one that formerly masked a large part of the province, covering the country to a considerable depth, as in the LaHave valley he found it from sea level to two hundred feet above it. It is always in contact and cemented to the bed-rock and almost immovable without the aid of dynamite, and yet in spite of its extreme hardness, it has been excessively divided and now is left only in patches. In origin as glacial, he considers "the presence of striated boulders testifies with no little weight, and from a northern source proved by its contents, which consist of slate from near by, quartzite from the northwest, granite from the central watershed, diorite from the south side of the Annapolis valley and trap from near the Bay of Fundy. In no more striking manner can its immense relative antiquity be illustrated than by comparing its highly oxidized condition with that of the overlying till.'

So far no deposit of this character has been detected near Halifax to rest on the granite intrusions, and this, perhaps, is not a matter of surprise, for the binding material that cements the stones together is iron oxide, evidently derived from the decomposition of pyrite which is prevalent in much of the graphitic strata. Indeed it is considered by the stone workers of the place that a similar action is now going on where trickles of water pass rusty from nodules of pyrite. The binding together of the coarse material composing the conglomerate in

question, has been very thorough, and the rock, strong and durable, is in marked contrast to the rest of the superficial drift classed with the Pleistocene which ordinarily about Halifax shows little trace of cementation, although Mr. Prest found interbedded bands of bog iron ore and cemented gravels in the LaHave till.

As to the time of deposition, the general impression among observers has been that the formation as a distinct rock was subsequent to the earliest period of the ice age, when the older rocks were rubbed down, furrowed and scratched by the passage over them of stones in the grip of Pleistocene ice. Now the object of these remarks is to ask for a reconsideration of this generally accepted view, and offer reasons for thinking that the age of the lowest of some of the deposits on the Cambrian may belong to a period more remote than the Pleistocene—a conclusion that would be very effective in a consideration of the vast antiquity of the main physical features of this province.

In composition much of the conglomerate appears to be largely made up of fragments from the slate group of the Cambrian. A granite pebble was found with some quartzite at the Halifax Dockyard, but only a few well-worn pebbles and small boulders of quartzite were detected in the conglomerate on the Dartmouth shore. Very possibly the patches of conglomerate owe their preservation largely to their position on the slates whence came the ferruginous cementing water, while it may be that the original extensions of the same deposits on the granite and quartzite, where there were no cementing waters, more readily suffered erosion and were removed. This point wants looking into, in order to read aright the full story which this rock has to tell of past conditions. The few quartzite stones that were noticed at Dartmouth were some three hundred yards south from the edge of the quartzite group crossing the Narrows, and being well water-worn contrasted with the slate stones of the bottom portion of the deposit, which were

excessively weathered but angular in shape, and forming a breccia of local and untravelled fragments.

All who have seen the contact on the Dartmouth shore have noted the very ragged surface of the slate under the conglomerate, how excessively weathered it is, the sharp edges of the ridges standing up in a shattered condition and gradually blending with the mass of breccia filling between them the V-shaped gullies and fissures to a depth of several feet. The lower portion of the deposit is undoubtedly local and distinctly brecciated, while the upper part is of fragments more or less water-worn, but still strongly cemented together. There is no gradual passage into the loose condition of ordinary till. In very marked contrast with the weathered surface under the breccia is the eroded and often striated slaty lip of the depression that retains the deposit at this place.

If a rapid review of the Atlantic coast be made, we have in the extreme west a conglomerate deposit on the slates at Cape Cove which Dr. Honeyman considered Lower Carboniferous. On the LaHave there is one regarded by Mr. Prest as the oldest glacial and of great antiquity; at the head of Chester Basin are other deposits of conglomerate associated with Lower Carboniferous limestone; at Halifax there are conglomerate outliers of an age now up for discussion, while at the outlet of Kelley's Lake, near Grand Lake, and Gay's River, are deposits hitherto accepted as Lower Carboniferous. Then on the Cambrian and Pre-Cambrian of the seaboard of Cape Breton at Gabarus, Flamboise, etc., there are, according to the Geological Survey, outlying patches of Lower Carboniferous strata.

Most of the known patches of this conglomerate about Halifax rest on a highly weathered surface without trace of marine denudation or glaciation; but of the deposit itself at LaHave Mr. Prest has pointed out that the stones of the upper portion are striated and therefore glacial. Hence, he has concluded that his Bridgewater conglomerate is not Lower Carboniferous but the very earliest deposit of the Pleistocene.

There are two typical exposures in this neighborhood worthy of close study. One is made by the railway cutting at the entrance of North street station, and the other is across the harbor on the Dartmouth shore opposite the Dock-yard. Both clearly show weathered slate ridges rising up shattered and settling to blend with the breccia filling the intervening fissures.

The Halifax conglomerate occurs at the Imperial wharf at Ferguson's Cove and northward in spots to the last exposure of rocks near Purcell's Cove; on the west side of the North West Arm about Melville Island; on both sides at the head of the Arm, and half way up the hill on the side of the road to Chain Lakes. Again on the Dutch Village road near the Three Mile House; in the railway cutting out of North Street station, and on the shore of the harbor north of the sugar refinery at Richmond. At the latter spot the conglomerate is twelve or more feet thick and is seen to rest on a smoothed and much striated surface of slate. At a greater elevation in the railway cutting mentioned, the glacial abrasion has not removed the previously weathered and shattered rock surface of a preceding age, and a cemented breccia occupies the ancient runlets and V-shaped channels in the weathered slates identical with the exposure of the conglomerate at sea level on the opposite Dartmouth shore. When one considers the durability of the slate,⁽¹⁾ and the very slight decomposition it has undergone on the uncovered glaciated knolls, and then note the great depth in these rocks to which the pre-glacial weathering extended before the deposition of the conglomerate, one is forced to extend an extreme age to the pre-conglomerate cycle of exposure.

The student of glacial phenomena will be interested in noting in the drift composing the islands of Purcell's Cove, transported blocks of this conglomerate indicating the comple-

(1) The durability of the slate of this region is well illustrated by the tombstones made of it and set up one hundred and thirty years ago. They show the light lines scratched for the guidance of the sculptor as sharp as though made recently.

tion of a cycle of conditions which terminated in the disruption of the conglomerate deposit and its transportation in the moraine matter that came along the edge of the granite from the north-westward. Also in excavations in mounds on the north side of Tower Road, Halifax, where rusty and cemented slate fragments form a distinct layer over the dark blue slate debris which rests directly on the uneroded slate surfaces.

The generally accepted supposition that the conglomerate outliers are all of one age, may be met by an assumption that among the basal conglomerate of the Lower Carboniferous some may have been glacial deposits. This is no new view, but the evidence so far obtained is said to be inconclusive. In this province we have on the Cambrian rocks conglomerates associated with plaster and limestone of unquestioned Lower Carboniferous age as at Chester Basin. Mr. Fletcher's report on Cape Breton,⁽¹⁾ speaks of scattered patches of conglomerate, etc., resting on pre-Silurian felsites—many of which he has no doubt are of Carboniferous age. To that horizon also are placed the conglomerates resting on the Cambrian rocks at Gay's River, etc. It seems, therefore, reasonable at least to suspect some of the conglomerate outliers on the Cambrian in the same range of country, may be also older than the Pleistocene.

In the paper already cited, Mr. Prest puts forward the importance of these deposits and the bearing they have on the study of auriferous washings, and it is to be regretted that other records have not been made in the same thorough way when tracing float or auriferous drift to its source in the nearby solid lead.

However much observers may differ as to the age of this lowest of the unconformable deposits on the Cambrian rocks, all must be agreed that the physical features of the province, as we now have them, were already rough hewn before the deposition of the lowest of the Carboniferous, and that what-

(1.) *Rept. Geol. Surv. Can.*, 1877-8, F., p. 23.

ever the extent of subsequent deposits may have been succeeding cycles in their denudation, did little more by their removal than revert to the Cambrian surface of the Pre-Carboniferous peneplane. The lines of main drainage are of subærial erosion established before this period, and the general surface suffered comparatively little by the subsequent passage over it of the ice sheets, beyond the removal of much, but not all, of the weathered and broken superficial material. The patches of deposit we have been considering in their relation to the Cambrian at various elevations, make probable such a conclusion.

A visit paid to the neighborhood of the head of Grand Lake and to Kelly's Lake, lying back of Wellington station, disclosed a conglomerate cemented with bog iron ore at the crossing of the abandoned old road over the brook from Kelly's Lake. At the outlet of Kelly's Lake, apparently damming back the waters of the lake, occurs the conglomerate referred to by Dr. Honeyman. Its surface was seen to be rounded and a good specimen was obtained smoothed and grooved. The character of the rock, with its hematitic pebbles, bears a striking resemblance to some of that about Gay's River, and left no doubt in my mind that it also was, as Dr. Honeyman regarded it, of Lower Carboniferous age, while the deposit lower down the brook was Post-Pliocene. The contact of the upper rock with the Cambrian slates was not found exposed, but the strip appeared to be quite narrow, while it extended for a quarter of a mile or more to the westward. Other exposures of the bog ore deposit are reported to occur in the neighborhood, and west of Wellington station.

During the past summer, attention was directed for commercial purposes to deposits of bog iron ore which occur in a strip of country two miles wide along the south side of the Musquodoboit valley. These deposits are in low swampy depressions of the blue black graphitic and ferruginous slates of the Lower Cambrian, east and west of the Caribou gold district with which they range.

Deposits were found at Newcomb's Corner, Fall River, etc., in a conglomerate largely made up of bits of slate, and prospecting licenses extended some twenty-five miles.*

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*In the *Summary Report of the Geological Survey for 1903*, Mr. Faribault mentions eleven localities from which bog iron ore was obtained, and which yielded to Dr. Hoffmann an average analysis of the whole eleven specimens no less than 52 per cent. of metallic iron. See *Sum. Rept.*, 1903, p. 185.