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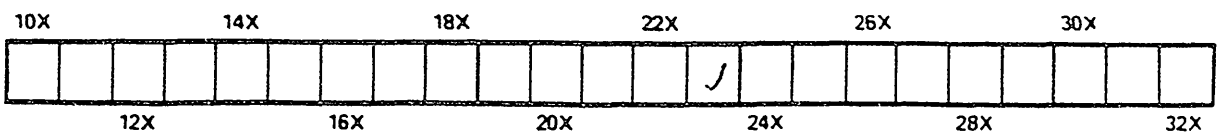

THE

CANADIAN NATURALIST

AND

Quarterly Journal of Science.

ON PORTIONS OF THE SKELETON OF A WHALE FROM GRAVEL ON THE LINE OF THE CANADA PACIFIC RAILWAY, NEAR SMITH'S FALLS, ONTARIO.

By J. W. Dawson, LL.D., F.R.S.

Bones of large whales are of not infrequent occurrence on the less elevated terraces of the Pleistocene period on the Lower St. Lawrence. I have seen them at several places in the neighborhood of Metis, on the lowest sea terrace, now elevated only a few feet above the level of the sea, and they are reported to have been found on the second terrace at an elevation of 60 to 70 feet. Mr. Richardson, late of the Geological Survey, informs me that he has seen them in several other places on the lower terraces. It has also been reported that bones of a whale were found on Mt. Camille in rear of Metis at a considerable elevation; but Mr. Richardson, who visited the locality, failed to verify the statement. The bones found on the lower, and therefore modern terraces are usually in a good state of preservation and have a very recent appearance. The above statements relate to remains of the larger whalebone whales.

Remains of the *Beluga* or small white whale were found by the late Dr. Zadok Thompson, author of the "Natural History of Vermont," in the marine clay in the township of Charlotte, Vermont, at an elevation of 150 feet above the sea. They were associated with shells of *Saxicava* and *Leda*. The species was supposed to be distinct from the *B. Catodon*, Gray, and was named by Thompson *B. Vermontana*. I have found detached bones of *Beluga* in the Post-pliocene clays of Rivière du Loup, and considerable portions of a skeleton were found in the

excavations for the Intercolonial Railway, on the south side of the Baie des Chaleurs, and were described by Gilpin in the Transactions of the Nova Scotia Institute of Natural Science.* Bones have also been found in the brick-clays near Montreal, and a specimen was discovered several years ago in sand holding *Saxicava*, near Cornwall, Ontario. The last-named specimen was studied by Mr. Billings, and its bones compared with those of the modern species in the McGill College Museum. On this evidence Mr. Billings concluded that it belonged to the modern species, and I believe extended this conclusion to Dr. Thompson's specimen, the distinctive characters of which, as stated by that naturalist, seem not to exceed the individual differences in modern specimens.

But though the *Beluga*, which now extends its excursions far up the St. Lawrence, and has even been captured in the vicinity of Montreal, occurs as far west as Cornwall, no remains of the larger whales have, so far as I am aware, been found so far inland until the discovery of the specimens referred to in the present note. These were found, as I am informed by Archer Baker, Esq., General Superintendent of the Canada Pacific Railway, "in a ballast pit, at Welshe's, on the line of the C. P. Railway, three miles north of Smith's Falls, and thirty-one miles north of the St. Lawrence River, in the Township of Montague, County of Lanark. They occurred in gravel at a depth of 30 feet from the surface, and about 50 feet back from the original face of the pit."

Mr. Peterson, C.E., has been kind enough to obtain for me the elevation of the place where the remains were found, as indicated by the railway levels. It is 420 feet above the level of the St. Lawrence at Hochelaga, or as nearly as possible 440 feet above sea level. It is interesting to observe that this corresponds exactly with the height of one of the sea terraces on the Montreal mountain, and is only 30 feet lower than the well-marked beach with sea shells above Côte des Néiges, on the west side of the Mountain. The highest level at which Post-pliocene marine shells are known to occur on Montreal Mountain, is near the park-keeper's house, at an elevation of about 520 feet. These marine deposits of Montreal are of the same geological period with the Cetacean remains in question, so that the animal to which these belonged may have sailed past the rocky islet which

* Vol. II., 1874.

then represented Montreal Mountain at an elevation of 400 feet above the lower levels of the city, and in a wide sea which then covered all the plain of the lower St. Lawrence.

The deposit in which the remains occurred is no doubt the equivalent of the Saxicava sand and gravel, and was probably a beach or bank near the base of the Laurentian hills, forming the west side of a bay which then occupied the Silurian country between the Laurentian hills north of the Ottawa, and those extending southward toward the Thousand Islands, and which opened into a wide extension of the Gulf of St. Lawrence, reaching to the hills of Eastern Canada and New England, and westward, perhaps, to the Niagara escarpment at the head of Lake Ontario. Such a sea might well be frequented by whales in the summer season, and individuals might occasionally be stranded on shallows or driven ashore by gales or by the pressure of floating ice.

The bones secured consist of two vertebrae and a fragment of another with a portion of a rib, and others are stated to have been found. They are in good preservation but have become white and brittle through the loss of their animal matter. On comparison with such remains of whales as exist in the Peter Redpath Museum, and with the figures and descriptions of other species, I have little doubt that they belong to the Humpback whale, *Megaptera longimana* of Gray, *Balaena boops* of Fabricius, a species still common in the Gulf of St. Lawrence, and which extends its range some distance up the River, and is more disposed than most others of the large whales to haunt inland waters, and to approach the shores. I have seen it as far up the river as the mouth of the Saguenay, and there is reason to believe that occasionally it runs up much further. It is a species well known to the Gaspé whalers and often captured by them. Of course with so little material it is not possible to be absolutely certain as to the species, but I think it may safely be referred to that above named. The larger of the two vertebrae, a lumbar one, has the centrum eleven inches in transverse diameter and is seven inches in length. The smaller, a dorsal, is ten inches in its greater diameter and four in length. Through the kindness of Mr. Baker, the specimens have been deposited in the Peter Redpath Museum of McGill University.

POLYZOA OF THE QUEEN CHARLOTTE ISLANDS. PRELIMINARY NOTICE OF NEW SPECIES.

By the Rev. Thomas Hincks, B.A., F.R.S.

In this paper I propose to give a diagnosis of a number of Polyzoa from the Queen Charlotte Islands, entrusted to me by Dr. G. M. Dawson, on behalf of the Geological Survey of Canada.

These forms will be more fully described and figured in a special report on the Polyzoa of these islands, which I hope to publish hereafter. As the preparation of the plates may occupy some time, it seems better to record the new species at once, and so avoid the risk of being anticipated after much labor has been expended on the work.

All critical notes on the species will be reserved for the Report.

Family *Membraniporidæ*.

Membranipora, De Blainville.

MEMBRANIPORA NIGRANS, N. SP.

Zoœcia ovate (variable, sometimes arched above and narrowing downwards, sometimes broad-ovate, sometimes oval), irregularly disposed, margins much elevated, crenate, the whole front of the cell covered by a rather coarse stout membrane of a black color; oral valve large; on each side at the top a pointed *avicularium*, placed on the margin, depressed at the base, the beak sloping upwards, mandible directed obliquely downwards; very large *avicularia*, slightly raised in front, with a broad triangular mandible, which is bent abruptly in the middle, scattered amongst the zoœcia. *Oœcium* very shallow, just covering the extremity of the cell, smooth, with a raised rib across it a little above the oral margin.

Zoarium of a deep black color, forming a large irregularly spreading crust.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

MEMBRANIPORA EXILIS, N. SP.

Zoœcia oblong, quincuncial, subtruncate above and below, set closely together, of considerable size and delicate material, margin thin, a good deal raised, the front wall wholly membranous; at the top of the cell 2 spines, and 3 or 4 on each side (or some-

times a smaller number), situated on the upper half of the cell, pointed, slender, suberect, jointed to a tubular base; a sessile *avicularium* on the margin at one side (often absent), just below the top, beak sloping upwards, scarcely bent at the extremity, mandible blunt, directed obliquely outwards. *Oœcia* (?)

Loc. Houston-Stewart Channel, Queen Charlotte Islands, enveloping *Cellaria borealis*, Busk, with a very thin crust (*Dr. G. M. Dawson*).

MEMBRANIPORA CONFERTA, N. SP.

Zoœcia oval, quincuncial, set closely together, front wall wholly membranous, margin thin, smooth; on each side about 4 sharply pointed spines, and (often) a central one below, which bend rather abruptly over the area and meet in the middle; an *avicularium* at each side on the margin, just below the upper end, slightly raised, pointed, the mandible directed upwards, a small erect spine below the *avicularia*; at the bottom of the cell a single pointed *avicularium* with triangular mandible variously turned, *Oœcium* rounded, smooth, with a variously shaped depressed area (or fossa) in front, composed of thinner material than the rest of the surface, and appearing dark-colored as compared with the surrounding dense white crust.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

MEMBRANIPORA LEVATA, N. SP.

Zoœcia small, oval, distinct, quincuncial, margin very slightly raised, thin, smooth, the whole front closed in by a smooth, light-colored, and rather glossy membrane, which lies very much on a level with the edge of the cell; above each zoœcium, on a somewhat quadrate area, a small nodule, with a pointed *avicularium* on one side of it, the mandible directed transversely upwards. *Oœcium* rounded, smooth, umbonate.

Loc. Houston Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

MEMBRANIPORA ECHINUS, N. SP.

Zoœcia quincuncial, oval, distinct, separated by rather deep interspaces, 2 spines at the top and 7–8 slender, pointed, and rather tall spines down each side, which slant inwards but do not meet in the centre; on each side, springing from below the second spine from the top, a pedicellate *avicularium*, the upper part large and much swollen (closely resembling a " bird's

head,"), very slighty hooked at the extremity, apparently jointed to an extremely thin pedicle, mandible slender, pointed. *Oœcium* (?).

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Family *Cribrilinidæ.*

CRIBRILINA, Gray.

CRIBRILINA FURCATA. N. SP.

Zoœcia ovate, quincuncial, very regularly disposed, moderately convex; surface smooth and lustrous, often of a reddish-brown color, on each side four to six shallow grooves, radiating to a median line, and a central one below, which are occupied by a row of roundish pores set very closely together, the ridges between them slightly raised, usually bearing several elliptical pores: orifice arched above, straight below, much broader than high, on each side a stout bifid spine (occasionally simple); peristome much thickened in front and rising into a central mucro. *Avicularia* none. *Oœcium* large (covering about half the cell above it), rounded, taller than broad, depressed in front, with a shallow oral arch; surface smooth, rather thickly punctured.

Loc. Off Cumshewa Harbor, Queen Charlotte Islands (*Dr. G. M. Dawson*).

CRIBRILINA HIPPOCREPIS, N. SP.

Zoœcia ovate, quincuncial; surface lustrous, flattish (sutures very shallow), traversed by radiating ridges (three to five on each side), which pass from the sides to the centre (no median keel), the grooves between them occupied by a line of rather large oblong pores; at the margin of each ridge an elliptical foramen, covered in by a delicate membrane: orifice large, well arched above, constricted a little above the lower margin, which is straight; operculum of a rich reddish brown; peristome not elevated, lower margin much thickened, usually terminating on each side in a knob; large, elongate, depressed spatulate avicularia scattered amongst the cells. *Oœcium* (?).

Surface of zoarium flat; color brown, with a tinge of red, in old states white and highly calcified.

Loc. Cumshewa Harbor and Houston-Stewart Channel, Queen Charlotte Islands, on shell (*Dr. G. M. Dawson*).

Family *Myriozoidæ* (part.), Smitt.

SCHIZOPORELLA, Hincks.

SCHIZOPORELLA CRASSILABRIS, N. SP.

Zoœcia large, elongate, ovate, quincuncial, very distinct, convex, sutures not very deep; surface dense, punctured (the punctures often obliterated by the calcification; orifice suberect suborbicular, with a broad rounded sinus occupying nearly the whole of the lower margin; peristome raised and thickened, forming a wall round the orifice, often massive in front, where it is carried out into a broad projection, which is notched or sinuated in the centre. *Avicularia* none. *Oœcium* large, rounded, broader than high, with rather large punctures.

Loc. Houston-Stewart Channel, Queen Charlotte Islands 15–20 fms. (*Dr. G. M. Dawson*).

SCHIZOPORELLA LONGIROSTRATA, N. SP.

Zoœcia ovate, disposed in lines, moderately convex, (sutures shallow); surface roughened or minutely granulated, covered with an epitheca; orifice arched above, lower margin extended into a wide rounded sinus; peristome thin, elevated at each side; on one side, generally a little below the orifice, an elongate, slender, pointed, dependent *avicularium*, the mandible (which is broad at the base and tapering above) directed obliquely downwards, usually turned slightly outwards. *Oœcium* rounded flattened in front, thickly punctured, with a shallow oral arch.

Loc. Off Cumshewa Harbor, on shell (*Dr. G. M. Dawson*).

SCHIZOPORELLA INSCULPTA, N. SP.

Zoarium foliaceous and bilaminate or incrusting. *Zoœcia* large, ovate, quincuncial, depressed separated by raised lines, sutures shallow; surface vitreous, glossy, thickly covered over its whole extent with punctures; orifice arched above, the lower margin almost entirely occupied by a wide very shallow sinus; peristome thin, moderately raised, extended in front (beyond the sinus) so as to form a small chamber, in which is a rounded orifice (? *avicularium*). *Oœcia* profusely developed, very large (covering about two-thirds of the cell above), elongate, rounded above, with a tall oral arch, thickly covered with slightly granulated ridges, which radiate from the opening to the base.

Loc. Queen Charlotte Islands, under 30 fms., attached to a stem, and on shell (*Dr. G. M. Dawson*).

SCHIZOPORELLA MACULOSA, N. SP.

Zoœcia quincuncial, rather small, moderately convex, sutures shallow; surface shining, covered with small punctures, which are closed in by a brownish membrane, and give a spotted appearance to the front wall; orifice arched above, with a shallow bluntly-pointed sinus below, not contracted at the opening; peristome slightly thickened, on one side just below the orifice (or occasionally on both sides) a small rounded *avicularium* on a prominent boss. *Oœcium* (?).

Loc. Queen Charlotte Islands, on shell (*Dr. G. M. Dawson*).

SCHIZOPORELLA TUMULOSA, N. SP.

Zoœcia quincuncial, very regularly arranged, very convex, ovate, much elevated centrally below the mouth, the wall sloping steeply down to the margin of the cell; surface dense, smooth, rather glossy, areolated round the edge, ridges radiating towards the centre; orifice orbicular, with a small central sinus, not contracted at the opening, peristome not elevated; immediately below the orifice, at one side of the sinus a rostrum, bearing on one side a pointed *avicularium*, the beak very slightly bent at the extremity, mandible directed upwards, the rostrum rising into a short mucronate point behind the *avicularium*; very commonly on the front of the cell near the bottom a much raised *avicularium* (mounted on a prominent elevation), with a pointed mandible directed straight outwards. *Oœcium* rounded, smooth, much broader than high, with a tall oral arch, filled in by a calcareous plate.

Loc. Off Cumshewa Harbor, Queen Charlotte Islands, in 20 fms., forming a brownish spreading crust (*Dr. G. M. Dawson*).

SCHIZOPORELLA DAWSONI, N. SP.

Zoœcia ovate, quincuncial, very moderately convex, separated by raised lines, highly calcified, vitreous; surface reticulato-punctate (punctures appearing as deep shafts in the vitreous crust); orifice arched above, much broader than high (narrow between the upper and inferior margins); a shallow rounded sinus in the centre of the lower margin, not contracted at the opening; peristome perfectly simple, not raised. *Avicularia* none. *Oœcium* rounded, closely united to the cell above, somewhat depressed in front, glossy, covered with rather large punctures; a prominent, thickened border round the opening.

Loc. Virago Sound, Queen Charlotte Islands (*Dr. G. M. Dawson*).

SCHIZOPORELLA FISSURELLA, N. SP.

Zoœcia small, quincuncially disposed, ovate, the lower portion flattish; oral region raised, tubular, suberect; surface smooth, porcelanous, shining, sutures extremely shallow; orifice immersed, arched above, straight below, with a narrow slit-like sinus; peristome thickened and elevated round the mouth, so as to form a kind of neck, carried out in front into a mucronate process, which is sometimes notched in the centre. *Zoœcium* rounded, smooth, with a small longitudinal fissure above the opening, a central tooth-like process just within the oral arch.

Loc. Dolomite Narrows, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Family *Escharidæ* (part.). Smitt.

LEPRALIA (part.), Johnston.

LEPRALIA BILABIATA, N. SP.

Zoœcia quincuncially arranged, short, very slightly convex (the sutures little more than incised lines), rounded above, widening out at each side and narrowing off towards the base, which is subtruncate; surface dense, smooth, of a somewhat waxy appearance; orifice large, occupying nearly half of the front surface, rounded above, very slightly contracted immediately above the lower margin, which is somewhat arched; peristome not elevated; operculum smooth, of a deep black color, distinctly bilabiate. *Avicularia* none. *Oœcium* a subtriangular extension of the cell above the orifice, very little raised, a great part of its front surface occupied by a large foramen, closed in by membrano-chitinous material.

Zoarium of a very dark brown color (almost black).

Loc. Houston-Stewart Channel, Queen Charlotte Islands, on shells (*Dr. G. M. Dawson*).

When the *zoœcium* is open, the orifice is occupied in great part by the entrance to a tubular passage (through which the polypide issues), which is formed *below* by the thickened border of the operculum, and *above* by a distinct chitinous rim. These two lips are brought together so as to close the entrance when the operculum is shut.

LEPRALIA NITESCENS, N. SP.

Zoœcia quincuncial, short-ovate, very ventricose; surface dense, vitreous, highly polished and glistening, smooth, with obscure radiating ridges, punctured, sometimes areolated round the margin; orifice much higher than broad, immersed in the

older cells, arched above, slightly contracted a short way above the lower margin, which is a little curved outward; peristome not raised, the inner edge of the oral aperture finely denticulate; 3 or 4 spines above; on each side, in a line with the lower margin, a strong nodulous process; about the centre of the margin an *avicularium*, with rounded mandible placed on a swelling, which extends some way below the mouth, and facing sideways, mandible directed upwards; often on the front of the cell near the bottom (to-wards one side) a bracket-like projection, bearing a rounded *avicularium*. *Ovicium* (?).

Zoarium forming a brownish patch on shell.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

LEPRALIA CLAVICULATA, N. SP.

Zoœcia ovate or lozenge-shaped (sometimes irregular in shape and size), quincuncial, depressed; surface glossy, thickly covered with minute circular punctures, which give it a pretty speckled appearance; orifice arched and expanded above, slightly narrowed below, contracted by small projection on each side a short distance above the lower margin, which curves slightly outward. *Avicularia* keyhole shaped, placed on a distinct area very much smaller than that of the cell, and commonly immediately above a zoœcium, mandible directed upward. *Ovicium* very large, elongate (much higher than broad), depressed toward the opening, rising above into a kind of knob, white, glossy, thickly punctured; the surface for some distance above the oral arch frequently traversed by longitudinal furrows.

Zoarium a large, spreading crust.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

MUCRONELLA, Hincks.

MUCRONELLA PRÆLUCIDA, N. SP.

Zoœcia ovate quincuncial, slightly convex, separated by raised lines, surface thickly covered with roundish punctures, lustrous; orifice arched above, lower margin straight (no denticles); peristome raised, especially at the back or in front, where it rises in the centre into a blunt mucronate projection, which bends slightly inwards, the surface of the peristome smooth, entire, and very glossy. *Avicularia* none. *Ovicium* (?).

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

MUCRONELLA PRÆLONGA, N. SP.

Zoœcia very long, quincuncially arranged, wider above than at the base (elongate-ovate, sometimes appearing almost subtubular), convex, depressed below, rising towards the orifice; surface thickly covered with punctures, shining (the glistening appearance due to the presence of an epitheca); orifice suborbicular, peristome elevated round it, carried out in front into a very prominent process, often much thrown back and elongated, sometimes simply pointed, sometimes bi- or trimucronate; on the inner side of it a single, small, sharply-pointed denticle; the upper margin produced in the centre into a sharp spinous process. *Avicularia* none. *Ovicium* (?).

Zoarium forming a whitish, subcircular patch on shell.

Loc. Queen Charlotte Islands (*Dr G. M. Dawson*).

SMITTIA, Hincks.

SMITTIA SPATHULIFERA, N. SP.

Zoœcia large, ovate, quincuncial, moderately convex, separated by raised lines, surface reticulato-punctate; orifice arched above, lower margin straight and within it a large bifid tooth; peristome raised and thickened, and produced below into a spout-like sinus, within which is a short spatulate *avicularium*, mandible directed downwards. *Ovicium* large, immersed, closely united to the cell above; surface roughened, punctured round the edge.

Zoarium a brownish crust on shell.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

[ADDITIONAL.]

MEMBRANIPORA, De Blainville.

MEMBRANIPORA PROTECTA, N. SP.

Zoœcia contracted above, expanded below, disposed rather irregularly in lines, set closely together, front wall wholly membranous, margin smooth; 2 erect spines (sometimes bifid) at the top, below them on each side a single bifid spine, and below these 2 large, branched, antler-like spines, which meet over the aperture; numerous *avicularia* interspersed amongst the cells, placed on a distinct area; beak elongate, slanting upwards, mandible with a triangular base, the upper portion long, slender, setiform. *Ovicium* (?).

Loc. Virago Sound, Queen Charlotte Islands (*Dr. G. M. Dawson*).

NOTE ON THE OCCURRENCE OF SIPHONOTRETA SCOTICA, DAVIDSON, IN THE UTICA FORMATION, NEAR OTTAWA, ONTARIO.

By J. F. Whiteaves, F.G.S.

(Read before American Association for Advancement of Science, Montreal, 1882)

In the spring of 1881, three specimens of a remarkable *spinose brachiopod* were collected by Mr. J. W. H. Watts, R.C.A., from a band of impure limestone in the Utica slate, at Cumming's Bridge, near Ottawa. These specimens, which Mr. Watts has since presented to the Museum of the Geological Survey of Canada, consist of two perfect examples of the beaked and perforated valve, which is probably the ventral, and of one detached dorsal valve in which the beak is obsolete. Over most of the central area of the sides of the valves the spines are broken off, and where this is the case the surface is marked with pitted imbricating concentric lamellæ—the pits representing the fractured bases of the spines. In each case the margins of the valves are densely fringed with a single and continuous row of fine hair-like spines, except immediately upon the beaks.

Upon examination with an ordinary simple lens it was at once apparent that these specimens are referable to De Verneuil's genus *Siphonotreta*, and that in most respects they bear a very close resemblance to an English species, the *S. Anglica* of Prof. Morris. But the spines of *S. Anglica* are distinctly stated to be annulated, whereas those of the Canadian specimens appeared perfectly smooth when viewed under an achromatic microscope with an inch and a half objective.

A few month ago the writer had occasion to send some Canadian fossil *Brachiopoda* to Mr. Thomas Davidson, F.R.S., for examination and comparison with British species. In the parcel forwarded the three examples of the *Siphonotreta* from Cumming's Bridge were included, and in a letter received from Mr. Davidson in May last, they are reported upon as follows:—

"The *Siphonotreta* from near Ottawa interests me much. It is identical in shape and characters with the Upper Llandeilo species, which I named *Siphonotreta Scotica*. I am very uncertain whether the Wenlock Shale species, named *S. Anglica*, by Morris, is the same or not. Only one crushed specimen of the *S. Anglica* has been found, and its spines are annulated, as described by Morris. I could see no annulations in the spines of the many specimens of *S. Scotica*, found by Mrs. Gray in the

Upper Llandeilo of Craighead, nor do I see any in your specimens. As there is uncertainty as to the specific identity of the highest Upper Silurian form with the Lower Silurian one, and as none have been found in all that mass of intervening strata, I prefer provisionally to retain the two names, or until other Upper Silurian species shall have been found."

S. Scotica was originally described and figured in the Geological Magazine for January, 1877, and if the Canadian specimens are specifically identical with those from Scotland, the species must have had a considerable range in time, for the Upper Llandeilo rocks are generally regarded as of about the same age as the Chazy Limestone of the State of New York, and the Utica Slate as corresponding to beds on a comparatively high horizon in the Caradoc or Bala Group. To the palæontologist Mr. Watt's discovery will be of special interest, as this is the first time that the occurrence of a species of *Siphonotreta* in North America has been placed upon record.

ON A RECENT SPECIES OF HETEROPORA FROM THE STRAIT OF JUAN DE FUCA.

By J. F. Whiteaves, F.G.S.

(Read before American Association for Advancement of Science, Montreal, 1882)

The genus *Heteropora* was constituted by De Blainville in 1830, for the reception of a number of fossil species of Polyzoa of the order Cyclostomata, whose characters are thus defined by Busk:—"Polyzoarium erect, cylindrical, undivided or branched; surface even furnished with openings of two kinds; the larger representing the *orifices* of the cells, and the smaller the *ostioles* of the interstitial canals or tubes." "The essential character of the genus," writes Dr. H. A. Nicholson, "is thus the possession of a skeleton made up of two kinds of tubes, larger and smaller, the latter being the most numerous." Further, it has been ascertained that the tubes of *Heteropora* are provided with cross partitions and radiating spines, and that their walls are perforated by numerous openings. These structures have been held to be the homologues of the tabulæ and septa of the tabulate corals, and of the mural pores of the Favositidæ. Lindström, in 1876, maintained that the Palæozoic fossils known to geologists as *Chætetes*, *Stenopora* and *Monticulipora* have almost exactly the

same kind of internal structure as *Heteropora*, and consequently that the former genera should be removed from the class Anthozoa, to which the true corals are supposed to belong, and placed with the Polyzoa—a conclusion which had been arrived at ten years before by Dr. Rominger.

Many species of *Heteropora* have been described from the Mesozoic and Tertiary rocks of Europe and the United States, but no living representative of the genus had been discovered until 1879. In that year Mr. Waters described and figured a recent species from Japan, under the name *H. pelliculata*, in the *Journal of the Royal Microscopical Society*; and a little later in the same year, in the *Journal of the Linnæan Society*, Mr. Busk published a diagnosis, accompanied by illustrations, of a living Polyzoon from New Zealand, which he called *H. Neozelanica*. Mr. Waters and Dr. H. A. Nicholson, however, have both expressed the opinion that the *H. Neozelanica* of Busk is identical with the previously described *H. pelliculata*.

On the coast west of Sooke, Vancouver Island, in the Strait of Juan de Fuca, Mr. James Richardson, late of the Geological Survey of Canada, found a single specimen of a recent polyzoon in 1874, which, in the writer's judgment, cannot be distinguished by any tangible character from the Japanese and New Zealand species of *Heteropora* described by Messrs. Waters and Busk. No thin sections of this specimens have been made to show the minute structures of the interior, but the whole of the outer surface has been carefully examined under the microscope, and camera drawings of some of the most striking appearances thus presented have been made. The punctured, calcareous pellicle which Mr. Waters represented as closing the mouths of the interstitial canals in *H. pelliculata*, the character which suggested that specific name, can be well seen in part of the Canadian specimen. The general shape of the Polyzoary of the latter and the microscopical character of other portions of the surface agree perfectly with Busk's figures of the corresponding parts of *H. Neozelanica*. In one portion of the surface of the Fuca polyzoon it was noticed that the apertures of some of the larger tubes project distinctly beyond the general level, a feature not specially indicated in any of Messrs. Waters' or Busk's illustrations, but this slight variation from their types can scarcely be held as indicative of a specific difference from them.

ON CANADIAN FRESH-WATER POLYZOA.*

By William Osler, M.D.

The Polyzoa, or Bryozoa as they are sometimes called, form an exceedingly interesting group of animals. From their extensive distribution in geological formations and from the abundance and great beauty of the marine species at the present day, they have attracted an unusual share of attention from naturalists, while the elegance and plant-like appearance of many of the forms make them at the sea shore and in the museum favorites with the public. For a long time the Polyzoa were classified with the hydroid polyps among the Radiata, and even by Owen, in 1855, this method was adopted. Dr. J. V. Thompson, in 1830, was the first to separate them and apply the name Polyzoa to the whole class. At present they are classified as the lowest division of the Mollusca, forming together with the Tunicates and Brachiopods the class Heterobranchiata in the old system, or the division Molluscoida in the new. The Polyzoa are divided into two orders, 1st, the Phylactolæmata, in which the tentacles are arranged in the form of a horse shoe or crescent, and which are provided with a valve guarding the throat. 2nd, the Gymnolœmata, in which the tentacles are arranged in a circle, and the throat is not provided with a valve. In the Phylactolæmata there are three sub-borders, of which the first, Lophopea, contains almost all the fresh-water species. Prof. Allman divides the Lophopea into two great families, the Cristatellidæ and the Plumatellidæ—in the former the animal is locomotive, in the latter fixed. The genera in which Canadian species occur, as far as we know at present, are Cristatella, Plumatella and Pectinatella, and the five species which I have identified *Cr. ophidioidea*, *Pl. diffusa*, *arethusa* and *vitrea*, and *Pect. magnifica*.

As I have nothing new upon this subject to bring forward, I shall proceed to make some general remarks upon the structure and life history of these creatures, and demonstrate the specimens on the table before you. I may as well here explain one or two terms which will be frequently used in the descriptions. The term *cœnœcium* when employed indicates the common system and solid basis of the animal. The external coating is

* Read before the Natural History Society.

called the ectocyst, the internal the endocyst, and the horse shoe shaped disk supporting the tentacles the *lophophore*—strictly the bearer of the plume. The first species to which I will direct your attention is the *Pectinatella magnifica* of Leidy, described by him in the proceedings of the Academy of Science of Philadelphia, for Nov., 1851, and defined as follows:—*Cœnœcium* massive, gelatinoid, hyaline, fixed, investing bodies. Orifices arranged in irregular lobate areolæ upon the free surface. Lophophore crescentic. Ova lenticular, with an annulus and marginal spines. The specimens on the table show well the hyaline gelatinous nature of the *cœnœcium* and the arrangement of the Polyps upon the surface. This is perhaps the most abundant fresh-water Polyzoon in the country, being found in the quiet waters about the mouths of the numerous streams, and in the small lakes. It is not very abundant in Quebec, but it has been found near St. Andrews, and I obtained a beautiful specimen from Lake Memphremagog. I have not seen it in the neighborhood of Montreal. This species prefers quiet, still waters, not too much exposed, nor of large extent and subject to commotion from waves. Thus I have never found it in Lake Ontario itself, but always in little sheltered marshy bays, where it is found encrusting logs, upright sticks, and the stems of rushes. My attention was early directed to this form as it exists in extraordinary profusion in the Desjardin canal, which leads from Burlington Bay to my native town Dundas. The wooden sides of the canal basin in the months of July and August are almost uniformly covered with this magnificent species. The growth begins about 1½ to 2 feet below the surface and extends in depth for the same distance or even further, rarely, however, deeper than six feet. The masses form extensive sheets usually a few inches in thickness, or else beautiful symmetrical projections, 6-12 inches in thickness, which spring either from a bed of the Polyps or are isolated. In the summer of 1867, during a visit of my friend, the Rev. W. A. Johnson, of Weston, I showed him the masses, and we agreed to subject them to examination with the microscope, not having any idea as to their real nature. Judge of our delight when we found the whole surface of the jelly was composed of a collection of tiny animals of surpassing beauty, each of which thrust out to our view in the zoophyte trough a crescent-shaped crown of tentacles. Recognizing it as a Polyp we were greatly exercised as to its position, presenting as it did

in the method of growth, such variation from the ordinary species described in our zoological text books. Happily in the American Naturalist for that year we met with Mr. Alpheus Hyatt's papers on the Fresh-water Polyzoa, then in course of publication, and obtained full information therefrom. On examining the surface of a mass of Pectinatella the polyps are seen to be arranged, as seen in the spirit preparation, in close areolæ, which, being crowded and compressed together, often assume hexagonal outlines. From the periphery of these irregular areas the polyps project, the central part being as a rule unoccupied. When in the water the protrusion of the innumerable tentacles gives a fine velvety appearance to the surface, which entirely disappears on touching the polyps or agitating the water. This species is, however, much less timid than some others, and the polyps over even a small mass do not all withdraw on a slight irritation. The color of the polypidom is a light brown, or when the tentacles are extended, a faint rosy red hue, due to the color about the throat, glimmering through them. Towards the central part of the areolæ, white, brown and dark spots are seen, representing oval at various stages of development. The cœnœcium composed of the dense aggregation of polyps is closely united to the subjacent gelatinous mass, which constitutes here the ectocyst. On removal of the polyps the surface of the jelly presents patterns corresponding to the arrangement of the animals, irregular areas grooved in a radiate manner. The superficial portion of the ectocyst has often a reddish tint, and the deeper parts slightly greenish from the presence of a confervoid growth. Many masses of large size present a jelly perfectly colorless and pure throughout. Upon the development of this jelly, which is to be regarded as a definite excretion or secretion from the animal, the size of the polyp masses depends. When encrusting boards they are usually flat, larger conoidal projections occurring at intervals. Around the stems of rushes the most beautiful masses are found. The small one before you gives a good idea of the graceful symmetry of the growth. I have measurements of such a symmetrical cluster about a reed which was 14 inches in length and 10 in circumference, the weight 9 lbs. In some seasons the luxuriousness of the growth of these creatures is extraordinary. In the still quiet water in the marsh on either side of Desjardin canal, just before it passes through the Burlington heights, I have met with masses which would not go into a pail. The largest I have ever seen lay at

the bottom in about nine feet of water. I could hardly believe it was a mass of polyps, but, to satisfy my curiosity, I stripped and went in for it. With the greatest difficulty I brought it up in my arms, but could not get it out of the water for the weight, which must have been close upon 25 lbs. It resembled in form one of those beautiful masses known as brain coral.

On account of the colorless nature of the ectocyst and the extent to which the polyps protrude, this species is the most favorable to study the general arrangements of the organs, the perfect transparency allowing every detail in the structure to be seen. I have found it best to cut a thin vertical slice from the mass, containing on the surface not more than one or two rows of polyps, and examine in the zoophyte trough with a half-inch glass. It is much easier in this way to obtain a view of the complete animal than in the live box. The shock of the section and removal to the trough causes complete retraction of the polyps, and the surface of the cœnœcium looks smooth, or presents only slight tuberous elevations, corresponding to the situation of the orifices. On watching one of these, the sphincter closing it may be seen to relax, and the ends of the tentacles protrude through the orifice, feeling about from side to side as if to ascertain whether the "coast was clear." Finding no cause for alarm, the relaxation of the sphincter proceeds, the tentacles are pushed out still further, resulting at last in the complete evagination of the polyp. The beautiful crescentic tuft is arranged in the form of a horse shoe, or the letter U inverted, the tentacles spring from each side of the summit of the double outline, the mouth being at base. The number of the tentacles ranges from 50–80; they are sigmoid in outline and increase slightly in length at the extremities of the arms. The inner rows incline towards each other, the outer curve gracefully in the opposite direction. The surface of the tentacles is covered with cilia, which are in constant motion, creating a vortex, at the apex of which the mouth is situated. The tentacles act independently as well as in concert, and thrust and bend in any direction, pushing away objectionable matters which may have got into the throat, or are present in the neighbourhood. Frequently one of the large infusoria coming withing the vortex is carried down and attempting to escape is prevented by the interlacement of the tentacles which bending over form a cage. The sensitiveness of these ciliated arms is extreme and through them the creature obtains warning of approaching danger, and instantly withdraws itself.

From beneath the crescentic lophophore the alimentary canal hangs, which presents the following parts for observation: the epistome, a valve-like projection overhanging the mouth, the œsophagus or throat, the stomach, intestine and anus.

The epistome is a tongue-like organ arising at the junction of the inner arms of the lophophore, and serves as a valvular protection for the mouth. It possesses a set of muscles by which it can be readily moved and jerks up and down very frequently. It appears to keep materials in the throat rather than prevent the entrance of anything obnoxious. Like the tentacles it is covered with cilia. All the parts about the region of the espistome have a dark rose-red color, and this gives a peculiar brilliancy to the animals. A somewhat funnel-shaped mouth leads directly into the œsophagus, a short colorless tube, which widens slightly as it descends. A valve-like construction separates it from the stomach, into which, as soon as the œsophagus is full, the food is expelled by the contraction of the muscular walls.

The stomach forms an elongated tubular cavity in which the food is subject to a constant peristaltic action during the process of digestion. The lining membrane is plicated and the cells upon the folds are of a brown color, containing a fluid which Prof. Allman regards as a biliary secretion. The intestine or cœcum is a short broad cavity separated from stomach by a valve and placed parallel to the œsophagus, opening by an anal orifice immediately beneath the lophophore. The undigested residue of the food is gradually pushed through the cœcal valve and distends the intestine and is expelled by the contraction of the cœcal walls and carried away by the action of the cilia of the tentacles. From the lower part of the stomach a cord-like process, the funiculus, extends, and connects it with the bottom of the cœnœcium.

There is no definite circulatory system in the Polyzoa. A colorless fluid bathes the interior of the cœncœcium and the perigastric cavity. By the action of the cilia which line the interior of the cœnœcium currents are created which are rendered evident by the small particles carried round.

Respiration is probably carried on by the cilia covering the tentacles, but our knowledge of this function is extremely slight.

The nervous system of the fresh-water Polyzoa is represented by a definite ganglion which lies in the neighborhood of the

œsophagus, immediately below the epistome. It is easily seen in Pectinatella and presents curious contractions and expansions. By these the position of the mass is altered, sometimes approaching nearer the œsophagus, at others being in the hollow of the epistome. Nerve branches may be seen proceeding from this ganglion chiefly towards the epistome and tentacles.

The muscular system is well developed and the muscles form either sphincters or elongated branches. A definite sphincter surrounds the orifices of the cœnœcium and closes them tightly when the polyps are retracted, relaxing again for their protrusion. The longitudinal bands arise from the base of the cœnœcium, and passing up are distributed in three different localities, on the stomach, the base of the lophophore, and the tentacles, and are called respectively the gastric, lophophoric and brachial retractions. By the action of these muscles the little animal can be instantaneously withdrawn, and the sphincter closing effectually shields them from injury and attack. Other muscles are described by Hyatt and Allman, in connection with the epistome and endocyst.

The Phylactolœmata are reproduced by budding and true ovulation. From the side of the polyps buds arise which develope into mature forms and in this way the colonies are increased. Another method of budding results in the production of free gemmæ or statoblasts, which arise from the funiculus. These present a horny sheath, usually dark brown in colour, and an annulus or margin, which in some species is provided with spines. In Pectinatella, the spines number from 12–20, in Cristatella there is a double row, one shorter, the other longer, 50–60 in all, and the extremities are furnished with from 4–6 hooklets. The statoblasts float on the surface of the water and the armed ones get entangled in the weeds.

The method of production of true ova was first described by Allman. They originate in a bud-like mass at the upper side of the endocyst and are fertilized by spermatozoa, the testicles being an offshoot from the funiculus.

In the genus Plumatella I have determined three Canadian species, *arethusa*, *vitrea*, and *diffusa*. The members of this genus have dendritic, plant-like cœnœcia, which are firmly attached to the surface of submerged twigs, stones and water-plants. The cœnœcium is composed of little hollow branched tubules, divided into cells, from the apex of which the little polyp

protrudes, while at the other end it is in communication with the parent polyzoon. The branches are generally attached along the greater part of their length, though sometimes, as in this specimen of *P. arethusa*, they are free in nearly the whole extent. The color is owing to the ectocyst which when first secreted is thin and jelly like but soon becomes consistent, and at last dark brown. The endocyst lies immediately within this and is continuous throughout the system of branches.

The species of this genus are widely distributed throughout Canada in the quiet ponds and marshes attached to twigs, submerged logs and the under surface of the leaves of the water-lily.

The Cristatellidæ, the most highly organized of the Polyzoa, have a locomotive cœnœcium. There are two American species C. Idæ and C. ophidioidea. The one which I have studied here conforms to the latter, as described by Hyatt, in both statoblasts and number of tentacles. It is not nearly so common as the other forms. I have on several occasions met with the statoblasts in gatherings, but have never found the polyp except in the small lakes near the summer residence of Mr. G. W. Stephens, in the County of Maskinonge, Quebec. In Lac Rouge, the rocks at water's edge, at about the depth of from one to two feet presented numerous specimens about an inch and a half to two inches in length and one-third of an inch in breadth. The movement was slow, in those which I observed in a small basin, not more than an inch in the 24 hours. The statoblasts differ from those of Pectinatella in possessing a double row of hooklets with from two to six points.

Note.—I have received from the Rev. Thomas Hincks, the distinguished authority on British Polyzoa, a reprint from the Annals and Magazine of Natural History for March, 1880, entitled "On a supposed Pterobranchiate Polyzoon from Canada." It is based on a communication from his father, the late Professor Hincks, of Toronto University, in which a short account is given of a polyzoon found on a sunken boat in the Humber river, near Toronto. According to the description "the tentacles, instead of being disposed in a horse-shoe figure and forming a continuous series, as in the ordinary fresh-water species, are borne on two distinct erect lobes, which are separated at the base," the arrangement met with in the Pterobranchiate Polyzoa. At the date of Professor Hincks' letter, Dec. 1868, I was a student in his Natural History classes, and during the autumn of '68 had often

taken him specimens of various sorts, and among them a mass of Pectinatella, which I had found in an old submerged barge near the mouth of the Humber. I remember the fact very distinctly, as it was the first specimen of Pectinatella which I had found near Toronto, and Professor Hincks took a great interest in it, as he had not met with any fresh-water Polyzoa in Canada. Could this have been the specimen? It is a curious coincidence, to say the least, and perhaps in a look through the Museum of the University the specimen might be found, and the statoblasts would be sufficient to decide the question. Professor Hincks gives a sketch of the lophophore and it is hard to think that he could have been mistaken as he was an unusually skilful observer. The submerged barge was for many years a favorite collecting ground, and in some seasons Pectinatella was very abundant in the quiet water inside of it.

ON CERTAIN PARASITES IN THE BLOOD OF THE FROG.*

By William Osler, M.D., M.R.C.P., Lond.

Fellow of the Royal Microscopical Society of London, President of the Microscopical Society of Montreal, Professor of the Institutes of Medicine, McGill University.

In my Practical Histology class, during the winter of 1881–82, while the students were working at the blood of the frog (*Rana Mugiens*), I noticed in one of the slides a remarkable body like a flagellate infusorian. I thought that it was one which had got into the blood at the time of withdrawal, from the water on the web of the foot. Meeting with examples in the slides of several other students, my attention was again directed to it, and I made several sketches and wrote down the following description:—"Finely granular protoplasmic body, somewhat triangular in shape, about the size of a colorless corpuscle. The narrow end is prolonged into a cilium, while the other presents a broad band of rapidly undulating protoplasm, which at one angle is prolonged into a long lash-like process. The undulating fringe and the cilia are in constant motion, giving the appearance of rapid waves passing from one corner to the other, the waves of protoplasm gradually increasing in length and tenuity until they have the appearance of projecting cilia.

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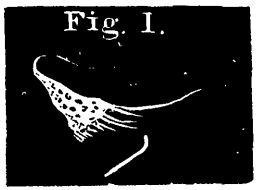
*Read before the Montreal Microscopical Society.

No nucleus can be seen. Though in constant action no change of locality takes place." Fig. 1.

Fig. 1.

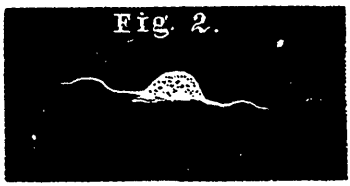


On looking up the subject I found that the little organism was the *Trypanosoma sanguinis* which had been described originally by Gruby as an entozoon in the blood of frogs, and by Ray Lankester (not at the time knowing Gruby's observations) as *Undulina*, the type of a new group of Infusoria.

Though a trifling little object it possesses considerable interest as there is still a doubt concerning its real nature and the movement which it displays is unusual, being neither the slow, creeping rhizopodal motion, nor yet truly ciliary. Minute protoplasmic organisms usually display one or other of these types of movement, but in the object under consideration, there is a peculiar wavy undulation along one margin of the creature together with a lashing vibratile action. Studying the margin under a high power a rapidly succeeding series of waves is seen to pass from one side to the other, increasing in length until at one corner the wave is extended into a lengthened cilium resembling the whip-like flagellum of an infusorian. In the specimens which I examined the undulations always passed in one direction and it appeared as if from the tips of any of the waves the protoplasm could be extended into cilia, though usually only those at one end presented them. It is this latter feature, together with the peculiar wavy character of the motion that gives the creature a special interest and makes it quite an exceptional one among organisms of its class. A fine hair-like extension from the narrow end was also in constant motion and appeared to vary considerably in length, as if it were only a delicate process of the protoplasm, and, unlike a true *cilium*, capable of elongation or retraction. I kept one under observation for over an hour, during which time the movements kept up, but got slower towards the close. The undulatory motion at last ceased, but the tail-like

projection and the flagellum at the margin of the broad end continued to move (the appearance is represented at fig. 2.)

Fig. 2.



and were evident after motion had ceased. This would favor the view that these processes were "cilia," and not merely temporary extensions of the protoplasm, though the remarkable manner in which the cilia were extended and retracted shows that they were not similar in all respects to the cilia of Infusoria or of various animal cells. Professor Lankester speaks of it as "a mouthless infusorian, closely allied to Opalinidæ, from which, however, it differs essentially, as well as from *Infusoria ciliata* generally in possessing no cilia." Gruby described it as a parasitic entozoon, while Siebold* states that it is not an independent organism, but simply an undulating membrane swiming freely. Dr. Gaule† has advanced some rather startling views concerning this little body which he believes originates in, or is a transformation of a colorless blood cospuscle. He states that on the warm stage the process of conversion of the white blood corpuscle into the *Trypanosoma* may be readily followed and takes place by the development at one margin of a vibratile cilium and a rapidly undulating membrane. He recognized four or five types of these transformed blood corpuscles and calls them "Kymatocytes." They may return to their original corpuscular condition. I have tried to follow these observations of Gaule but without success and adhere to the opinion that we have to deal here with a minute parasite, the affinities and life history of which have yet to be worked out. They were not abundant in the blood of my frogs and were only met with in two. I have not found them this season in any of the frogs in my tanks.

This session my attention was called by a member of my Histology class to what he thought was a peculiarly elongated white corpuscle in the frog's blood, but which I recognized as another

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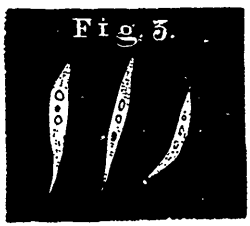
* Micrographic Dictionary—Undulating Membranes.
† Arch. f. Anat. u. Physiol. (Phy. Abt.) 1880.

parasitic form. The blood examined by the student on that day was taken from two bull frogs (*Rana Mugiens*), but only one contained the parasites. The organism presents the following characters:—Body an elongated oval, sausage-shaped, ends conical, one sometimes narrow and prolonged. Length somewhat more than half a red corpusele. The protoplasm is homogeneous and more translucent than that of colorless corpuscles and shows two or more small central vacuoles (?) with a few granules. Movements slow and creeping, accompanied by an occasional bend or twist of the body, go on at ordinary temperature; a little accelerated but not altered in character on the warm stage. The tail-like end though produced does not terminate in a cilium. Fig. 3.

Fig. 3.

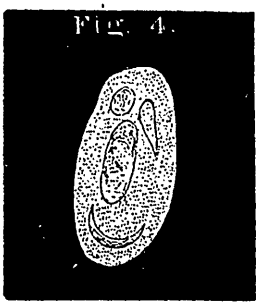


This parasite was originally figured by Ray Lankester, when describing the Undulina (Trypanosoma) but he has only recently, in the *Quarterly Journal of Microscopical Science*, for January, 1882, given a full description of it, and established its position. He calls it *Drepanidium ranarum*. Dr. Gaule, of Leipzic, has studied these bodies and has come to conclusions as remarkable as those at which he arrived concerning *Trypanosoma*. He calls them "Wurmchen," *vermicles*, and believes that they are protoplasmic portions of the corpuscles of the blood which assume an elongated form and display movements. He has found them within the cells not only of the blood but of the spleen, kidney and liver and has seen them penetrate and enter blood corpuscles by their active movement.

Dr. Lankester shows very clearly that these organisms are truly parasites belonging to the Gregarinidæ or Sporozoa, those lowly protozoal forms, many of which at some time of their existence are parasitic in the interior of cells. He suggests that it is a young stage and the more developed or Gregariniform condition of the parasite exists in some part of the body of the frog. He points out that these bodies have a striking resemblance to those figured by Lieberkühn, as spores or pseudo-navicula from

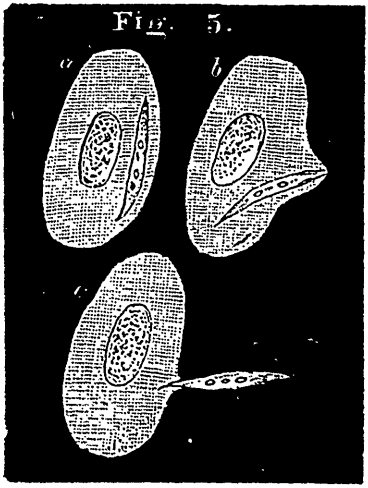
the kidney of the frog. Within the cells they can best be seen on the addition of salt solution 3%. I have found, after trying a number of solutions, that Pilocarpin ½% brings them out very clearly. In one frog the red corpuscles contained, in addition to the Drepanidia, smaller irregular masses, fig 4.

Fig. 4.



In blood from a small frog they were very abundant, and could be seen well without any reagent. Fig. 5 *a* represents a corpuscle with one inside which travelled round the cell four or five times, and then migrated from it as shown at Figs. 5 *b* and *c*. This curious phenomenon was witnessed several times, and did not seem to injure the corpuscles very much, some presenting no trace of the point of exit, others a slight depression.

Fig. 5.



PRELIMINARY NOTICE OF NEW FOSSILS FROM THE LOWER CARBONIFEROUS LIMESTONES OF NOVA SCOTIA AND NEWFOUNDLAND.

By J. W. Dawson, LL.D., F.R.S.

I.—NOVA SCOTIA.

The following are specimens from the collections of Dr. Dawson, made in Nova Scotia and now in the Peter Redpath Museum, and which are either undescribed or serve farther to illustrate species described in the author's Acadian Geology

Discites Hartti, dawson.

[*Gyroceras Hartti*, Acadian Geology.]

The original description of this species in Acadian Geology (page 311) was based on a specimen showing the outer or body chamber only, and this from its form was at the time (1868) supposed to be referable to the genus *Gyroceras*. I have, however, recently collected at Brookfield additional specimens, which throw new light on its structure and affinities. The species may now be described as follows.—

Form discoidal, apparently with an open umbilicus. Whorls with the dorsal side flat or nearly so. This flat space is separated on each side by a shallow furrow from a strong latero-dorsal ridge, and this by a broader shallow depression from the umbilical ridge, which in some specimens seems to be divided into two by a very slight medial depressed line. Siphuncle small and sub-central, being nearer the dorsal than the ventral side; septa slightly angulated at the latero-dorsal ridge. Body-chamber with slight transverse rugae. Aperture projecting at the latero-dorsal ridge and receding at the umbilical ridge into a deep sinus. Diameter of largest specimen, apparently adult, 2.5 centimetres.

This species may be compared with *Nautilus* (*Trematodiscus*) *trisulcatus* M. & W. (Illinois Report, Vol. II.) or with *N.* (*Discites*) *sulcatus*, Sby. As the characters on which the first named authors rely for separating their genus *Trematodiscus* from *Discites* are somewhat vague and scarcely apply to the pre-

sent species, I think it well to place it in the genus or sub-genus *Discites* of McCoy; remarking, however, that it might be included in *Trematodiscus*, should that sub-genus be sustained.

LOXONEMA CARA, S.N.

Shell small, elongate, surface polished and shining, volutions about eight, regularly curved and marked by about thirty thin vertical ridges crossing the whole of each volution. Aperture apparently regularly oval. Length 7 millimeters, breadth at second turn 2 millimetres. It somewhat resembles a species figured but not named in Worthen's Illinois Reports, Vol. V, Plate XXIX, fig. 3.

This beautiful little shell was found by Mr. W. Gurley, of Danville, Illinois, in specimens of limestone from Windsor, Nova Scotia, and was by him kindly communicated to the writer.

PLEUROTOMARIA ACADICA, S.N.

Somewhat elongate, volutions four, nearly horizontal at the suture and bending downward at a right angle, giving them a square section, especially in the lower volutions. On the body whorl the angle between the upper and lateral surfaces forms a distinct ridge. Surface otherwise quite smooth. Length 4 millimetres. It is allied to *P. Chesterensis* of Meek and Worthen and to *P. altivittata* of McCoy.

From collections made by Prof. Hartt, at Windsor, Nova Scotia.

SANGUINOLITES BROOKFIELDIANUS, S.N.

Among my specimens from the Lower Carboniferous Limestones of Nova Scotia, there have been for many years casts and fragments of a bivalve shell of the above genus, but too imperfect for description. In a recent visit to Brookfield I obtained better specimens, and now venture to describe the species as follows:—

Shell more than twice as large as wide, anterior end regularly rounded, hinge line straight, ventral line slightly and regularly curved, posterior end sub-truncate. An oblique ridge extends from the beak to the latero-posterior angle. In front of this ridge the sides are marked with unequal concentric ridges of growth, behind it the surface is smooth, but in well-preserved specimens shows two slender longitudinal ridges dividing the

triangular space into three equal parts. There are indications of a slight internal transverse rib near the anterior end, suggesting affinities with King's genus *Pleurophorus*. It is nearly allied to *S. plicatus* of McCoy. Length of the largest specimen 3.5 centimetres.

Lower Carboniferous Limestones at Brookfield and Windsor.

Aviculopecten Lyelli, (var. *alternans*.)

In describing the Aviculopectens of the Lower Carboniferous (Acadian Geology, pp. 305 to 307), I have mentioned specimens resembling *A. Lyelli*, but larger and more coarsely marked, and which I compared with *A. plicatus* of Sowerby. Many additional specimens of these shells, collected from time to time, appear to show gradations connecting them with the typical *A. Lyelli*, which they perfectly resemble in general form and general style of markings, but differ in larger size and in having broader ribs, nodose rather than squamous, and generally showing toward the edge alternations of coarser and finer ribs. The larger and more characteristic specimens of this form might readily be considered distinct; but intermediate forms seem to show that there is no specific distinction. My best specimens are from the limestones of Brookfield and the Shubenacadie.

Berenicea insueta, s.n.

Group of cells oval, about one millimetre in length and somewhat raised in the centre; on the dorsal valve of a shell of *Athyris subtilita*. Cells round, spirally arranged, somewhat oblique to the surface. Spaces between cells granular. About ten cells in the length of the group.

Encrusting *Polyzoa* of this kind appear to be rare in the Carboniferous limestones of Nova Scotia. The present species occurs in Prof. Hartt's collection from Windsor.

Megastroma laminosum, s.n.

Broadly expanded layers about one millimetre in thickness, and two millimetres or more apart. Each layer consists of a double membrane, beset with numerous spicules pointing inwards and looking like two brushes facing each other. The membranes are penetrated by openings or oscula, and appear to be porous or reticulate in their substance and to have cellular thickenings in places, giving them a peculiar appearance. The layers sometimes

though rarely unite, and are sometimes not continuous when seen in section; this appearance being perhaps produced by large openings or spaces. In each layer the ends of the opposing spicules are sometimes in contact, sometimes separated by a space, empty or filled with calcite. The intervals between the layers are occupied by organic limestone, consisting of small shells and fragments of shells and corals. As many as twelve or thirteen layers are sometimes superimposed, and their horizontal extent seems to amount to a foot or more. The layers have a deep brown color, while the enclosing limestone is of a light gray tint.

This remarkable body was found in the fossiliferous limestone of Brookfield, in patches parallel with the stratification, and at first sight resembled a coarse *Stromatopora*. When sliced and examined under the microscope, it presents the appearance above described The membranes referred to, from their deep brown color would seem to have been of a horny or chitinous character. They are sometimes bent and folded, as if by pressure, and appears to have been of a flexible and tough consistency. The spicules connected with it, if really organic, would seem to have been set in the membrane, and to have been corneous rather than silicious. I have, however, no absolute certainty that these apparent spicules may not be rather the effect of prismatic crystals of calcareous spar penetrating a soft animal matter and impressing on it their own structure. If the spicules are really organic, the structure must be of the nature of a sponge. If otherwise, it must have consisted of double membranous layers enclosing between them a softer organic matter, and sufficiently firm to retain their form till filled in with calcareous fragments. Unless the structure was of vegetable origin, which I do not think likely, it was probably a Protozoan of some kind. In either case it is different from any fossil hitherto found in the Lower Carboniferous limestones of Nova Scotia.

II.—NEWFOUNDLAND.

The following species are contained in limestone from Port-au-Port and other places in St. George's Bay, Newfoundland, collected by Dr. Robert Bell and Mr. P. Patterson, and now in the Peter Redpath Museum. The limestone is similar lithologically to that of Brookfield, Windsor, and other places in Nova Scotia, and the greater part of the fossils are common to Newfoundland and Nova Scotia.

SERPULITES MURRAYI, S.N.

Tube cylindrical, slightly curved in the part preserved, smooth, with indications of a thin shell. Diameter of largest specimen 14 millimetres at the larger end and 11 millimetres at the smaller end. Length 10 centimetres. Several fragments of smaller size may belong to young individuals or to the terminal portions of adults.

This tubular cast, destitute as it is of the outer shell, can scarcely be referred with certainty to the serpulæ. It might have belonged to a mollusk; but in the mean time may be provisionally referred to *Serpulites*. The specimens are from Dr. Bell's collection at Port-au-Port. Dedicated to Alex. Murray, C.M.G., F.G.S.; Director of the Geological Survey of Newfoundland.

MACROCHEILUS TERRANOVICUS, S.N.

Shell conical in form, with five volutions strongly shouldered and with deep suture, each turn becoming one-third smaller than that below. Lower volutions each with 12 to 13 vertical ribs, more strongly marked at the suture and fading below. Aperture ovate, rounded in front, slightly angled behind. Umbilicus small. Length 8 millimetres.

Very abundant in some specimens in Dr. Bell's collections from St. George's Bay. A little shell found very abundantly at Pugwash, Nova Scotia, and referred in Acadian Geology (p. 309) to the genus *Turbo*, probably belongs this genus. It differs from the present species in having as many as twenty folds in the suture.

PTERONITES GAYENSIS (var. *ornatus*).

General form of shell similar to that of *Pt. Gayensis* (Acadian Geology p. 301), but differs in its somewhat larger size and in the ornamentation of the whole shell with delicate raised concentric lines instead of obscure rounded wrinkles. The left beak is considerably more prominent than the right, the hinge line slightly curved inward, and the ridge along it well marked. Length of shell one centimetre. Port-au-Port, Newfoundland, collections of Dr. Bell and Mr. Paterson.

I should have been disposed to regard this shell as a distinct species, but for the fact that there is a probability that the Gay's River specimens have lost their finer ornamentation, and that

several of the shells common to Newfoundland and Nova Scotia show a larger size and better development in the more northern locality.

With the above species are the following, already described in Acadian Geology, as found in the Lower Carboniferous of Nova Scotia:—

Serpulites annulatus, Dawson.
Conularia planicostata, Do.
Aviculopecten Debertianus, Do.
Bakevellia antiqua, Munst.
Cypricardia sp.
Terebratula sacculus, Martin.
Spirifera glabra.
Productus semireticulatus, Martin.
P. Cora, D'Orbigny.
Streptorhynchus crenistria, Phillips.

ALPINE FLORA OF THE PROVINCE OF QUEBEC.

By J. A. Allen, New Haven, Conn.

In the summer of 1881 I joined a party which visited the eastern portion of the Shickshock Mountains, in Gaspé County. Although only about 4000 feet high, these mountains have a more extensive treeless area than the White Mountains, and many patches of snow remained on them at the beginning of August. Below is given a list of some of their plants, and of a few from the south shore of the Lower St. Lawrence. The willows were named by Mr. Bebb, some of the grasses by Dr. Vasey, and some of the other plants by Mr. Watson.

The following were collected on Mount Albert:—

Ranunculus affinis, R. Br. var. leiocarpus, Trautv.
Arabis alpina, L.
Viola palustris, L.
Silene acaulis, L.
Lychnis alpina, L.
Arenaria arctica, Stev.
A. verna, L.
A. verna, L. var. hirta, Wats.
A verna, L. var. rubella, Hook.
Sibbaldia procumbens, L.
Parnassia Kotzebuei, Cham. and Schl.
Epilobium origanifolium, Lam.
Solidago Virga-aurea, L. var. alpina, Bigel.
Gnaphalium sylvaticum, L. var. norvegicum, Gunn.
Arnica mollis, Hook.
Nabalus nanus, D. C.
Vaccinium cæspitosum, Mx.
V. ovalifolium, Smith.
V. uliginosum, L.
Arctostaphylos alpina, Spreng.
Cassiope hypnoides, Don.
Bryanthus taxifolius, Gray.
Rhododendron Lapponicum, Wahl.
Loiseleuria procumbens, Desv.
Pyrola secunda, L. var. pumila, Paine.
Diapensia Lapponica, L.
Armeria vulgaris, Willd.

Veronica alpina, L.
Castilleia pallida, Kunth. var. septentrionalis, Gray.
Oxyria digyna, Campdera.
Comandra livida, Richardson.
Betula glandulosa, Mx.
Salix arctica, Br. var. Brownii, Anders.
S. chlorophylla, Anders.
S. Cutleri, Tuckerm.
S. desertorum, Richards.
S. herbacea, L.
Juniperus communis, L. var. alpina, L.
Goodyera Menziesii, Lindl.
Juncus trifidus, L.
Scirpus caespitosus, L.
Eriophorum russeolum, Fr.
Carex rigida, Good.
C. scirpoidea, Mx.
Phleum alpinum, L.
Poa alpina, L,
Festuca scabrella, Torr.
Aira atropurpurea, Wahl.
Hierochloa alpina, Roem. and Schul.
Danthonia sericea, Nutt.
Pellaea densa, Hook.
Asplenium viride, Huds.
Aspidum aculeatum, Swz. var. Braunii, Koch.
A. aculeatum, Swz. var. scopulinum, Eaton.
A. fragrans, Swz.
Cystopteris montana, Bernh.
Lycopodium alpinum, L.
Lycopodium Selago, L.
Selaginella selaginoides, Link.

Table-topped Mountain affords in addition:—
Draba androsacea, Wahl.
Cerastium trigynum, Vill.
Lonicera involucrata, Banks.
Salix argyrocarpa, Anders.
S. vestita, Pursh.
Luzula arcuata, Meyer.
Carex rariflora, Smith.
Calamagrostis Langsdorffii, Trin.
Woodsia glabella, R. Br.

Some northern plants occur both on the coast and mountains, as

Artemisia canadensis, Michx.
Rhinanthus Crista-galli, L.
Polygonum viviparum, L.
Carex atrata, L.
C. Capillaris, L.,
C. voginata, Tausch.

The following grow on the shores of the Ste. Anne River.

Anemone parviflora, Mx.
Dryas octopetala, L. var. Drummondii, Watson.
Solidago bicolor, L. var. concolor.
Graphephorum melicoides, Beauv.
Poa caesia, Smith.
Woodsia hyperborea, R. Br.

Near Ste. Anne des Monts on the coast were found:

Stellaria longipes Goldie. var. Edwardsii, Watson.
Montia fontana, L.
Parnassia parviflora, D. C.
Hippuris maritima, Hellenius.
Arnica alpina, Murray
Gentiana Amarella, L. var. acuta, Hook. f.
Pleurogyne rotata, Griseb.
Spiranthes Romanzoviana, Cham.
Zygadenus glacus, Nutt.
Carex gynocrates, Wormsk.

Near Matane were collected:

Astragalus oroboides, Hornem. var. Americanus, Gray.
Epilobium latifolium, L.
Pedicularis palustris, L. var. Wlassoviana, Bunge.
Plantago eriopoda, Torr.
Rumex salicifolius, Weinm.
Blysmus rufus Link.
Carex norvegica, Schk.,

THE GEOLOGY OF PORT HENRY, NEW YORK.*

By T. Sterry Hunt, LL.D., F.R.S.

Port Henry, in Essex County, is well known as a locality where the highly inclined Laurentian gneisses, with their associated limestones and iron ores, rise from beneath the nearly horizontal paleozoic strata of the Champplain valley. The gneiss just above the Port Henry iron-furnaces presents alternations of lighter feldspathic and darker hornblendic beds with others highly quartzose, and includes layers of a sulphurous magnetite which are, however, insignificant when compared with the great deposit of this ore mined at Mount Moriah, in the vicinity. Near by is seen a considerable breadth of white crystalline somewhat graphitic limestone, along the eastern border of which are three smaller beds of two or three feet each, of the same rock, interstratified with layers of crumbling gneiss.

Half a mile southward, near the town, a quarry is opened in a more coarsely crystalline limestone, in which, as seen in 1877, were enclosed irregular masses and layers of the adjacent gneiss, sometimes transversely broken, but scarcely separated, and from two to three inches in thickness, though sometimes much larger. The limestone was marked by lighter and darker bands, containing more or less graphite and pyrites, and in parts held coarsely crystalline sphene and green pyroxene, in layers. We have here one of those cases which led Emmons and Mather to assert the eruptive character of these limestones, and it is probably a similar instance which lately led an eminent geologist to describe crystalline limestones in this region as overlying unconformably the gneisses. The phenomenon, in the writer's opinion, is one which he has elsewhere described at length, namely the occurrence of great calcareous veinstones, which hold the characteristic minerals of the adjacent interbedded limestones, and like granitic and metalliferous veinstones, have been deposited from solutions

* This note is an abstract of a paper read before the American Association for the Advancement of Science, at Saratoga, in August, 1879, but, through an oversight, not then published. As it contains some matters of interest to geologists, I send the note as then written, without change, to the *Canadian Naturalist*.—T. S. H., January, 1883.

in the fissures of the broken gneissic strata, and are not unfrequently brecciated, as in the present case. These calcareous masses are not eruptive but endogenous. The Laurentian rocks abound in similar instances. (*Second Geol. Survey of Penn.*, Report E, pp. 166, 167.)

A few miles north from Port Henry the gneiss, with its magnetites, is replaced by the massive bedded labradoritic rocks of the Norian series (the hypersthene rocks of Emmons) with great masses of titanic iron-ore, which latter abound near Westport. Prof. Hall has described these rocks as newer and unconformable with the underlying gneiss; which accords with the numerous *observations of the relations of these two series made in Canada.* The Norian rocks are well displayed along the railway between Westport and Port Kent, where a nearly continuous cutting of about five miles through them, around Willsborough Bay, affords a good opportunity for their study. Prof. Leeds has lately published a valuable series of chemical and microscopical studies of the Norian rocks of this region.

The Potsdam sandstone, the basal member of the overlying palæozoic series is well seen in a railway-cutting at Port Henry. The lower beds are massive and compact, dark bluish or iron-gray, with lighter bands and thin blackish shaly layers. Dipping gently to the northward, they become overlaid by the higher beds of the division, which are light gray and porous, and composed apparently of agglutinated silicious grains, as if deposited from solution, as long ago remarked by Prof. Hall for the similar strata of Iowa. Some of those upper layers have irregular cavities, as if from the disappearance of organic remains, and others exhibit numerous vertical cylindrical markings differing alike from the *Scolithus linearis* of the Primal sandstone and the *S. Canadensis* of the Potsdam of the Ottawa basin. The markings at Port Henry are small vertical cylindrical cavities, often eight or ten centimetres in length and about three millimetres in diameter; having a concentric interior tube or cylinder of about two millimetres external and one millimetre internal diameter, and sometimes exhibiting traces of concentric layers. Farther study is needed to determine the origin of these markings which I have elsewhere described. (*Second Geol. Survey of Penn.*, Report E, p. 138.)

Above these sandstones are seen massive layers of an impure dark bluish limestone without observed fossils, holding eighteen

per cent. of magnesia, and probably representing the so-called Calciferous sandrock, which is really an impure dolomite. As seen along the railway, these beds have at first a very gentle dip to the northward, which soon grows steeper until, where lost sight of, a few hundred feet from the wall of gneiss, they dip towards it with an angle of about sixty degrees to the northwest. The almost constant eastward dip of the paleozoic strata on the east side of the Champlain and Hudson valleys, as a result of which the newer seem to pass below the older and more crystalline rocks, is well known. It is easy to conceive that lateral pressure, from the contraction of the earth, acting upon horizontal strata deposited against a barrier of older and resisting rocks, may, according to circumstances, either cause them, by the sliding of their edges, to be raised up and made to dip away from the older rocks (a case frequently met with)—or else, the edges remaining fixed, the compressed strata beyond will be upraised in one or more folds (which may even be over-turned) often with faulting, so that the proximate portions are made to dip towards the resisting barrier. This condition, as was well shown by H. D. Rogers, is seen in the Primal and Auroral strata along the north-west base of the South Mountain in the great Appalachian valley. We have here at Port Henry apparently an example, on a small scale, of the same phenomenon on the opposite side of the valley, and against the southeast base of an ancient barrier of Laurentian gneiss.

NOTES ON THE MORE IMPORTANT COAL SEAMS OF THE BOW AND BELLY RIVER DISTRICTS.

By George M. Dawson, D.S., F.G.S., Associate Royal School of Mines.

The fuels contained in the rocks of the Bow and Belly River districts vary from lignites, but slightly superior in quality to those of the Souris region, to materials containing a very small percentage of water, forming a strong coke on heating, yielding abundance of highly luminous hydrocarbons, and precisely resembling ordinary bituminous coals, though of Cretaceous or Laramie age. In describing them the general term *coal* will be used, as it is impossible to draw a definite line between the two classes among the numerous intermediate varieties.

A seam of coal of good quality occurring on the lower Bow and Belly Rivers, is seen in the banks for many miles at a varying height above the water, owing to the light undulating dips by which it is affected. It is generally not more than a foot or eighteen inches in thickness though so persistent in extent, but at one point on the Belly River it thickens to three feet, forming a workable seam, which appears to be of good quality throughout. This locality is thirty-two miles in a direct line from "Coal Banks." No analysis has yet been made of this fuel.

The locality just referred to as "Coal Banks" is at the crossing of the Belly River by the trail to Benton. The coal occurring at this place is that which has been described as existing at the base of the Pierre. It is one of the best in the district, and has been worked to a small extent for some years at this point by Mr. N. Sheran. The outcrop of this seam is now known to extend from a point about six miles up the St. Mary River to that part of the Belly near and below Coal Banks, and then to run northward to the Bow River. South of the point indicated on the St. Mary River, it has not yet been traced, but as it appears remarkably constant in thickness and general character, both here and at the Bow River, sixty-six miles distant, it doubtless extends considerably further in each direction, and may also be assumed to underlie the plains between the Belly and Bow Rivers in workable thickness.

The drift deposits average about one hundred feet in thickness over this part of the plains, and it is consequently, in general,

only in the river valley or in the larger coulées which flow into them that the Cretaceous rocks can be seen. The Belly Valley in this part of its course is about 300 feet deep, and averages nearly a mile in width. It therefore cuts about 200 feet into the Cretaceous rocks, and displays fine sections of these. There are in this vicinity several associated coal seams; one of these, that which has been opened by Mr. Sheran, I may, for the sake of clearness, refer to as the "main coal." It is more or less perfectly exposed at intervals along this part of the Belly for a distance of about twelve miles, or from the working at Coal Banks to Big Island of the map. Above the Coal Banks the measures are affected by a light anticlinal swell which brings up older rocks, and the outcrop runs round by the west, appearing on the river again at the mouth of the St. Mary. At the furthest point up the St. Mary, where the coal appears (almost seven miles from the mouth of the river), it shows the following sections, the second column being a continuation of the first at a spot about 100 yards further down stream:—

	ft.	in.
Rusty ironstone layer	0	8
Blackish and rusty shale	5	0
Coal	0	3
Blackish shale	6	0
Coal	0	6
Soft carbonaceous shale	0	4
Coal	0	8
Soft, thin shale, highly carbonaceous in upper part	0	6
Ironstone shale	0	6
Blackish shale	3	0
Coal	0	8
Carbonaceous shale (some coal)	1	6
Coal (partly below water	1	6

	ft.	in.
Coal	1	0
Shaly coal	0	6
Coal	1	3
Shale	0	2
Coal	0	9
Grey shale	4	0
Coal	1	4
Grey shale (to water)	4	0

About two miles further down the St. Mary the coals are again seen, with the following development:—

Coal (rather shaly)	1	0
Coal	1	5
Shale	0	3
Coal	0	9
Shale	10	1
Coal	3	8
Shale (with obscure plant impressions)	6	0

At the mouth of the St. Mary the main seam has a thickness of three feet six inches, but about eighteen inches at the top is rather shaly.

On comparing these sections on the St. Mary with those at Coal Banks and on the Belly River to the north, it will be noticed that the coal at the first-mentioned locality is more divided by shales and less favourably situated for working.

On the part of the Belly River near Coal Banks the measures have, as a whole, a light westerly dip, while that part of the outcrop between Coal Banks and Big Island forms a minor synclinal hollow in its edge, across which the river cuts in a direction nearly coinciding with the main strike of the measures, and gives rise to a great display of coal on this part of the valley. The coal-bearing horizon, as above mentioned, lies at the base of the Pierre, and its position between the dark shales of this formation and the pale sandy beds of that underlying it, renders it easy to define the situation of the coals, even where their actual outcrop is concealed. For a distance of five miles north of the Coal Banks exposures, the dark shales just referred to occupy the river valley, while the outcrop of the coal is carried eastward to an uncertain distance by the light synclinal undulation above referred to. The gentle inclination of the measures shows that the coal might be reached at a moderate depth by shafts sunk through the dark shales in this part of the valley, from which it might with facility be worked up its slope to the eastward. The undulating character of the dips renders it impossible to estimate the exact depth at which the seam would be found, but it is probably not over 500 feet below the river, midway between its southern and northern outcrops in the valley. It may also be worked on a smaller scale, but with great facility, by levels driven into the actual outcrops in the river banks.

Having thus briefly described the general mode of occurrence of the coal on this part of the Belly River, the following more detailed notes on the outcrops which occur will serve to show the actual character of the seam.

At the Coal Banks, the coal has been extracted chiefly by quarrying along the natural outcrop, though during the past summer a small level has been begun. The outcrop is situated in the front of a steep scarped bank facing the river, and the seam, which at the southern end of the bank is about 30 feet above the water, dips away below the water at the northern. The fol-

lowing section shows the mode of occurrence and association of the coal in the bank, but does not extend upward to the base of the drift deposits :—

		ft.	in.	
	Finely laminated grey shale	8	0	
	Coal (shaly below)	1	6	
	Grey, thin-bedded shale	12	0	
	Ironstone	0	3	
	Grey shale	1	9	
	Coal	0	8	
	Grey shale and nodular sandstone, carbonaceous below	7	0	
Main seam.	*Coal*	1	4	Coal, 5′ 4″
	Shaly parting (often almost absent)	0	4	
	Coal	4	0	
	Carbonaceous shale	2	0	
	Grey shale	2	0	
	Ironstone	0	4	
	Greyish and brownish shale	3	0	
	Carbonaceous shale	3	0	
	Coaly shale	0	8	
	Grey shale	2	0	
	Coal	0	4	
	Carbonaceous shale (to water)	1	4	

The dip at this place is about N. 83° W. (mag.), at an angle of 5 to 8 degrees.

On the opposite side of the river, at the next bend, the coal seam is again well shown. It is slightly undulating, and dips gradually away below the water level at the northern end of the bank. The part of the section designated above as the Main Seam is here as follows :—

	ft.	in.
Coal	1	6
Shaly parting (1 to 3 inches)	0	2
Coal	3	3
Total coal	4	9

About four inches in thickness at the base of the seam is here laminated in texture, but appears nevertheless to be of good quality. The general dip is about N. 50° W. (mag.), at an angle of less than 5°.

From this point for a distance of five miles down the valley, the dark shales overlying the coal are alone seen. When it

again appears, in the west bank of the river, the Main Seam shows the following section:—

	ft.	in.
Coal	1	6
Shale	0	3
Coal	4	6
Shale	1	6
Coal	2	9
Total coal	8	9

The lowest division of the seam at this place is apparently not represented in the sections previously described. The coal in it is somewhat laminated, but seems to be of good quality. The dip is here about S. 70° W. (mag.) at at angle of 5°.

About three miles further north, extensive exposures of the coal are again found in the scarped bank or cliff facing the river, at a height of about 100 feet above the water level. The dip is light and undulating, but on the whole westward, or away from the river. The Main Seam is here composed as follows:—

	ft.	in.
Coal	2	6
Carbonaceous shale	0	7
Coal	2	2
Carbonaceous shale	1	0
Coal	1	3
Total coal	5	11

The coal here appears to be of good quality throughout. North of this point on the river the Main Seam is not again found well exposed, though in several places the associated rocks are shown in such a way as to indicate that it outcrops below the drift a short distance east of the river valley.

At the point at which the base of the Pierre should cross the Little Bow River, a seam of coal a few inches thick was observed, but the exposures did not bring the main seam into view.

The coal-bearing horizon appears again on the Bow River at Grassy Island, about thirty-three miles in a direct line below the Blackfoot Crossing, at lat. 50° 25′ 15″. In their general appearance, arrangement and thickness, the seams here exposed closely correspond with those on the Belly River. The subjoined sections exhibits the relations of the coal at this place:—

	ft.	in.
Lead grey shale	25	0
Coal	1	6
Soft grey and yellowish-grey shaly sandstone	13	0
Carbonaceous shale, coaly streaks	2	3
Coal (good and sound throughout)	4	6
Dark grey shale and shaly clay	7	0
Coal	1	0
Carbonaceous shale	1	0
Coal	0	8
Soft shale and clay	8	0
Coal and carbonaceous shale (to water)	1	6

The seams dip westward at a very light and constant angle. The seam four feet six inches in thickness probably represents the Main Seam of the Belly River.

Some general facts regarding the composition of the coal of this horizon in the Cretaceous may be given. The analysis by Prof. Haanel quoted in my report on the Geology and Resources of the 49th Parallel (p. 179, No. III, in table) is of coal from this seam, but probably from that part of the outcrop near the mouth of the St. Mary River. The same remark applies to a specimen which was analysed by Dr. Harrington. (Report of Progress, 1877-78, 49 C.) Prof. Haanel's analysis shows 6.69 per cent. of moisture and 6.36 per cent. ash. Dr. Harrington's specimen contained 5.79 per cent. water and 2.05 ash. A specimen from Mr. Sheran's mine, collected and examined by myself, yielded the following result:—

Water	6.52
Volatile combustible matter	31.03
Fixed carbon	56.54
Ash	5.91
	100.00

The coal is compact, does not easily break up by handling or exposure, and is in every respect a very excellent fuel, but does not yield a coherent coke.

In correspondence with the increased distance from the mountains of the outcrop of the same seam on the Bow River, and probable inferior degree of alteration to which it has been subjected, the coal is there found to contain more water, approximating in this respect to some of the Souris River lignites. From these, however, it still differs in its more compact texture and resistance to weathering and the regular vertical cleat or jointage

planes by which it is traversed, which cause it to assume cuboidal instead of conchoidal forms on fracture. A preliminary examination of an outcrop specimen from the locality gave the following result:—

Water	12.37
Volatile combustible matter	32.33
Fixed carbon	46.39
Ash	8.91
	100.00

The seam occurring at the summit of the Pierre formation on the Bow River, and the point which I have designated as Horse-shoe bend, has a very light westerly or north-westerly dip, and is not known to be represented on the Belly River, though it is probably its continuation which appears on the Little Bow, near the mouth of the Snake Valley. The outcrop of Horse-shoe bend is situated about fifteen miles east-north-east of the Blackfoot Crossing. The seam appears at a height of 135 feet above the river, and is exposed for nearly half a mile. It is four feet four inches in thickness, compact and hard where not long weathered, and in physical character resembles that last described. A preliminary examination of an outcrop specimen showed the following composition:—

Water	13.67
Volatile combustible matter	37.16
Fixed carbon	40.50
Ash (reddish)	8.67
	100.00

Still following an ascending order in the series, the seam which has been known for some years at Blackfoot Crossing next claims attention. This is several feet higher in the section than the last, and is distinctly included in the Laramie. It is probable that still another seam exists between this and that last described, but no good sections of it were found.

Coal occurs in several places on the Bow River a few miles above the Blackfoot Crossing. The seams are too thin to work, but are probably on the same horizon with that described below. Throughout this region the beds are affected by gentle undulating dips, and though they have besides a very light general inclination westward, they may be considered as practically horizontal.

The outcrop from which a small quantity of coal has been

extracted, and which has been referred to by several travellers, is situated six and a half miles eastward from the Blackfoot Agency buildings, on a coulée which runs northward to the Bow. The deposit here consists of two seams, the upper averaging one foot eight inches in thickness, the lower three feet. They are separated by about a foot of carbonaceous shale. At this spot the bed may be traced about 500 feet in natural exposures, and is affected by variable dips which do not exceed 5° in amount. The thickness of the seams continues nearly uniform, and they would afford, say, four feet six inches of clean coal, the whole of which would be worked at once. The immediate banks of the coulée are about 80 feet high at this place, the upper two-thirds being composed of drift deposits, which rest on a worn undulating surface of the rocks below. The general level of the surrounding prairie is about 110 feet above the horizon of the coal, and no exposures of the coal or associated rock are found except in the river banks or coulées, which cut deeply into the surface of the plain.

In following the coulée northward from the spot just described, the coal is frequently seen on the right or east bank for about a mile, after which the coulée opens into a wider valley with sloping grassy sides, and exposures cease. Owing to the slope of the bottom of the coulée towards the river, the beds are cut into more deeply near its mouth, and at the last exposure the seam is about thirty feet up in the bank. The upper seam is here not well shown, but the lower exhibits a few inches over four feet of good coal. In an exposure intermediate between this and the first, the upper seam is eight inches thick, the shales one foot, and the lower seam four feet four inches. The seams are underlain by at least twenty feet of soft whitish sandstone. The same bed appears near the Agency buildings, where the Indian trail going eastward, leaves the valley, but the coal seams are here wanting or very poor.

Between the Blackfoot Crossing and the coulée above described, the same coal-bearing horizon appears in several places in the banks of Bow River. The seams are here more favorably situated for working, and of greater thickness than in the coulée. The subjoined section shows their mode of occurrence at one point:—

	ft.	in.
Coal	1	8
Black carbonaceous shale	1	4
Coal	1	8
Shale	0	3
Coal	0	9
Shale	0	3
Coal	3	0
Shale	1	0
Coal	1	10
Total	11	10
Total coal	8	11

The coal is here again underlaid by whitish sandstone for about thirty feet, or to the water's edge. Nearly opposite the exposure, on the south side of the river, the seam appears at intervals in the bank, at a height of about forty feet above the water, for at least a quarter of a mile. It is affected by a series of light undulations.

The natural exposures serve to prove the continuity in good workable thickness of the coal deposit over a tract of country several miles in extent, and its nearly horizontal attitude and moderate depth below the surface of the plains, would enable it to be proved by boring at a small expense over any desired area.

In texture, this coal is not so firm or well adapted for transport as those of the localities previously described, but in composition appears closely to resemble that of Horse shoe bend.

The following are analysis of the fuel from this place; the first from a specimen obtained by Prof. Macoun, the second from one collected by myself, and probably not subjected to such prolonged desiccation:—

	I.*	II.
Water	10.72	13.20
Volatile combustible matter	29.26	33.80
Fixed carbon	46.09	48.10
Ash	13.93	4.90
	100.00	100.00

Three coal bearing localities on the head waters of the Oldman River appear to be of sufficient importance to obtain notice at the present time, but as the country toward the base of the

* By Mr. C. Hoffmann. Report of Progress, 1879–80, p. 12 B.

mountains becomes more fully known, it is probable that numerous additional outcrops will be discovered.

At the Government Indian Farm, south of Pincher Creek, a seam of coal occurs about one mile from the farm buildings up the valley of the small stream on which they are situated. The rocks in the lower part of the valley belong to the St. Mary River subdivision of the Laramie, and dip toward the north-north-east (mag.) Their angle gradually increases from about 20° till the beds become nearly vertical where the coal occurs. Beyond this point the rocks are concealed, but the coal very probably occupies a position very near the base of the Laramie.

Near the coal seam, the beds have been much disturbed, and the coal itself is slickensided and broken throughout in such a way as to cause it to crumble easily by handling. The seam is two feet in thickness where exposed, but it is said to have been considerably thicker where followed into the bank. The opening made on the coal has, however, since been filled in. This seam should reappear on Pincher Creek, above the crossing place of the road, but the horizon at which it should occur appears to be covered.

An analysis of the coal from this seam by Mr. Hoffmann is given in the Report of Progress for 1878–79, p. 12 H. It may be quoted here for comparison with those of the other seams, and illustrates the improvement in quality of the coals on their approach to the base of the mountains:—

Water	6·26
Volatile combustible matter	29·31
Fixed carbon	55·70
Ash	8·73
	100·00

On the middle fork of the Oldman River, a few miles below the falls, and nearly north of the mill on Mill Creek, two miles of good coal occur in a scarped bank on the north side of the stream The beds are each about three feet in thickness, and are folded in a very remarkable manner, illustrating the intensity of the force which has acted in crumpling the rocks near the base of the mountain. It is probable that these beds occupy a horizon near the base of the Laramie. They approximate in character to true bituminous coals, and would yield coherent cokes, but no analysis has yet been made of them.

The section in which these coal seams occur is as follows. The order appears to be descending, but the whole may not improbably be overturned:—

	ft.	in.
Grey to black, very fine shale, with occasional small fish scales and bones, becoming sandy and yellowish at base	6	0
Ferruginous sandstone	0	6
Greyish, soft sandstone or arenaceous clay, with some thin ironstone layers	10	0
Harder greyish and ferruginous sandstone, with some obscure plant fragments	6	0
Hard, flaggy, yellowish sandstone	2	0
Grey sandy shale and shaly sandstone	3	0
Coal	3	0
Soft black carbonaceous shale	0	9
Grey sandy shale	3	6
Grey sandy shale and sandstone	4	6
Grey flaggy sandstone, weathering rusty	2	6
Grey sandy shale and shaly sandstone	5	0
Coal. Imperfectly seen, but at least three feet of good quality	3	6
Carbonaceous shale	1	0
Grey sandy shale	4	0
Ferruginous sandstone	0	6
Greenish-grey sandstone	10	0
Grey and blackish carbonaceous shale	4	0
Greenish grey, soft sandstone	6	0
Sandstone with arenaceous and carbonaceous shale, and general greenish-grey tints (about)	80	0
	155	9

On Mill Creek, about four miles above the mill, a seam of coal outcrops. The measures are somewhat broken, and the seam appears to be rather inconstant in thickness. It was intended last autumn to make a careful examination of this neighborhood, and to endeavour to follow the coal-bearing horizon southward and north-ward from Mill Creek to its outcrop on other streams, but this was prevented by the the early onset of wintry weather. The coal is of excellent quality, and yields a firm coke. It has been used to a small extent in blacksmith-work at the mill. The following are sections of the seam on opposite sides of a break or fault which traverses the measures at the outcrop:—

	ft.	in.
Coal (rather shaly)	3	1
Coal	2	0
Shale	1	4
Coal	2	0
Shale	1	4
Coal	2	0
Total coal	9	1

	ft.	in.
Coal (rather shaly)	2	0
Shale	1	0
Coal (apparently good throughout, with the exception of a few shaly partings, not equalling four inches in all)	6	0
Total coal	8	0

The geological horizon of the coal at Mill Creek has not been determined.

GENERAL REMARKS ON THE COALS AND LIGNITES.

Whether from an economic or purely scientific point of view, one of the most interesting results of the exploration of the Bow and Belly River country is the determination of the fact that the coals are not confined to a single horizon and formation, but characterize at least four zones in the geological series of this region. The fuels found in the Laramie represent, at least in a general way, those characterizing the same formation or its representative, the Fort Union Group, eastward on the plains of the Souris River. As far north as the Athabasca and Peace Rivers, fuels are now known to occur in rocks of about the same age. The coal seam which has been referred to as attached to the summit of the Pierre shales, is not known to be represented elsewhere, unless indeed by a very thin seam near the same horizon on the Smoky River. (Report of Progress, 1878–89, p. 125 B).

The coal at the base of the Pierre, which has been worked at Coal Banks, on the Belly River, has not been recognized in a workable form beyond the limits of the district now described. The dark, highly carbonaceous beds at the base of the Upper Shales of Smoky River, are, however, at about this horizon, and in one place a thin seam of lignite coal is locally developed (op. cit. p. 118 B). A bed of lignite described by Prof. Cope on the

Missouri as in some places of possible economic value must also be of nearly the same age. (Bulletin U. S. Geol. & Geog. Survey, Vol. III., p. 566.) It is further worthy of remark that this coal-bearing horizon at the base of the Pierre of the interior continental region is, as nearly as possible, equivalent to that at the base of Chico Group, which yields the coals of Vancouver Island at Nanaimo and Comox.

The coal in the series below the Pierre on the Bow and Belly Rivers may be taken in a general way as representing those which occur in the Lower or Dunvegan Sandstones of the Pine River in the Peace River country (*op. cit. p. 116 B*).

The occurrence of workable coal seams at several different horizons, and the proved continuity of some of them over great areas, guarantees an abundant supply of fuel in this district, a matter of great importance in a country which over great areas is almost entirely destitute of wood. The quality of some of the fuels is such as to render them suitable for transport to a distance, and it is doubtless on this belt of coal-bearing rocks in the vicinity of the mountains that the railways of the North West will depend chiefly for their supply.

The quantity of coal already proved to exist is very great. The distances for which the outcrops of certain seams have been traced have been mentioned. Approximate estimates of the quantity of coal underlying a square mile of country in several localities have been made, with the following results:—

Main Seam in vicinity of Coal Banks, Belly River. Coal underlying one square mile, 5,500,000 tons.

Grassy Island, Bow River. (Continuation of Belly River Main Seam.) Coal underlying one square mile, over 5,000,000 tons.

Horse-shoe Bend, Bow River. Coal underlying one square mile, 4,000,000 tons.

Blackfoot Crossing. Workable coal in seam as exposed on Bow River. Underlying one square mile, 9,000,000 tons.

—*Report Geol. Survey of Canada*, 1882.

ON THE FORMER SOUTHWARD DISCHARGE OF LAKE WINNIPEG.

By J. D. Dana.

The most remarkable of the changes that are known to have occurred in the water-courses of North America is that in the discharge of Lake Winnipeg from a former southward course by the Minnesota Channel and Mississippi to its modern discharge into Hudson's Bay, first announced and sustained by General G. K. Warren, in a report of 1867, published in a Report of the U. S. Engineers for the year 1868 (pp. 307-314), after levellings along these rivers, by order of the Government, in 1866 and 1867. The question was more fully illustrated by General Warren in "an Essay concerning important physical features exhibited in the Valley of the Minnesota River and upon their signification," submitted to the Chief of Engineers in 1874, and published in the Report for 1875 (pp. 385–402); and afterward, further discussed by him in his paper on the Bridging of the Upper Mississippi, in the Report for 1878 (pp. 909 to 926) with a reproduction of some of the maps of the essay of 1874.

In the first of his papers, that of January, 1867, General Warren, after mentioning the evidences that "Lake Winnipeg was once continuous southward over the central portion of the Red River of the North, and had its outlet down the Minnesota, and not down the Nelson to Hudson's Bay" (pp. 307), considers the origin of the former hydrographical conditions. He speaks of the possibility of an ice-barrier in the north in the Glacial era; but he sets this idea aside, and argues for an actual change of land-level, and makes the southward discharge to have ended in consequence of a depression of land to the south, accompanying (as added in his paper of 1875) a rise to the north; and instancing, as examples of a corresponding change of level, the former *southward* discharge of Michigan Lake through the Illinois River, and of Winnebago Lake through the Wisconsin River. A map of the large Winnipeg Lake—larger he observes than Lake Superior and Michigan together, and having the Saskatchewan River as the head stream—accompanied the written report sent to the Department, but it was not published. The same view is presented at more length in the paper of 1874 (Report for 1875), along with a wider discussion of the facts,

and a review of the writings of previous travellers who had recognised the lake-like features of the region.

The idea of the southward discharge of Lake Winnipeg was presented again in 1875 by Mr. George M. Dawson, in his excellent Report on the Geology of the region in the vicinity of the 49th Parallel, with a recognition of General Warren's paper, but with the statement that the inference was an independent one. In explanation, he says (pp. 253, 254) that "by the flow of a large volume of water in this direction, the excavation of the basins of the Winnipeg group of lakes and the great valley of the Red River itself can be explained; the river cutting downward and westward on the sloping surface of the Laurentian rocks at the expense of the Cretaceous strata and later of the limestones of the Devonian and Silurian; the blocking up of the southern exit and changed direction of flow being a phenomenon only similar to that which is known to have taken place with the great lakes of the St. Lawrence."

The ice-barrier hypothesis has been sustained, in place of that of a change of level, by *Professor N. H. Winchell*, in his Minnesota Report for 1877, who there observes, in his explanation, that the lake, having first appeared at the south or Minnesota end, "grew toward the north as fast as the retreating ice-sheet made way for it." In the Minnesota Report for 1879, the same view is urged, with more detail, by Mr. Warren Upham.

A decision between these two conflicting explanations is of great importance to a right understanding of Quaternary events as well as of fundamental principles in terrestrial dynamics; and I therefore review here the more prominent facts, taking them mostly from General Warren's papers and the Report of Mr. Dawson.

1. The Red River of the North, rising in Lake Traverse, flows northward along the west side of Minnesota for 225 miles, crosses then the 49th Parallel, and continues on the same course for 90 miles to Lake Winnipeg; the distance from Lake Traverse to Lake Winnipeg being 315 miles.

2. The Minnesota, rising to the westward of Lake Traverse, enters its valley within two miles of it and flows south, through Big Stone Lake, to the Mississippi at Minneapolis.

3. The Valley of Red River, after narrowing much, is still 46 miles wide on the 49th parallel, and, for a long distance south

of the parallel, it has an average width of 30 miles (General Warren's map and G. M. Dawson's statement); toward Lake Traverse it narrows rapidly, is a mile long along the lake, the sides rising abruptly from the borders of the lake; beyond this lake, southward, it continues on, one to two miles wide, as the valley of the Minnesota River; and, where it joins the Mississippi, the valley has four times the width of the Mississippi valley above the junction (General Warren).

4. All now agree that the wide part of the valley which stretches northward from Lake Traverse is lake-bottom prairie, that it was adopted by the Red River, not made by it (Dawson); and that the part south of this lake is, as General Warren first showed, the deserted highway of the overflowing river and lake.

5. The Red River lake-bottom valley is bordered much of the way by abrupt sides rising 100 to 200 feet to the top of a terrace-plain or plateau; and, similiarly, the Minnesota channel has sides usually 100 to 150 feet in height.

6. Heights above the sea-level:

(B. C. means Boundary Commission Report.)

	1. Lake-bottom prairie.	2. Bordering plateau.
Near 45° 30′ N., between Big Stone Lake and Lake Traverse (5 miles apart)	970	1,120
Near 47 N., at Fargo and Moorhead	900	1,050 (?)
On the 49th parallel near Pembina and St Vincent,*	784 (B.C.)	East side 989 West side 994
Toward Lake Winnipeg	740	810
Height of Lake Winnipeg (about the mouth of Red River, a great marsh) 710 feet		

* The height of the Lake of the Woods is 1048 feet (B.C.); of the divide between it and the near-by head of Rosseau River, a westward-flowing tributary of Red River along the 49th parallel region about 1078 feet (Dawson); edge of the plateau where it looks down on the lake-bottom about Pembina, 90 feet less (B.C.), and hence about 988 feet; Pembina Mountain, on the west side, 210 feet above the lake-bottom prairie, and hence 784+210=994 feet above the sea-level. Red River as it flows in its channel is 20 to 60 feet below the surface of the lake-bottom prairie; at Pembina, about 50 feet (Warren).

The heights on Minnesota River are (Winchell's Report):

Surface of bordering plateau near Big Stone Lake	1,125
At Mankato, 145 miles south	975
At Shakopee, 50 miles northeast	925
At junction with the Mississippi	800 to 820

7. The *slope* of the lake-bottom prairie is *northward*, toward Lake Winnipeg; and, from the 49th parallel, according to Dawson, it is nearly six inches per mile; the mean slope from Moorhead in Minnesota, 150 miles south of the 49th parallel, is little less than one foot per mile.

The slope of the bordering plateau *northward* from Lake Traverse to Lake Winnipeg, 315 miles, is about one foot per mile; for 1,125–810=315.

The slope of the bordering plateau along the Minnesota from Big Stone Lake to Mankato (145 m.) is *southward* and about one foot per mile; for 1,125–975=150.

8. The material of the lake-bottom, where examined by Mr. Dawson, is mostly yellowish clayey earth or loess, containing calcareous matter enough to effervesce freely with acids; the upper portion is rarely so coarse as to be called sand, though sometimes an arenaceous clayey material; that of the border is also somewhat arenaceous. The depth of this lake-bottom deposit is generally 40 feet or more over the central portions, but it thins towards the sides. This point is illustrated in the plate facing p. 248 in Dawson's Report. He represents the loess as overlying stratified drift and boulder clay. The surface of the prairie rises somewhat toward the sides; but whether the depression is more than would result from the drying (and consequent contraction) of so much wet loam after the disappearance of the lake, is not ascertained. It is rare to find anything like pebbly areas or pebbles over it.

9. The outline of the lake-bottom prairie has the appearance of being, so far as it extends, the outline of the great Winnipeg Lake, and is so recognized by Warren, Dawson and others.

10. The material of the bordering high plateau along both the Red River portion and the Minnesota is coarse gravel and sand; much of it unstratified till, much, more or less stratified; and the upper surface is often pebbly or stony, with occasional boulders.

Roseau River, for 25 miles east of the western edge of the plateau, says Dawson (p. 214), has cut deeply into the plateau

formation so as to have high bluff sides; and the sections show alternating beds of clay, sand and gravel characterised by "current bedding;" one of them having stratified arenaceous clay below, then coarse gravel, then sand, and then gravel as the top beneath the soil; another "typical one" consisting of hard-compacted clay below, partly stratified, then a thin pebbly bed, then sand, then the upper gravel. These are given by Mr. Dawson as examples of the constitution of what he calls the "Drift Plateau of Eastern Manitoba and Northern Minnesota." He says of the great "High-level Plateau" that it is frequently irregular in detail, covered with banks and ridges of sand and gravel of the nature of "kames," but on the whole, remarkably uniform; on the 49th parallel it rises gently eastward toward the Lake of the Woods, 90 feet in the 77 miles. On the upper part of the Minnesota the deposits are largely the Glacial drift (General Warren, and Professor Winchell), with also portions that are bedded.

Conclusion.—Taking the accounts of the region from which we have cited to be correct, we have the deduction forced upon us that Winnipeg Lake did not lose its discharge into Hudson's Bay and become the great lake with southward discharge, because of a barrier of ice or of any other kind. For if so, if there had been no great change of slope over the region, the shores of the *great* lake should be approximately horizontal, to its outlet at Lake Traverse, and if horizontal, they would have a height in the vicinity of the present Winnipeg of 260 feet above the lake, supposing the waters just up to the Lake Traverse level, and 300 feet if the water at this place of discharge was merely 40 feet deep. Instead of this condition, *the observed shore line has nearly the present general slope of the surface;* and, further, *the slope of the lake-bottom prairie is not much different from that of the bordering plateau on either side.*

We have thence the conclusion, since the present outline of the lake-deposits or losses whatever the present slope, was approximately the shore-line and once horizontal, that there has been a great change in the level of the land, as General Warren urged. The idea of a change in the position of the earth's centre of gravity sufficient to change the slope of the surface a foot a mile, or half a foot, cannot be reasonably entertained.

We may infer also, from the near correspondence between the northward slope of the lake bottom prairie and that of the bordering plateaus, that the prairie and plateau were affected alike by the conditions as to level. And we may deduce from the regularity of the slope, that the conditions as to level affected equally the region from Lake Traverse to Lake Winnipeg, and beyond doubt also to a much greater undetermined distance northward.

This conclusion bears so profoundly on questions as to the condition of the earth's interior, and the origin of changes of level over the earth's surface, that it is greatly to be desired that further investigation should place the facts beyond all doubt.

Admitting that the facts are correctly given, they appear to point to the following succession of events:

The fact that the lake deposits are underlaid by unstratified drift, shows that before the era of the great lake the glacier had moved southwestward over the region, and deposition of moraine material had taken place. The high-level prairie either side of the lake region and of the Minnesota valley is made largely of this unstratified drift; but the generally level surface in the part toward lake region and valley, and the stratification in much of the material, are evidence that the floods from the melting glacier covered and levelled it, and stratified its bedded deposits; the coarseness of these deposits, and the large size of the valley of discharge, that the flood waters had great velocity; the height of the prairie, that they stood 100 to 150 feet above the present level of the region including Lake Traverse, instead of the 40 feet at the divide above supposed. This time of maximum flood and of rather violent fluvial conditions was followed by the era of the Great Lake, that is of quiet waters and lacustrine deposits, with slow discharge over the Lake Traverse region; which may have been brought about in part by diminished supply of waters from the melting ice and precipitation, but more, with little doubt, by a diminution in the slope of the general surface, which was a part of the great change of slope that went on, as explained by General Warren, until the land was reduced to its present pitch and the streams to their modern courses.

The application of a new name, Lake Agassiz, to the flooded Lake Winnipeg, proposed by Mr. Upham because of its alleged relation to the retreating ice-sheet, tends to obscure the great

historical facts in the case. All desire to honor Professor Agassiz, and no one more so than the writer; and still the name that most deserves honor in connection with the developments in Central North America is that of General G. K. Warren. But rather than use either, it is better to let the accepted name, Lake Winnipeg, be the name for past, as it is for the present time.

NATURAL HISTORY SOCIETY PROCEEDINGS.

The first regular meeting for the session 1882–83 was held on the evening of October 30th—Principal Dawson occupied the chair.

Mr. Wm. Little and Rev. Robert Campbell were elected members of the Society, and Messrs. J. H. Burland, J. A. Porter, J. Alphonse Beaudry and Albert Holden, were proposed for membership.

Principal Dawson read an interesting paper on "Portions of the Skeleton of a Whale from Gravel on the line of the C.P.R., near Smith's Falls," which have been presented to the Peter Redpath Museum, and were exhibited to the Society. The remains were those of one of the larger whales, probably *Balæna boops*. This species is well known to the Gaspé whalers. The writer had seen it as far up the St. Lawrence as the mouth of the Saguenay, and there is reason to believe it occasionally runs up much further. Some evidence exists that whales caught at Gaspé have a species of barnacle known only in the Pacific Ocean. Possibly these have discovered the North-West passage. The bones of the Mastodon (land elephant), which are often found, probably belong to the same period as these whales. The whales, seals, and other fishes still exist in our seas, while the land animals are extinct. When these whales were stranded the sea was probably 450 feet above the present level of the St. Lawrence.

Dr. T. Sterry Hunt said that the interesting remarks of Dr. Dawson showed that the naturalist of the present day not only studied the remains which he discovered, but also reconstructed the geography of the surface of the globe. Historically these bones were ancient, but geologically quite recent, and were valuable as showing the changes now going on.

For further particulars concerning these remains the reader is referred to page 385 of this number of the *Naturalist*.

The second meeting was held on Monday evening, Nov. 29th—The President occupied the chair.

Messrs. J. H. Burland, J. A. Porter, J. Alphonse Beaudry and Albert Holden were elected ordinary members. Mr. A. D. Ross was proposed as an honorary member.

The Somerville Lecture Committee reported progress.

A letter from the Royal Society of Canada was read, asking the Society to elect annually a delegate to attend its meetings at Ottawa, and report on the work of the Society during the session.

Dr. T. Sterry Hunt's paper on the "Taconic Controversy in Geology" was reserved for next meeting, the author being out of town.

Mr. F. B. Caulfield exhibited a large collection of Canadian Lepidoptera, which he offered for sale.

Dr. Edwards called the attention of members to a small white Hydra which he had found in his aquarium.

A collection of minerals, presented by a lady to the Museum of the Society, was examined by the members present, after which the meeting adjourned until December 18th.

The meeting adjourned from November 27th was held on December 18th.

Dr. T. Sterry Hunt occupied the chair. Prof. R. J. Fowler exhibited and described his water-color drawings of Canadian fishes, ordered by the Canadian Government for the Canadian Exhibit in London. A pleasant evening was spent examining these drawings and listening to the Professor's remarks on species and varieties of Canadian fish and on Pisciculture.

The third meeting was held on Monday evening, January 25th—the President, Principal Dawson, occupied the chair.

Routine business being ended, a letter was read from Mr. Wickstead, relative to the exorbitant Customs duties on scientific instruments.

After considering the letter it was resolved on motion, that the Recording Secretary draw up a memorial to the Minister of Finance, requesting him to reduce the customs duties on microscopical and other scientific instruments and preparations.

The Somerville Lecture Committee reported that the Rev. Robert Campbell, pastor of St. Gabriel Church, would deliver the first Somerville lecture of the season on Thursday next, his subject being "The Life and Bequests of the Rev. James Somerville," founder of the course.

Mr. A. D. Ross was elected an honorary member, and Mr. J. T. Donald was appointed representative of the Society at the next meeting of the Royal Society of Canada.

A large number of recently bound valuable books belonging to the library were exhibited, and on motion the thanks of the Society were tendered Messrs. J. H. R. Molson, Marler, and J. H. Joseph, for their liberality in defraying the expenses of the binding.

Dr. T. Sterry Hunt, F. R. S., then delivered a short lecture on the "Taconic Controversy in Geology. In the course of his remarks he explained the relation between the Palæozoic and the older crystalline rocks of North America. He spoke of the great belts which form the Taconic hills of Eastern New England, and which had been regarded as of the Palæozoic age. He showed the stratagraphical grounds for regarding them as much older and as belonging to the Eozoic period. The same rocks, he stated, in conclusion, were to be found in Nova Scotia, Trinidad, South America and British India.

The Rev. Robert Campbell then suggested that the Society should unite with the St. Gabriel Church congregation and the Montreal General Hospital, to erect a monument over the grave of the late Mr. Somerville, founder of the Somerville Lectures, in Mount Royal Cemetery. After giving an interesting account of the removal of the body from the old cemetery on Dufferin Square to its present resting place at Mount Royal Cemetery, he proposed that a gentleman be appointed to confer with the representatives of the congregation and the General Hospital as to what measures could be taken for the erection of a monument.

On motion Mr. G. L. Marler, the Treasurer of the Society was appointed for this purpose.

The President reported that he had recommended the purchase of such specimens of Mr. Caulfield's collection as were not already in the Society's cabinets, at a cost not to exceed $10.

MISCELLANEOUS.

Canadian Fish.

The collection of fish from the waters of this Province for entry at the International Exhibition at London, next year, is at present under the hands of the taxidermist, and will be ready for shipment in a few weeks. Some expense has been gone to in preparing the collection of these specimens, but it is hoped that the exhibit will, besides attracting attention to the commercial value of our fisheries, be the means of attracting to the Gulf and our Atlantic seaboard, the large and influential body of sportsmen who now go to Norway or up the Baltic from Great Britain and the Continent, and thus not only cause considerable sums of money to be spent among our people, but make Canada known to a rich class, having a considerable influence over emigration from the other side. Mr. J. A. N. Gregory, Agent of the Department of Marine and Fisheries at Quebec, has charge of the exhibit, which will include the following:—White porpoises, 2,000 lbs. weight, 15 feet in length; puffing pig or hog fish, 3 feet 6 inches in length; dog or ground shark, 600 lbs. weight, 13 feet in length; thresher shark, 13 feet in length; mackerel shark, 8 feet 6 inches in length; small shark (lamna), 3 feet in length; harp seal; harbor seal; square flipper seal; young Greenland seal; eel-shaped blenny, 12 lb. weight, 2 feet 6 inches in length; wolf fish or cat, 40 lbs. weight; tunny or horse mackerel, 8 feet 9 inches in length; smooth skate, 5 feet in length; skate, 2 feet 6 inches in length; halibut, 224 lbs. weight, 6 feet 7 inches in length; halibut, 200 lbs. weight, 6 feet 4 inches in length; lump fish, 15 inches in length; codfish, 60 lbs. weight, 5 feet 2 inches; haddock, 13 lbs. weight, 3 feet in length; sheep's head, 2 feet 6 inches in length; star fish, 5 to 12 points; sea spider, common crab, hermit crabs, shells, sponges, shrimps, sculpins, white fish, 3 lbs. weight, 18 inches in length; white dace, 1½ lbs. weight, 15 inches in length; perch, 10 inches in length; sunfish; black sea bass, 13 inches in length; common bass, 9 inches in length; black bass, 16 inches in length; smelt, 12 inches in length; bull frog, sardines, tommy cod, eelpout, mud fish (beaver fish), 7 lbs. weight, 2 feet in length; sea cucumber; sea bass (striped), 20 lbs. weight, 2 feet 10 inches in length; lobsters, 10 lbs.; eels, 8 lbs. weight, 4 feet 6 inches in length;

salmon, 38 lbs. weight, 3 feet 10 inches in length; salmon 45 lbs. weight, 4 feet in length; land locked salmon (wanoanish) 60 lbs. weight, 2 feet in length; great lake trout; lunge 3 feet in length; sea trout, 22 inches in length; speckled trout, 22 inches in length; sturgeon, (short nose), 5 feet 6 inches in length; sturgeon (sharp nose), 3 feet 6 inches in length; do., 4 feet 9 inches in length; muskelonge, 40 lbs. weight, 4 feet 2 inches in length, and 35 lbs. weight, 4 feet in length; pike, 15 lbs. weight, 3 feet 4 inches in length, and 12 lbs. weight, 3 feet in length; gar pike, pickerel, channel catfish, 15 lbs., 8 lbs., and 4 lbs. in weight; mudpout, bullhead, pike, perch (yellow) 8 lbs. 2 feet 3 inches in length; turbot, 5 lbs. weight, 2 feet in length; mooneye, 1 foot in length; pale sucker, mullet sucker, common sucker, mullet.

Also a Restigouche bark canoe used in salmon fishing; a Murray Bay canoe used in porpoise hunting, and a model of a gulf fishing schooner.

Experiments with Chemical Manure.

In a recent number of the *Chemical News*, Mr. A. B. Griffiths gives the result of some experiments made to ascertain if possible the reason why plant life, when treated with a chemical manure, composed principally of animal charcoal, phosphates and ferrous sulphate, should grow so luxuriantly. The details of the experiments are as follows:—

Three very young savoy cabbages, all nearly of the same weight, and in a healthy condition, were chosen. No I. cabbage was planted on a piece of land, and no manure was added to the soil on which it grew. No. II. cabbage was planted on the same piece of land and near to No. I., but was treated with a weighed quantity of this chemical manure. No. III. cabbage was planted on a different piece of land to that on which No. I. and II. stood, and was treated like No. II. with the same quantity of manure, but grew more in the shade.

Plants Nos. I. and II. therefore received the same amount of sunlight and rainfall, but No. III. plant grew under different conditions. All the plants were placed in the ground on the same day, and grew from February to December. Then they were carefully taken up with their roots attached, all adhering soil was removed by washing, and they were then weighed.

Plant No. I., grown without the manure, weighed 4 lbs. $2\frac{1}{2}$ ozs.

Plant No. II., grown with the aid of the manure, reached the great weight of 9 lbs. 3 ozs.

Plant No. III., also treated with the manure, but under different circumstances to those of No. II., weighed 8 lbs. 6 ozs.

These were grown in a garden in the vicinity of Lower Norwood, Surrey.

Now, various parts of the leaves and of the stem of each plant were separately reduced to ashes, the greatest care being taken in the incineration, to prevent the alkaline salts fusing, &c. The plants were burnt on a platinum sheet made in the shape of a muffle, and heated at a low temperature in a gas furnace. The ashes gave the following results on being submitted to chemical analyses:—

	No. I.		No. II.		No. III.	
	Leaves.	Stalk.	Leaves.	Stalk.	Leaves.	Stalk.
Potash	33·951	41·231	31·634	39·223	31·521	38·929
Lime	15·665	13·601	14·210	13·583	14·310	13·621
Soda	2·523	4·296	1·825	2·360	1·917	1·813
Iron (Fe_2O_3)	8·323	1·502	12.290	3·521	11·832	3·005
Magnesia	4·936	6·210	3·128	6·000	2·921	5·942
Phosphoric Acid	12·931	14.463	16·210	18·944	16·123	18·891
Sulphuric acid	8·613	9·619	7·641	8·916	7·592	8·922
Chlorine	7·994	6·781	7·310	4·200	7·400	4·319
Silica	4·999	2·294	5·631	3·121	6·265	4·468
	99·935	99·997	99·879	99·868	99·881	99·910

It will be seen from the above analyses that the plants treated with the manure contain a larger proportion of iron than those grown without the manure, and the leaves contain a larger percentage of iron than the stalks.

The conclusions to be drawn from these experiments are:—

1st.—The plants when grown in soil containing iron in a soluble form, and with phosphoric acid also in a soluble form, are healthier and larger than if they had been grown in a soil which did not contain these soluble compounds.

2nd.—The plants grown in soils containing this mineral manure appear to absorb larger quantities of soluble iron and soluble phosphates than when not so treated.

3rd.—The plant No. II., which was placed in the most favorable position as regards sunshine and rain, absorbed a greater amount of soluble iron and soluble phosphoric acid than plant No. III., which was grown in a less favorable position. Whether the plants have the power of selecting and taking up by their rootlets these compounds from the manured soil, or whether the plants simply absorb any substance in solution supplied to them, I am unable to say; but it appears that the healthy condition and gigantic growth of the plants Nos. II. and III. were due to the fact that they were supplied with iron (in a soluble form, $FeSO_4$) and phosphoric acid also in a soluble form.

I am inclined to think that a fairly large proportion of soluble iron and soluble phosphates in a soil is favorable to the growth of plants of a deep green color (that is, plants which develop a large amount of chlorophyll cells), like the varieties of cabbage.

From the researches conducted by Mr. F. C. Phillips, of the United States, "On the Absorption of Metallic Oxides by Plants" (CHEMICAL NEWS, vol. xlvi., 224), it seems that his experiments confirm the non discriminating theory of plant absorption of Dr. Freytag.

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