

11

On a subdivision of the Acadian Carboniferous Limestone,
with a ~~section~~ a description of ^{a section} these rocks at Windsor N.S.
by C. Fred Hazel Arn.

During several excursions made ^{previous} to the year 1864 (to Nova Scotia) I visited Windsor, Brookfield and Schubencadie and Stewiacke making extensive collections of the fossils of the Carboniferous limestone so abundant at these localities. Taking care to keep all the species obtained from any one of these bed or set of beds ~~together~~ ^{any} separate from those from other beds, I soon found that certain groups of fossils were limited to their occurrence to certain beds and that by means of these ~~fossil~~ ^{groups of species} the whole series might be subdivided somewhat after the manner of the sub-carboniferous limestone of the West. In the summer of 1864 I spent some time examining the same ground and only out a section exposed on the ^{river} Avon R at Windsor. The collection made at that time I had an opportunity, through the kindness of Prof. Agassiz, of examining at the Museum of Comparative Zoology; but before my studies had been ^{brought} to completion they were interrupted by my Brazilian journey and as I have in this city no facilities for resuming them I have sent a considerable collection of these fossils to Dr. Dawson & Mr. Billings for determination so that ample material will be afforded for the establishment of the faunal differences of the subdivisions of the Acadian Carboniferous limestone which I shall attempt to point out in this paper.

On the right bank of the river Avon at Windsor, a few rods below the bridge there begins a bluff, which attaining in some places a height of ~~50~~ ^{fifty or sixty feet} ~~feet ^{feet} skirts the shore for the distance of about half a mile above the bridge when it gradually descends ~~into a tract~~ ^{into a tract}~~

of Marsh which occupies the shore for nearly three-quarters of a mile further up, where there is a good exposure of a heavy bed of limestone ^{seen} ~~appears~~ - a bluff called the Old King rock. The bluff below the toll-house ^{the bridge} is composed of drift, a great part of the mass being derived from the underlying dark red, soft, friable, calcareous, marl-like sandstone. ~~of the~~ At the toll-house the first rocks in situ appear buried deeply under the drift deposit, Thence southward for about half the length of the bluff above the bridge the beds of Carb. limestone, ~~marly~~ ^{clayey} sandstone etc., crop out under the drift. Some of the harder beds ~~occupy the whole face of the cliff~~ extend from top to bottom of the cliff; but owing to the softness and friable nature of the marly beds and the way in which the beds of limestone are broken up by the action of the weather & hidden by drift & debris the section is not easy to work out. Fortunately the line of strike of the beds is such as to carry them out on the ^{sloping} shore and tho' they are ~~now~~ much hidden by ~~much~~ shingle and mud deposits of the turbid Avon we are able to gather together materials for the piecing together of our section and occasionally to gain a clue as to the arrangement of the beds which is not given with the cliff.

Beginning at the beds of the toll-house and going thence southward along the shore we find the following succession of beds:

The first rocks seen at the toll-house are beds of limestone having a strike of S. 15° E. and a dip of 65° to the Northward. and of which a thickness of about ^{twelve feet} 12 ft. is visible. The upper part then limestone are, in their weathered state, cream colored, earthy, soft & highly laminated, but with some compact

bands. They afford ^{of slender} ~~flattened~~ ^{flattened} cylindrical kind without
 carbonaceous coating, a ~~Productus~~ ^{Productus} of the ~~Cora~~ ^{Cora} type, exactly like
 that so common in a reef just south of the bridge, and of
~~Blakeella~~ ^{Blakeella}-like shell. In the middle portion is a band of
 soft, earthy, light lead colored limestone apparently full of fucoids
 and with a few fragments of shells. In the lower part there is a
 not very compact, light brown (weathers) limestone of a beautiful
 oolitic structure. Then follows ^{in descending order} a bed of very friable, fine grained
 greenish sandstone cemented by carbonate of lime, which is succeeded
 by a bed of the same character, but of a deep red color from the
 presence of iron, but this has several greenish layers. This bed occu-
 pies the shore for a distance of about ^{some five feet} (75 ft.). In the lower part it is
 much obscured by rubbish. The cliff is then occupied for a distance
 of about ^{thirty} 30 feet (horizontal) by a limestone of a loam texture
 and a light bluish color mottled with white, probably altered
 by the action of the weather. The bed is much fractured & hidden
 by debris. Then succeeds an irregular mass of ~~Braccia~~ ^{Braccia} com-
 posed of angular fragments of limestone, ^{and this} rests on bed of light lead-
 colored, highly laminated calcareous shale & limestone bands, thick-
 ness six feet, strike E. 15° S. Dip 25° Northward. Fucoids.
 Underlying this is a highly vesicular limestone the cavities being
 lined with minute crystals of Calc. spar. Thickness ^{five feet} 5 ft ±. Then
 come ^{fifteen} 15 feet of light lead colored, fissile, often highly laminated
 limestone, which from its harden form the most prominent part of
 the cliff and extend in a reef down to low water mark. These
 beds are very rich in fossils.

The most characteristic fossil of this ^{bed} is a ^{Productus} of the ^{True} *Cora* type, but differing from *P. Lyelli* ^{de Vermeille} in its quite smaller size, its long perpendicular posterior marginal prolongation, its more prominent & less numerous ^{surface} lines which is given by a more regular and frequent implantation or bifurcation. ~~It is to this productus which the majority of paleontologists would I doubt not unhesitatingly refer to P. Cora, and but to C. Lyelli. I have given the name of P. novascotiae believing that it is a distinct species.~~ This *Productus* is exceedingly common in certain layers of the shelly limestone. Among the few other forms associated with it is a *Blakevella* usually indifferently preserved and a slender branching graptoid often preserved as a carbonaceous film. ~~Some~~ minute stems of *Crinoids* occasionally occur. It is worth of note that *Crinoidal* remains are exceedingly rare in the limestones of the Carboniferous about the Basin of Minas and I have obtained only the stems, which are always minute. The dip of them bed varies from 35° to 50° Northward; strike same as last observed.

Successive ^{beds} ~~beds~~ are ^{beds} of a very dark, blackish limestone very hard ^{cracking into} small irregular pieces & wearing nodular thickness ^{five to six feet} 5-6 feet. This is full of fossils the most characteristic is a *Spirifer* which appears to differ from *Spirifer glaber* Martin ^{various} only in its smaller dimension, a small *Rhynchonella* with large plait ^(R. Ida, not a Spirifer) like *Doctoplicatus* but larger, and I have found here a single specimen of a *Phillipsia* which differs from *P. Howi* in wanting the tubercles on the apical rings & pleurae of the side lobes, in the shape of the pygidium which more rounded in outline & in which the given ~~of~~ are distinctly marked in the six anterior pleurae. For this species which appears to be new I have proposed the

* The following regarding this as a variety of *P. Cora* long proposed by me. It may be designated as var. *Novascotiae*, the name long proposed by me.

cor. beds.
To the series of beds characterized by *P. novae-zealandica* and *P. spines* I suppose it name of *Strophomena* limestone

in his description of this sub-⁵acidic geology name of *P. Vindobonensis*. ^{Dr} Dawson has inadvertently made a ~~mistake~~ placing this bed on the southern side of the ^{gully} fault about 500 yds. There is also a minute *pholites apiculatus* shell occurring ~~underlying the bed~~ ^{in the bed}.

Underlying these beds are ^{seven one-half} $7\frac{1}{2}$ feet of calcareous sandstone of a light lead color and decomposing into a soft, non tenacious mass, then ^{nine} 9 feet of compact, fluggy light brown, limestone with chalybeate partings, without fossil apparently, & very friable shale of a bluish tint much decomposed at the surface and hidden by rubbish, here we have a fault, ^{a dislocation of} and the beds are separated by about 8 feet.

Then comes a bed of red, very friable, marly, calcareous sandstone of which a thickness of about ^{thirty} 30 feet is exposed. Here the surface water has excavated a considerable gully thro' the soft sandstone.

There can be no doubt that ~~as far~~ Dr Dawson has somewhat described, there is a fault here, for the bed on the other side of the gully are seen dipping southward and there is no repetition of the beds strata.

Continuing the section, the pink bed seen on the opposite side of the gully is exactly like that last described and occupies the shore for some ^{eighty} 80 feet. ^{this is overlain by} A bed of limestone, fluggy, with bands more compact. In the cliff these beds have a dip southward of 40° ; but at its foot they become more nearly vertical and run out some ^{twenty} 20 feet on the beach with a strike of $E. 10^\circ S.$ and an almost vertical dip, inclining however to the south about 96° to 95° . Along a belt of mud on the shore at low tide we find the same beds appearing with the same strike near the bed of the river; but their dip is reversed and they are inclined to the northward at an angle of 25° to 30° . Thickness of beds just

Twenty to twenty-five feet.

described as 25 ft.

A bed of the red marly sandstone about 35-40 feet thick next follows. It seems to be irregularly stratified and there are several green layers. This same bed ^{is seen only} succeeds at low water mark to that last mentioned, ~~with a strong south~~ Bed of limestone with a strong southerly dip next come occupying the cliff for a distance of ^{south to southerly} 80-100 feet along its base, whence they extend out on the shore for some ^{twenty feet} 20 ft. with an ^{entirely} ~~inclined~~ and ^{almost vertical} ~~upright~~ dip. In their line of strike across the a belt of sand & mud and shingle, a few yards down the beach, the same beds appear again describing a slight curve ^{to} the north on the inclined beach, tracing them towards low water mark and they gradually change their dip toward the north until at the bed of the river it is about 60° N. Examined at the base of the cliff the limestone of these beds is of a bluish color, weathering light brown, concretionary in the lower part, & with a band in the middle of a beautiful oolitic structure. This limestone appears to be quite unproductive in fossils except in one or two thin bands which are closely packed full of minute gastropods & joints of slender stemmed Crinoids. Associated with these are occasionally found a fossil resembling a large *Dentalium* but Mr. Meek writes me that it does not belong to that genus. The fossils which characterize this bed seem to me to be quite distinct from those found in the other beds. I have not observed this ^{limestone} ~~bed~~ elsewhere.

A bed of the red marly sandstone (thickness?) overlies the limestone appearing also at the foot of the beach with and this is overlaid in turn by a bed of limestone ^{fifteen} 15 feet in thickness having a southward dip of 45°. This last bed is seen to be

Ward
Ward
Lewiston
1873

(8)

overlaid by a bed of brecciated marly sandstone having a layer of a green tint about a foot thick at its base. The face of the cliff is here not very clear, but the limestone is seen to be broken abruptly off by a fault and the marly sandstone to ~~see~~ occupy the face of the ^{bluff} cliff from top to bottom. This fault I developed by cutting a way through the face of the bluff.

The limestone last described is very compact and of a light, clear, leaden-blue color, ~~the~~ weathering however to a brown. It seems to be made up of alternate layers of very hard and a concretionary limestone and a softer kind so that they wear unequally which gives to their upturned edges, exposed on the sea shore, a rubble appearance. This bed has usually been supposed to be non-fossiliferous and it is not mentioned by ~~Prof~~ Dr. Dawson in his Acadia geology. Struck with the resemblance ~~between~~ between the light tinted limestone here to that which at Kennetcook affords the Phillipsia Howi ^{Billings}, I was led to examine it with care and was rewarded by finding a specimen of that trilobite together with a Lophrentis common to the Kennetcook and Cockequegin limestones, ~~together~~ and a number of other fossils. Among them was a spirifer over two inches long, a valve of which was

In S. Dawson's collection there is a large Orthoceras
and a Bellerophon from Kennetcook

(8)

which refer doubtfully to Athyris lamellosa L'Eveille. A. Producta
quite indistinguishable from the ordinary form of P. semi-reticularis
~~which~~ another species like P. costatum with very long spines.

There are also several species of myoid lamellibranchs, and occasion-
ally one finds a minute fish tooth. # An Athyris somewhat like
A. subtilis, but distinct, occurs in this bed both at Windsor
and Kennetcook together with a ~~Stenopora~~ Stenopora and a
Fenestrella (Reticopora?) both of which are not found in both
beds.

The Kennetcook limestone is quarried for building purposes
and the library of King's College at Windsor is partially built of
it. From this limest Prof. How has collected many of these fossils.
A fenestrella occurs quite abundantly in some of the layers at Ken-
netcook but I have never detected it at Windsor. &
~~these~~ ^{of the same} ~~these same~~ beds appear ~~far~~ low down on the shore ~~much~~
~~that~~ but badly exposed owing to the loose material encumbering the
surface. ~~contains~~ The same limestone ^{bearing?} the same fossils
are exposed at Lower Stewiacke on the Stewiacke River near the
house of Mr. Jacob Stevens, where it has a strike of N. 50° E. &
a dip of 45° S.W. This bed is so well characterized both faunally
and lithologically and has an extension over so large an

9
Tends to merit a ^{place name} ~~name~~ ^{are} that I would propose for it the name of Kennetcook
~~the~~ Limestone

Continuing our examination of the bluff still farther south
from the fault last described ~~there~~ we find the rock so dis-
integrated and the stratification so obscured by the fall of rubbish
over its sloping face that little else can be ascertained except
the presence of beds of nearly ^{sandstone} and limestone from the oblique line
~~now~~ seen on the face of the bluff. About one hundred yards beyond
the fault occurs a bed of snowy white gypsum containing stellar
crystals of ~~gypsum~~ ^{selemnite} disseminated thro' it, which being of a brownish
tint are very conspicuous ~~on the weathered~~ on the weathered sur-
faces. ~~If we cross the hill~~ This gypsum was formerly quarried
at this point for exportation. If we cross the hill in the line
of strike ^{of the bed} we ~~soon~~ reach ~~it~~ at a short distance from the river the
principal quarry of this vicinity excavates in this same bed which
is here about ^{thirty} 20 feet in thickness with a strike of S. 35° E. and
a dip of 15° to 30° to the southward. The excavations made in quarrying
the gypsum is some ^{thirty} 20 feet deep, 100 feet wide & 500 feet
long. The bed does not seem to be very regular and it appears
to be composed of concretion.

~~Return~~ Returning to the river side we find the section fails from the
 gypsum bed ~~and~~ and it is not until we reach a fence where
 the shore bends eastward that we meet with any exposure of rock
 of any interest. Here there is an irregular mass of limestone
 of a brownish color exceedingly rich in fossils being almost wholly made
 up of shells. There are often empty, so as to give the rock an open
 texture. Following ^{the higher land of} the shore eastward along a marsh ^{for a few rods} ~~continued~~ we find
 it making a bend southward once more along a low bluff of the same
 limestone and here as well as at the first named exposure of
 the limestone beautiful specimens of its characteristic fossils may
 be obtained in great quantity. The bed is so badly exposed that its
 thickness cannot be determined, and it has a slight southward
 dip.

Windsor limestone

This bed which I shall call the Windsor Bed have afforded me
 a large number of very interesting species, among which the following
~~one~~ may be named as the most characteristic;

of Radiata, a few Crinoid joints, very minute, have been detected
 but they are by no means common. A Stenopora ^{S.} ~~Stenopora~~ terispore
 (spongia of Acad. zoology) is exceedingly common & very characteris-
 tic of this bed.

Debert beds dark shaly impure limestone.

Bed 2. Shaly. somewhat cherty like Bed 2 & 3.

(11)

The fauna of this bed is not rich & articulated, but it has afforded a *Lepididia*? a *Scaphula*(?) and part of the cephalothorax of another Crustacean (a decapod?) which is in the hand of Dr. Dawson & Mr. Billings for study. **

It is in Mollusks that this bed is especially rich and of them the following may be named: —

Bryozoans, a species of *Fenestrella* [Reticular?] different from the species occurring elsewhere, very rare.

Brachiopods, *Rhynchonella* *Evangelinae*, not *Camarophoria*?

Globulina? of Davidson's paper, very common, this has the characteristic oral supports of *Rhynchonella*, which on careful examination a large proportion of the specimens being hollow.

A small *Productus*, ^{P. Dawsoni not.} of the *Cora* type is very abundant. It is very different from the other *Productus* of Nova Scotia & it differs from *P. Lyelli*, *D. Vermeil* is being constantly smaller, more globose and wanting in the large marginal prolongation.

A *Terebratula* (*T. Sacculus* Mart.) is not a common fossil in the bed, I have examined large ^{numbers} collection of specimens of the form & have compared them not only with the *T. Sacculus* of Davidson's paper from the overlying bed, but also with ^{specimens} of that species from Dr. Koninck's collection in the Museum of Comparative Zoology but I can not satisfy myself that they are specifically identical.

Lamelli-branches, several species of *Aviculopecten* are especially abundant. Of one of these, *A. v. v.* ^{simplex} Dawd., Mr. Meek writes me as follows: "There are among the Windsor collection several good specimens of a little shell exceedingly like the so called *Pecten pusillus* (not a true *Pecten*) from the European Permian rocks. They are very similar, and in

* This is probably the shell which Davidson has referred to in his paper on Acadia ~~the~~ Carboniferous Brachiopoda as *Rh. pugnax* but it bears a striking resemblance to the form which he has figured as *Camarophoria? Globulina?* This is certainly a *Rhynchonella* for it has the characteristic oral supports of this genus. It is quite distinct from *R. pugnax*.

** The specimen is too imperfect for determination J.W.D.

There is not uncommon a terebratula-like shell which shows fine preserved characters of terebratella. This is the first evidence we have of the existence of the genus above the Devonian. The species is named *C. Angelus* Dant.

ded almost no difference observable on direct comparison with good European specimens now before me are the slightly more ~~to~~ ventricose form of the valves and the rather more prominent anterior ear of the left valve of the Windsor shell. Perhaps this ear in the left valve is also a little more defined from the swell of the umbo in some of the larger specimens from Windsor but on comparing examples of the same size as the German specimens here, (which are not so near so large as some figured & foreign works) it is difficult to see characters by which they can be distinguished. They are in fact more nearly alike than the figures given of P. pusillus by different European authorities or in some cases by the same author as varieties of that species. In short, if found associated in the same rock at the same locality with P. pusillus few would suspect them to be ^{Different} ~~separate~~ species."

Aviculoplecta fallax ~~McClary~~ ^{McClary}? Windsor & Albert R. Dr. Dawson;

A. ~~varia~~ nova scotica Dawson, Schubencacadi Dr. Dawson;

Pteronites Gayensis Dawson, Gay's River, Dawson;

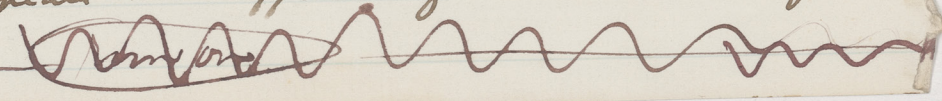
Macrodon elegans ~~schubencacadi~~ ^{schubencacadi}? Windsor, Dawson and Hartt;

Modiola poolii Dawson, Windsor Dawson and Hartt.

Besides the above there are several other lamellibranchs not yet determined.

Gastropods Naticopsis Howi, nov. One of the commonest fossils of this ~~bed~~ the Avon ~~etc.~~ beds.

I have detected only a single fragment of Conularia in these beds and this appears to be different from the species of the overlying beds.



List of Primordial Fossil put into the hands
of Dr. Dawson for description. C. F. Hart.

R. signifies Redcliffes Mill Stream, parish of Dunmoy, St. John
Co. N.B. C. Coldbrook a locality a few miles east of St.
John. & St. J. St. John City.

N.B. Those specimens which come from Coldbrook were all
collected by E. Matthews. Those from Redcliffes Mill St. by
Prof. Bailey, E. Matthews, J. W. Hart & myself. while those
which come from St. John are from J. W. Hart & myself.

Cephalopods, a single Orthoceras has been collected at Windsor.

Windsor limestone is

The Avon beds are well developed at Brookfield and Stewiacke, ^{where} ~~they~~ ^{it} holds the same fossils as ^{at} Windsor. I have not ~~seen~~ ^{seen} had an opportunity of examining extensive collections from the other Acadian localities so that I am unable to report their ^{existence} elsewhere.

At the Eastern end of the little bluff last described there is an accumulation of broken masses of a limestone similar to that of the ^{Windsor limestone} ~~Avon beds~~, but it is lighter in color, more compact, of a light brownish tint, and ~~contains~~ ^{is} composed almost entirely of fossil remains. The species are with rare exceptions distinct from those which are found in the ^{Windsor limestone} ~~Avon~~ beds. Among the masses of rock here found are not seen a single ~~specimen~~ ^{specimen} from the Avon beds so that it is evident that here there is a bed of limestone which overlies the Avon beds. Three quarters of a mile farther up the river across to a wide marsh is the St. King rock, which is composed of the same limestone which furnishes the same fossils. Here however the beds are seen with a slight northward dip. The beds in their lower part are less compact than in the upper where they pass into a very hard fine grained limestone capable of taking a high polish. Fossils occur all through the bed but they are especially abundant in the upper part. ~~The~~ ^{Stewiacke limestone} This bed to which I would call the ~~Stewiacke limestone~~ appears to be overlaid by a bed of Sydney which lies between the two localities, at the head of the marsh, which ^{appears} ~~appears~~ to occupy ~~the~~ a synclinal valley.

Radiates.

Articulatiles.

144

Stenopora limulorum

The Windsor beds are very rich in beautifully preserved fossils of Radiates. There is a great paucity ^{of species} as elsewhere in Nova Scotia, occasional minute crinoid stems being all the evidence of the existence of representatives of that branch of the animal kingdom.

Of Articulatiles there are very few ^{species}. ~~representations~~, ~~occasional~~ a Serpula (?) tube occurs rarely, together with a Lepidodictya and a Miner. Mollusks are the reigning type, ~~especially~~

Phryganodon are represented by a few species of

There is a pretty Stenopora (S. acadica Daw.) which is very common & is one of the most characteristic fossils of this limestone.

Fenestella / Reticpora: one elegant species ~~of this~~ F. Lyelli Dawson refers doubtfully to Fenestella carinata McCoy. These Fenestellidae are exceedingly abundant and eminently characteristic of this limestone when ever it occurs.

Of Brachiopods there are many representations. P. Lyelli ~~is the~~ new (typical form) ^(P. Lyelli) is one of the commonest fossils both at Windsor and elsewhere and this is associated with an abundance of P. Davidsoni, not, ~~+~~ (P. semireticulata Davidson's paper) and F. Saccardi. The Lecanospira referred to the last mentioned author is T. Saccardi Martin, and the forms referred to him is Athyris subtilis, Spirifer ~~acuticostata~~ ^{acuticostata} ~~and~~ Spiriferina ~~crustacea~~ ^{crustacea} ~~Dawson~~ ^{Dawson}.

~~all of which identification I believe, after the study of a large number of specimens, to be incorrect.~~ ^{is found} Besides there are ~~also~~ a number of Rhynchonellae & other brachiopods which appear to be confined to this bed.

Lamnellicrinids are abundant and among the most characteristic may be named the following:

Aviculopecten reticulata Daw. Windsor & Guys River.

A. vancouverensis Nova Scotia Daw (= A. plicata of Readi [ology]);

Macrodon Hardingi Daw. very characteristic

Conocardium academicum, not, rare.

The ~~gasteropods~~ are all minute and ~~not~~ as yet undetermined
~~The Cephalopods are represented by a species~~

A ~~Conularia~~ is occasionally met with at Windsor & Stewiacke.

Of the Cephalopods we have a large Nautiloid shell.
Nautilus (Cryptoceras) avonensis Daw. not uncommon
 at Windsor & Stewiacke ~~and~~ a Hematomia (?) and
 also two or more species of Orthoceras.

I cannot report a single fragment of a vertebrate from
 this ~~low~~ ^{Stewiacke} ~~low~~ limestone. *

* The whole of the fossils referred to in this paper
 will be described in the forthcoming edition of
 Dr Dawson's Acadian Geology, 2nd ed.

At his suggestion I sent a small collection of these fossils to Mr. Meek who writes me as follows:—

"A small collection of these same fossils from Windsor was presented to the Smithsonian Institution by Dr. E. Foreman some three or four years ago since, and they have remained a puzzle to me ever since. If they had been ^{brought} in from some unexplored region of the Rocky Mountains, for instance, I confess I should have referred them to the horizon of the upper Coal Measures, or to that of a series of rocks known in Kansas as the Permian-Carboniferous, from the remarkable mingling in them of Coal Measure and Permian types there, but on reading over the able publications of Dr. Dawson, Sir Charles Lyell and Mr. Davidson on the age of these Nova Scotian beds, I was led to the conclusion that this must be one of those very rare cases ~~which~~ where physical structure shows ~~that~~ ^{paleontology} to be at fault."

"Altho' I am not positively sure that any of the species are absolutely identical with those of the higher horizon, these fossils certainly present a remarkable Permian-Carboniferous look, and when viewed collectively they are unlike the western ^{sub-}Carboniferous fauna, for instance there are here & from Windsor several good specimens showing both valves with their surface markings of an Avicula-lopectes undistinguishable by any characters yet observed from A. occidentalis, of Shumard (= lopectes cleavelandicus ~~the~~ Swallow) one of our most common and ~~and~~ characteristic coal measure, Permian-Carboniferous and Permian species in the West, which, so far as yet known, has never been found below the upper Coal measure, at any rate of the western localities."

"Another shell represented in the collection from Windsor & casts, is very similar to varieties of the so called Mytilus squamosus from the English Permian. It has almost pre-

cing the form and agree in size, as well as in showing
 between the beaks the cast of a little depression on
 a shelf or septum within the beaks such as we often
 see in species of *Myalina*, to which these shells ^{doubtless} belong.
 Another little shell from Windsor is quite as nearly like
 a little Permian Carboniferous species as the west known
 as *Sedgwickia* ? *concava* M & H.; while you have from
 the same cast of an *Edmundia* very like a western
 coal measure form "x x x" Taking the whole group of Windsor
 Mollusca including the *Canelli* branch, any one familiar with
 the fossils of the western coal measures ~~west~~ and Permian-car-
 boniferous beds, would, upon palaeontological grounds alone
 be very strongly inclined to refer the Windsor rocks at least
 to the upper coal measures. ⁹⁹ This conclusion Mr. Meek hardly
 feels that we ought to accept seeing that so many able pro-
 fessors have united in placing the beds in the Sub Carboniferous; but
 expresses the opinion that "it may be an example of what
 Barrande would call an upper coal measure or even
 Permian-carboniferous fauna 'colonized' far back in the
 Sub carboniferous period."

The ~~the~~ Carb. limestone ^{and} marl. of Windsor certainly ^{only} ~~only~~ the ~~the~~ plant bearing ~~beds~~ ^{of} Shale & Sandstones of the Lower Coal Measures which are seen exposed as at ^{Windsor Brook} Horton Bluff, Carpercaup and Wolfville skirting the edge of the Carboniferous Basin. and ~~that~~ Dr. Dawson has described these ^{marine} limestones ~~marl~~ ^{and} gypsum as occupying a synclinal trough in the lower coal measure strata ~~extending~~ ^{extending} from Windsor to Steveston a distance of some ^{fifty} ~~50~~ miles. Over this region the ^{middle} ~~lower~~ coal measures do not occur, so that of these limestones there is no stratigraphical evidence to contradict the evidence afforded and in this region Dr. Dawson has suggested that the upper limestones may represent the ~~of~~ ^{of} 3 paleontology as to their permocarboniferous age. ~~I have not~~ ^{have not} had any opportunity of studying the limestones except about the Basin of Minas, and neither have I been able to examine sufficient sections of fossils to enable me to determine whether the above division I have marked out obtain elsewhere. From a careful study of ~~the~~ the evidence ^{with these fossils} ~~not~~ ^{forwarded} by Dr. Dawson it certainly seems ~~prove~~ ^{prove} that the limestones ^{with these fossils} include the true coal measures; but I ^{in other parts of Nova Scotia} see no reasons for considering them ~~of~~ ^{as} ~~subcarboniferous~~ ^{as the equivalent of} ~~subcarboniferous~~.

This whole subject is one of great interest and needs the most careful investigation. It will now be of much importance to have the limestones of north-east Nova Scotia and of Cape Breton compared with those of the Basin of Minas in order ~~to~~ ^{to} ascertain whether the same divisions obtain there as at Windsor. Another interesting point to be studied is the extension of the ^{gypsum} marly sandstones, the conditions of their deposition and the influence which they may have had on the extent of life over the region they occupy. Might not some material be gathered from this new and rich field bearing on that vexed question of descent with modification? ~~The fauna of the limestones I have named are very different~~ ^{The difference} ~~does it result from the extension~~.

New York. May 28th 1867.

(Over)

Note by Dr. Dawson. Much credit is due to Mr. Hartt for the careful manner in which he has worked up the Succession of fossils in the limestones of the Annapolis. I have endeavored in the new edition of Canadian Geology to apply his results to other parts of Nova Scotia. In regard to the resemblance of the Windsor Fauna to the Permian Carboniferous of the West, it is to be remembered (1) That no such distinction as Sub-Carboniferous & Carboniferous can hold in Nova Scotia. The Windsor Fauna is simply the Marine Fauna of the Carboniferous and some of the beds may be coeval with the coal measures as I suggested many years ago (Geol. Soc. Trans.). (2) The Lithological character of these beds is like that of the Permian, and ^{similar} like the beds of the Permian in different periods of the present resemblance of Fauna. (3) That the Fauna in question actually lived in the lower Carboniferous period, is proved by the sections in Cumberland, Britain, and Cape Breton, which show the limestones with these shells lying below the productive coal measures. I have fully illustrated these points in the new edition of Canadian Geology.

Hartt's Paper

(4) Mr. St. John has shown that the supposed Permian-Carboniferous fauna applies to the upper members of the Windsor limestones more especially.