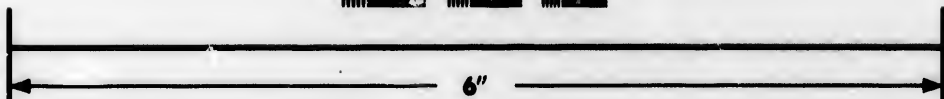
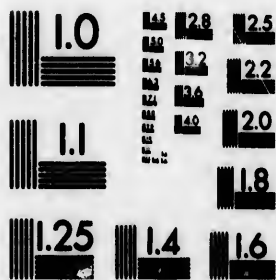


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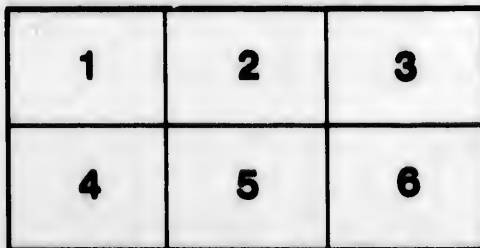
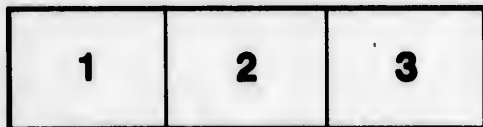
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ON THE

SILURIAN & DEVONIAN ROCKS

OF

NOVA SCOTIA.

BY J. W. DAWSON, LL.D., F.G.S.

[Communicated to the Natural History Society of Montreal.]

In the peninsula of Nova Scotia, the formations older than the carboniferous system, which is there so largely developed, are represented by disturbed and partially metamorphosed beds, occupying a broad belt of country on the south-eastern or Atlantic coast, and certain irregular hilly tracts in the interior. These beds were described by me in a paper communicated to the Geological Society of London in 1849, and subsequently in my "Acadian Geology;" in which work will be found references to the labours of previous observers. These notices were confessedly very imperfect, owing to the difficulties of the formations themselves, the deficiency or bad state of preservation of the fossils, and the absence of sufficient suites of these for comparison. With the view of remedying these deficiencies, I have embraced such opportunities as have occurred to me since the publication of "Acadian Geology," to study these rocks in those parts of the country which appeared to promise the most satisfactory results. My collections of fossils have also been increased by contributions received from Dr. Webster of Kentville, who has long directed his attention to the New Canaan and Nictaux districts, which I have had the advantage of exploring under his guidance; from the Rev.

D. Honeyman,* who has carefully collected the fossils of the Arisaig section, and from Mr. C. F. Hart of Wolfville. Prof. Hall of Albany, has also kindly consented to apply his unrivalled knowledge of the palæozoic fauna of America to the determination of the fossils, and has enabled me to publish with this paper, his descriptions of the more important new species.

With these aids, though aware that the complete solution of all the difficulties of these deposits must await a systematic and detailed survey, I hope to fix with certainty the geological position of several important series of beds, and thus to afford some data for comparison with the formations of similar age in other countries.

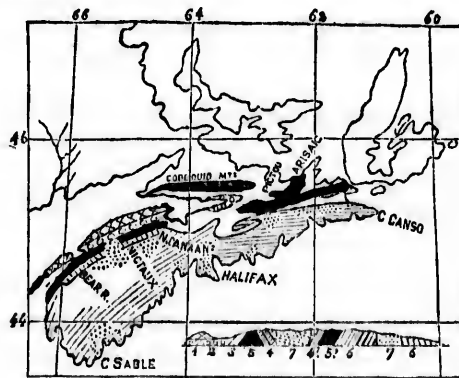


Fig. 1.—Explanation of the Map and Section.

- (1) Secondary Trap.
- (2) New Red Sandstone (Permian or Triassic.)
- (3) Carboniferous. (In eastern part of Nova Scotia proper.)
- (4) Devonian.
- (5) Middle and Upper Silurian.
- (6) Metamorphosed Lower Silurian.
- (7) Granite.

The numbers refer to the section and to the corresponding shades of the map.

In my paper of 1849, I attempted to arrange the whole of these infra-carboniferous rocks of Nova Scotia, in two great divisions: (1.) The slate and quartzite formation of the Atlantic coast. (2.) The slaty, calcareous, and ferruginous formation of the inland hills. The second of these groups will be found in the sequel to include beds ranging from the Middle Silurian to the lower Devonian. The first is certainly older, and probably of Lower Silurian age.

* See also a paper by Mr. Honeyman, in the Transactions of the N. S. Lit. & Sci. Society.

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I.—LOWER SILURIAN.

The Atlantic coast series, which I regard as probably of this age, has afforded little that is new since my former publication on the subject. It extends continuously, with prevailing east and west strike and northerly dip, from Cape Canso to the middle of the peninsula at Halifax Harbour. Thence it continues with prevailing north-east and south-west strike to the western extremity of the province. Its most abundant rocks are coarse clay slate and quartzite in thick beds. In some districts the slates are represented by mica-schist and gneiss, and interrupted by considerable masses and transverse bands of intrusive granite. It has afforded no fossils; but it appears to be the continuation of the older slate series of Mr. Jukes* in Newfoundland, which has afforded trilobites of the genus *Paradoxides*.† These fossils would indicate a position in the lower part of the Lower Silurian series, possibly on the horizon of the Potsdam sandstone or Lingula Flags. If so, the Lower Silurian limestones are either absent or buried by the unconformable superposition of the next series, or of the carboniferous beds which in some places immediately adjoin these older rocks.

It is however proper to state that on a comparison of these rocks with the series of altered deposits from Eastern Canada, collected by the Canadian Survey, and elaborately examined by Mr. Sterry Hunt, they appear more nearly to resemble those of the Hudson River group than any other of the series. It seems also, that chiastolite and staurotide, which occur abundantly in some parts of the Nova Scotia coast series, as for example, at Cape Canseau and in Shelburne, are characteristic in Canada and New England of altered Upper Silurian and Devonian rocks. It is possible that this last fact may be accounted for by the local occurrence of some beds newer than the others; and the characters of the Silurian and Devonian series, as seen elsewhere in Nova Scotia, seem at least to exclude the mass of these coast rocks from any formation newer than the Middle Silurian.

II.—MIDDLE AND UPPER SILURIAN.

The inland group of metamorphic rocks is more variable in its character, presenting many varieties of shales and slates some-

*Survey of Newfoundland.

† Salter, Proceedings Geological Society of London, 1859.

times talcose and chloritic, often coarse and arenaceous, and associated with beds of sandstone and quartzite, and with calcareous layers. In some districts there are also extensive beds which have the appearance of interstratified igneous products both of hornblende and felspathic composition. The associated igneous rocks are granite (which appears to be continuous with that of the coast series and intrusive), syenite, diorite, porphyry and compact felspars. The more highly altered portions are penetrated by numerous veins of peroxide and carbonate of iron, with copper and iron pyrites.

These beds, as well as the overlying Devonian series, have been thrown into folds, varying in direction from east and west to north-east and south-west, and have been at the same time much altered and disturbed by plutonic rocks. They afterwards suffered extensive denudation, forming both anticlinal and synclinal valleys, in which were deposited beds of the carboniferous system, and of the New Red Sandstone of Nova Scotia, a deposit still of uncertain age.* This denudation has apparently been so complete as to remove from view nearly all the softer and least altered beds, the remains of which appear principally at the margins of the valleys now filled by the carboniferous series. Even in these exceptional spots they have in some instances been farther obscured by trappean eruptions of carboniferous or later date. The following are the principal localities in which I have been able to obtain determinable fossils. The geographical position of these points is noticed in the accompanying map. (Fig. 1, p. 132.)

ARISAIG.

Near this place, at the extreme northern limit of the Silurian system on the eastern coast of Nova Scotia, is one of the most instructive sections of these rocks in the province. At the eastern end of the section, where they are unconformably overlaid by lower carboniferous conglomerate and interstratified trap,† the Silurian rocks consist of gray and reddish sandy shales and coarse limestone bands dipping south at an angle of 44°. The direction of the coast is nearly east and west, and in proceeding to the eastward, the dip of the beds turns to south 30° west, dipping 45°,

* See Journal Geol. Society, Vol. 4, and Acadian Geology.

† See papers by the author in Proceedings Geological Society, 1843-4.

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so that the series, though with some faults and flexures, is on the whole descending, and exhibits in succession to the rocks just mentioned, gray and dark shales, with bands and lenticular patches of coarse limestone, some of which appear to consist principally of brachiopodous shells *in situ*, while others present a confused mass of drifted fossils. Below these the beds become more argillaceous, and in places have assumed a slaty structure, and occasionally a red colour. The thickness of the whole series to this point was estimated at 500 feet. The dip then returns to the south, and the beds run nearly in the strike of the shore for some distance, when they become discoloured and ochraceous, and then red and hardened; and finally, at Arisaig pier, are changed into a coarse reddish banded jasper, where they come into contact with a great dyke of augitic trap of carboniferous date. Beyond this place they are much disturbed, and so far as I could ascertain, destitute of fossils. The alteration of the beds extends to a distance of 300 yards from the trap, and beyond this in some places slaty cleavage and reddish colours have been produced; the latter change appearing to be connected with vertical fissures traversing the beds.

In the lower or shaly portion of the Arisaig series, the characteristic fossils are *Graptolithus* not distinguishable from *G. clintonensis*, *Leptocælia (Atrypa) intermedia*, (Hall,) a new species closely allied to *L. hemispherica* of the Clinton group of New York, *Atrypa emacerata*, *Orthis testudinaria*, *Strophomena profunda*, *S. rugosa*, *Rhynconella equiradiata*, *Avicula emacerata*, *Tentaculites*, allied to or identical with *T. distans*, *Helo-pora* allied to *H. fragilis*. There are also abundant joints and stems of orinoids, and a *Pulceaster*, the only one as yet found in Nova Scotia, which was presented to me by Mr. Honeyman, and has been described by Mr. Billings in the Canadian Naturalist under the name of *P. parviusculus*. These and other fossils associated with them, in the opinion of Prof. Hall, fix the Geological position of these rocks as that of the Clinton group, the upper Llandovery of Murchison, at the base of the upper Silurian or top of the middle Silurian.

In the upper and more calcareous part of the series, fossils are very abundant, and include species of *Calymene*, *Dalmania*, *Homalonotus*, *Orthoceras*, *Murchisonia*, *Clidophorus*, *Tellinomya*, and several brachiopods, among which are *Discina tenuilamellata*, *Lingula oblonga*, *Rhynconella quadricosta*, *R. Saffordi*, (Hall.)

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allied to *R. Wilsoni*, *R. neglecta*, *Atrypa reticularis*,* all found in the upper part of the Middle Silurian or in the Upper Silurian elsewhere in America. Most of the other forms are new species, descriptions of which will be found in Prof. Hall's paper appended to these notes. The general assemblage is on the whole like that of the Clinton, but is of such a character as to warrant the belief that we may have in these beds a series somewhat higher in position, and probably of Upper Silurian age. The new species *Chonetes Nova-Scotica* is very characteristic of the upper member.

On the whole we must regard the Arisaig series as representing the upper part of the Middle Silurian, probably with a part of the Upper Silurian, a position much lower than that assigned to it in my Acadian Geology, which was, however, at the time, based on the opinions of the best palæontologists who had examined specimens from these rocks. Unfortunately the Arisaig series stands alone, wedged between carboniferous and plutonic rocks, so that no opportunity occurs on the coast of verifying these conclusions derived from fossils, by the evidence of stratigraphical connection with newer or older Silurian deposits, and I have been unable to devote sufficient time to this object to attempt to trace the beds in their succession or continuation inland.

EAST RIVER OF PICTOU.

The next example of fossiliferous Silurian rocks known to me is on the east branch of the East River of Pictou, and its vicinity, where these deposits rise from beneath the lower carboniferous series, forming the high ground on the eastern side of the river. The beds are here much altered and penetrated by igneous dykes, and are vertical, with very high southerly dips and N. E. and S. W. strike. They consist of coarse slates and calcareous bands resembling those of the upper Arisaig series in mineral character, and holding many of the same species, especially *Chonetes Nova-Scotica*; but we have here in addition a great bed of fossiliferous peroxide of iron, in some parts forty feet in thickness, and with oolitic structure; but passing into a ferruginous sandstone, and associated with slate and quartz rock. The age of these rocks relatively to the Arisaig series, it is not easy to determine. The stratigraphical evidence, though obscure, would place them in a higher position. The fossils are in a bad state of preservation; but in so far as

* Also *Strophomena corrugata*.

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they give any information, it coincides with the apparent relation of the beds. Similar ferruginous beds occur in the Clinton series, (the Sargent of Rogers) in New York and Canada; and as we shall find in the sequel, in a much higher position in the western part of Nova Scotia. On the whole I regard the beds seen at the East River of Pictou as belonging to the same line of outcrop with the Arisaig series, but as containing in addition to the upper member of that series, beds higher in the Silurian system, or perhaps Lower Devonian.

COBEQUID MOUNTAINS.

At the eastern end of this chain, in Earleton and New Annan, though the rocks are generally in a highly metamorphosed condition, fossils are found in a few places; and in so far as I have been able to determine from very small suites of specimens, are those of the upper Arisaig series. From the apparent continuity of strike along this long salient line of outcrop, it seems probable that these fossils indicate the true age of the greater part of the sedimentary rocks of the Cobequid hills; a conclusion confirmed by their similarity in mineral character to the altered equivalents of the Arisaig and East River series as seen elsewhere. The arrangement of the beds and their mineral contents in the central part of the chain, will be found noticed in my paper of 1849, already referred to. They are not known to contain beds of iron ore; but have enormous vein-like deposits of spathic and specular iron associated with the carbonates of lime and magnesia, and running with the strike of the beds.

NEW CANAAN.

Between the East River of Pictou, and New Canaan in King's county, 100 miles distant, I know no Silurian beds with fossils; and in the central part of the province these rocks disappear under the carboniferous deposits. In the hills of Horton and New Canaan they reappear, and constitute the northern margin of a broad belt of metamorphic and plutonic country, occupying here nearly the whole breadth of the peninsula. The oldest fossiliferous beds seen are the fine fawn-coloured and gray clay slates of Beech Hill, in which Dr. Webster, many years since, found a beautiful *Dictyonema*, the only fossil they have hitherto afforded. It is a new species, closely allied to *D. retiformis* and *D. gracilis* of Hall, and will be described by that palæontologist under the name of *D. Websteri*, in honour of its discoverer. In

the mean time I may merely state that it is most readily characterised by the form of the cellules, which are very distinctly marked in the manner of *Graptolithus*. A portion of a frond is represented in Fig. 2.

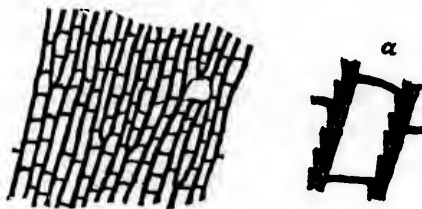


Fig. 2.—Part of frond of *Dictyonema Websteri*, Hall. *a*, portion magnified.

The *Dictyonema* slates of Beech Hill are of great thickness, but have in their upper part some hard and coarse beds. They are succeeded to the south by a great series of dark coloured coarse slates, often micaceous, and in some places constituting a slate conglomerate, containing small fragments of older slates, and occasionally pebbles of a gray vesicular rock, apparently a trachyte. In some parts of this series there are bands of a coarse laminated magnesian and ferruginous limestone, containing fossils which, though much distorted, are in parts still distinguishable. They consist of joints of crinoids, casts of brachiopodous shells, trilobites and corals. Among the latter are two species of *Astrocerium*, not distinguishable for *A. pyriforme* and *venustum* of the Niagara group, and a *Heliolites* allied to *H. elegans*, if not a variety of this species. On the evidence of these fossils and the more obscure remains associated with them, Prof. Hall regards these beds as equivalents of the Niagara formation of the New York geologists, the Wenlock of Murchison. Their general strike is N. E. and S. W.; and to the southward, or in the probable direction of the dip, they are succeeded, about six miles from Beech Hill, by granite. They have in general a slaty structure coinciding with the strike but not with the dip of the beds, and this condition is very prevalent throughout this inland metamorphic district, where also the principal mineral veins usually run with the strike. The beds just described run with S. W. strike for a considerable distance, and are succeeded in ascending order by those next to be described.

III.—DEVONIAN.

It is probable that Devonian rocks, in a metamorphosed state

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are extensively distributed throughout the districts now under consideration; but the only localities in which they have been clearly recognised, are along a line of outcrop on the northern margin of the hilly region westward of New Canaan. The first and most important of these exposures is at

NICTAUX.

At this place, 20 miles westward of New Canaan, the first old rocks that are seen to emerge from beneath the New Red Sand stone of the low country, are fine-grained slates, which I believe to be a continuation of the Dictyonema slates of Beech Hill. Their strike is N. 30 to 60 E., and their dip to the S. E. at an angle of 72°. Interstratified with these are hard and coarse beds, some of them having a trappean aspect. In following these rocks to the S. E., or in ascending order, they assume the aspect of the New Canaan beds; but I could find no fossils except in loose pieces of coarse limestone, and these have the aspect rather of the Arisaig series than of that of New Canaan. In these, and in some specimens recently obtained by Mr. Hart, I observe *Orthoceras elegantulum*, *Bucania trilobita*, *Cornulites flexuosus*, *Spirifer rugæcosta?* and apparently *Chonetes Nova-Scotica*, with a large *Orthoceras*, and several other shells not as yet seen elsewhere. These fossils appear to indicate that there is in this region a continuance of some of the upper Arisaig species nearly to the base of the Devonian rocks next to be noticed.

After a space of nearly a mile, which may represent a great thickness of unseen beds, we reach a band of highly fossiliferous peroxide of iron, with dark coloured coarse slates, dipping S. 30° E. at a very high angle. The iron ore is from 3 to 4½ feet in thickness and resembles that of the East River of Pictou, except in containing less silicious matter. The fossils of this ironstone and the accompanying beds, as far as they can be identified, are *Spirifer arenosus*,* *Strophodonta magnifica*, *Atrypa unguiformis*,

* There is in the iron ore and associated beds another and smaller *Spirifer* as yet not identified with any described species, but eminently characteristic of the Nictaux deposits. It is usually seen only in the state of casts, and often strangely distorted by the slaty structure of the beds. The specimens least distorted may be described as follows: General form, semi-circular tending to semi-oval, convexity moderate; hinge line about equal to width of shell; a rounded mesial sinus and elevation with about ten sub-angular plications on each side; a few sharp growth ridges at the margin of the larger valves. Average diameter about one inch; mesial sinus equal in width to about three plications. I shall call this species, in the meantime, *S. Nictavensis*.

Strophomena depressa, and species of *Avicula*, *Bellerophon*, *Favosites*, *Zaphrentis*, &c. These Prof. Hall compares with the fauna of the Oriskany sandstone; and they seem to give indubitable testimony that the Nictaux iron ore is of Lower Devonian age.

To the southward of the ore the country exhibits a succession of ridges of slate holding similar fossils, and probably representing a thick series of Devonian beds, though it is quite possible that some of them may be repeated by faults or folds. Farther to the south these slates are associated with bands of crystalline greenstone and quartz rock, and are then interrupted by a great mass of white granite, which extends far into the interior and separates these beds from the similar, but non-fossiliferous rocks on the inner side of the metamorphic band of the Atlantic coast. The Devonian beds appear to dip into the granite, which is intrusive and alters the slates near the junction into gneissoid rock holding garnets. The granite sends veins into the slates, and near the junction contains numerous angular fragments of altered slate.

Westward of the Nictaux River, the granite abruptly crosses the line of strike of the slates, and extends quite to their northern border, cutting them off in the manner of a huge dyke, from their continuation about ten miles further westward. The beds of slate in running against this great dyke of granite, change in strike from south-west to west, near the junction, and become slightly contorted and altered into gneiss, and filled with granite veins; but in some places they retain traces of their fossils to within 200 yards of the granite. The intrusion of this great mass of granite without material disturbance of the strike of the slates, conveys the impression that it has melted quietly through the stratified deposits, or that these have been locally crystallised into granite *in situ*.

MOOSE RIVER.

At this place the iron ore and its associated beds recur on the western side of the granite before mentioned, but in a state of greater metamorphism than at Nictaux. The iron is here in the state of magnetic ore, but still holds fossil shells of the same species with those of Nictaux.

BEAR RIVER.

On this stream, near the bridge by which the main road crosses it, beds equivalent to those of Nictaux occur with a profusion

of fossiliferous sandstone plants these with sandstone with occurrence of European water the an alternative where repeated by the slate, vicinity

The metamorphisms include the recent and almost all the geological history of the state

the water be

of fossils. The iron ore is not seen, but there are highly fossiliferous slates and coarse arenaceous limestone, and a bed of gray sandstone with numerous indistinct impressions apparently of plants. In addition to several of the fossils found at Nictaux, these beds afford *Tentaculites*, an *Atrypa*, apparently identical with an undescribed species very characteristic of the Devonian sandstones of Gaspé, and a coral which Mr. Billings identifies with the *Pleurodictyum problematicum*, Goldfuss, a form which occurs in the Lower Devonian in England, and on the continent of Europe.

Westward of Bear River, rocks resembling in mineral character those previously described, extend with similar strike, but in an altered condition, and in so far as I have been able to ascertain, destitute of fossils, quite to the western extremity of the peninsula, where they turn more to the southward, and are as I suppose, repeated by a sharp synclinal fold, after which they are succeeded by the Atlantic coast series, consisting of quartzite and clay slate, with chlorite and hornblende slates at Yarmouth and its vicinity, and further to the S. E. of mica slate and gneiss.

GENERAL REMARKS.

The above facts show that we can recognise among the partially metamorphosed sub-carboniferous rocks of Nova Scotia, formations ranging from the Middle Silurian to the Lower Devonian inclusive; but of a more argillaceous and less calcareous character than the series occupying this position in the mainland of America. The principal masses of plutonic rock associated with these beds, and especially the granite, are of newer Devonian date; but there is evidence of igneous eruptions as far back as the beginning of the Upper Silurian, and of the continuance or recurrence of such action as late as the carboniferous period. In and near the non-calcareous Lower Silurian series, granite prevails, almost to the entire exclusion of other plutonic rocks. At a greater distance from these, the plutonic rocks penetrating the Upper Silurian and Devonian series, though apparently of nearly the same age with the granite, are principally syenite and greenstone.

With respect to the general arrangement of the formations, though I cannot venture to speak with confidence on this point, with reference to a district so much disturbed, and which I have been able only very imperfectly to explore, I may suggest, as at

present the most probable arrangement, that represented in the little section attached to the map. The coast series would thus belong to an anticlinal, bringing up Lower Silurian rocks. On these, in proceeding to the north-west, rest middle and upper Silurian and perhaps Devonian beds in a metamorphosed condition, which along the northern margin of the metamorphic district rise again with an opposite dip, at Arisaig, East River, New Canaan, &c., forming a trough, the middle of which, in the east, is divided by a secondary anticlinal and filled with carboniferous rocks, but in the west is occupied with a great mass of granite into which the beds appear to have sunk in the direction of their dip. Beyond the northwestern edge of this trough, the Silurian beds probably again dip to the northward, but are hidden by carboniferous deposits, and reappear in another anticlinal with east and west strike in the Cobequid Mountains.

Rocks similar in character and relations to those above described are extensively distributed in the Island of Cape Breton and also in New Brunswick, but I have no detailed knowledge of their distribution. The formations described in this paper, represent in age, and resemble in their state of alteration, many portions of the metamorphosed Silurian and Devonian rocks of New England and Eastern Canada. In the latter, the relations of the intrusive granite and the middle and upper Silurian rocks as described by Sir William Logan, and as I have observed them in a few localities, strikingly resemble the phenomena observed in Nova Scotia.

I have no doubt that a detailed survey of these rocks in Nova Scotia and Cape Breton, would develop many curious and intricate disturbances, and might also ascertain the presence of members of the Silurian series, now supposed to be absent, but which may be only obscured by denudation. In the mean time local observers can do much to increase our knowledge of these rocks by carefully collecting the few fossils that remain unobliterated in the semi-metamorphic beds, and the above remarks may serve to guide such explorations, and to enable geologists to speak with more confidence than heretofore of the older palæozoic rocks of an important region of eastern America.

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*Descriptions of New Species of Fossils from the Silurian Rocks
of Nova Scotia.* By JAMES HALL.

1. CRANIA ACANTHOSA. N. sp. Fig. 1.

Circular or broadly sub-oval, moderately convex, the greatest convexity near the apex; apex obtuse.

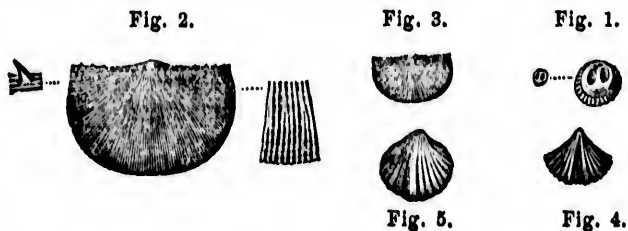
Several casts show a central elevated area, with strong muscular impressions; the more elevated portion being surrounded by a flattened border, which is radiatingly striate.

These specimens are casts which appear to be of the ventral valve; and the form of the muscular impressions is so characteristic of the genus that I can have little hesitation in thus referring them.

2. DISCINA TENUILAMELLATA. Var. *subplana*.

Shell broadly elliptical, or suborbicular, externally depressed, apex subcentral; surface marked by thin sharply elevated lamellæ.

This closely resembles the Niagara species of New York, but may be distinct. Should further examination prove it a distinct species, the name *D. subplana* may be adopted.



3. CHONETES NOVA-SCOTICA. N. sp. Fig. 2.

Shell semielliptical, width varying from once and a half to nearly twice the length. The ventral valve variably convex, and often showing a flattened or slightly concave space down the middle of the shell; cardinal margin ornamented by four or five minute spines on each side of the beak; cardino-lateral margins often a little wrinkled; surface finely striated, striæ flexuous, dichotomising and increasing by interstitial addition, so that there are more than one hundred on the margin of the shell; striæ increasing in size below the umbo; concentric striæ fine, close, rounded and slightly undulating.

Dorsal valve moderately concave; striæ much stronger below the middle of the shell and sometimes bifurcating toward the margin.

This species resembles in form the *Chonetes cornuta* of the Clinton group of New York, but is a much larger and more ventricose shell; the striæ are proportionally less numerous and more closely arranged, the interstices being less than the striæ while in the *C. cornuta* the interstices are wider than the striæ, and the latter increase only by interstitial additions below the middle of the shell. A stronger and more elevated stria often marks the median line from beak to base of the ventral valve.

4. *CHONETES TENUISTRATA*. N. sp. Fig. 3.

Shell semi-oval, twice as wide as long; ventral valve moderately convex, hinge line equalling the width of the shell; surface marked by fine, even, closely arranged striæ, which apparently increase only by interstitial additions, and are not flexuous. The number of striæ on the margin of the shell is nearly one hundred.

This species is more finely striated than the preceding, the striæ not flexuous, more even, and in shells of equal size much more numerous. This species is somewhat larger and more closely striated than the *C. cornuta* of the Clinton group of New York.

5. *SPIRIFER RUGÆCOSTA*. N. sp.

Shell somewhat semi-elliptical; dorsal valve very convex, with the mesial fold depressed along the centre; ventral valve with a wide deep mesial sinus; plications six or seven on each side of the mesial fold and sinus, strong, and much elevated, subangular, crossed by numerous strongly elevated, lamellose, imbricating concentric striæ.

The specimens examined are almost all imperfect casts, some of which preserve the impression of the strong concentric striæ, and in one or two specimens an impression of the shell reveals the strength of the surface markings.

In many respects this species resembles the *S. pertamellosa* of the lower Helderberg group in New York, but the mesial elevation of this species is flattened or depressed, a character never observed in New York specimens.

6. *SPIRIFER SUBSULCATUS*. N. sp.

Shell semi-elliptical, hinge line equalling or greater than the length of the shell below; plications five or six on each side of the

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mesial fold; mesial fold somewhat flattened or very slightly rounded on the summit; plications rounded; surface concentrically lamellose.

The specimens are all casts, or impressions of the shells.

They bear some resemblance to *S. sulcatus* of the Niagara group, and are intermediate between that species and the *S. cycloptera* of the Lower Helderberg group.

7. TREMASTOSPIRA ACADIÆ. N. sp. Fig. 4.

Shell wider than long; beak of the ventral valve produced and incurved; mesial depression marked by a small fold on each side, which originates about one-third of the length below the beak and continues to the margin; sinus bounded on each side by a more strongly elevated plication, beyond which are six other plications on each side.

Surface marked by fine concentric striæ.

This shell is referred to the genus *Trematospira* from external characters alone, which are unlike *Rhynchonella* proper, and the shell is not a *Spirifer*.

8. RHYNCHOSPIRA SINUATA. N. sp.

Shell ovoid, ventricose beak of the ventral valve incurved; a mesial sinus beginning a little below the beak; surface marked by about eight or nine simple scarcely subangular plications on each side the mesial sinus.

Surface marked by concentric lines of growth.

This species differs from the *R. formosa* of the Lower Helderberg rocks of New York in the plications being more slender, in the more defined sinus of the ventral valve, and the continuation of the two small folds in the sinus nearly to the beak.

9. RHYNCHONELLA SAFFORDI.

Shell varying in form from ovoid to globose. Full grown specimens usually wider than long, and sometimes becoming extremely ventricose, so that the diameter across the two valves much exceeds the length. Ventral valve depressed convex, with the beak minute, closely incurved; dorsal valve very ventricose, most prominent toward the front. Cardinal slope a little depressed, sides rounded, and the front in direct line flattened but not depressed. Surface finely plicated, plications little elevated,

rounded or scarcely subangular, about five or six depressed in the flattened sinus of the ventral valve and a corresponding number raised on the flattened mesial elevation, which rises abruptly though usually but slightly above the lateral portions of the shell. From ten to fourteen plications mark the surface on each side of the mesial fold and sinus. Plications in front marked by a sharp groove along the centre, and those of each valve deeply interlocking.

This species resembles the *R. nucleolata* of the Lower Helderberg rocks of New York, and in some specimens it approaches to *R. ventricosa*, but is always much more finely plicated than either. It closely resembles the *R. Wilsoni* of Europe in its general form, but the plications are more rounded and somewhat coarser, and while in that species the sinus causes no depression in the ventral valve below the general surface of the shell, in ours there is an abrupt depression as well as a slightly abrupt elevation on the dorsal valve, while there is no similar feature in the *R. Wilsoni*.*

The Nova Scotia specimens are in all respects identical with those from Tennessee.

The geological position of the specimen from Tennessee is in rocks of the age of the Lower Helderberg group, associated with *Pentamerus galeatus*, *P. Verneuili*, *Spirifer macrolepura*, *Spirifer perlamellosa*, *Spirifer cycloptera*, and others.

10. LEPTOCELIA INTERMEDIA. Fig. 5. N. sp.

Shell concavo-convex; outline semi-elliptical, cardinal extremities rounded, and the hinge-line a little shorter than the greatest width of the shell; ventral valve moderately convex, carinate in the middle by a strong plication, with six or seven smaller ones on each side, the lateral ones slightly curved towards the outer extremity. Dorsal valve concave, with a broad shallow mesial sinus, the margins on either side being bent a little upward, giving a sinuous outline to the margin of the shell; surface marked by fine concentric striae.

This species resembles the *L. hemispherica* of the Clinton group in New York, in general form, but the hinge line is shorter and the extremities rounded; the mesial elevation consists of a single strong plication, while in *L. hemispherica* the surface is regularly plicated, with the central one sometimes a little stronger than the others.

*Sowerby, M. C., vol. II., page 38, says: The "sinus at the front, although deep, does not alter the evenness of the surface."

11. MODIOLOPSIS ? RHOMBOIDEA. N. sp. Fig. 6.

Shell sub-rhomboid, rounded in front, wider and obliquely truncate behind, hinge-line slightly ascending from the anterior end; beaks subterminal, posterior umbonial slope obtusely subangular below, anterior to which the shell is flattened; basal margin nearly straight, the shell gradually widening behind and the posterior basal extremity abruptly rounded. Surface evenly striated concentrically.

Anterior muscular impression very strong, posterior muscular impression less strongly defined, but still very conspicuous and sub-duplicate; palleal line simple, nearly parallel to the basal margin, strongly and almost equally defined in all parts of its length between the two muscular imprints.

This shell bears some resemblance to *M. primigenius*, but is less ventricose in the middle, and the sub-angular umbonial slope is not so well defined in that species.

12. MODIOLOPSIS SUB-NASUTUS. N. sp.

Shell elongate sub-spatulate, the length being more than twice the greatest width hinge-line; slightly ascending posteriorly; beaks sub-anterior, the anterior end very narrow, gibbous on the umbones, with a sub-angular ridge on the umbonial slope which extends to the postero-basal angle; basal margin nearly straight, the posterior end somewhat flattened and obliquely sub-truncate at the extremity; surface marked by concentric lines of growth.

This shell bears a close general resemblance to *M. nasutus* of the Trenton limestone, but a careful comparison shows it to be wider and more abrupt at its posterior termination, while the direction of the striae of growth is very distinctive, these marks being regularly curving toward the posterior end in *M. nasutus*, while in this species they are abruptly bent at the postero-basal angle, and again on the cardinal side, corresponding with the truncate posterior extremity of the shell.

13. CLIDOPHORUS CUNEATUS. N. sp.

Shell ovoid, gibbous in the middle and on the umbones, gradually declining behind; beaks anterior, sub-terminal; anterior end broadly rounded, the posterior end narrower and sub-acute, posterior umbonial slope marked by an obtuse rounded ridge, which extends to the posterior extremity, and below this an unde-

finer sinus which, expanding, extends to the postero-basal extremity, while a less defined ridge bounds this sinuosity on its anterior side; surface marked by fine irregular concentric striae.

In the casts of this shell there is a strong linear straight clavicle, extending from a point just anterior to the beak two-thirds across the valve.



Fig. 6.



Fig. 7.



Fig. 8.

14. *CLIDOPHORUS CONCENTRICUS*. N. sp. Fig. 7.

Shell sub-equilateral, very broadly oval-ovate, the anterior end the broader; height nearly four-fifths the greatest length; anterior side a little shorter and more broadly rounded at the extremity; a slight depressed sinus on the posterior umbonial slope, which is more anterior than in the preceding species. Surface marked by even band-like concentric striae; shell thin; a linear curving clavicle extends from the cardinal line just anterior to the beak more than half way to the base.

The prominent points of distinction between this and the preceding shell are the nearly central beaks, the band-like striae, and the curving clavicle with the broad and nearly equal extremities of the valve.

15. *CLIDOPHORUS ERECTUS*. N. sp. Fig. 8.

Shell somewhat rhomboid-ovate, the height and length about equal; umbones prominent, beaks nearer the anterior end, somewhat curved and elevated; posterior cardinal line curving, with a scarcely defined ridge along the umbonial slope; basal margin strongly rounded, sinuate on the postero-basal margin and regularly rounded, with a scarcely defined ridge extending down the slope just anterior to the clavicle. Surface finely striated concentrically, a slightly curving clavicle extending from the cardinal line nearly two-thirds the distance to the anterior basal margin.

This species differs from the preceding in the equal length and breadth and consequent greater proportional height, in the sinuosity of the postero-basal margin, and more abruptly-rounded basal outline, and the curving forward of the beaks.

16. CLIDOPHORUS ELONGATUS. N. sp. Fig. 9.

Shell sub-elliptical, length about twice the height, beaks much nearer to the anterior end, which is narrowly rounded; umbones rounded, prominent; a defined gradually widening depression extends from the umbo to the posterior basal margin, causing a straightening or slight sinuosity in the edge of the shell; a defined ridge along the posterior slope between the sinus and the cardinal margin. Surface very finely striated. A slender clavicle extends from the anterior cardinal margin a little more than half-way to the base, and curving slightly forward.

This species differs externally from all the others in the greater proportional length and in the rounded umbones.

The *C. cuneatus* of the same size is a stronger and proportionally higher shell, having a less defined sinus on the posterior slope, and a much stronger clavicle.



Fig. 9.

17. CLIDOPHORUS SEMIRADIATUS. N. sp.

Shell somewhat oval-ovate, length about one third greater than the height.

Surface marked by fine concentric band-like striæ, and the posterior slope by flattened dichotomized radiating striæ, the two sets of striæ gradually dying out at their junction. A faint line anterior to the beak marks the place of the clavicle.

18. CLIDOPHORUS NUCULIFORMIS. N. sp.

Shell nearly equilateral, subventricose, height and length as seven to nine. Anterior end rounded, basal margin regularly curved; posterior end sub-acute, a slight flattening or depression along the posterior umbonial slope, and between this and the cardinal line a narrow ridge. On the anterior slope there is a depressed line almost parallel to the cardinal line, marking apparently the course of the clavicle. Surface marked by fine concentric striæ.

This species resembles in form the *C. concentricus* in its equilateral form, but the fine unequal concentric striæ and the difference in direction of the clavicle are sufficient to distinguish it.

19. CLIDOPHORUS SUBOVATUS. N. sp.

Shell, broadly oval or ovate, moderately and evenly convex; beaks near the anterior end; umbones moderately elevated; a scarcely defined depression extending from the umbo towards the postero-basal extremity; anterior extremity rounded, posterior extremity unknown (? regularly rounded); clavicle extending half way from the anterior cardinal margin to the base of the shell. Surface marked by fine unequal sub-lamellose striæ.

This shell is larger and more regularly convex than any of the others here described, and more inequilateral than any except the *C. cuneatus*.

20. NUCULITES [ORTHONOTA] CARINATA. N. sp. Fig. 10.

Shell extremely elongate, nearly three times as long as wide; sides sub-parallel; hinge line straight, beaks appressed, sub-anterior, the anterior extremity rounded; posterior extremity obliquely truncate, longer on the hinge line than on the basal margin. Surface marked by a sharp carina which extends from the umbo obliquely to the postero-basal angle, the space anterior to this carina marked by distinct elevated lamellose striæ, and intermediate finer ones. The space between this and the cardinal line smooth and slightly depressed. Cardinal line anterior to the beak showing six or seven crenulations. A strong clavicle extends from the anterior cardinal line with a gentle curve nearly to the base of the shell.



Fig. 10.



Fig. 11.



Fig. 12.

This shell presents characters not before observed combined in one species. It has the general form of *Orthonota*, while the crenulated cardinal line and the anterior clavicle are characters of *Nuculites*. The shell is readily distinguished from species of either genus heretofore described. The *Orthonotæ*, yet known, have the surface marking much less sharply defined.

21. TELLINOMYA ATTENUATA. N. sp. Fig. 11.

Shell elongate, narrow, more than twice as long as high, anterior end short and rounded, beak elevated, situated a little in

advance of the anterior third, posterior end narrow and abruptly rounded; basal margin slightly curved, and impressed posterior to the centre; posterior cardinal line straight but gradually declining; contour evenly convex. Surface concentrically striated, shell thick.

This shell resembles the *T. machæriiformis*, but the anterior end is proportionally longer and more regularly round, the posterior narrower and more attenuated, and the convexity of the shell much greater. It is much smaller and proportionally more elongated than the *T. nasuta* of the Trenton Limestone.

22. TELLINOMYA ANGUSTATA. N. sp.

Shell elongate, narrow elliptical, more than twice as long as wide, beaks fully one third from the anterior end. The anterior and posterior ends similar and equally rounded; basal margin regularly curved without indentation or sinuosity. Surface evenly convex and very finely concentrically striated.

23. LEPTODOMUS, (SANGUINOLITES,) ARATUS. N. sp.

Shell rhomboid-ovate, ventricose, beaks at the anterior third of the valve, incurved and pointed forward, umbones gibbous, a slight depression from the umbo directly to the base of the shell leaving a slight impression in the central margin; posterior slope sub-angular, the angle not defined; anterior slope with a defined angular ridge which borders a large cordiform lunette; anterior sharply rounded; basal margin nearly parallel with the hinge line, curving upwards at the posterior extremity, and somewhat obliquely truncated from the cardinal line. Cardinal line straight posteriorly, with a wide and deep ligamental area. Surface marked by strong unequal ridges and furrows parallel to the basal margin, which become obsolescent on the posterior cardinal slope.

It is scarcely possible to refer any fossil with satisfaction to the genera *Sanguinolites* or *Leptodomus* of McCoy, since the grouping of species under these names appears to us to comprise a heterogeneous assemblage in either case. Our shell corresponds in its external features with *Leptodomus costellatus* of McCoy, so far as the general form, surface markings, ligamental area, etc. and is doubtless generically identical with that shell.

24. MEGAMBONIA (?) CANCELLATA. N. sp. Fig. 12.

Shell sub-ovate, widening posteriorly; beak anterior incurved, umbo gibbous, with a gibbous umbonial slope on the posterior side, which is scarcely diverging from the cardinal line; posterior extremity rounded, the basal margin arcuate, with a slight impression anterior to the middle, the anterior end a little gibbous. Surface cancellated by concentric and radiating elevated striæ.

It is not possible from the specimen before me to refer this species satisfactorily to any known genus.

25. MEGAMBONIA STRIATA. N. sp.

Shell somewhat oval, the basal and cardinal lines nearly parallel; beak sub-anterior, small; umbones convex, scarcely gibbous; umbonial slope regularly convex, below which is a slight depression reaching to the postero-basal margin; posterior end rounded, the longer part of the curve on the basal side. Anterior end short and narrow, somewhat abruptly rounded. Surface marked by regularly radiating rounded striæ with faint concentric lines of growth.

This differs from the preceding species in being less gibbous, in the more nearly parallel cardinal and basal lines, in the direction of the umbonial ridge, and in the stronger radiating striæ.

24. AVIOULA HONEYMANI. N. sp. Fig. 13.

Left valve: body of the shell obliquely ovate, convex and somewhat gibbous towards the umbo, anterior wing small rounded, posterior wing large triangular, obtuse at the extremity, extending two-thirds the length of the shell. The line between the wing and body of the shell well defined by a slight abrupt depression along the junction. Surface marked by rounded radiating striæ which are interrupted by fainter concentric undulations or lines of growth; the wing is marked only by concentric striæ.

This species bears some resemblance to *A. emacerata* of the Niagara and Clinton groups of New York; but its form is slightly more oblique, and the wing is marked only by concentric striæ, while in the New York species the radiating lines on this part are stronger than the concentric ones.

25. MURCHISONIA ARISAIGENSIS. N. sp.

Shell teretely conical, volutions about five, gradually increasing from the apex, rounded with a slight angulation or carina in the middle. The surface is unknown and the angular band on the volution is the only means of determining its generic relations.

This differs from any of the described species of Murchisonia from American localities.

26. MURCHISONIA ACICULATA. N. sp.

Shell slender, very gradually tapering, volutions about six or seven, the last ones moderately ventricose, aperture elongate-oval or ovate, rounded at the anterior margin, columella plain; volutions marked by a distinct band along the centre, and a sub-sutural carina marking the upper side of the volutions; surface striated.

Fig. 13.



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Fig. 15.



27. HOLOPEA REVERSA. N. sp. Fig. 14.

Shell small, sinistral; spire depressed, volutions about three; the two first small and gradually expanding, the last one rapidly expanding and ventricose; aperture wide expanded; suture impressed. Surface unknown.

This shell has the general form of *Holopea*, but I have seen only a single specimen, which is a cast. It is remarkable and readily recognised from the sinistral spire.

28. ORTHOCERAS PUNCTOSTRIATUM. N. sp. Fig. 15.

Shell slender, very gradually tapering, almost cylindrical; Septa distant about one third the diameter. Siphuncle central; section circular. Surface very finely striated with unequal undulating striæ, the interstices between which, are punctæ which are oblong indentations often becoming confluent.

This species is remarkable for its extremely gently tapering form; the fragment of more than an inch long, showing scarcely a perceptible diminution in diameter. There are twelve and a half chambers in the space of one inch. The surface markings are peculiar, and among the species of the genus known to us constitute a distinctive character.*

29. CORNULITES FLEXUOSUS. var. GRACILIS.

This fossil resembles the one in the Clinton group of New York, but is somewhat more slender, and the annulations a little more closely arranged. The specimens from the rocks of New York present some variation in form, and the comparative distance of the annulations. None of them, however, are so slender as the Nova Scotia specimens.

30. HOMALONOTUS DAWSONI. N. sp. Fig. 17.

Caudal shield somewhat parabolic, obtuse at the extremity, very convex, width at the anterior side greater than the length of the



Fig. 16.

* The Arisaig beds afford at least three other species of *Orthoceras*. One, the largest of the three, has a marginal inflated siphuncle, and the septa about one-eighth of an inch apart, for a specimen two inches in diameter. It tapers very gently, and in all the specimens found is elliptical in its cross section. It occurs in the upper series. A second, found in the lower series, is marked with strong annulations placed closely together. A third, occurring in the upper series, and discovered since the specimens were submitted to Professor Hall, is a very beautiful species, apparently new, but closely resembling *O. perolegans*, Salter, of the Lower Ludlow formation. It is cylindrical, but slightly flattened; septa very convex and one-twentieth of an inch apart in a specimen half an inch in diameter; siphuncle central. Surface with slight rounded annulations from one-eighth to one-fourth of an inch apart, and covered with delicate transverse striae, scarcely visible to the naked eye, and about sixteen in a line. Under the microscope the striae appear as thin sharp parallel curved ridges, the spaces between being finely granulated and wider than the ridges. I would name this species *O. elegantulum*.— (See Fig. 16.)—J. W. D.

axis. Axis wider than the lateral lobes, distinguishable (in casts) from the lobes by a bending of the ribs and a scarcely perceptible depression along that line; annulations abruptly prominent; seven on the lateral lobes and nine on the axis, the anterior ones bending slightly backward at the line of division between the axis and the lateral lobe; each successive one bending more and more abruptly till the last one approaches a rectangular turn; the whole curving gently forward at their extremities, and all terminating abruptly before reaching the margin. Behind the seventh annulation the axis is marked by two more annulations, leaving nearly one-fourth of its length smooth.

This species is described from the casts and impressions of the caudal shield, so that the crustaceous covering is unknown. It is readily distinguished by the broad not prominent axis, the rectangular direction of the annulations on the axis, and their abrupt bending at the lateral furrow. An impression of a few imperfect annulations of the body shows that they are strongly elevated, much more so than in any known American species.

31. CALYMENE BLUMENBACHII. var.

Caudal shield somewhat semicircular, axis very prominent, marked by about seven annulations, lateral lobes marked by five ribs the four anterior ones bifurcating. Surface granulose. The specimens are not sufficient to make any satisfactory determinations regarding specific differences.



Fig. 17.

Fig. 18.

32. DALMANIA LOGANI. N. sp. Fig. 18.

The specimens are two or three imperfect cephalic shields, one preserving the palpebral lobes, and others consisting principally of the glabella, with two or three parts of caudal shields. There is a fragment of a cheek which may be of this species. Cephalic shield somewhat semicircular. Glabella ovate, wider in front and truncate behind, depressed convex; occipital ring narrow, prominent; occipital furrow bending a little forward in the middle and curving gently backward in the middle of each side, and

again turning forward; posterior furrows narrow and sharply impressed, each one extending about one third across the glabella and curving forward at their outer extremities; central furrow linear, obscure, having a direction transverse to the axis; anterior furrow obscure oblique to the axis, linear, extending to the margin of the glabella a little forward of the eye; frontal lobe regularly rounded anteriorly. A fragment of a cheek in the same association is broad, produced posteriorly in a short strong spine, and marked by a broad sub-marginal groove. Caudal shield somewhat semi-elliptical, convex, acute behind, axis very prominent, rounded and marked by about eight annulations, which are gently curved backward at the extremities; lateral lobes with six simple flattened ribs which terminate in a thickened border, and separated from the axis by a strongly defined furrow; extremity abruptly pointed.

The glabella of this species more nearly resembles *Phacops* in the general form and faintly impressed furrows, of which the posterior one is conspicuous. The form of the palpebral lobe, and the absence of tubercles at the base of the glabella, together with the form of the caudal shield, ally it with *Dalmania*, and it may be compared with *D. Phillipsi* of Barrande, but has a more pointed caudal shield, and the cheek, if correctly referred, is prolonged in a posterior spine.*

33. BEYRICHIA PUSTULOSA. N. sp. Fig. 19.

Valves unequally semi-oval, a little more than once and a half as long as wide; surface marked by three prominent ridges; central, anterior, and posterior. The central one is a single oblong oval tubercle which is directly transverse to the dorsal margin and a little nearer the anterior side. The anterior ridge consists of a single highly elevated, rounded or papillose tubercle near the dorsal margin, and an elongated elliptical tubercle placed obliquely near the antero-ventral margin, and in older specimens sometimes swelling and spreading over the margin. The posterior ridge rises near the dorsal margin, and making a slightly broader curve than the posterior end of the valve approaches the ventral margin at the centre: the ridge is high and angular with a small prominent

* Attached to a fragment of one of these trilobites is a small *Spirorbis*. It is dextral, with two to three turns, and rounded concentric wrinkles on the last whorl.—J. W. D.

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tubercle at the dorsal extremity, and from four to six smaller spine-like tubercles along its curve. The central ridge or tubercle is separated from the lateral ridge by a distinct furrow, and its continuation from the base of the tubercle passes between the lower ends of the two lateral ridges. Ventral and lateral margins with a narrow thickened rim.

This species resembles very nearly the *B. tuberculata* of Kloden, as described and figured by Mr. T. Rupert Jones. In our specimens the dorsal angles are more rounded; the posterior ridge at its base is never extended beyond the middle of the valve, and is marked on its crest by several small spine-like tubercles. The anterior ridge is usually more extended along the ventral margin in our specimens, and the furrow is better defined, while the tubercles are never flattened above or overhanging the base as shown in the European specimens. Smaller specimens, which appear to be the young of this species, present some slight variations of surface markings, but show less difference than the young of *B. tuberculata*.



Fig. 19.



Fig. 20.

34. BEYRICHTIA EQLATERA. N. sp. Fig. 20.

Nearly equilateral, very convex, marked by three smooth or nearly smooth ridges. The central ridge is an oblong tubercle reaching from near the dorsal margin a little more than half way to the ventral margin. The posterior ridge is a little larger, but scarcely differing in form from the anterior one, its ventral extremity terminating beneath or a little in advance of the middle of the central tubercle. The furrow is narrow but well defined on the two sides of the central tubercle, and becoming shallow in its passage to the marginal furrow; ventral and lateral margins thickened.

35. LEPERDITA SINUATA. N. sp.

Minute sub-ovate, anterior end narrow, dorsal line one-third shorter than the length of the valve; an extremely minute tubercle near the anterior end. Centre extremely convex or ventricose; ventral margin near the posterior end a little sinuous, or indented from the inner side. Surface smooth under an ordinary lens.

Two specimens only of this species have been observed, both of them having the same dimensions.

36. *TENTACULITES DISTANS*. var.

The specimens under examination do not present any important points of difference from those of the Clinton group in New York. In the Nova Scotia specimens there are numerous annulations near the apex, which are not observable in the New York specimens.

37. *HELOPORA FRAGILIS*, var. *ACADIENSIS*.

The specimens under examination offer no very important difference from those in New York, and as the Nova Scotia examples have been more or less compressed and worn, they are scarcely in a satisfactory condition for nice discrimination.

All the above fossils belong to the Arisaig series of Mr. Dawson's paper. Nos. 4, 10, 30, 36 and 37 appear characteristic of the dark and olive shales of the lower member, in which are also *Strophomena profunda*, *S. rugosa*, *Orthis testudinaria*, *Atrypa emacrata*, *Rhynconella equiradiata*, *Graptolithus Clintonensis*, and crinoidal columns; also a *Modiolipsis* allied to *M. subcarinatus*. The remaining species are in the coarse limestone and reddish shale of the upper member, in which are also *Strophomena corrugata*, *Atrypa reticularis*, *Rhynconella neglecta*, *Lingula oblonga*, *Bucania trilobita*, and a *Chatetes* or *Stenopora* similar to that of the Clinton formation. *Cornulites flexuosus* is almost the only species which occurs equally in both groups of beds. Some of the *Clidophori* are also found in both groups.

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