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ART. XXII.—*On Lower Silurian fossils from a limestone of the original Taconic of Emmons*; by JAMES D. DANA.

[Read at the meeting of the American Association at Ann Arbor in August, 1885.]*

THE Lower Silurian fossils hitherto reported from rocks of the Taconic system have come either from localities to the north of the original Taconic area, in the State of Vermont, or from others to the southwest of it, in Dutchess County, New York. The discovery of fossils which I have now to announce was made the present season in a limestone of the original Taconic series of Professor Emmons, his "Sperry limestone," within a mile and a half of the Massachusetts boundary.

That the facts may be fully understood as to what is the *original* and, therefore, *true* Taconic, a brief review of the subject is here introduced; for mistakes are still continually made by writers on the subject.

Professor Emmons, in his first account of the "Taconic System," which makes thirty pages of his Report (in quarto) on the Geology of New York, published in 1842,—mentioned as the constituent rocks, commencing on the west: (1) "Taconic slate," in eastern New York, including the Hoosic slates;† (2)

* Some changes have since been made in order to include the facts from additional observations on the fossils and rocks of the region.

† Of this division of "Taconic slate," his No. 5, in the tabular statement on page 144, Prof. Emmons says, on page 150, "No organic remains have been found in the rocks; it is even destitute of those obscure markings which are called *fucoids*."

the "Sparry limestone" interstratified with the slates west of the Taconic Range and for the most part lying against the west side of the range; (3) The "talcose" or "magnesian" schist (as he called it) constituting the Taconic Range, and Greylock or Saddle Mountain, the high ridge between Williamstown and Adams in the northwestern angle of Massachusetts; (4) the Stockbridge limestone, east of the range of Taconic schist; (5) quartzyte.

He described the prevailing dip of the strata as eastward, as later investigators have done. He made the sparry or western limestone older than the Taconic schists, the limestone dipping under the schists. The belt of sparry or western limestone (sparry is a misleading term and was afterward rejected by him) he described as extending through the New York towns of Hoosic, Petersburg, Berlin, New Lebanon, Canaan and Hillsdale, along the west side of the Taconic Range.

The above-mentioned series of rocks constituted the Taconic System as propounded and described by Prof. Emmons in 1842. He says, on page 136 of this Report:

"The Taconic System, as its name is intended to indicate, lies along both sides of the Taconic Range of mountains, whose direction is nearly north and south, or, for a great distance parallel with the boundary line between the State of New York and those of Connecticut, Massachusetts and Vermont." He remarks that the rocks extend farther north through Vermont into Canada, but gives no details about Vermont or Canada localities, and adds, "It is, however, in Massachusetts, in the County of Berkshire, that we find the most satisfactory exhibition of these rocks."

Prof. Emmons's declaration, in this first detailed account of the system, as to what is the typical Taconic series, must be accepted; and the geological age of these beds—the rocks of the original Taconic System—whatever it may prove to be, must therefore be taken as the age of the Taconic System.

The stratigraphical observations of Prof. Emmons are right. But he took a step of questioned correctness when he concluded in 1842 that the system was intermediate in age between the New York Potsdam sandstone and what he calls the "Primary" system lying to the eastward; or, as stated, in another place (on page 163) that the rock "appears to be equivalent to the Lower Cambrian of Sedgwick." For the criterion of age which he announced, namely: "As a general rule, certain minerals are found in particular rocks" was of unascertained value; and the facts referred to as a basis of his conclusion: that the Taconic quartzite is interstratified with limestone; that the limestones are peculiar in grain; and others of related character, are doubtful evidence for separating them

from corresponding New York rocks. He says (p. 139), "we find no fossils in the rocks of which I am speaking, and hence can derive no aid from that source upon which any reliance can be placed." He states no case of unconformability with the New York rocks. In a later publication he refers to a case of *dislocation*, as he terms it, in the Hoosic region, but not to any of true unconformability. Dislocation, that is, faulting, it is well known, proves nothing as to distinction of system; and the particular facts at Hoosic referred to are proved to be of merely local interest, by the general range of facts in the Taconic region.

Through the use of his lithological canon,—*his*, for he was the first to announce it—Professor Emmons had identified, by 1844,* areas of Taconic rocks in Rensselaer County, New York, Northern Vermont, Canada, Maine, Rhode Island and Michigan; and later, in New Jersey, Virginia, North Carolina and Georgia; and others have used the canon since with equal success, even sometimes at *very* long range.

In saying that such a use of lithological distinctions was unwarranted, I mean to assert that geological investigation with reference to the canon had not advanced so far as to make its application safe, and render it certain that fossils might not yet be discovered to upset the conclusion. I mean to assert, further, that the conclusion *does not* now stand against actual discoveries of Silurian fossils later than Potsdam that have recently been made.

The history of Taconic geology suggests caution with regard to the use of lithological distinctions as evidence of geological age. It shows how easy it is, under such prompting, to put assumptions for facts, to say "I know" when one ought to say "I doubt," and to build up systems that are likely to fall to pieces.

Professor Emmons, after he had found slates in Washington County, New York, *looking like Taconic*, and which he called Taconic, made the discovery in them of trilobites, large trilobites, which Barrande later pronounced to be *Primordial* species. This was evidence to him that these beds were of later age than the typical Taconic, and so he made for them the subdivision of *Newer Taconic*. The discovery was a grand one, and may well give us a high opinion of Prof. Emmons as a geological observer. But the conclusion that the rocks were rocks of his Taconic system had not been proved.

Prof. Emmons, in his *American Geology*, where he makes his latest exposition of the Taconic subject (covering with it

* Chapter on the Taconic System of his N. Y. Agricultural Report (1846), issued in advance of the volume under date of 1844.

† "American Geology," by Prof. E. Emmons. 1855, Part II, p. 40.

122 pages of the volume), includes in the *Lower Taconic*, "as developed in Williamstown and Adams;" the quartzite; the schists of the Greylock ridge and others west; the Stockbridge limestone; and, with these, the western or "sparry" limestone and the associated slates; that is, all the true original Taconic. To the Upper Taconic (p. 49) he refers the black slates and calcareous beds at Easton, Washington Co., N. Y., which, four or five miles north of Bald Mountain, afforded him the Primordial trilobites; similar slates and limestones at St. Albans, with some sandstones. He also includes the slates and limestone of Poughkeepsie and of the region east of there to Sharon, Connecticut—beds which have recently been proved to contain abundantly, in some localities, Hudson River, Trenton and Calcareous fossils (made known from the Poughkeepsie slates first by Mr. Nelson Dale, and from the limestones, by Prof. W. B. Dwight and the author), and which recent discoveries of Prof. W. B. Dwight prove to be also in part of Potsdam age, as a paper of his, prepared for the present meeting of the Association, announces.*

Now the larger part of all that has been written on the Taconic question is about the outside rocks—the "Newer Taconic." Volumes have been devoted to them which have settled nothing. Emmons did not make those Primordial slates Taconic by calling them so, any more than Dr. C. T. Jackson made the Red sandstone of the Lake Superior region Triassic by calling it so, because the red sandstone of the Connecticut Valley had been determined to be Triassic. Should it be substantiated that the original Taconic of Emmons is in part of Calcareous, Trenton and Hudson River age (that is, Lower Silurian), what has been gained from the effort to prove the Primordial slates of Washington County, N. Y., to be not only Taconic in system, but Taconic *newer* than the original Taconic?

We have now unimpeachable evidence—evidence from fossils—that those Primordial Trilobite beds are *not newer* than the typical or original Taconic; that the limestones of the true, original, typical Taconic, on the contrary, are the newer. The Lower Silurian fossils here referred to were found, as has been stated, in the "sparry" or western limestone of the Taconic System—the oldest limestone stratum of the system according to Emmons in 1842. They are from Canaan, New York, the town next south of New Lebanon. The Boston and Albany railroad, as it crosses the State-line in leaving Massachusetts for Albany enters the town of Canaan and its limestone area; and the fossils have been collected from a cut along the railroad, and from ledges of limestone half a mile south of the road and a mile north of it.

* Published at p. 125 of this volume.

The limestone of this belt is mostly a gray, fine-grained crystalline rock, varying to whitish on one side, and to blackish, faintly crystalline, on the other. Short lines and blotches, suggestive of fossils, are common in its grayer portions, but distinct forms I had failed to find. Hope was renewed during the past winter by receiving, from Mr. D. Clark, of Tyringham, a piece of obviously fossiliferous limestone labeled "West Stockbridge." It led to an unsuccessful search in that town in which I was aided by Prof. Dwight of Poughkeepsie. On his return homeward, Prof. Dwight continued his search in Canaan, N. Y., the next town west, and there he had success. This careful investigator found fossils in the limestone at two localities, one at the railroad tunnel, southeast of Canaan Center, and the other, half a mile to the south, in a feebly crystalline blackish variety of the limestone. I was shortly afterward in Canaan for further search and study of the rocks, and also at other times later; and I discovered evidences of fossils also in the limestone in place two miles east of Canaan Center, on the farm of E. S. Hall, but none as distinct as those of the localities first visited by Prof. Dwight.

Prof. Dwight by slicing and polishing has brought to light several determinable species, notwithstanding the metamorphism of the rock. The paper following this contains the results of a careful study of them by himself and Mr. S. W. Ford; and Plate VII, illustrating it, shows at a glance, that this Taconic limestone is not pre-Cambrian or Cambrian. The species include remains of Murchisonias, Pleurotomarias, Crinoids, Fenestellæ, a Trilobite, and probably of Brachiopods; and multitudes of fragments not determinable. From the fossils, these authors are led to refer the limestone, that is, the part of it affording the fossils, probably to the Trenton period.

Two of the localities affording fossils occur in the main belt of the limestone, where it is half a mile to a mile wide, and the third (the locality at the railroad tunnel) in a limestone area on the west side of an isolated belt of schist or slate, which connects with the main belt two miles north, near Queechy; and they are all within two miles of the Massachusetts boundary and a mile or less from the schist of the Taconic range. The distribution of the areas and the positions of the localities will be given on the map of Middle and Northern Berkshire which I shall soon publish in this Journal.

At the railroad tunnel the limestone dips eastward at a small angle (15° to 20°) beneath the slates; and the locality that has afforded the fossils is hardly 200 yards from the overlying slates on the east and south. Both of the localities found by Prof. Dwight are very near this isolated ridge of schist, that of the tunnel limestone on the west of it, and the other ledge

near the east side; and they render probable, if not certain, the overlying position of the schist in this ridge.

But the fossils above mentioned are not those of the specimen of limestone received from Mr. D. Clark. That specimen was given him by Mr. J. W. Smith, of Canaan-4-Corners, and came from the farm of Mr. E. S. Hall above referred to. Unfortunately, all that is now exposed to view is in three loose angular masses, two feet in cubic size and smaller, and not a ledge.

A fourth larger mass was till recently in sight; but it has had its upper part removed to a considerable depth below the surface in clearing the farm of its rocks, and I was informed by Mr. Smith, that in the removal two wagon loads of blocks were carried off, though a large portion was left under the soil. As the farm was under cultivation through the season, I could not have an opening made. An attempt to find the underground mass made since I left the region has proved unsuccessful; so that it will have to remain undiscovered until another season opens. As to the origin of the four masses, all I can say now is that, if transported, they are not probably from any point outside of the valley; for they are angular masses, little worn, and lie all within fifty feet of one another. As the rock is a porous one, it would wear more easily than other portions of the limestone and hence be likely to be covered with soil.

Although the evidence from these specimens is not yet available because of the doubt as to locality, it is of interest to note that they are almost identical in character with the fossiliferous Wappinger valley limestone (part of Emmons's Western Taconic limestone) at Pleasant Valley, a few miles northeast of Poughkeepsie. Like that, it consists largely of nodules of so-called *Chætetes compactus* (now shown by Mr. Dwight to be a *Solenopora*), which give it the aspect of a conglomerate. Along with this fossil, the eye easily detects disks of crinoids, true *Chætetes*, and in one case a portion of a large *Receptaculites*, similar to that found with the same limestone at Rochdale near Poughkeepsie. Prof. Dwight has made slices of the rock and says that it contains all of the kinds of fossils occurring in the Pleasant Valley limestone, and others observed by him only at other localities in that region. There is no doubt of its Trenton age.

In former papers I have presented evidence, gathered by myself and earlier observers, proving that the Taconic range and the adjoining limestones on the east and west, constitute, in the main, a great synclinal or compound synclinal. It hence follows that fossils of the western limestone of Canaan indicate the Lower Silurian age of the eastern or Stockbridge limestone.

But, more than this, the eastern and western limestones have a surface connection. From New Lebanon the western continues northward, and three miles to the north (in Stephentown) it stretches on, in a north by east direction, into Massachusetts, passing in a broad belt through the towns of Hancock and Williamstown, as my Berkshire map, above alluded to, will show, confirming Professor Hitchcock's map of 1841. Thence it extends northward *uninterruptedly* into Vermont (as the Vermont geological survey, and my own observations prove), and becomes the great central marble belt of that State, passing through Bennington, Dorset, Rutland, and to and beyond Middlebury. Thus the same Taconic limestone belt that contains Trenton and Chazy fossils in Rutland, Vermont and towns farther north, as shown by the Vermont Geological Survey, is now proved to have Lower Silurian fossils west of the Taconic range at Canaan in eastern New York.

The reading of this paper at the meeting of the American Association was followed by remarks by Prof. James Hall and also by Prof. N. H. Winchell. Prof. Hall observed rightly that the conclusion as regards the Lower Silurian age of the Taconic rocks was not new. This fact I have urged in all my papers on the Taconic rocks except the present one; and I made it the special point of the paper preceding this one, presented in 1882 to the Geological Society of London, showing that the conclusion I held had been sustained by every geologist who had investigated the region and published on it since the Taconic system was first announced—W. B. and H. D. Rogers, W. W. Mather, E. and C. H. Hitchcock, and A. Wing. In my *Manual of Geology*, the bibliography of the Taconic system is given under the two heads of authors sustaining its Lower Silurian age, and those not; and among the former is the name of Prof. Hall.

Unfortunately for the science, Prof. Hall, while one of the foremost to contest the conclusions of Prof. Emmons before the Association of Geologists and Naturalists in 1840 to 1845, published nothing on the subject; neither were his remarks before the Association published in its brief proceedings. Moreover, no paper giving his later opinion has since appeared. In 1884 (September 13), 40 years after those discussions, I received from him (as a sequel to a letter of enquiry as to any publications of his on the subject) two plates of stratigraphical sections across the Taconic region, prepared by him 40 to 45 years since, showing plainly careful labor in the field with reference to settling the debated question. This most welcome addition to the facts afforded proof conclusive of the synclinal character of portions of the Taconic range, as I have stated in a notice of them in volume xxviii (1884) of this Journal (p. 311). I had also asked him in my letter his opinion as to the age of the Hoosic Slates (40 miles north of Canaan), from which Prof. Emmons and others, in his publications later than 1842, had reported Graptolites, this point bearing

directly on the age of the accompanying limestones. In his reply, as I report in the notice (on p. 312), he said that he was at "present uncertain as to the precise period of the Hoosic Slates." Prof. C. H. Hitchcock, in 1884, had referred to the fossils as proving the Lower Silurian age of the limestone, and in a letter of the 30th of January last, says: "I do not recall any fossil there except the graptolites."

At the time of the earlier discussions in 1840 to 1844, in which Professors Hall, Rogers, Mather and others, took part, the only Taconic rocks under consideration were, as Prof. Hall remarked in a letter to me of last September, those of the true Taconic range, as defined in the above paper. I had no part in the discussion; in fact, I knew nothing about the Taconic except what I learned from the discussions after 1842, owing to my absence from the country for the four years previous; my first published opinion on the question is in my *Manual of Geology* (1863) in which Logan's conclusion was adopted.

The report of Prof. Hall's remarks at Ann Arbor implied that he spoke of having known of fossils from Canaan 40 years since.

But, in a letter received soon after, he informed me that he was misunderstood and that he referred to fossils from the limestone of Hoosic. The graptolites of the Hoosic slates are the only fossils of that town mentioned by Prof. Emmons or others in the various controversial writings on the subject; and as no notice of any fossils in the Hoosic limestone had ever been published, I enquired in another letter as to the species, in order to make the argument from the facts more satisfactory, but have not yet received the desired information. It is to be hoped that they will soon be announced, that the evidence as to the age of the Taconic schist may be of the fullest possible character.