ART. XXXIII.—*The Upper Hamilton and Portage Stages of Central and Eastern New York*; by CHARLES S. PROSSER.

THE correlation of the Upper Devonian rocks of central and eastern New York has for a long time been a question of great difficulty and several interesting statements have recently been published in reference to this problem. The region is one familiar to me, and while recognizing the generally accurate description of the geologic sequence of this mass of rocks, the correlation and consequent age of a portion of the terranes under consideration, included between the base of the Oneonta sandstone and the top of the Hamilton stage, seem to call for a brief explanation of their paleontology and stratigraphy. This region was somewhat briefly described by Dr. H. S. Williams in a paper on "The classification of the Upper Devonian"* in 1885; in addition to this a large amount of data has been accumulated in reference to the paleontology and stratigraphy of the region, the greater part of which is in the hands of Dr. Williams for use in the preparation of a monograph describing the Devonian system of the United States.

The term "Oneonta group" has been used for two entirely different geologic terranes in the same region of New York, hence it would seem advisable to review the history of the use of the names under consideration.

The Oneonta sandstone was defined by Vanuxem in 1840, as follows: "*Montrose sandstone*, or sandstone of Oneonta; this is the last or upper rock of the third district [third geological

* Proc. Am. Assoc. Adv. Sci., vol. xxxiv, p. 225. See in particular Sections No. VIII, IX, X on the chart of meridional sections accompanying the paper.

district of New York]; it consists of many veins of gray sandstone, and sometimes of red sandstone . . . this rock is found in Otsego, Chenango and Broome counties [New York]; it covers the whole of the upper part of Susquehannah county, in Pennsylvania, and being there an abundant rock and surrounding the town of Montrose, I have thought it well to apply its name to this rock.”* This description classed as one formation the Oneonta sandstone, which in that region is overlaid by rocks containing at the base a Portage fauna, higher Chemung species and finally is capped by the Catskill stage, the united mass of these terranes forming Vanuxem’s Montrose or Oneonta sandstone. In the same year, Professor Mather proposed the “Catskill Mountain series” and described it as “that [series] which lies between the Helderberg limestone series and the coal-bearing rocks of Carbondale in Pennsylvania.”† In his following report Professor Mather subdivides this series into eight groups as follows :

- “ 1. Conglomerates and grits.
2. { Red and gray grits with red shales mottled with green spots.
3. { Montrose sandstone of Professor Vanuxem.
4. Chemung group of Professor Vanuxem.
5. Ithaca “ “ “ “
6. Sherburne flags “ “ “
7. —————
8. Hamilton group “ “ “
9. Marcellus shales “ “ “ ” ‡

Vanuxem in his final report classed together the “Montrose and Oneonta Sandstone of the Reports” and called them the “Catskill group;” which he regarded as equivalent to the “Old Red sandstone of England.”§

In 1841 Conrad published a classification of the rocks of New York. The “formations” were numbered in ascending scale and the following were referred by him to the “Upper Silurian Series” :

- “ 26. Oneonta group.
25. Cazenovia “
24. Tully limestone.
23. Sherburne group.
22. Shales near Apulia.
21. Black slate.” ||

* 4th Ann. Rep. Third Geol. Dist. N. Y., p. 381.

† 4th Ann. Rep. First Geol. Dist. N. Y., p. 227.

‡ 5th Ann. Rep. First Geol. Dist. N. Y., p. 77.

§ Geol. N. Y., Pt. III, 1842, p. 186.

|| 5th Ann. Rep. Palæontology N. Y., p. 31.

There is one mistake in reference to the stratigraphic order of the groups of the above list. The "Cazenovia group" belongs *below* instead of above the Tully limestone. This error was corrected by Vanuxem in his final report, where under the heading of the Hamilton, the "Cazenovia group" is given as one of its divisions.*

To one who is not familiar with the geological outcrops near Cazenovia, a glance at the geological map of New York of 1843, or the one showing the "Geographical distribution of the Tully limestone in central New York" by Professor S. G. Williams,† will show the exposures of Tully limestone as considerably south of Cazenovia. Of course the "Black slate" represents the Marcellus shale, while the "shales near Apulia," and the "Sherburne group" are parts of the Hamilton stage as stated by Vanuxem.‡ It is interesting to note that the term "Sherburne group" of Conrad is not the same as the "Sherburne flagstone and shale" of Vanuxem as will be seen from an attentive examination of his final report.§ The Sherburne flagstones of Vanuxem are a mass of sandstones in the Chenango Valley above the horizon of the Tully limestone, which are mostly non-fossiliferous and are synchronous with the lower part of the Portage as exposed farther west. Below these flagstones are argillaceous shales which contain an abundance of Hamilton fossils, as for instance in the shales at Rexford or Sherburne falls. The same zone is well exposed in the gorges near Smyrna where the Sherburne flagstones form the top of the high hills, and most of the species which Conrad gave as belonging to the "Sherburne group" were from "near Smyrna." The following, which are now all well known Hamilton species, were named and described:

Nuculites oblongatus, *N. rostellatus*, *N. bellistriatus* [now *Nucula bellistriata*], *Orthonota undulata*, *Cypricardites oblonga* [now regarded as a synonym of *Modiomorpha concentrica* (Con.) Hall], and *C. rugosa* [now *Goniophora rugosa* (Con.) Miller].||

Above this zone Conrad placed the Tully limestone, but apparently no representative of the Genesee shale is given. The highest rocks are the Oneonta group which are supposed to have been named from exposures near that town. *Nuculites cuneiformis*, *N. maxima* [now *Paleoneilo maxima* (Con.) Hall], and *Cypricardites carinata* [now *Goniophora carinata* (Con.) Hall] were named and described from this formation at

* Geol. N. Y., Pt. III, p. 150.

† Sixth Ann. Rep. State Geologist [N. Y.] for 1886; map following p. 28.

‡ Geol. N. Y., Pt. III, p. 150.

§ See the explanation of the names that had been used for different parts of the Hamilton on p. 150, and the same for the Portage on p. 172.

|| 5th Ann. Rep. Paleontology N. Y., pp. 50-54.

Oneonta. The shales and sandstones which contain these fossils are exposed at the base of the high hill near Oneonta, and are *below* the reds and grays which compose the terrane to which Vanuxem gave the name Oneonta sandstone. The quarry, a short distance west of Oneonta and below the highway, contains these species in association with others, especially *Paracyclas lirata* (Con.) Hall, *Chonetes scitula* Hall and *Tropidoleptus carinatus* (Con.) Hall. Above the highway fossils become rare and gradually disappear, the last species noted being *Nuculites cuneiformis* Con. and *Palaeoneilo maxima* (Con.) Hall, about half way up the hill. It seems that Conrad's name for this zone was not considered in the final reports of the New York Survey, although Vanuxem referred to the horizon in several places; for instance in describing the hill near Oneonta, mentioned above, it is stated that the Catskill group or Oneonta sandstones of Vanuxem "occupy the highest part of the face of the hill, the base of which is composed of rocks which I [Vanuxem] have supposed to belong to the Ithaca group."*

So far as the writer is aware he first called attention to the twofold use of the term "Oneonta group," and indicated the stratigraphic place of each zone.† The zone is well exposed in the Susquehanna, Unadilla, and Chenango river valleys, especially at Oneonta, Oxford and Norwich. In reference to the correlation of the deposits below the Oneonta sandstone there seem to be many conflicting opinions, owing to the fact of the absence of the Tully limestone and the Genesee shales in central and eastern New York. It is true that their distinctive lithologic characters simplify the matter of separating the Hamilton from the overlying Portage in all that area where they are present. But the writer found that a careful study of the facies of the fauna of each zone, supplemented by actual observation of their stratigraphic position and relation in the field, enabled him to separate the fauna of the typical Hamilton from those of the modified Hamilton faunas of the overlying rocks in regions where there was no trace of the Tully limestone or Genesee shale.

This method of separating the Hamilton from the Portage above was thoroughly tested during the summers of 1890-91 in an examination of the Devonian system along the eastern face of the Catskill mountains from Greene county, New York, to Carbon county in eastern Pennsylvania. It was noted that although the fossils in the upper rocks were mostly species found in the typical Hamilton of central and western New York, still there were slight variations or even varietal modifi-

* Geol. N. Y., Pt. III, p. 192.

† Proc. Am. Assoc. Adv. Sci., vol. xxxvi, 1887, p. 210.

cations which when observed, enabled one to separate them. There are frequently lithologic variations to assist, as in eastern Pennsylvania, which were used to advantage in the work of Prof. I. C. White for the 2d Geological Survey of that State, and a knowledge of these *two* characters was found necessary for the correlation of the Upper Devonian of this region. This principle was tested several times by different observers and it was found that those paleontologists who had simply studied the species in a general way without considering the minor variations due to the difference in geographic distribution or stratigraphic range did not recognize the different facies of these faunas but called them all Hamilton; while two paleontologists who had closely studied the characters of the faunas and had also noted similar comparatively slight changes in reference to the distribution and range of species for another region, on being shown collections of these fossils without any information as to their stratigraphic position, invariably recognized those that came from the beds corresponding to the typical Hamilton of New York, as well as the slightly modified faunas from the overlying rocks. And this recalls the principle stated by Dr. H. S. Williams when describing the classification of the Upper Devonian for southern and western New York, viz:—"the complications arising from both geological and geographical modifications of fossil faunas are so great that the attempt to determine horizons by single or by roughly identified fossils will certainly lead to erroneous results."* The failure on the part of paleontologists to observe this rule and the tendency on the part of the stratigraphic geologists to base their correlations mainly on lithologic characters have continually made futile all attempts toward an accurate correlation of the terranes of the Upper Devonian for southern and eastern New York, and eastern Pennsylvania.

In a recent article is the statement that "the basal beds [of the Oneonta formation] are gray flags which merge into the Hamilton;"† but no data is given in favor of such correlation and I suppose the opinions of other geologists were followed.

This particular part of the series is one to which the writer of this paper has given especial attention, not only so far as the fossils from the different regions and horizons are concerned but he has also made cross sections at various points from

* Proc. Am. Assoc. Adv. Sci. vol. xxxiv. 1886, p. 231.

† The stratigraphical relations of the Oneonta and Chemung formations in eastern Central New York; by N. H. Darton. This Journal, III, vol. xlv, p. 206. In addition see on p. 207 the statement that the Hamilton is exposed at Lyon Creek bridge, near Oxford: also, that "The Chemung rocks to which Mather and others refer lies below the Oneonta beds or about 1,000 feet below the actual base of the Chemung horizon, and are Hamilton in position. This fauna is meagre and consists of species supposed by Vanuxem to be Chemung in central New York, but now known to be Hamilton."

central New York to central Pennsylvania and traced the continuation of the different zones, so that he feels inclined to speak with considerable positiveness in reference to this portion of the New York Upper Devonian. Moreover, since a new geologic map of New York is in process of coloration, it seems that attention should be called to the correlation of this particular part of the series. Indeed, most of the statements that have been made during the last ten years as to the age of these rocks are not so accurate as the conclusions of Vanuxem over fifty years ago; so that if this area be colored on the new map, as one would infer from these occasional statements, the map for that section of the State will not be so accurate as the one of 1843. These remarks apply especially to that part of the geologic column which in western central New York extends from the Genesee shale to the base of the Chemung, while for central and eastern New York and Pennsylvania from the Marcellus shale to above the lower reds and grays, called the Oneonta sandstone, as high as marine fossils have been found.

Our reason for differing from the ordinary statements in reference to the age of the rocks immediately underlying the Oneonta sandstones (which compose the Oneonta group of Conrad) will be much more clearly understood if we consider first a section like that of Cayuga lake, where the Tully limestone and Genesee shale are present in their full development, and consequently where there can be no question as to the upper limit of the Hamilton stage as originally defined and generally understood and accepted. The bluffs along Cayuga lake and the exposures south of Ithaca, which have been carefully studied and fully described by Dr. H. S. Williams in various publications, afford such a section.* Along the shores of Cayuga lake are exposed 1,000 feet of argillaceous shales and sandstones containing an abundant and typical Hamilton fauna. Capping the Hamilton is the Tully limestone varying from 15 to rather more than 20 feet in thickness. This is overlaid by the Genesee shale, a very fissile, black, argillaceous shale 100 feet in thickness in this region which in some of the glens, as Burdick's, is capped by a prominent sandstone nearly four feet in thickness. The sandstone marks the beginning of the Portage, the lower division of which is composed of sandstone and shales containing but few fossils with a thickness of 250 feet.† Succeeding this division is the "Ithaca group" of Vanuxem, or the middle Portage of Professor Williams, with a thickness of

* See particularly Bull. U. S. Geol. Survey, No. 3, 1884; also Science, vol. i, old series, Oct. 16, 1880, p. 190. Proc. Am. Assoc. Adv. Sci., vol. xxx, p. 1, of reprint, and *ibid.*, vol. xxxiv, p. 222.

† This part constitutes the entire Portage of the Cayuga lake region as described by Professors Hall and Vanuxem in their final reports. See Geol. N. Y., Pt. IV, p. 250, and *ibid.*, Pt. III, p. 174.

450 feet. Portions of this division contain abundant fossils and the fauna is made up of an assemblage of Hamilton, Portage of western New York and a few species which are found in the Chemung, together with those that are peculiar to the Ithaca zone. Following the "Ithaca group" are 600* feet of shales containing only a few fossils which are mainly the same as those of the Lower Portage. Professor Williams, who first noticed and described this zone, called it the Upper Portage and consequently assigned to the entire Portage of the Cayuga lake region, a thickness of 1300 feet. Succeeding these barren shales and sandstones are shales of different lithologic character which contain the regular Chemung fauna as known somewhat farther south in the typical locality near Chemung, and possibly row with better exposures near Waverly. In this section there has never been any question as to the upper limit of the Hamilton, and no one has proposed to call the rocks of the "Ithaca group" with a modified Hamilton fauna, a part of the Hamilton stage. The Ithaca fauna was correlated differently by Vanuxem who called it "a group between the Portage and Chemung," and by Professor Hall who considers it the lower part of the Chemung stage; but both of these geologists overlooked the non-fossiliferous zone above, which was observed by Professor Williams, who has classified the rocks of this section in a perfectly satisfactory manner.

Now if we consider the section of central New York along the Chenango valley, we shall find a decided change in the order of the stratigraphic character of the section, although certain zones or stages may be and have been traced continuously by several geologists from Cayuga lake into the Chenango valley. The Tully limestone and Genesee shale are two stages which have been followed to a locality near Smyrna village in the northern part of Chenango county. To be sure they are much less in thickness than where exposed on Cayuga lake, still there is no question that they represent the same geologic horizon, as has been attested by every observer who has gone over this field. It was so understood by Vanuxem, in 1842;† more definitely described by Prosser in 1887;‡ the Tully limestone mapped with this eastern exten-

* For the thickness of these divisions of the Portage see Prosser in Trans. Am. Inst. Min. Eng., vol xvi, p. 945; also for the thickness of the Upper Portage see this Journal, III, vol. xxxii, p. 193, where Professor Williams says: "The fossiliferous zone at Ithaca is separated from the lowest beds containing characteristic Chemung fossils by about 600 feet of nearly barren, flaggy and shaly deposits, but with a few fossils which belong to the characteristic Portage fauna."

† Geol. N. Y., Pt. III, pp. 164, 169 and 292.

‡ Proc. Am. Assoc. Adv. Sci., vol. xxxvi, p. 210, where the thickness of the Genesee shale is given as 20 feet, and the limestone layers and calcareous shales as 25 feet, near Upperville in Smyrna township.

sion by Professor S. G. Williams in the same year,* and finally so indicated by Dr. H. S. Williams in 1890.†

The bearing of this horizon will be immediately appreciated when we remember that Smyrna is in the Chenango river valley, while Oxford is nineteen miles farther south in the same valley near which place it is stated the Hamilton is exposed. The fossiliferous zone near Oxford is well exposed at Norwich and on the hills near North Norwich, but farther north at Sherburne it is found only near the top of the high hills and at Smyrna it is hardly reached at the summit of the highest hills. Some of the species belong in the Portage and many occur in the Hamilton, among which are those slightly modified from the Hamilton forms. The recurrence of the Hamilton species in the higher beds has probably led several geologists to refer these rocks to the Hamilton stage, and to ignore the clear and perfectly conclusive stratigraphic evidence of their age. The most authoritative correlations of this zone with the upper part of the Hamilton stage are indicated in the following foot note.‡

The stratigraphic sequence and general correlation of the Hamilton and Portage stages for Chenango and Otsego counties were described by the writer in 1887;§ but at this time it

* Sixth An. Rep. State Geol. [N. Y.] for 1886, p. 13; and see map facing p. 28.

† Bull. Geol. Soc. Am., vol. i, p. 489.

‡ In the Geol. Surv. N. Y., Palæontology: vol. v. Pt. I, Lamellibranchiata II, 1885, several species are reported from localities in this zone which is called Hamilton: as *Goniophora carinata* (Con.) Hall, from Oneonta, p. 302; *Microdon* (*Cypricardella*) *complatus* Hall, below Norwich, p. 312; *Nuculites cuneiformis* Con., at Oneonta, p. 326; *Palæoneilo arata* Hall, "shales of the Hamilton group, near Norwich," p. 342; *Prothyris planulata* Hall, near Norwich, p. 460; *P. lanceolata* Hall, Norwich, p. 461; *Phthonia nodicostata* Hall, near Oneonta, p. 474; and finally on p. 517 is the statement that the Oneonta sandstone "comes in at about the close of the Hamilton period, or more properly may be regarded as the result of changes which terminated the conditions of the Hamilton group," while on p. 518 the Upper Devonian of Otsego, Delaware, and Chenango counties is correlated as follows:

"Catskill group.

Chemung "

Oneonta { Portage group.
Hamilton (Upper).

Hamilton group."

A similar statement in reference to the age of these rocks occurs in *ibid.* Lamellibranchiata I, as *Leptodesma Rogersi* Hall is reported "in the shales of the Hamilton group at Norwich, Chenango county," p. 177. Finally, in 1886, Professor Hall made the following statement in reference to a section near Oxford: "The results of the most recent investigations have served to substantiate my previous published statements, and clearly show that the Oneonta sandstone rests upon well marked Hamilton strata, and is succeeded by strata carrying the fossils of the Chemung Group" (Fifth An. Rep. State Geologist [New York] for 1885, p. 4). Also the section on p. 11 represents the lowest shales and sandstones as belonging to the "Hamilton group," and mentions *Spirifera mesastrialis*, *Paracyclas lirata*, and *Palæoneilo muta* from these beds.

§ The paper was read at the New York meeting of the Am. Assoc. Adv. Sci., and an abstract published in vol. xxxvi, p. 210.

seems important to indicate more of the data upon which this classification was based. The upper zone of the Hamilton stage as exposed in the creeks and railroad cuts near Earlville, Smyrna and Sherburne, which was called the "Sherburne group" by Conrad, is composed of moderately coarse arenaceous shales which alternate with more argillaceous and calcareous shales containing abundant fossils. Along Pleasant brook above and below the Ontario and Western railroad station, in the edge of Smyrna village, as well as farther up the brook toward Upperville, are excellent exposures of these shales. Various species are abundant and careful search would be rewarded by a large list of Hamilton fossils. A moderate search has afforded the writer the following species from along Pleasant brook and other exposures near Smyrna village, Chennango county.

1. <i>Ambocælia umbonata</i> (Con.) Hall	34. <i>Goniophora hamiltonensis</i> Hall. (rr)
----- (aa)*	35. <i>Goniophora rugosa</i> (Con.) Hall. (rr)
2. <i>Spirifera fimbriata</i> (Con.) Hall. (cc)	36. <i>Grammysia arcuata</i> (Con.) Hall. (r)
3. <i>Tropidoleptus carinatus</i> (Con.) Hall	37. <i>Modiomorpha subalata</i> (Con.) Hall
----- (ac)	----- (rr)
4. <i>Chonetes coronata</i> (Con.) Hall. (cc)	38. <i>Leptodesma Rogersi</i> Hall (?) ---- (rr)
5. <i>Chonetes deflecta</i> Hall (?) ---- (r)	39. <i>Pterinopecten Vertumnus</i> Hall. ---- (c)
6. <i>Chonetes setigera</i> Hall ---- (c)	40. <i>Cypricardina indenta</i> (Con.) Hall (r)
7. <i>Spirifera mucronata</i> (Con.) Bill. (c)	41. <i>Modiella pygmæa</i> (Con.) Hall ---- (rr)
8. <i>Spirifera medialis</i> Hall ---- (rr)	42. <i>Microdon</i> (<i>Cypricardella</i>) <i>bellistriatus</i>
9. <i>Spirifera granulifera</i> Hall ---- (a)	(Con.) Hall ---- (rr)
10. <i>Atrypa reticularis</i> (Linn.) Dal ---- (r)	43. <i>Grammysia constricta</i> Hall ---- (rr)
11. <i>Athyris spiriferoides</i> (Eaton) Hall (rr)	44. <i>Nucula lirata</i> (Con.) Hall ---- (rr)
12. <i>Orthis Vanuxemi</i> Hall ---- (rr)	45. <i>Orthonota carinata</i> Con. ---- (rr)
13. <i>Strophodonta perplana</i> (Con.) Hall (rr)	46. <i>Leda rostellata</i> (Con.) Hall ---- (rr)
14. <i>Streptorhynchus chemungensis</i> (Con.)	47. <i>Palæoneilo muta</i> Hall ---- (rr)
Hall ---- (r)	48. <i>Phthonia cylindrica</i> Hall ---- (rr)
15. <i>Cyrtina hamiltonensis</i> Hall ---- (rr)	49. <i>Mytilarca</i> (<i>Plethomytilus</i>) <i>oviformis</i>
16. <i>Cryptonella planirostra</i> Hall ---- (rr)	(Con.) Hall ---- (r)
17. <i>Chonetes scitula</i> Hall ---- (c)	50. <i>Tellinopsis submarginata</i> (Con.) Hall
18. <i>Cimitaria recurva</i> (Con.) Hall ---- (rr)	----- (rr)
19. <i>Paracyclas tenuis</i> Hall ---- (rr)	51. <i>Pterinea flabella</i> (Con.) Hall ---- (rr)
20. <i>Palæoneilo emarginata</i> (Con.) Hall (r)	52. <i>Cimitaria elongata</i> (Con.) Hall. (rr)
21. <i>Schizodus appressus</i> (Con.) Hall. (rr)	53. <i>Phthonia sectifrons</i> (Con.) Hall. (rr)
22. <i>Palæoneilo constricta</i> (Con.) Hall. (rr)	54. <i>Glytodesma erectum</i> (Con.) Hall. (rr)
23. <i>Nuculites triqueter</i> Con. ---- (c)	55. <i>Nucula corbuliformis</i> Hall ---- (rr)
24. <i>Nuculites oblongatus</i> Con ---- (rr)	56. <i>Phacops rana</i> (Green) Hall ---- (c)
25. <i>Pholadella radiata</i> (Con.) Hall ---- (r)	57. <i>Dalmanites Bootli</i> (Green) Hall. (rr)
26. <i>Orthonota</i> (?) <i>parvula</i> Hall ---- (rr)	58. <i>Homalonotus DeKayi</i> (Green) Em-
27. <i>Prothyris lanceolata</i> Hall ---- (rr)	mons ---- (rr)
28. <i>Macrodon hamiltoniæ</i> Hall ---- (r)	59. <i>Platyceras carinatum</i> Hall ---- (rr)
29. <i>Leda diversa</i> Hall ---- (rr)	60. <i>Pleurotomaria capillaria</i> Con. ---- (r)
30. <i>Nucula bellastrata</i> (Con.) Hall ---- (rr)	61. <i>Coleolus tenuicinctum</i> Hall ---- (rr)
31. <i>Microdon</i> (<i>Cypricardella</i>) <i>tenuistriatus</i> Hall ---- (rr)	62. <i>Bellerophon crenistria</i> Hall ---- (rr)
32. <i>Modiomorpha concentrica</i> (Con.) Hall	63. <i>Bellerophon Leda</i> Hall ---- (rr)
----- (rr)	64. <i>Nucleospira concinna</i> Hall ---- (rr)
33. <i>Modiomorpha mytiloides</i> (Con.) Hall	65. <i>Chonetes mucronata</i> Hall ---- (rr)
----- (r)	66. <i>Leiorhynchus multicosta</i> Hall ---- (rr)

* The relative abundance of the species is indicated as follows:—aa = very abundant, a = abundant, cc = very common, c = common, rr = very rare, r = rare.

On the upper part of Pleasant brook between five and six miles from Smyrna village is an exposure of Tully limestone which is probably the one mentioned by Vanuxem.* The exposure is by the side of the brook, just above the highway bridge, where 26 inches of limestone are exposed with a blue argillaceous shale below, which contains plenty of fossils. The following species were obtained from this shale:—

1. <i>Spirifera mucronata</i> (Con.) Bill. (a)	5. <i>Nuculites oblongatus</i> Con. (rr)
2. <i>Vitulina pustulosa</i> Hall (a)	6. <i>Orthonota undulata</i> Con. (rr)
3. <i>Tropidoleptus carinatus</i> (Con.) Hall (r)	7. <i>Palæoneilo emarginata</i> (Con.) Hall (rr)
4. <i>Modiella pygmaea</i> (Con.) Hall (rr)	8. <i>Dalmanites Boothi</i> (Green) Hall (r)

About one-half mile farther up the brook is an exposure of black, argillaceous, fissile shale, fifteen feet in thickness, in which an excavation has been made in search of coal. No fossils were found in the black shales, which are succeeded by rather thin sandstones.

There is a moderately steep hill west of Smyrna village and Pleasant brook, which is mostly covered above the gorge, though there are occasional exposures. In the highway near the top of the hill, in a small run, are smooth blue shales which are non-fossiliferous. In the field near the summit of the hill, about one mile west of Smyrna and from 475'–500' above the R. R., is a small excavation that was made in searching for flagging stones. The rock is a coarse arenaceous shale, not as blue as the lower exposure, and contains a few fossils.

The following species were obtained:

1. <i>Spirifera mesacostalis</i> Hall (c)	6. <i>Atrypa reticularis</i> (Lin.) Dalman (rr)
2. <i>Spirifera fimbriata</i> (Con.) Bill. (?) (r)	7. <i>Chonetes setigera</i> Hall (rr)
3. <i>Cyrtina hamiltonensis</i> Hall (c)	8. <i>Ambocælia umbonata</i> (Con.) Hall (r)
4. <i>Leiorhynchus mesocostalis</i> Hall (c)	9. <i>Phacops rana</i> (Green) Hall (rr)
5. <i>Productella</i> cf. <i>speciosa</i> Hall (r)	

Below Upperville a small run, on the western side of Pleasant brook, gives a section from the fossiliferous Hamilton shales up through the Tully limestone and Genesee black shales into the overlying barren Portage. The shales in the lower part of the run contain specimens of

* See Geol. N. Y., Pt. III, 1842, p. 164, where Vanuxem says under "localities where observed.—The first point going west is on the turnpike from Sherburne to DeRuyter, about eight miles from the former village." Also under the geological description of Chenango county it is stated:—"The Tully limestone was seen but in one locality at the north western part of Smyrna, on the road to DeRuyter village where the road crosses the west branch of the Chenango." *ibid.*, p. 292. This outcrop was considered by Prof. S. G. Williams as the one described by Vanuxem (Sixth An. Rep. State Geologist [N. Y.], 1886, p. 18).

1. <i>Tropidoleptus carinatus</i> (Con.) Hall	4. <i>Orthis Vanuxemi</i> Hall.....(rr)
(a)	5. <i>Pulvoneilo emarginata</i> Con.....(rr)
2. <i>Spirifera mucronata</i> (Con.) Bill. (rr)	6. <i>Nucula lirata</i> (Con.) Hall (?).....(rr)
3. <i>Leiorhynchus multicosta</i> Hall....(r)	7. <i>Phacops rana</i> (Green) Hall.....(rr)

Above this zone about twenty-five feet of rather sandy limestone alternating with shales are exposed, and above the limestone twenty feet of black, fissile shale in which no fossils were found. Overlying the black shale are thin, regular sandstone layers, one-fourth to one-half inch thick which at first alternate with blocky, blackish argillaceous shales. The sandstones gradually become thicker for some distance and then are overlaid by blue, smooth shales which weather to an olive color. Beyond Upperville, twenty-five feet above the highway along which the black shales are exposed, a small quarry has been opened in the sandstone in which an occasional fossil occurs. Some search revealed only the following forms:—

1. <i>Lunulicardium fragile</i> Hall ..(rr)	3. <i>Crinoid stems</i> .
2. <i>Leiopteria</i> ——— sp.....(rr)	<i>Leiorhynchus mesocostalis</i> Hall (rr)

A single specimen of the last species was found, which was not surely in place in the quarry, but possibly came from higher up the hillside.

The section on the upper part of Pleasant brook and the one just described on the hillside below Upperville, taken in connection with the one up the hill west of Smyrna show a passage from blue, argillaceous shales containing an abundant Hamilton fauna, up through the impure Tully limestone, the black Genesee shale, a sandstone zone and another of blue shale into coarse arenaceous shales or thin sandstones containing a meagre fauna, the species of which are found in the Portage and Ithaca groups. It seems to me there is no question but that the section passes from the Moscow shale of the upper Hamilton through the Tully limestone and Genesee shale into the lower Portage.

At Sherburne there are not such clear sections of the transition deposits from the Hamilton to the Portage, as at Smyrna; but there are excellent exposures of the upper Hamilton as well as some of the moderately fossiliferous overlying Portage.

Along Mad brook east from Sherburne village for one mile to Harrisville, rising from about the R. R. level to an elevation of 240' above, at the reservoir in Harrisville, are numerous and excellent exposures of blue argillaceous shales with some coarse blue arenaceous shales forming the upper portion of the Hamilton stage. A limited search in the shales along Mad brook yielded the following species:—

1. <i>Chonetes coronata</i> (Con.) Hall. (aa)	26. <i>Macrodon hamiltoniae</i> Hall. (rr)
2. <i>Chonetes setigera</i> Hall. (aa)	27. <i>Modiella pygmaea</i> (Con.) Hall. (c)
3. <i>Chonetes lepida</i> Hall. (rr)	28. <i>Orthonota</i> (?) <i>parrula</i> Hall. (r)
4. <i>Spirifera mucronata</i> (Con.) Bill. (aa)	29. <i>Orthonota carinata</i> Con. (r)
5. <i>Spirifera granulifera</i> Hall. (rr)	30. <i>Orthonota undulata</i> Con. (r)
6. <i>Spirifera fimbriata</i> (Con.) Hall (rr)	31. <i>Cimitaria elongata</i> (Con.) Hall. (r)
7. <i>Ambocelia umbonata</i> (Con.) Hall (r)	32. <i>Pholadella radiata</i> (Con.) Hall (aa)
8. <i>Athyris spiriferoides</i> (Eaton) Hall	33. <i>Prothyris lanceolata</i> Hall. (rr)
(r)	34. <i>Grammysia arcuata</i> (Con.) Hall (c)
9. <i>Orthis Vanuxemi</i> Hall. (r)	35. <i>Modiomorpha mytiloides</i> (Con.) Hall
10. <i>Strophodonta perplana</i> (Con.) Hall	(rr)
(r)	36. <i>Sphenotus solenoides</i> Hall. (rr)
11. <i>Strophodonta inequistriata</i> (Con.)	37. <i>Tellinopsis subemarginata</i> (Con.)
Hall. (a)	Hall. (rr)
12. <i>Streptorhynchus chemungensis</i>	38. <i>Cypricardinia indenta</i> (Con.) Hall
(Con.) Hall. (r)	(rr)
13. <i>Tropidoleptus carinatus</i> (Con.) Hall	39. <i>Microdon</i> (<i>Cypricardella</i>) <i>bellistri-</i>
(c)	<i>atus</i> (Con.) Hall. (rr)
14. <i>Spirifera tullia</i> Hall. (rr)	40. <i>Glyptocardia speciosa</i> Hall. (rr)
15. <i>Chonetes mucronata</i> Hall. (rr)	41. <i>Goniophora hamiltonensis</i> Hall. (r)
16. <i>Chonetes scitula</i> Hall. (rr)	42. <i>Mytilarca</i> (<i>Plethomytilus</i>) <i>oviformis</i>
17. <i>Nuculites triquetus</i> Con. (aa)	<i>mis</i> (Con.) Hall. (r)
18. <i>Nuculites oblongatus</i> Con. (r)	43. <i>Loxonema delphicola</i> Hall. (a)
19. <i>Palaeoneilo constricta</i> (Con.) Hall (a)	44. <i>Pleurotomaria capillaria</i> Con. (r)
20. <i>Palaeoneilo emarginata</i> (Con.) Hall	45. <i>Bellerophon Leda</i> Hall. (r)
(r)	46. <i>Bellerophon acutilira</i> Hall. (rr)
21. <i>Palaeoneilo muta</i> Hall. (r)	47. <i>Coleolus tenuicinctum</i> Hall. (r)
22. <i>Nucula bellistriata</i> (Con.) Hall. (c)	48. <i>Dalmanites Boothi</i> (Green) Hall (c)
23. <i>Nucula corbuliformis</i> Hall. (r)	49. <i>Phacops rana</i> (Green) Hall. (r)
24. <i>Nucula lirata</i> (Con.) Hall. (r)	50. <i>Homalonotus De Kayi</i> (Green) Em-
25. <i>Paracyclas tenuis</i> Hall. (rr)	mons. (rr)

About one mile southeast of Sherburne village is a high hill near the foot of which, about seventy-five feet above the R. R. level or 1117' A. T.,* are somewhat coarse arenaceous shales with a moderate number of fossils, principally of the large species, as *Spirifera granulifera* Hall and its usual associated species. The fauna is distinctively Hamilton and the shales are in the Hamilton stage. Then for a distance of 440' the hill slope is covered and at an elevation of 515' above R. R. level or 1557' A. T., there is an outcrop of coarse arenaceous shales alternating with thin blue flagstones. This bed contains some fossils and the fauna is the same as that of the highest exposures on the hills near Smyrna. The blue argillaceous shale, black shale and limestone below this zone are not shown in this section, on account of the thick deposit of drift.

About three miles north of Sherburne is the Mulligan quarry, at the top of a high hill, which furnishes thin blue flagstones with coarse irregular shales above them, containing fossils similar to those near the top of the hill west of Smyrna and the one southeast of Sherburne. By the barometer, this exposure is from 424' to 446' above the R. R., or 1466' to 1488' A. T.

* The R. R. station at Sherburne is 1042' A. T.

At North Norwich, five miles south of Sherburne the zone of blue argillaceous shales, with no fossils, is well exposed along Blue or Cold brook, about 76' above R. R. level or approximately 1099' A. T.* At about 144' above R. R. or approximately 1167' A. T., is the base of the zone containing fossils. This zone is well exposed in the old Harris, now known as the Wilkes, quarry which was mentioned by Vanuxem† and is in the edge of Plymouth, about 305' above R. R. level or approximately 1378' A. T. Exposures near the top of the hill 427' above the R. R. or approximately 1456' A. T., still contain the same fauna.

In the Harris or Wilkes quarry the following species were found:

1. <i>Spirifera mesacostalis</i> Hall.....(c)	13. <i>Goniophora carinata</i> (Con.) Hall (?)
2. <i>Atrypa reticularis</i> (Linné) Dal. (cc)	(rr)
3. <i>Leiorhynchus mesocostalis</i> Hall (c)	
4. <i>Chonetes scitula</i> Hall (?)(a)	

This species is abundant; but in the condition of impressions renders identification difficult. Some of the specimens approach *C. setigera* Hall in form, though they are not so convex near the umbo as those found at Ithaca.

5. <i>Chonetes lepida</i> Hall(rr)	
6. <i>Cyrtina hamiltonensis</i> Hall --- (rr)	
7. <i>Strophodonta</i> sp. ———, ----(rr)	

Two imperfect impressions which are similar to *S. perplana* (Con.) Hall.

8. <i>Productella</i> sp. . -----(c)	
9. <i>Microdon</i> (<i>Cypricardella</i> (<i>bellistriata</i> (Con.) Hall or <i>M. tenuistriata</i> Hall(rr)	

A single specimen which has the proportions of *M. bellistriata* as well as those of the elongated form of *M. tenuistriata* Hall (see Pl. 73. fig. 28). It is impossible to determine whether the specimen has the fine striae of *M. tenuistriata* or the coarse striae of *M. bellistriata*.

10. <i>Paracyclas lirata</i> (Con.) Hall..(rr)	
11. <i>Cimitaria recurva</i> (Con.) Hall..(r)	
12. <i>Palaeoneilo emarginata</i> (Con.) Hall(rr)	

This species is reported from Copley's quarry at Oneonta.‡ A comparison of specimens from the two localities fails to prove them precisely similar; but the North Norwich specimens are nearer this species than any of the others figured in this work.

14. <i>Modiomorpha</i> sp. (a broken specimen)(rr)	
15. (?) <i>Glossites depressus</i> Hall --- (rr)	

A single specimen which apparently belongs to this genus and species.

16. <i>Palaeoneilo constricta</i> (Con.) Hall(rr)	
17. <i>Orthis</i> sp.(rr)	
18. <i>Leptodesma</i> cf. <i>Rogersi</i> Hall --- (r)	

These specimens do not have as mucronate ears as most of those figured: but some of them resemble closely the one figured on pl. 21, fig. 9 (Pal. N. Y., vol. v, Pt. I, Lamell. I), which is stated to be from the Hamilton shales at Norwich, N. Y.

19. <i>Streptorhynchus chemungensis</i> (Con.) Hall.....(r)	
20. <i>Actinopteria Boydi</i> (Con.) Hall (rr)	
21. <i>Phacops rana</i> (Green) Hall....(rr)	

Of the seventeen species specifically identified in the above list, counting those that are questioned, there are twelve that occur in the "Ithaca group" at Ithaca. The general range of the other five species is as follows:

* The R. R. station at North Norwich is about 1023' A. T.

† See Geol. N. Y., Pt. III, 1842, pp. 178, 293.

‡ Pal. N. Y., vol. v, Pt. I, Lamell. II, p. 302; see pl. 44. fig. 7 for figure of form similar to the North Norwich specimen.

Paracyclas lirata (Con.) Hall, common in the Hamilton of central and eastern New York, and then extends well up into the Portage; *Cimitaria recurva* (Con.) Hall, Hamilton of central New York and reported from Mt. Upton* which is near the same horizon as the Norwich and Oneonta zone; *Goniophora carinata* (Con.) Hall, from Oneonta and Mt. Upton and consequently in this zone; *Leptodesma Rogersi* Hall, in the upper Hamilton and at Norwich;† and *Phacops rana* (Green) Hall, is reported doubtfully from the Upper Helderberg and occurs in the Marcellus, Hamilton, Tully limestone, and Chemung. Consequently it is clear that so far as the fossils are concerned this list shows a closer relationship with the "Ithaca group," as stated by Vanuxem in 1842,‡ than with any other stage. To be sure most of the species occur in the Hamilton stage, but so do the majority of the species found in the "Ithaca group" at Ithaca, and judged by that alone the zone might be referred to the Hamilton instead of the Portage where its stratigraphical position and other evidence show it to belong.

At Norwich, six miles south of North Norwich, the base of this zone has been carried by the dip below the surface. A number of observations along the Chenango valley indicate the dip to be between 35 and 40 feet per mile for that region. The high hill west of Norwich affords a good section of 550 feet. At the base of the hill on the Canaswacta creek are the lowest rocks, at an approximate elevation of 985', which are bluish rather arenaceous shales containing fossils. At 1140' is the base of an old quarry which runs up to 1193' and in this quite a good many fossils were found. The most common species are *Paracyclas lirata* Con., *Chonetes scitula* Hall, *Tropidoleptus carinatus* Con., *Rhynchonella Stephani* Hall (?) and *Atrypa reticularis* (Linné) Dal. At 1230' are the last shales containing fossils below the reds and grays. The most abundant fossils are segments of crinoid stems, but with these are specimens of *Paracyclas lirata* Con. and *Cypricardella (Microdon) bellistriata* (Con.) Hall. At 1262' are rather fine fissile shales which are succeeded by coarse sandstones at 1370'. A prominent concretionary sandstone occurs at 1410' and at 1460' is a coarse gray sandstone. The first red shale resting on thin fissile olive shales, occurs at 1475' and in the red shales at about 1479' is a somewhat calcareous layer with pebbles containing numerous fish scales which are found to a less extent in the red shales close to this stratum. The red shale stops

* Pal. N. Y., vol. v, Pt. I, Lamell. II, p. 468.

† *Ibid.*, Lamell. I, p. 177.

‡ See Geol. N. Y., Pt. III, p. 178, where this quarry is described under the head of the Ithaca group.

near the altitude of 1500' and is succeeded by coarse gray sandstone which continues to the top of the hill with an approximate altitude of 1555'. At 1535' is Crandall's flagstone quarry in coarse gray sandstone. In a cut on the D. L. & W. R. R. less than one-half mile north of the station, and in the quarries along Ransford creek, toward the reservoir northeast of the village, are excellent places for collecting fossils.

In a small creek about one mile north of Oxford or seven miles southwest of Norwich are exposures of shale containing the same fauna as at Norwich, though this is near the upper part of the zone which soon disappears beneath the surface. On the eastern side of the Chenango valley, at the Lyon Brook Bridge of the O. & W. R. R. is a good section showing the top of the Oneonta zone in the creek below the bridge with the lowest red shales about 150 feet higher, in an old quarry just east of the south approach to the bridge. This section was briefly described by Dr's C. E. Beecher, J. W. Hall and Mr. C. E. Hall.* In addition to the species mentioned, the writer found fronds of *Archæopteris* in the lower red shale near the railroad bridge, while still higher, in the zone of the Oneonta sandstone in the first R. R. cut north of the 218th mile post, are specimens of *Amnigenia catskillensis* (Van.) Hall, and plates of *Holonema rugosa* (Claypole) Newb.† Between Oxford and the summit on the O. & W. R. R. and about one-sixth of a mile west of the 214th mile post, is a cut through red and greenish shales in which fossils occur as described in the above mentioned report. One-quarter of a mile east of the Summit in another R. R. cut are greenish and olive shales containing numerous fossils overlying the Oneonta sandstone.

A similar section may be constructed along the Susquehanna River from Oneonta to Bainbridge. In the Anthony White quarry, at the foot of the high hill just west of Oneonta, are abundant fossils that belong in the "Oneonta group" of Conrad, which continues up the hill for about 200 feet, the upper portion being composed of the Oneonta sandstone of Vanuxem. The rocks at the base of this hill, or Conrad's "Oneonta group," were correlated quite accurately by Vanuxem, who stated that he supposed them to belong to the "Ithaca group."‡ Through the kindness of Dr. H. S. Williams I am able to quote from his Ms. list of the fossils collected in the Anthony

* Fifth Ann. Rep. State Geologist [N. Y.] 1885, p. 11; see page 4 for credit.

† For an account of these plates see Dr. H. S. Williams in Proc. Am. Assoc. Adv. Sci., vol. xxxix, p. 337; Prof. Claypole in Am. Geologist, vol. vi, pp. 255-257, and Prof. Cope in Proc. U. S. Nat. Mus., vol. xiv, p. 456.

‡ Geol. N. Y., Pt. III, p. 192. The clause reads, "the base of which [hill] is composed of rocks which I have supposed to belong to the Ithaca group."

White quarry. The zone is called the *Paracyclas lirata* stage of the Hamilton fauna and its stratigraphic position was shown by Dr. Williams in 1885.* A list of these species with their geologic range is given below.

Number of Species.	Fauna of Conrad's "Oneonta group" at Oneonta, New York.	Geologic Stage.†									
		List of Species.									
		Upper Helderberg.	Marcellus.	Hamilton.	Hamilton of eastern New York.‡	Portage.§	Ithaca	Oneonta.	Portage of eastern New York.	Portage of eastern Pennsylvania.**	Cheunung.
		1	2	3	4	5	6	7	8	9	10
1	<i>Microdon (Cypricardella) bellistriata</i> (Con.) Hall	—	—	x	x	—	x	—	—	x	x
2	<i>Paracyclas lirata</i> (Con.) Hall	—	—	x	x	—	—	x	x	x	—
3	<i>Tropidoleptus carinatus</i> (Con.) Hall	—	—	x	x	x	—	x	x	x	x
4	<i>Palæoneilo maxima</i> (Con.) Hall	—	—	x	x	—	—	—	—	x	—
5	<i>Grammysia magna</i> Hall	—	—	x	x	—	x	—	—	—	—
6	<i>Grammysia bisulcata</i> (Con.) Hall	—	—	x	x	—	—	—	—	—	—
7	<i>Cimitaria recurva</i> (Con.) Hall (?)	—	—	x	—	—	—	x	—	—	—
8	<i>Tellinopsis submarginata</i> (Con.) Hall	—	—	x	x	—	—	—	—	—	—
9	<i>Modiomorpha concentrica</i> (Con.) Hall	—	—	x	x	—	?	—	—	—	—
10	<i>Spirifera mucronata</i> (Con.) Bill	—	x	x	x	—	—	?	—	—	—
11	<i>Goniophora carinata</i> (Con.) Hall	—	—	—	—	—	—	x	—	?	—
12	<i>Homalonotus De Kayi</i> (Green) Emm.	—	x	x	x	—	—	—	x	x	—
13	<i>Nuculites triquetus</i> Con.	—	?	x	—	—	—	—	—	—	—
14	<i>Microdon (Cypricardella) gregarius</i> Hall	—	—	x	x	—	x	—	x	x	x
15	<i>Leptodesma Rogersi</i> Hall	—	—	x	x	—	—	x	—	?	—
16	<i>Leiopteria De Kayi</i> Hall	—	—	x	x	—	—	—	—	—	—
17	<i>Orthonota undulata</i> Con.	—	—	x	x	—	—	—	—	—	—
18	<i>Microdon (Cypricardella) complanatus</i> Hall	—	—	x	x	—	—	x	—	—	—
19	<i>Pleurotomaria sulcomarginata</i> Con.	x	—	x	x	—	—	—	—	—	—
20	<i>Spirifera mesastrialis</i> Hall	—	—	x	x	—	x	—	x	x	x

* Proc. Am. Assoc. Adv. Sci., vol. xxxiv, Chart of Meridional Sections of the Upper Devonian deposits of New York, Pennsylvania and Ohio, Section X, A'; where the *Paracyclas* fauna (A'), is shown immediately underlying the Oneonta reds and grays, (F').

† The data used in showing the geologic range of the species in the above list are derived principally from the various works of Professors Hall, H. S. Williams and Prosser. The distribution is confined to New York and eastern Pennsylvania which have been studied with such care that the evidence can be used with considerable force in this correlation. The range of a portion of the species reported from the Portage of eastern New York and Pennsylvania depends upon lists of the author, which have not yet been published. The horizon of this eastern fauna is clearly above the Hamilton, but we have not yet sufficient evidence to attempt its correlation with the different zones of the Portage in central and western New York.

‡ The horizon of the species reported by Professor Hall, and some other authors, from the Hamilton of eastern New York is believed to require further investigation. The writer has evidence showing that a portion of these localities really

Of the twenty species named in the above list fourteen are known to occur above the Hamilton, while five of the remainder are reported from the Hamilton of eastern New York, which as stated above needs revising since some of the so-called Hamilton horizons are in the Portage, and only one species so far as previously known occurred no higher than the Hamilton stage.

At Sidney, twenty-one miles southwest of Oneonta, the top of the Oneonta sandstone is reached in the hill forming the divide between the Susquehanna and Unadilla Rivers northwest of the village.

In Secor's quarry, about 140 feet above the railroad level at Sidney* are grayish to olive sandstones with greenish and bluish argillaceous shales. Plant and crinoid stems were found in the debris of the quarry, while near the top of the hill are loose slabs, with no indications of having been moved any considerable distance, containing poorly preserved specimens of *Leiorhynchus* and *Lamellibranchs*. At New Berlin Junction on the Ontario & Western R. R., two miles from Sidney, or at Bainbridge five miles down the Susquehanna River are numerous specimens of fossils which in both cases overlay the zone of the Oneonta sandstone.

The difficulty in correlating these deposits in which part of the stratigraphic series has disappeared and paleontologically many of the species common in the rocks below reappear in the higher rocks, in some cases unchanged and again slightly modified, may be overcome, it is believed, by carefully studying both the fauna and the stratigraphic relations of the rocks. This test has been made by the writer in southeastern New York and eastern Pennsylvania, where in the absence of the Tully limestone and Genesee shale, the problem is about the same as that presented along the Susquehanna River valley, and he believes it possible to separate the Hamilton from the overlying rocks of Portage age by the faunas contained in the respective stages.

belongs stratigraphically above the horizon of the Tully limestone and Genesee shale. Consequently it was considered best to give a separate column to those species separated from the Hamilton of eastern New York, some of which should probably be credited to the Portage.

§ Most of the species given in this column are from central and western New York.

|| Mainly from Ithaca and vicinity, forming the middle Portage of that region.

¶ This is the Oneonta zone of Conrad and the occurrence of the species at other localities than Oneonta, mainly from Norwich and Mt. Upton, Chenango County, is given.

** The species reported from the Portage of eastern New York and Pennsylvania are mainly from my own lists.

* Elevation of station at Sidney 992' A. T.

The Pennsylvania geologists have been inclined to call the upper stage Chemung,* while some of the official geologists of New York have called the same rocks Hamilton, because certain species of fossils more or less common in the Hamilton stage occur in these rocks. At the Washington meeting of the International Congress of Geologists, a series of these fossils arranged in their stratigraphic order was exhibited to several geologists and Dr. H. S. Williams recognized the difference in age, thus proving that a careful study of these faunas will enable one to separate them.

In order to show the nature of this fauna, a list of the species noted along the Delaware River above Port Jervis, New York is given. From the Hamilton were obtained:—

1. <i>Spirifera granulifera</i> Hall ----(aa)	26. <i>Grammysia bisulcata</i> (Con.) Hall (rr)
2. <i>Spirifera mucronata</i> (Con.) Bill. (aa)	27. <i>Cimitaria corrugata</i> (Con.) Hall. (rr)
3. <i>Tropidoleptus carinatus</i> (Con.) Hall	28. <i>Actinopteria Boydi</i> (Con.) Hall. (rr)
----- (aa)	29. <i>Modiomorpha concentrica</i> (Con.) Hall
4. <i>Orthis Vanuxemi</i> Hall ----- (a)	----- (rr)
5. <i>Chonetes coronata</i> (Con.) Hall --- (r)	30. <i>Microdon (Cypricardella) bellistriatus</i>
6. <i>Ambocelia umbonata</i> (Con.) Hall (rr)	(Con.) Hall ----- (rr)
7. <i>Leiorhynchus multicosta</i> Hall. --- (rr)	31. <i>Nuculites oblongatus</i> Con. ----- (r)
8. <i>Chonetes setigera</i> Hall. ----- (u)	32. <i>Grammysia constricta</i> Hall. ----- (rr)
9. <i>Chonetes scitula</i> Hall ----- (c)	33. <i>Orthonota undulata</i> Con. ----- (rr)
10. <i>Nucleospira concinna</i> Hall. ----- (rr)	34. <i>Paracyclos lirata</i> (Con.) Hall --- (rr)
11. <i>Athyris spiriferoides</i> (Eaton) Hall (rr)	35. <i>Orthonota (?) parvula</i> Hall ----- (r)
12. <i>Cyrtina hamiltonensis</i> Hall. ----- (rr)	36. <i>Modiella pygmaea</i> (Con.) Hall --- (rr)
13. <i>Palæoneilo constricta</i> (Con.) Hall (r)	37. <i>Pterinea flabellata</i> (Con.) Hall --- (rr)
14. <i>Nuculites triquetra</i> Con. ----- (rr)	38. <i>Leda rostellata</i> (Con.) Hall. ----- (rr)
15. <i>Palæoneilo emarginata</i> (Con.) Hall	39. <i>Glyptodesma erectum</i> (Con.) Hall. (rr)
----- (rr)	40. <i>Hyolithes actis</i> Hall ----- (rr)
16. <i>Nucula bellistriata</i> (Con.) Hall --- (rr)	41. <i>Tentaculites bellulus</i> Hall ----- (r)
17. <i>Palæoneilo muta</i> Hall. ----- (rr)	42. <i>Coleolus tenuicinctum</i> Hall. ----- (rr)
18. <i>Palæoneilo maxima</i> (Con.) Hall. --- (rr)	43. <i>Cyrtolites (Cyrtoneilla) pileous</i> Hall
19. <i>Nucula corbuliformis</i> Hall ----- (rr)	----- (rr)
20. <i>Nuculites cuneiformis</i> Con. ----- (rr)	44. <i>Lozonema hamiltoniae</i> Hall. ----- (rr)
21. <i>Goniophora hamiltonensis</i> (Hall) Mill.	45. <i>Bellerophon Leda</i> Hall. ----- (rr)
----- (rr)	46. <i>Bellerophon acutilirata</i> Hall --- (rr)
22. <i>Microdon (Cypricardella) tenuistriatus</i> Hall (?) ----- (r)	47. <i>Homalonotus DeKayi</i> (Green) Emm.
23. <i>Tellinopsis submarginata</i> (Con.) Hall	----- (rr)
----- (rr)	48. <i>Dalmanites (Cryphæus) Boothi</i>
24. <i>Pholadella radiata</i> (Con.) Hall --- (rr)	(Green) Hall (?) ----- (rr)
25. <i>Leda diversa</i> Hall. ----- (rr)	49. <i>Psilophyton princeps</i> Dn. ----- (rr)

The fossils of the above list were all collected from exposures along the Delaware River or the neighboring hills not more than two and one-half miles above Port Jervis. The age of the formation is Hamilton, although it has been mapped and described as Hamilton and Genesee.†

* For a discussion of a section in reference to this view see an article by Prosser in this Journal, vol. xlv, p. 210, where the question is discussed in detail.

† See 2d Geol. Survey Penna. G^o, p. 194, and especially the geological map of Pike and Monroe counties accompanying this report.

The next higher zone is well exposed along the south bank of the river both below and above the N. Y., L. E. & W. R. R. bridge, three miles northwest of Port Jervis. The following species were obtained from this locality:—

1. <i>Spirifera mesastrialis</i> Hall ----(rr)	6. <i>Palæoneilo plana</i> Hall.....(rr)
2. <i>Palæoneilo emarginata</i> (Con.) Hall	7. <i>Paracyclas lirata</i> (Con.) Hall..(rr)
(rr)	8. <i>Grammysia subarcuata</i> Hall (?) (rr)
3. <i>Leda diversa</i> Hall.....(r)	9. <i>Modiomorpha subalata</i> (Con.) Hall
4. <i>Microdon</i> (<i>Cypricardella</i>) <i>tenui-</i>	var. <i>chemungensis</i> Hall (?) ..(rr)
striata Hall (?)(rr)	10. <i>Actinopteria Boydi</i> (Con.) Hall..(a)
Possibly it is <i>M. gregarius</i> Hall, but	11. <i>Homalonotus DeKayi</i> (Green) Em-
it resembles the former more closely.	mons(rr)
5. <i>Orthonota carinata</i> Con.....(rr)	

The zone from which the above species were obtained was called Chemung by the Pennsylvania Survey;* still the fauna is not a Chemung but a modified Hamilton one and the zone belongs to the Portage stage of central and eastern New York.

It seems clear to the writer that the above lists of fossils with the statement of their stratigraphic position show that the fossiliferous zone underlying the Oneonta sandstone in Chenango and Otsego counties is not the top of the Hamilton but belongs in the Portage stage. It appears to be well established by careful study that the typical Hamilton fauna and the higher or modified faunas, when considered in connection with their stratigraphic position, may be traced for a long distance across eastern New York and Pennsylvania. The facts briefly described in this paper, which have required a considerable amount of investigation and study, are commended to the attention of those engaged in the preparation of the new geologic map of New York.

Topeka, Kansas, May, 1893.

* *Ibid.*, p. 194, where it is stated that the Chemung commences about one-half mile above the Erie railroad bridge and continues down the river for nearly two miles. See also the geological map with the report.