ORGANIC REMAINS

OF THE

NIAGARA GROUP AND ASSOCIATED LIMESTONES.

By JAMES HALL.

I. RELATIONS OF THE NIAGARA GROUP WITH THE LECLAIRE, RACINE AND GUELPH LIMESTONES.

In the study of the fossils of the Niagara group and associated strata, previous to the publication of the final *Report on the Fourth Geological District*, and also to the publication of the second volume of the *Palæontology of New York*, I separated a few species found in the impure drab-colored limestone from Wayne county, New York.

The limestone containing these fossils became exposed only in the bed of the canal during its excavation; and the low country, or deeply drift-covered surface in the vicinity, did not admit of any exposure of the rock in place. The materials were thrown out of the excavation in connection with the soft marls of the Onondaga salt group, and the specimens of rock containing the fossils preserved the peculiar celluliferous structure and characteristic color of the argillaceous limestone of that formation. Differing so essentially from any known beds in the Niagara group, I did not hesitate to refer them to the Onondaga salt group, since there was no evidence of any other formation in the neighborhood.*

* The same reference of the species had, in fact, been made during the Geological Survey, and they were thus published in the *Report on the Fourth Geological District*, in 1843.

Throughout the State of New York, the country along the junction of the Niagara and Onondaga salt formations is low and level, or covered by drift accumulations; and no opportunity offered of discovering any exposure of similar beds along the course of the outcrop. In some places in Monroe county we have been able to trace the two formations to within a few feet of their contact with each other; but no fossiliferous beds, similar to those of Wayne county, have been found. Subsequently, after a considerable portion of Vol. ii of the *Palæontology of New York* had been printed, my attention was called to some peculiar fossils collected at Galt, in Canada West; and in visiting that locality, I discovered some species identical with those before known, from beds which I had regarded as of the Onondaga group in New York. As this limestone at Galt (and Guelph) was clearly above the great Niagara limestone of the Falls, and contained an almost entirely different set of fossils, I very naturally inferred that it belonged to the next higher formation, or the Onondaga salt group, and that the Wayne county locality was a feeble representation of the limestone of Galt.* For these reasons the two were treated as identical, and referred to the age of the Onondaga salt group; an opinion at that time sustained by the members of the Canadian Geological Survey.

At a later period, during the Geological Survey of Iowa, I recognized, at the Leclaire rapids on the Mississippi River, a limestone holding the same relative position, having the same lithological character, and containing some identical and many similar fossils with the limestone of Galt or Guelph, in Canada West; and I thus announced its apparent relations in the *Report on the Geology of Iowa*, 1857, Vol. i, p. 75:

"Should the identity of the limestone of these two distant localities be proved, it will afford sufficient ground for separating these beds from the Onondaga salt group, and for establishing a distinct group. It seems quite probable that the limestones of this period have their eastern extremity in Central New York, where, from their small development, as well as from similarity of lithological character, there seemed no sufficient ground for separating them from the non-fossiliferous beds of the Onondaga salt group.† Since, however, in Canada, these beds attain considerable importance, and (admitting the conclusions above given) acquire a still greater thickness and

* The name "Galt" being considered objectionable on account of a similar term already in use, and the same rock occurring also at Guelph, it has been called the "Guelph formation" in the nomenclature of the *Geological Survey of Canada*.

† My views regarding the presence of the Onondaga salt group proper in Wisconsin and Iowa have somewhere been called in question, and I have only to remark in this place that I have seen no reason on my own part, nor facts adduced on the part of others, to change my opinion in reference to the occurrence of this formation in the localities I have heretofore cited.

more distinctive character on the Mississippi River, it seems necessary to elevate them to the same rank as the other groups of the series."

Some two or three years later I explored the geology of the central and eastern portions of Wisconsin and the adjacent parts of Illinois. I here found the limestone of Racine, and a part of Waukesha and some other localities, resembling in all respects that of Leclaire and holding many of the same fossils. It is likewise underlaid by the even-bedded darker-colored limestone, bearing *Halysites catenulatus*, *Pentamerus oblongus*, and many large Orthoceratites, which are everywhere regarded as evidence of the Niagara age. I could not hesitate, therefore, to parallelize the succeeding beds with the limestone of Leclaire, though we had failed to trace that formation across the country in a continuous outcrop. At the same time, on critical examination of the collection of fossils made at Racine and at some other points, I detected many species known as characteristic of the Niagara formation in the State of New York, requiring its recognition as a member of that group (rather than of the Onondaga salt group), and uniting with it as identical in position the Leclaire limestone.*

At the same time, we have recognized from Racine and adjacent localities, including Leclaire in Iowa and a single locality in Illinois, the following species which are identical or very closely allied to those from Galt in Canada West: *Pentamerus occidentalis*, an *Obolus*-like fossil, a *Favosites* and a species of *Amplexus* which are identical in several localities, *Cyclonema sulcata*, *Murchisonia logani*, *Murchisonia* identical or closely allied to *M. mylitta*, Billings, an undescribed *Murchisonia* from Racine identical with one from Galt, *Subulites ventricosa*, *Pleurotomaria solaroides ?* *Loxonema longispira*, besides other forms which are closely allied to species of the Guelph limestone.

An examination of several localities in Wisconsin shows that this peculiar fossiliferous limestone is very unequally distributed. At Racine it has a very considerable thickness;† while in other places, either from denudation or other causes, it is very thin, or even absent. In some places in the vicinity of Milwaukee and Waukesha, there are indications of beds of passage from the regularly bedded limestones below to the unequally bedded rock above. There appears indeed very good evidence of the irregular or unequal accumulation of this higher rock in many of the localities along a considerable portion of the outcrop; and where the lower

* *Report on the Geology of Wisconsin*, p. 67. 1861

† I am inclined to believe that I have over-estimated the thickness of the limestone at Leclaire from the presence of lines of false bedding, but I have had no opportunity of a reëxamination of the locality.

part of the formation comes to the surface, the upper rock does not appear to be developed. I am therefore induced to believe that this limestone at Racine, the mass at Leclaire and extending thence into Iowa, as well as the Guelph formation in Canada and the feeble representation of the same in New York, are really lenticular masses of greater or less extent, which have accumulated upon the unequal surface of the ocean bed in a shallow sea during the latter part of the Niagara period. These isolated masses of limestone have close relations with each other, while their relations with the Onondaga salt group, though very intimate in the single locality in Central New York, become less and less conspicuous in a westerly direction.

In the *Geology of Canada*, published in 1863, the Guelph limestones are described as constituting a distinct formation; but Sir. W. E. Logan remarks:

"It has already been stated that the strata seen near the mouth of the Rivière aux Sables, at Chief's Point, probably strike along the coast by Lyell Island to Cape Hurd, and belong in part to the Niagara formation, whose characteristic fossils are met with in several localities along the shore. These strata, however, have for the most part the lithological characters of the Guelph formation, and some of their undescribed species of Murchisonia have a strong resemblance to others found in this series. The *Pleurotomaria huronensis*, which belongs to the Guelph rocks, occurs on Lyell Island associated with *Pentamerus oblongus* and other characteristic Niagara species; so that it is not impossible that some of the strata along this coast may constitute a passage between the Niagara and Guelph formations.

"The Guelph formation appears to be absent from the State of New York; and in Canada it probably has the form of a great lenticular mass, the limit of which between Niagara and Guelph is uncertain, though it appears to extend beyond Ancaster. In the other direction, it seems to thin out in Lake Huron, before reaching the northern peninsula of Michigan."

I should not omit to say here, that so far as my investigations have extended on the islands of Lake Huron and Lake Michigan, with the peninsula between the latter and Green Bay, I have found the presence of the lower portions of the Niagara group, with the general absence of the higher beds. At the same time, along this great extent few fossils occur except *Pentamerus oblongus*, *Halysites catenulatus*, and two species of Favosites, with some other corals; and it is only on continuing the observations to the southward in Wisconsin, that we find a larger number of the Niagara species proper. This indication of beds of passage, pointed out by Sir W. E. Logan, will, I presume, be found in all or nearly all localities where a junction of the two formations can be seen.