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AND

DOLOMITIC BUILDING STONES

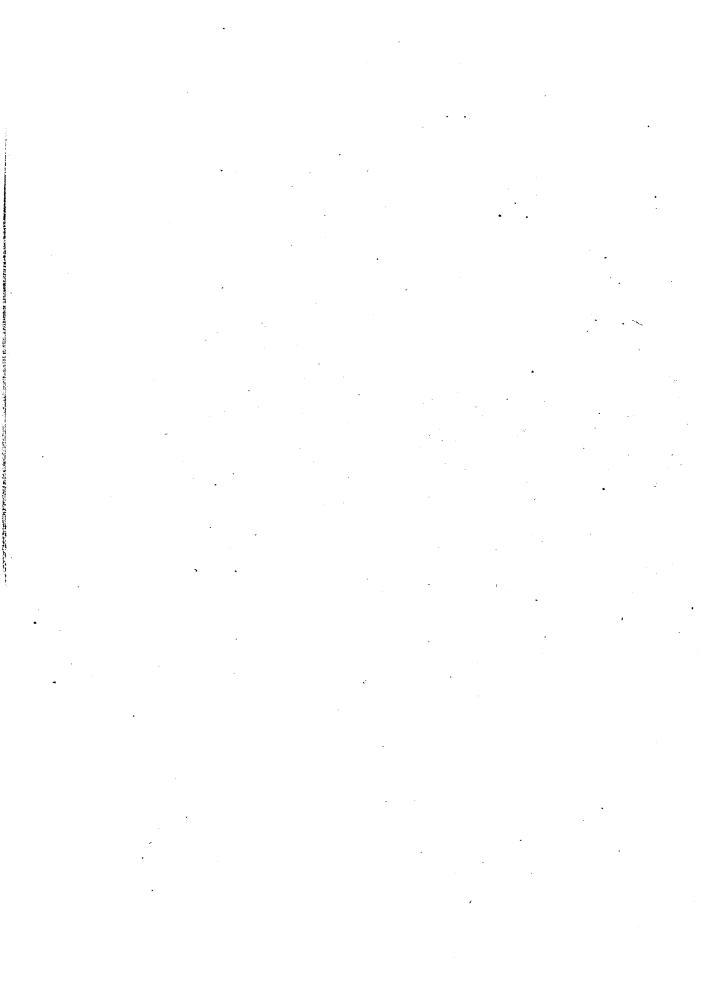
FROM THE NIAGARA OF IOWA.

BY

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## SOME LIME-BURNING DOLOMITES AND DOLOMITIC BUILDING STONES FROM THE NIAGARA OF IOWA.

BY GILBERT L. HOUSER.

The manufacture of lime and the quarrying of building stone form an important industry in portions of eastern Iowa. The rocks used belong chiefly to the Devonian and Silurian systems. These rocks contain a variable amount of magnesia, the calcium carbonate being often replaced by magnesium carbonate to the extent of one-half of its bulk, and thus partake of the character of true magnesian limestone or dolomite. The dolomites receiving especial attention in this place are exposed in portions of Cedar, Scott and Clinton counties. The field explored covers all of the natural exposures south of and including township number 80. In these preliminary notes are given the geological observations on the upper portions of the Niagara, the chief economic uses of the formation and some information concerning the present connected industries.

The limestone is everywhere very hard and compact, breaking with splintery fracture and seldom showing any tendency to split up into thin laminae. Some of the layers are very fine-grained, resembling some of the lithographic stones in texture; but the greater portion is hard and somewhat crystalline, presenting a glittering surface when

freshly broken. The color varies from a gray to an almost purple hue. Numerous disturbances in the strata are met with in nearly every exposure. The beds are tilted and folded to a greater or less extent. It is not at all uncommon to find them dipping at an angle of thirty degrees. In some instances the dip has been observed to be as high as sixty degrees.

The chemical composition is that of true dolomite. A sample from Le Claire analyzed by Dr. Chandler gave the following results :

Insoluble silicates (sand).....	.42
Ferric oxide ( $Fe_2 O_3$ ).....	} -53
Aluminic oxide ( $Al_2 O_3$ ).....	
Calcium carbonate ( $CaCO_3$ ).....	57.54
Magnesium carbonate ( $MgCO_3$ ).....	41.51
	100.00

It will be observed that the percentage of insoluble compounds is very low; that the rock is in fact an uncommonly pure massive dolomite.

The economic value of the rock is readily seen. Limestone suited for the manufacture of common lime must be free from iron, silicates and aluminates. The analysis shows that these substances are practically absent. Furthermore, there is at present a belief, which seems to be borne out by practical experience, that lime made from a dolomite makes a more durable bond than when manufactured from the simple limestone. It is well known that magnesium carbonate is less soluble in water containing carbon dioxide than is the similar calcium compound. Hence it is that percolating waters will have less effect upon mortar made from the first rock mentioned than it will have on a pure lime cement. Then, too, in a mortar there is a certain amount of chemical reaction between the  $CaO$  or  $MgO$  and the silica; and the union

is regarded stronger where both calcium and magnesium silicates enter than where calcium silicate does alone. So it appears very desirable to have a certain amount of magnesium carbonate in connection with calcium carbonate in a rock that is to be burned for common lime. The rocks of the middle Niagara possess all of these desirable qualities and, as such, are pre-eminently adapted to the manufacture of a superior quality of common lime. Mortar made from this lime is easily and readily prepared, works smoothly and evenly, and withstands the action of the weather admirably. The durability of a building depends as much upon the quality of the mortar used as it does upon any other material entering into the structure; hence a really good lime must always have a high commercial value. Very few rocks, indeed, will make into as good lime as those of the middle Niagara; and none are found in the west that will burn better. The formation, then, is a very important one from an economic point of view.

Within the region examined, exposures of the middle Niagara are found at the following places: In the valley of the Cedar river between Plato and Cedar Valley; in the bluffs of Sugar creek at Lime City (Munn P. O.); in the ledges of Rock creek southwest of Tipton; in the bluffs overlooking the Mississippi in the neighborhood of Le Claire and Princeton; and in the valley of the Wapsipicon near Follets. At all of these localities the exposures have a profitable working thickness, and with the exception of Follets are not capped by a very great thickness of drift. Only two of the exposures, however, have been developed, and these are at Lime City and Cedar Valley.

There are two lime companies at Lime City: the Sugar Creek Lime Company and the United States Lime

Company. The former has recently leased the works of the latter, however, so that there is really but one company in operation there at present. The Sugar Creek Lime Company is incorporated with a capital stock of \$50,000. It gives employment to thirty men in the quarry and about the kilns, besides woodchoppers, haulers, etc. It has four kilns in operation ten months out of the year. Wood is used as fuel in three of the kilns and crude petroleum in the other. The petroleum is so easily managed and gives such uniform results that the company contemplates putting in the proper apparatus for using it in some of the other kilns. The annual output averages 60,000 barrels. The product is shipped over a switch of the C., R. I. & P. railroad which runs directly to the kilns from Wilton. The superior quality of the lime is acknowledged by builders everywhere.

At Cedar Valley George Gladfelter has been burning lime for the past five years. At present he has three kilns in operation and employs twenty-five men. Wood is used as fuel. The output during the year 1891 amounted to 37,500 barrels. The product is shipped over a branch of the B., C. R. & N. railroad which passes directly by the kilns. The lime from these works also enjoys a very enviable reputation among builders.

The B., C. R. & N. railroad between Plato and Cedar Valley passes within a few feet of large exposures of the middle Niagara which have not been developed. Lack of shipping facilities has prevented the growth of the industry at other places; but along this route all of the necessary factors are at hand and quarries could very profitably be developed.

The exposures southwest of Tipton cannot be utilized to advantage until a railroad is built up the valley of Rock

creek. The quantity of rock exposed in this region is inexhaustible and the quality is very superior. Shipping facilities constitute the only drawback to the establishment and maintenance of lime-kilns here.

The same cause prevents the profitable working of the exposures about Le Claire. Port Byron, just across the river, has a railroad; and the kilns of Le Claire could not place their product on the market in competition with their more fortunate rivals. The quantity of rock exposed on the Iowa shore is so great and the quality is so excellent that the kilns which could be established along the water would, in a large measure, support a railroad.

The exposures near Follets could easily be developed, provided the quality of the rock is such as appearances indicate. The B., C. R. & N. railroad lies in the valley adjacent to the exposures, so that shipping facilities are already at hand.

The upper Niagara has been effected by the deformations which have folded the middle Niagara, but the relative softness of texture has permitted rapid denudation of the most exposed portions—the anticlines—and consequently there are found everywhere only the synclines of this part of the group. The lowermost beds of the formation are seen at Le Claire, resting upon the strata of the middle Niagara. The rock is here a rather soft, bright yellow dolomite, very evenly bedded, occurring in layers ranging from a few inches to over a foot in thickness. There is scarcely a trace of sub-crystalline structure, a freshly broken surface being almost devoid of lustre. The layers are horizontally banded, bright yellow laminæ alternating with those containing a considerable percentage of ferric oxide. The rocks may be split along these planes, and weathering tends to separate the laminæ. The rock forms

a good building stone. The same beds are exposed in the vicinity of Follets.

The higher beds of the formation have a typical exposure at Anamosa, and within the region examined at Cedar Valley, Tipton and Sugar creek. These beds have the same lithological characters as those at the base of the formation. The layers range from one foot to several feet in thickness. The texture is very firm; color grayish to cream-yellow.

The strata of the middle Niagara, as has been already noted, are very valuable on account of the superior quality of lime which they produce. The upper Niagara rocks are not less valuable for use as a building stone. The rock is very evenly bedded, easily worked, and quite durable. The higher massive beds are particularly adapted to all the purposes of heavy masonry.

The building stone of Le Claire is quarried, at present, along Quarry creek. The well-known "Gambele Quarry" is now owned and operated by Velie and Nason, of Moline. The rock is taken out by hand, hauled to the river on wagons, a distance of about half a mile, and there loaded on barges. There are, besides, two smaller quarries in the bluffs of the creek: the Kellman quarry, and the Davis quarry. There is sufficient rock exposed here to warrant further development. Several abandoned quarries are located in the southern part of Le Claire. The stone in the large Arsenal building at Rock Island was taken from a quarry near the foot of the main street of the town.

The south bluff of the Wapsipinicon, just above Princeton, is made up of layers lying just as those at Le Claire. A few small quarries have been opened in the face of the bluff; but the rock is not utilized much at present. There are several intercalated bands of chert which often interfere with the work.



The north bluff of the Wapsipinicon exhibits beds equivalent to the Le Claire strata. S. T. Holman, of Comanche, has opened a small quarry in these beds, three miles east of Follets.

At Lime City the same beds are exposed just south of the works of the Sugar Creek Lime Company. Mr. Wilkison has a quarry here, and ships the product over the switch of the C., R. I. & P. railway noted above. The more valuable higher beds near Lime City are not developed. They are exposed in great force some two miles up the creek, where there is an inexhaustible supply of massive building stone, as good in quality as that quarried so extensively at Cedar Valley. Besides these massive layers there are several exposures of the lower building stone strata, and one anticline of the middle Niagara. Small quarries have been opened at several places in these exposures. Mr. Hinkhouse has taken out a small amount of stone about half a mile above Lime City. Mr. Fullweiner has a large quarry a mile farther up the creek; while Mr. Smith has taken out a considerable amount of building stone from the massive layer already noted.

The massive layer is well exposed three miles southwest of Tipton. The quality of the stone is identical with that noted farther on at Cedar Valley. J. C. Walters has a quarry in operation in these strata, and very largely supplies the demand for building stone throughout the surrounding country. This ledge could furnish blocks for heavy masonry in any quantity. M. C. Carey has a small quarry in strata apparently equivalent to the Le Claire beds.

The building stone industry at Cedar Valley has been developed on an extensive scale, good shipping facilities having made this development possible. The B., C. R. & N.

railway ran a switch to this point in 1884, and E. J. C. Bealer began to quarry and ship rock at that time. The quarries are situated in the higher massive beds of the upper Niagara; the equivalent of those exposed at Anamosa. Mr. Bealer has been constantly enlarging the capacity of his quarry, and at present employs a force of about one hundred men.

Blocks of any desired size can be taken out and shipped. The stone is used in the foundations for large buildings, bridge piers, range work, etc. Mr. Bealer has thus far made no attempt to put out cut-stone, preferring to sell the product in the rough.

The following figures show the annual output of the quarries:

	CAR-LOADS.
1889.....	4,000
1890.....	5,400
1891.....	5,000
1892 (estimated).....	6,000

The refuse from the quarries is taken by the B., C. R. & N. railway for ballast; and this is included in the above figures.

Machinery is used quite extensively in all of the operations. A central boiler house furnishes steam through a network of pipes to the drills and pumps. A conveniently located power house runs the several cranes. Portable steam channelers are employed to cut the layers into blocks. The extension of quarry is provided for by washing away the loose glacial deposit from the summit of the bluff. For this purpose a large hydraulic pump forces water from the river through a six inch main to the top of the quarry; and two streams of water are kept constantly playing on the superincumbent clay, washing it into long sluice boxes leading to the river. Stripping is thus carried on very

rapidly, with the minimum amount of labor and expense. A large machine shop is in constant operation repairing the various tools and machines employed in the quarry.

The great economic value of the formations referred to in these notes must not be overlooked. And their further development must be greatly advanced by extension of the present railway facilities.

