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DIVISION OF THE
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URBANA

REPORT OF INVESTIGATIONS — No. 90

HIGH-PURITY DOLOMITE IN ILLINOIS

BY

H. B. WILLMAN

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

URBANA, ILLINOIS
1943

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Topographic Mapping in Cooperation with the United States Geological Survey.

This report is a contribution of the Industrial Minerals Division.

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HIGH-PURITY DOLOMITE RESOURCES OF ILLINOIS

BY

H. B. Willman

SUMMARY

Illinois contains extensive deposits of pure dolomite which is suitable for many war uses, such as refractories for open-hearth furnaces, flux for blast furnaces, and the manufacture of magnesium. Some of the deposits are being developed on a large scale in the Chicago region and on a smaller scale at a number of other places. This study was undertaken to supply the present industry and possible new industries with information regarding additional sources of high-purity dolomite in Illinois.

In the Chicago region, comprising that area of northeastern Illinois mostly east of Joliet and north of Kankakee, this study has revealed the presence of many undeveloped deposits of high-purity dolomite in the Niagaran formations. Some of the purest deposits are ancient coral reefs. The data available from outcrops and a few wells suggest that certain deposits in the vicinity of Kankakee comprise several hundred acres of dolomite more than 100 feet thick and shallow enough to be quarried. Other deposits widely distributed throughout the Chicago region appear to be large enough for commercial exploitation. Deposits occur near Kankakee, Sag Bridge, Chicago Heights, Stony Island, Romeo, Hinsdale, New Lenox, Manhattan, LaGrange Park, Naperville, Frankfort, Lockport, and Lemont. High-purity dolomite is also present in other parts of the region but is generally deeply buried by glacial deposits or less pure dolomite. It could possibly be mined underground.

The Savanna-Port Byron region, which includes that part of northwestern Illinois where high-purity dolomite occurs in the Niagaran formations, contains numerous undeveloped deposits of high-purity dolomite, and some are of large size. Chemical analyses indicate that many of these deposits are of exceptional purity. Deposits which appear to have commercial possibilities occur near Savanna, Mt. Carroll, Lanark, Fulton, Albany, Morrison, Garden Plain, Fenton, Cordova, Port Byron, and Hillsdale.

The Rockford region is defined to include a large part of northern and northwestern Illinois where the Galena-Platteville formations contain high-purity dolomite. Although high-purity dolomite is widely distributed in this region it is usually less pure than that found in the other regions. The principal deposits occur in the Galena formation in several chert-free zones 20 to 70 feet thick. The formation has a total thickness of 200 to 250 feet but is mostly cherty dolomite. Typical exposures of the high-purity dolomite occur near Rockford, Belvidere, Oregon, Dixon, Freeport, Mt. Carroll, Elizabeth, and Galena.

The Grafton-Hardin region in Jersey and Calhoun counties, northwest of Alton, contains high-purity dolomite which is part of the Silurian formations. The principal exposures are near Grafton where the high-purity dolomite, generally about 25 feet thick, has a thick overburden except in small areas along the Mississippi bluffs.

INTRODUCTION

The use of high-purity dolomite for many purposes directly or indirectly related to the war effort, such as in the manufacture of magnesium, for flux, and for refractory dolomite, has focused attention on the resources of this important material. In northern Illinois deposits of high-purity dolomite have been worked on a large scale for many years furnishing stone for a wide variety of uses, and further supplies are available from these sources.

In addition to the deposits of high-purity dolomite which are being worked, Illinois contains numerous undeveloped deposits. Some of these deposits may warrant development in the present emergency because of favorable location, exceptional purity, some special physical or chemical characteristics, or the need for additional sources of stone.

Because some of the deposits have been worked for many years, and have only limited reserves, new deposits must eventually be opened. Therefore, description of the undeveloped resources is important from the viewpoint of both the present emergency and the future of the industry after the war.

Acknowledgments

This investigation was made by the author under the supervision of J. E. Lamar, geologist and head of the Industrial Minerals Division. Assistance in the field and laboratory was given by R. R. Reynolds, J. S. Templeton, and Cove Heilbronner. L. E. Workman, George E. Ekblaw, and Carl A. Bays, also of the Survey staff, were consulted on problems in stratigraphy.

Uses of High-purity Dolomite

Dolomite of high purity has many uses that depend principally on the chemical composition of the stone and other uses in which its physical character is of first importance. The chemical and metallurgical uses include its use as a refractory or in the manufacture of refractories for basic open-hearth furnaces, as a flux in blast furnaces, in the production of magnesium metal, in glass, for high-magnesium lime, for basic magnesium carbonate, for agricultural limestone, and for many other products. The Illinois high-purity dolomites in general have superior weather resistance and consequently are favored for physical uses, such as filter stone. The high-purity dolomites commonly meet the specifications for concrete aggregate and railroad ballast, but many tests show that other less pure deposits are also suitable for these uses. The freedom of the high-purity deposits from chert and other deleterious materials is advantageous for most physical uses.

Brines and sea-water are at present the principal sources of magnesium metal,[1] but the production of magnesium from dolomite is rapidly increasing. Magnesium can be recovered from dolomite by several processes. The Pidgeon ferro-silicon process has been accepted for rapid expansion of production because of the relatively low capital cost and the speed with which plants can be put into operation. Several plants are now producing magnesium by this process and others are under construction. In this process calcined dolomite is mixed with pulverized ferro-silicon and reduced in retorts at a temperature of 1150° C. in a vacuum. The vaporized magnesium is condensed in the cooled section of the retort. Metal of exceptional purity is produced. Dolomite with a high magnesium content is especially desirable, and it is reported that less than 0.06 per cent alkalies is preferred. Many of the dolomite deposits described in this report contain more than 21.0 per cent magnesium oxide and some contain more than 21.5 per cent, which is near the 21.7 per cent theoretically present in pure dolomite. Many of the samples tested contain less than 0.06 per cent alkalies.

[1] Seaton, Max Y., Production and properties of commercial magnesias: Am. Inst. Min. Met. Eng. Tech. Pub. 1496, 1942.
Wilson, P. D., Enlarging magnesium output a hundredfold: Min. Met. vol. 23, 1942, pp. 201-203.
Stedman, G. E., Ford makes magnesium: Chem. Met. Eng., vol. 49, No. 9, 1942, pp. 134-137.

Dolomite is also being used in the production of magnesium by the calcium chloride process. In this process calcined dolomite is treated with calcium chloride, a waste material from ammonia soda plants. The calcium is precipitated as calcium carbonate by carbon dioxide from the calcining kilns and is filtered off. The magnesium remains in solution as magnesium chloride. The solution is concentrated by evaporation, and the magnesium is separated by electrolysis.

In the electrolytic processes of magnesium production, additional feed for the cells can be obtained by treating calcined dolomite with hydrochloric acid which is a by-product of the electrolysis. However, in most electrolytic operations, hydrochloric acid or chlorine is recovered and used for other purposes.

In England magnesium is produced by a process using dolomite and sea-water.

The increased production of steel has greatly increased the consumption of dolomite both as refractories and as a flux. Dolomite of high purity is used as a flux in blast furnaces. In basic open-hearth furnaces dolomite is used as raw dolomite, as a calcined product, and as dead-burned dolomite, especially for patching and repair work. Large quantities of Illinois dolomite are used for these purposes.

Dolomite is also used in the manufacture of a refractory material by a process which involves calcination and removal of the lime by solution in water. The proportion of magnesia is thus increased so that the product is more refractory than dolomite.

High-purity dolomite is used in the manufacture of 85-per cent magnesia, an insulating material. The dolomite is calcined, hydrated, and carbonated under pressure. This precipitates the calcium carbonate which is then filtered from the solution. The solution which contains magnesium bicarbonate is boiled, precipitating a material known as technical carbonate which is mixed with asbestos to form 85-per cent magnesia.

High-purity dolomite is used in the manufacture of glass, some glass batches containing as much as 30 per cent limestone or dolomite. Most of the Illinois high-purity dolomite meets the specifications for use in glass except that it contains too much iron oxide for the highest grade glass. As the analyses from many deposits represent weathered material, the fresh dolomite in some deposits may be low enough in iron oxide to be used for high-grade glass.

High-purity dolomite makes a superior agricultural limestone. In comparison with the neutralizing value of pure calcium carbonte (pure limestone), arbitrarily placed at 100 per cent, a pure dolomite has a neutralizing value of 109 per cent. This value is referred to as the calcium carbonate equivalent. Stone with a calcium carbonate equivalent of 105 per cent or higher can be produced from most of the high-purity dolomite deposits.

Dolomite is used in the manufacture of magnesia although at present most of the commercial magnesia is produced from magnesite, sea water, and underground brines.[2] Because of the large market for magnesia in refractories, oxychloride cements, manufacture of epsom salts, rubber, glue, pigments, fertilizer, and many other uses, much research has been devoted to the problem of producing magnesia from dolomite. At present some magnesia is produced from dolomite by the process used in the manufacture of technical carbonate, described above. Also, a plant is under construction for the production of magnesia from dolomite by a process consisting of calcination, hydration, and treatment with hydrogen sulphide, thus permitting removal of the calcium in solution.[3] The magnesium hydroxide is calcined to magnesia. Calcium carbonate is a by-product. Other

[2] Seaton, Max Y., op. cit.

[3] Seil, G. E., New developments in the production of magnesia for refractories, reviewed by Bror Nordberg, Rock Products, Dec. 1942, p. 63.

chemical methods of separating the calcium and magnesium carbonates of dolomite have been devised but have not been demonstrated to be suitable commercially. Because of their high purity many of the dolomite deposits in Illinois appear to be suitable for the production of magnesia. The large consumption of magnesia and magnesia products in the Chicago industrial area and the distance of the principal sources of magnesia favor local production. The possibility of a pure calcium carbonate by-product is also of interest because of the distance of available supplies of high-calcium limestone.

Table 1.—Production of Dolomite in Illinois in 1941.[a]

	Tons	Value
Concrete, road metal, screenings	5,040,102	$3,818,833
Agricultural limestone	883,884	728,917
Metallurgical (including blast-furnace flux, and open-hearth refractories)	412,368	382,168
Railroad ballast	353,427	256,830
Lime and dead-burned dolomite	53,854	517,541
Asphalt filler	39,533	51,196
Building stone	10,546	23,975
Riprap	5,160	5,945
Other uses (whiting, fertilizer, filler, coal-mine dusting, filter beds, stone sand)	68,055	70,353
	6,866,929	$5,855,758

[a] Compiled and interpreted geologically by the author from data obtained in cooperation with the U. S. Bureau of Mines.

Table 2.—Limestone and Dolomite Consumed in the United States in 1940 by Uses[a]
Bureau of Mines data in tons of 2,000 lbs.

Use	Thousands of tons	Use	Thousands of tons
Agriculture:		Filler (miscellaneous)	94
Liming land	9,454	Food products	14
Fertilizer filler	234	Glass factories	637
Stock feed	93	Glue factories	16
Poultry grit	39	Magnesia works	172
Building and construction:		Metallurgy:	
Concrete, road metal	60,934	Flux	22,857
Cement manufacture	33,986	Other metallurgical	1,998
Railroad ballast	5,085	Refractory dolomite	2,594
Riprap	3,243	Silica brick	31
Building lime	2,021	Paints, pigments, whiting	264
Road base	1,130	Paper mills	1,467
Dimension stone	1,082	Petroleum refining	59
Limestone sand	407	Sewage, trade-waste treatment and filter beds	100
Asphalt filler, etc.	323	Sugar refineries	597
Mineral wool	124	Tanneries	145
Sand-lime, slag brick	39	Water purification	532
Stucco, artificial stone	27	Other	825
Chemical industries:			
Alkali works	4,879		
Calcium carbide, cyanamide	659		
Insecticides, fungicides, etc.	109		
Bleach	21		
Coal-mine dusting	99		
Coke and gas works	28	Total	156,418

[a] Tyler, Paul M., Plentiful supply of nonmetallic minerals aids war effort: Mining and Metallurgy, vol. 23, pp. 205-208, (April) 1942.

Dolomite has many other uses which have been described elsewhere.[4] The amount of dolomite produced in Illinois in 1941 is shown in table 1. The dolomite used for metallurigcal purposes, lime, and dead-burned dolomite is all high-purity dolomite. The stone used for other purposes includes some high-purity dolomite. The amount of limestone and dolomite consumed in the United Stated in 1940 is shown in table 2. Either limestone or dolomite is suitable for most of the purposes listed in table 2, and the variety of stone used depends largely on availability and price. The table indicates the relative size of the markets for limestone or dolomite in the industries listed.

Discussion of Terms

Dolomite is a rock composed principally of the mineral dolomite which is a compound of calcium and magnesium carbonates in equal molecular proportions, or about 54 per cent calcium carbonate and 46 per cent magnesium carbonate by weight. Dolomite rock always contains at least traces of intermixed impurities such as silica, alumina, iron oxide, and other substances (table 6). Much of the alumina is combined with silica in minute particles of clay. Free silica and iron oxide are present in varying quantities.

High-purity dolomite is defined for the purposes of this report as dolomite containing more than 97 per cent total carbonates and more than 20 per cent magnesium oxide (magnesia) or 42 per cent magnesium carbonate. High-purity dolomite is usually more than 98 per cent soluble in hydrochloric acid (p. 21). Although the above limits are more or less arbitrary, they serve to distinguish those dolomites likely to be preferred by the chemical and metallurgical industries. Furthermore, Illinois contains large deposits of dolomite with more than 97 per cent carbonates, and it is desired to direct attention to these resources. Some industries require stone with very low amounts of phosphorus, sulphur, alkalies, or other substances. Not all the deposits with more than 97 per cent carbonates meet the requirements in respect to these minor constituents, but deposits with less than 97 per cent carbonates are less likely to do so.

Dolomite which contains less than 97 per cent carbonates (more than 3 percent impurities) is described according to the character and amount of its impurities. *Slightly argillaceous dolomite* is a term used to describe dolomite which contains intimately mixed through it 3 to 10 per cent of material that is insoluble in hydrochloric acid and is largely clay. The term *argillaceous dolomite* is applied to dolomite containing more than 10 per cent of such materials. Similarly, dolomite in which the insoluble material consists largely of silt (grains larger than clay particles but smaller than sand grains) is described as *slightly silty* or *silty dolomite.* The foregoing limits of composition are selected expressly to meet the needs of this report.

The rock dolomite may contain a larger proportion of calcium carbonate than that present in the mineral dolomite. The excess calcium carbonate occurs principally as the mineral *calcite.* When calcite is present it replaces some of the mineral dolomite, thus lowering the amount of magnesium carbonate without reducing the total carbonates. With increasing amounts of calcite, dolomite grades into *limestone,* a pure limestone consisting almost entirely of calcite. The term "limestone" is also commonly used as a general term to include both limestone and dolomite, but for clarity the term is used herein only in the restricted meaning described above.

Some deposits consist of irregular interpenetrating masses of dolomite and limestone, the relative proportions and sizes of the masses varying from place to place in the same formation. These rocks may usually be recognized

[4] Lamar, J. E., and Willman, H. B., A summary of the uses of limestone and dolomite: Illinois Geol. Survey Rept. of Inv., No. 49, 1938.
Hatmaker, Paul, Utilization of dolomite and high-magnesium limestone: U. S. Bur. of Mines, Inf. Circ. 6524, 1931.
Goudge, M. F., Limestone in industry, investigations of mineral resources and the mining industry, 1929: Canada Dept. Mines, Mines Branch, No. 719, 1930.

by their mottled appearance on weathered surfaces—the dolomite masses weathering brown, the limestone light gray or light brownish-gray. The limestone may also be recognized by the sudden and rapid effervescence which results when treated with a dilute solution of hydrochloric acid, in contrast to the slow reaction of dolomite. In this test the surfaces should be fresh and free from powder, as powdered dolomite also reacts strongly.

Chert, sometimes called *flint,* is a form of silica that occurs in dolomite in deposits of various shapes called nodules, in lens-shaped masses, or in beds (fig. 1). Commonly the chert is light gray or white, but it may be dark colored. It is an undesirable constituent because it is harder than steel and is abrasive to crushing equipment, it lowers the carbonate content of the deposit, and it fractures readily on weathering.

Clay or shale partings occur along the bedding-planes in dolomite deposits, either as continuous beds or as thin films recognized by a greenish or bluish-gray powder on the surface of the bedding-planes (fig. 2). They also occur as thin discontinuous lenses in massive ledges of dolomite. They are composed largely of minute particles of clay minerals which chemically are hydrated aluminum silicates containing small amounts of magnesium, calcium, iron, titanium, or alkalies. If the clayey material is not bedded it is called clay; if well-bedded it is called shale. The partings are commonly darker in color than the dolomite and, where close together, give it a thinly layered or mottled appearance. On weathered surfaces the presence of clay or shale partings is commonly revealed by small reentrants. These impurities are undesirable constituents because they lower the carbonate content of the dolomite, they usually are associated with increased amounts of other undesirable constituents, and they lower the physical strength of the dolomite. Dolomite which contains clay partings or shale beds is described as *clayey dolomite* or *shaly dolomite.*

Clay pockets are masses of clay, generally large enough to be removed and thus permit use of the surrounding rock. The clay pockets are more or less lenticular masses, usually along bedding-planes and joints, but some are roughly cylindrical vertical masses which cut through a considerable thickness of the deposit.

Asphaltum is a bituminous material which fills pores in the dolomite in a few deposits. It is not detrimental for many uses.

Pyrite is a compound of iron and sulphur commonly occurring as brassy-colored crystals in aggregates and in minute individual crystals distributed through the dolomite. Where finely divided it appears to be black.

Limonite is a brown or yellow hydrated iron oxide, often called rust, which is abundant as a discoloring stain especially in outcrops but also in some places many feet back from the outcrops.

Character of High-purity Dolomite

In general the high-purity dolomite in Illinois consists of medium- to coarse-grained porous rock (fig. 3), free from chert or clay partings. The largest grains are usually about ½ mm in diameter, but most of the grains are smaller than ¼ mm. In some deposits the high-purity dolomite is well bedded in layers mostly from 1 inch to 1 foot thick. In others it occurs in massive layers mostly 3 to 10 feet thick and locally thicker. Some of the massive layers have traces of bedding-planes which are not recognizable on fresh surfaces but become evident when the dolomite is weathered.

Most high-purity dolomite deposits have well-developed fracture or joint systems. The joints are usually nearly vertical and many of them are continuous through a great thickness of rock. Parallel joint-planes are usually separated by 10 to 20 feet of rock. In most deposits there are two groups or systems of parallel joint-planes which usually are nearly at right angles to each other, and not uncommonly there is a third group which bisects the angle

Fig. 1.—Dolomite containing bands and nodules of chert. The chert in the center of some nodules is white and dense and is surrounded by porous chert which is weathered and discolored.

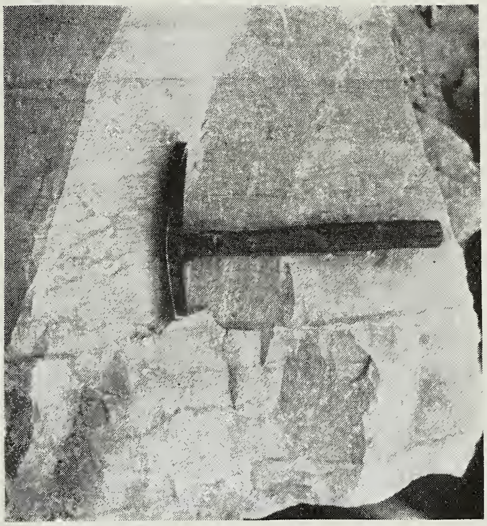

Fig. 2.—Dolomite containing clay partings and small nodules of white chert. The clay partings appear as thin dark wavy lines. Many are discontinuous.

Fig. 3.—Smoothed surface of high-purity dolomite showing the porous texture. The dark areas are pores. (Natural size.)

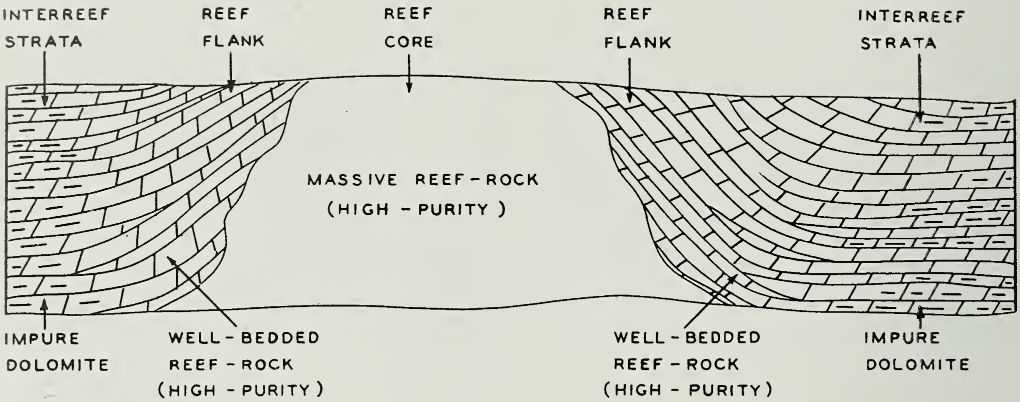

FIG. 4.—Diagrammatic cross-section of a typical reef.

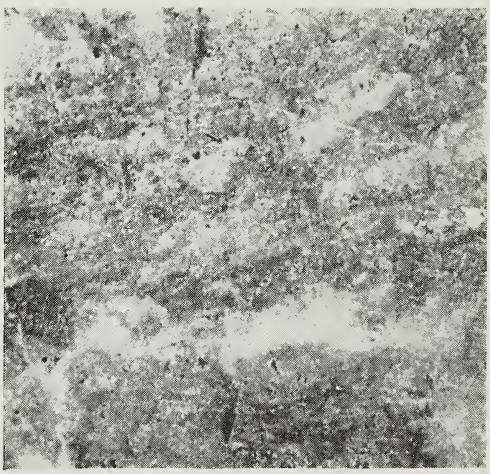

FIG. 5.—Fresh fracture surface showing the light and dark gray mottling that is characteristic of much of the high-purity dolomite. (Natural size.)

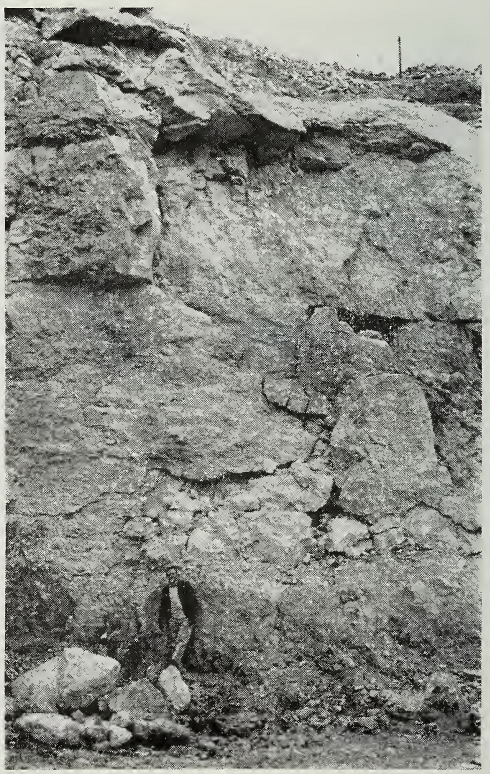

FIG. 6.—Massive high-purity dolomite in the core of a reef. Racine formation. Chicago region.

between the first two. Locally the strata have been offset, either vertically or horizontally or both, along joint-planes to form faults. Faults of a few feet of vertical displacement are common, but vertical displacements of more than 20 feet are rare.

In most areas the dolomite deposits appear to be flat-lying, but in reality they usually have a slight inclination from a horizontal plane and dips of 10 to 20 feet per mile are common. Observable dips up to 5 to 10 degrees occur locally[5]. In some deposits in which the formations are known to be essentially flat-lying, the beds are inclined at high angles. As these steeply dipping beds contain many fossils of corals and other reef-building animals, they are interpreted to be the outer sloping parts of ancient reefs, similar to those in present-day tropical seas. Much of the rock in the coral reefs is high-purity dolomite, and the recognition of the many variations of reef deposits is advantageous in both prospecting and development.

FIG. 7.—Dipping well-bedded high-purity dolomite on the flank of a reef. The massive dolomite in the core of the reef lies to the left of the strata photographed. Racine formation. Chicago region.

CORAL REEFS

The Niagaran dolomite in Illinois contains many coral reefs. The reefs consist of a core of massive high-purity dolomite surrounded by deposits of well-bedded high-purity dolomite in which the beds dip away from the core at high angles. At variable distances from the core the dip of the strata diminishes until the beds become horizontal. The horizontal strata which occur between the reefs are referred to as interreef strata. They consist of high-purity dolomite and of less-pure dolomite which commonly is cherty and argillaceous. A diagrammatic cross-section showing the relations of the strata in a typical reef is given in figure 4.

The dolomite in the reefs is nearly all highly porous, medium- to coarse-grained, and mottled or banded various shades of gray (fig. 5). Near the surface it is locally stained brown with limonite, but most of it weathers gray. Dolomite of this character is referred to as reef-rock.

The cores of the reefs, although essentially nonbedded, usually have a few undulating discontinuous bedding-planes and in places lenses of well-bedded dolomite (fig. 6). Some of the reef cores are at least one-fourth mile broad and

[5] One degree equals about 117 feet per mile.

more than 40 feet thick. The core rock is almost entirely high-purity dolomite and some of it is more than 99.5 per cent carbonates.

At places the steeply dipping strata on the flanks of the core (fig. 7) grade into the core rock, but at others they are sharply separated by a bedding-plane. In many exposures they maintain a fairly uniform dip for some distance from the core, locally as much as a half mile, and then flatten out and become horizontal in a comparatively short distance. In places these strata have dips of 45 degrees or more, but dips of about 30 degrees are more common. Most of the dolomite is of high purity and is similar in physical character and chemical composition to that in the reef cores, but locally a few thin beds of slightly argillaceous dolomite are present. Because minute films of clayey material occur along the bedding-planes, the well-bedded dolomite is commonly slightly less pure than the massive rock in the reef cores.

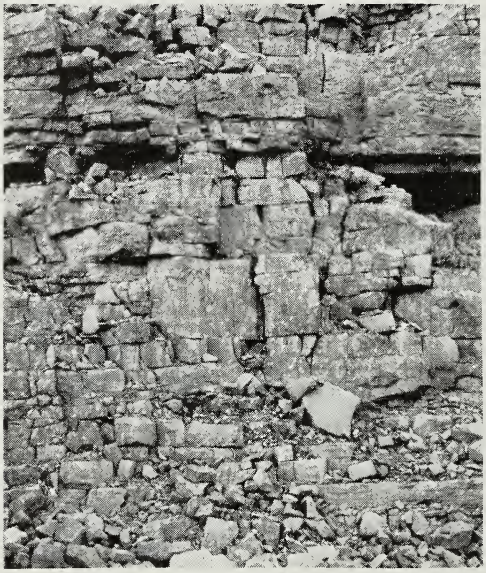

Fig. 8.—Horizontal well-bedded high-purity dolomite comprising the interreef strata near a reef. Racine formation. Chicago region.

In places the high-purity dolomite of the reefs continues with slight change in composition into the horizontal interreef strata (fig. 8), and in some places it may be continuous from one reef to another. However, at the margins of many reefs the high-purity strata grade into impure dolomite which in places is at least as much as 40 feet thick. The interreef strata commonly consist of interbedded high-purity dolomite and argillaceous dolomite, the relative proportions varying from place to place. Small reefs consisting of lenses of massive high-purity dolomite, some of which are 10 to 15 feet thick and 20 to 40 feet broad, also occur in the interreef strata.

Most outcrops and quarries individually reveal only a small part of a reef, but a consideration of the general character of the reefs will usually indicate the approximate position of the exposure in relation to the reef, which is important in planning a prospecting or development program. For instance, at an exposure of steeply dipping beds on the flanks of a reef, the direction to the pure dolomite usually found in the reef core is up the dip, whereas the down-dip direction is toward the interreef strata which probably are less pure. In the horizontal strata bordering a reef the proportion of impure beds and the amount of impurities in the individual beds commonly decreases toward a reef and thus indicates the most favorable direction for prospecting to find a reef.

The recognition of these structures as reefs is also important in estimating the size of deposits. The steeply dipping beds were not originally deposited as horizontal layers like most strata, and then tilted, because the total thickness of the individual beds, more than 1,000 feet in some deposits, is three or four times the known thickness of the formation. The dolomite was originally deposited, as it is now found, in steeply dipping beds on the flanks of the reef core. Therefore, in developing a quarry in such deposits, it cannot be assumed that the steeply dipping beds continue downward any great distance, as the beds may sharply flatten or thin out at an approximately horizontal plane at no great depth (fig. 4).

Geological Formations

The high-purity dolomite in most of the different geological formations in Illinois has distinguishing chemical and physical properties which commonly are persistent throughout regions of some size. Consequently, indentification of the geological formation in which a deposit occurs reveals some general information about its composition, probable variations, types of impurities, and other characteristics.

In Illinois high-purity dolomite occurs principally in the Niagaran formations of Silurian age and in the Platteville, Decorah, and Galena formations of Ordovician age. The position of these formations with reference to each other is shown in table 3. Their characteristics are described in each of the regions, the Niagaran formation on pages 26-30 and 53-59 and the Platteville, Decorah, and Galena formations on pages 78-83.

Samples, Analyses, and Tests

The results of chemical analyses have been used in most cases to determine whether or not a dolomite should be classed as high-purity. In some cases, however, acid-solubility tests and the study of mineralogical and physical properties have served as the basis for classification. The method of sampling and the nature of the analyses and tests are briefly described below.

Samples.—An ideal sample is a diamond-drill core in which every part of the deposit is present in an amount proportional to its thickness. In this study, samples had to be collected from outcrops or quarry faces, and the ideal sample was duplicated as nearly as possible by taking rock pieces of approximately equal size at uniform and closely spaced intervals vertically across the beds. If clay partings or chert were present they were added to the sample in proportion to the thickness represented. The entire sample was crushed, mixed, and quartered to the size needed for analysis.

In certain selected quarries or outcrops, individual samples were collected about every foot, or closer if changes in character were noted. In the laboratory a solubility test was made of each of these samples, as described (p. 21). The results of the solubility tests revealed variations in the purity of the strata, so that certain quarryable units which were comparatively uniform in composition could be differentiated. To obtain a composite sample of each unit for chemical analysis, the individual samples were combined in amounts proportional to the thickness represented. The analyses reveal the highest quality dolomite that can be produced from the deposit and also the average composition of the product if a quarry is developed to certain depths or in benches.

A few samples collected in another investigation were selected to represent certain types of dolomite. The analyses of these samples give valuable information because dolomite of the type represented occurrs in deposits thick enough to be quarried, but such deposits are not necessarily available at the location sampled. This applies to all samples in table 6 where no thickness is reported.

TABLE 3.—NOMENCLATURE AND CHARACTER OF ORDOVICIAN AND SILURIAN STRATA IN NORTHERN ILLINOIS

System	Series	Formation	Member	Usual Thickness (*feet*)	Dominant Rock
Silurian	Niagaran	Port Byron		50-75	High-purity dolomite
		Racine		250-300	High-purity dolomite; some argillaceous dolomite
		Waukesha		30-60	High-purity dolomite in northwestern Illinois Argillaceous and cherty dolomite in northeastern Illinois
		Joliet		50-75	Mostly slightly argillaceous, some cherty dolomite, some high-purity dolomite in northeastern Illinois; thin-bedded dolomite with clay-partings in northwestern Illinois.
	Alexandrian	Kankakee		20-60	Thin-bedded dolomite with clay-partings; locally some limestone; very cherty in northwestern Illinois.
		Edgewood		5-60	Sandy limestone and dolomite
Ordovician	Cincinnatian	Maquoketa		150-175	Shale, locally containing limestone and dolomite beds
	Mohawkian	Galena	Dubuque	30	Dolomite with shale partings
			Stewartville	40	High-purity dolomite
			Prosser	150-175	High-purity dolomite or near high-purity dolomite, except where it contains chert or limestone
		Decorah		20-40	Dolomite and shale, locally high-purity dolomite
		Platteville		100-150	Limestone and dolomite, part argillaceous and sandy, possibly some high-purity dolomite
		Glenwood		0-25	Shale and sandstone
	Chazyan	St. Peter		125-150	Sandstone
	Prairie du Chien	Shakopee		150-175	Dolomite, mostly cherty, sandy and argillaceous
		New Richmond		150-175	Sandstone
		Oneota		150-250	Dolomite, mostly cherty

Chemical analyses.—All the common constituents of dolomite were determined by analysis, and in certain selected samples determinations were made of less abundant substances which are important in some uses.

The amounts of calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$) were calculated from the determinations of calcium oxide (CaO), magnesium oxide (MgO), and carbon dioxide (CO_2). Many published analyses of limestone and dolomite report the amounts of calcium and magnesium carbonates as calculated directly from the amounts of calcium oxide and magnesium oxide, without respect to the amount of carbon dioxide shown by the analyses. Such results indicate, in most cases, a higher content of carbonates than actually is present. Studies of many analyses have shown that most dolomites do not contain sufficient carbon dioxide to combine with all the calcium and magnesium oxides to form carbonates. Therefore, some of the calcium or magnesium must be present in other compounds. Part of the magnesium oxide may be combined with alumina (Al_2O_3) and silica (SiO_2) in the clay present as an impurity in most dolomite deposits. Some of the calcium oxide may be present as calcium sulphate (anhydrite or gypsum) and calcium phosphate (apatite). The analyses are not sufficiently detailed to permit calculation of the amounts of these minerals, but the amounts are believed generally to be very small. Because the minerals containing magnesium oxide are more commonly present and more abundant that those containing calcium oxide, in calculating the amounts of carbonates it is assumed that all the calcium oxide is present as calcium carbonate, and further, that if there is not sufficient carbon dioxide to convert all the magnesium oxide to magnesium carbonate, some of the magnesium oxide is present in noncarbonate minerals. This also assumes that only calcium and magnesium carbonate are present, but actually a small part of the carbon dioxide may be present in other carbonates, principally ferrous carbonate. The error introduced where these assumptions are not entirely correct is believed to be small and probably not significant from the viewpoint of commercial uses. More accurate determination of the carbonates can be made only by detailed mineralogical study and exhaustive chemical analysis.

The method of calculating the amounts of carbonates reported in table 6 is as follows:

A. CaO in analysis $\times$ 1.785 = $CaCO_3$.
B. $CaCO_3$ (A) − CaO = CO_2 used in $CaCO_3$.
C. CO_2 in analysis − CO_2 used in $CaCO_3$ (B) = CO_2 remaining.
D. CO_2 remaining (C) $\times$ 1.916 = $MgCO_3$.
E. $MgCO_3$ (D) − CO_2 remaining (C) = MgO used in $MgCO_3$.
F. If analysis contains as much MgO as used (E) the amount of $MgCO_3$ (D) is presumed to be correct. If not, calculate as follows:
G. MgO in analysis $\times$ 2.091 = $MgCO_3$.

Solubility tests.—An approximate determination of the amount of carbonate in a dolomite can be made by carefully digesting a sample in hydrochloric acid and weighing the insoluble residue. The carbonates, most of the iron oxide, and some of the alumina, silica, and minor constituents go into solution. Comparison of the chemical analyses and solubility tests of many samples shows that a dolomite which is 98 per cent or more soluble in acid will contain more than 97 per cent carbonates, except in the few cases where unusually large amounts of soluble iron oxide are present. This is likely to occur only in samples of weathered dolomite.

Physical properties.—The high-purity dolomite and the less pure dolomite can usually be distinguished by their physical characteristics. High-purity dolomite commonly is relatively coarse-grained and has a high visible porosity.[6] Some high-purity dolomite has uniformly distributed small pores, but some has

[6] References to porosity throughout the report are to visible porosity. The total porosity has no uniform relation to the visible porosity.

large pores separated by less porous dolomite. In some deposits the different beds vary notably in the amount and distribution of the visible porosity. Dolomite of this character does not usually contain clay partings and chert is rarely present. However, experience has shown that if more than one or two per cent of these materials are present, other impurities are usually so abundant that high-purity dolomite probably cannot be produced commercially from the deposit.

The very fine-grained nonporous dolomite which has a dull luster is not high-purity dolomite.

Prospecting

Many of the deposits studied appear to have large tonnages of dolomite under thin overburden. The estimates of tonnage are based on the thickness of the deposit as revealed by outcrops and wells, on interpretations of the continuity of the strata as shown by studies of rock types and geologic structures, and on the size of the area with thin overburden as estimated from outcrops, wells, and by studies of the topography. Although such studies will usually permit a fair estimate of the size of the deposit, certain possibilities for error need be considered.

(1) Outcrops are rarely adequate to permit positive determination of the continuity of the rock throughout the deposits.

(2) Lateral variations in composition sometimes occur in short distances, especially in reef-type deposits.

(3) The fresh rock differs in composition from weathered rock, is often lower in iron oxide, and may be lower in silica, sulphur, and other constituents.

(4) Clay pockets may have been eroded from outcrops but may be common in the unexposed rock.

(5) The bedrock surface may lower or rise away from the outcrops so that the area with thin overburden may be greater or lesser than would normally be expected.

These factors demonstrate the need for adequate prospecting by drilling any deposit in which a considerable investment is to be made. By diamond-drill coring, samples can be obtained which are suitable for chemical analysis and which also reveal the physical character of the deposit, especially the distribution of impurities. Valuable information can be obtained from cable-tool or jack-hammer borings by collecting samples of the cuttings at close intervals. However, impurities in the rock may be selectively concentrated so that the cuttings do not accurately represent the deposit. Because of the possible variations in the deposits, a considerable number of borings may be necessary to prove definitely any large tonnage of stone.

If chemical analyses are made of samples taken at close intervals, the possibility of locating quarryable units of the desired composition is greatly increased. The analyses may also reveal some units which have special qualifications for certain uses.

Description of Deposits

A body of dolomite which appears to be quarryable or mineable is referred to as a "deposit," usually with the implication that the quantity of stone available is sufficient to support a commercial operation. All deposits are parts of geological formations of great extent. Therefore, most individual deposits do not have sharply defined lateral boundaries, although special conditions such as erosion, faulting, or changes in composition may sharply delimit some.

The high-purity dolomite deposits of Illinois are described by geographic *regions* (fig. 9), within which occur smaller *areas* selected for convenience in mapping and description. The deposits of the Chicago, Savanna-Port Byron, and Grafton-Hardin regions are all part of the Niagaran strata, but these regions are widely separated and the rocks differ in some characteristics. The Rockford region includes all of that part of northern Illinois which contains high-purity dolomite in the Galena-Platteville formations. The deposits in the Galena-

Platteville formations differ in chemical and physical characteristics from the dolomite deposits of Niagaran age.

In the Chicago, Savanna-Port Byron, and Grafton-Hardin regions all the known deposits of high-purity dolomite which offer promise are described. However, emphasis has been placed on those deposits which occur near the railroads or along the waterways, especially those deposits within a mile of

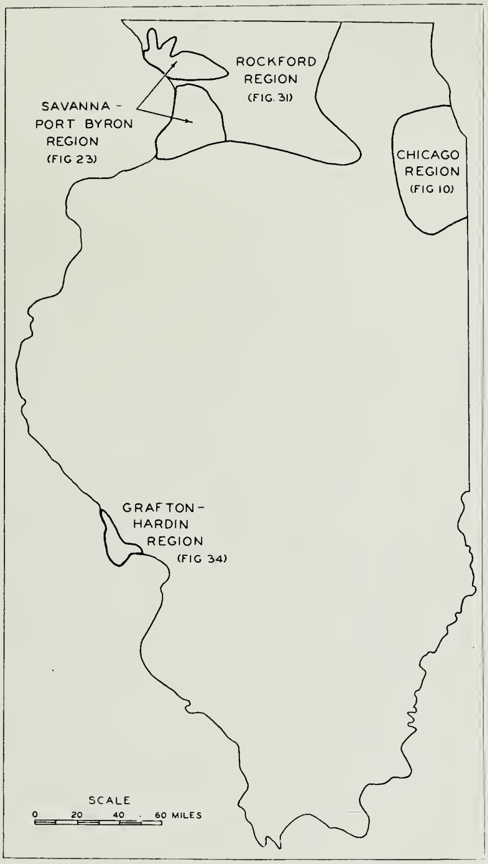

Fig. 9.—Regions of Illinois containing high-purity dolomite.

transportation. In the Rockford region the high-purity formations are so widespread and so many deposits have about the same quality that only a few typical deposits are specifically mentioned. Other quarry sites are present, many of which have been described previously.[7]

A few advantageously located deposits, the samples from which contain a little less than 97 per cent carbonates, are described with the high-purity deposits, especially where solubility or lithologic studies indicate that other parts of the deposit are probably of higher quality.

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[7] Krey, Frank, and Lamar, J. E., Limestone resources of Illinois: Illinois Geol. Survey Bull. 46, 1925.

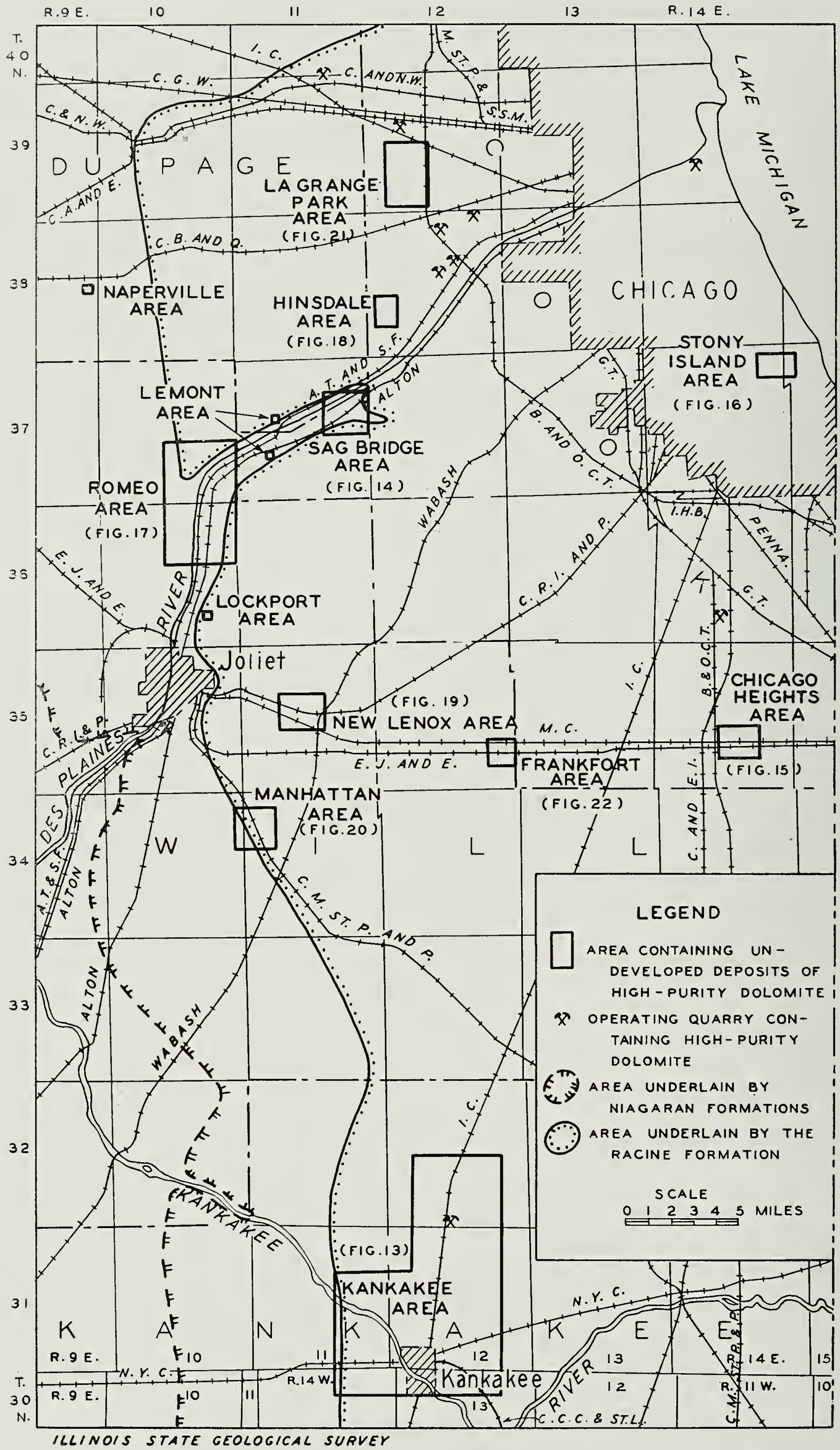

FIG. 10.—The Chicago region—showing the areas containing undeveloped deposits of high-purity dolomite, locations of operating quarries containing high-purity dolomite, and the area underlain by the Niagaran formations.

CHICAGO REGION

High-purity dolomite is available in the Chicago region from both producing quarries and undeveloped deposits. Undeveloped deposits believed to contain several million tons of stone with an overburden less than 10 feet thick are present. Some of the dolomite is exceptionally pure, containing more than 99 percent carbonates.

The Chicago region is defined for this report as that part of northeastern Illinois in which the Niagaran formations contain deposits of high-purity dolomite (fig. 10). This includes an area west of the city of Chicago as far as Naperville and Joliet and south as far as Kankakee. North and northwest of Chicago the Niagaran formations are also present but they are deeply buried by glacial deposits.

The Niagaran formations are exposed along the DesPlaines, DuPage and Kankakee rivers and their tributaries. In the uplands between the valleys the formations are deeply buried at most places, but in certain tracts, bedrock hills protrude through the glacial deposits. The bedrock surface is irregular and in some places the glacial deposits conceal hills and valleys which have a relief of 100 feet or more.

The formations generally dip or lower toward the east. As a result of the dip and the comparative flatness of the region, the oldest or lowest strata are exposed in the west part of the region and the youngest or highest in the east part.

Present Industry

In the Chicago region ten operating quarries contain more or less high-purity dolomite. In some quarries the entire working face is high-purity dolomite. In others the high-purity dolomite occurs in certain benches, and in still others it occurs in thin beds which have not been worked separately and are of doubtful commercial importance from the standpoint of the production of high-purity dolomite.

Large quantities of high-purity dolomite occur in and immediately adjacent to the city of Chicago, but many deposits are now the sites of residential districts or industrial plants, so that the dolomite cannot be quarried. Although some operating quarries have large reserves, others are surrounded by such districts and cannot expand laterally. Still others have only limited tracts of available high-purity dolomite. Additional deposits of high-purity dolomite may be found below the present floors of a few quarries, but many quarries have already been deepened through the strata where high-purity dolomite is likely to be found. Some of the remaining tracts of quarryable dolomite near the present quarries may ultimately be occupied by industrial plants, further reducing the reserves of high-purity dolomite.

Although the high-purity dolomite available for many of the present quarries in and adjacent to Chicago is an exhaustible resource, undeveloped deposits are available elsewhere in the Chicago region, and there appears to be ample supplies for many years to come.

The operating quarries which contain high-purity dolomite are listed below. Analyses of samples from these quarries are given in table 6.

Consumers Company, McCook, in NE. ¼ sec. 15, T. 38 N., R. 12 E., Cook County.

Consumers Company, Hillside, in SE. ¼ NE. ¼ sec. 17, T. 39 N., R. 12 E., Cook County.

Dolese and Shepard Company, McCook, in SW. ¼ sec. 15, T. 38 N., R. 12 E., Cook County.

Elmhurst-Chicago Stone Company, Elmhurst, in SW. ¼ NW. ¼ sec. 2, T. 39 N., R. 11 E., DuPage County.

Manteno Lime and Stone Company, Manteno, in SW. ¼ SE. ¼ sec. 33, T. 32 N., R. 12 E., Kankakee County.

Material Service Company, Chicago, in NE. ¼ SE. ¼ sec. 29, T. 39 N., R 14 E., Cook County.

Material Service Company, LaGrange, in NE. ¼ NW. ¼ sec. 10, T. 38 N., R. 12 E., Cook County.

Material Service Company, Riverside, in SW. ¼ NE. ¼ sec. 2, T. 38 N., R 12 E., Cook County.

Material Service Company, Thornton, in NE. ¼ sec. 33, T. 36 N., R 14 E., Cook County.

National Stone Company, Joliet, in NE. ¼ SE. ¼ sec. 21, T. 35 N., R 10 E., Will County.

Description of Formations

The Niagaran strata in the Chicago region consist of three formations, as follows:

Racine (youngest)
Waukesha
Joliet (oldest)

As high-purity dolomite occurs in the upper part of the Joliet formation and extensively in the Racine formation, a knowledge of the formations is useful in prospecting for deposits of high-purity dolomite and in evaluating their possibilities.

Joliet Formation

Character.—The Joliet formation is about 75 feet thick at Joliet and consists of five members as follows:

The basal member (A) consists of a variable sequence of dolomite and shale in beds mostly ½ inch to 3 inches thick. Much of the dolomite is pink, red, or greenish-gray, is medium-grained, varies from dense to porous, and contains green clay partings. Some beds consist of dense argillaceous dolomite which is pink, green, or gray. Thin beds of green and black dolomitic shale are also common. A bed of green shale locally as much as 8 inches thick is commonly present at the top of the member. The member is 15 feet thick in both the Lincoln Stone Company quarry in the SE. ¼ SE. ¼ sec. 20, T. 35 N., R. 10 E., and the abandoned quarry, called the Markgraf quarry, in the SW. ¼ SW. ¼ sec. 16, T. 35 N., R. 10 E. The base of the member is a prominent smooth bedding-plane which contains many sharp pits filled with green clay. This smooth surface is about 48 feet below the top of the north face of the Markgraf quarry and 13 feet above the main quarry floor in the Lincoln Stone Company quarry.

The second member (B) consists of dense very fine-grained argillaceous dolomite which contains many thin lenticular green clay partings. Most of the dolomite contains 10 to 15 per cent insoluble material, mostly silt and clay, but some shaly beds are more impure. Most of the dolomite is light gray, but pink and green beds are common especially near the base. The beds are mostly 6 inches to 2 feet thick, but a persistent 4- to 6-inch bed occurs at the top. The beds are separated by thin shale partings. The member forms the basal 9 feet 6 inches of the National Stone Company quarry in the NE. ¼ SE. ¼ sec. 21, T. 35 N., R. 10 E., and is 7 feet 6 inches thick in the Markgraf quarry.

The third member (C) consists of dense very fine-grained light gray nearly white argillaceous dolomite in beds mostly 6 inches to 2 feet thick, except that the lower 3 to 5 feet is commonly a single massive bed. The dolomite contains 10 to 15 per cent of insoluble material, mostly silt and clay. Nodules of chert are present except in the lower 4 to 6 feet. This member is 10 feet thick in the National Stone Company quarry.

The dolomite in the fourth member (D) is light gray, fine-grained, slightly porous, and slightly argillaceous. It commonly contains 3 to 5 per cent insoluble material. The beds are mostly 6 inches to 1 foot thick. Scattered nodules of chert occur in places. This member is 13 feet thick in the National Stone Company quarry.

The uppermost member (E) is commonly high-purity dolomite except where chert is present. It consists of light gray fine to medium-gained moderately porous dolomite. Locally the dolomite is mottled pink or various shades of gray. The dolomite occurs mostly in 2- to 4-inch beds, but a few beds are as much as 2 feet thick. The bedding-planes are usually stylolitic, and the strata do not separate easily along the bedding-planes. Thin green clay partings are present locally. The strata appear massive on fresh surfaces but weather thin-bedded. In places a little chert occurs in scattered nodules or in thin beds. The member is 25 feet thick in the National Stone Company quarry at Joliet: the lower 5 feet is in part pinkish and noncherty, the overlying 12 feet contains several discontinuous beds of chert, and the upper 8 feet is noncherty.

Composition.—Solubility tests show that the lower 45 to 50 feet of the Joliet formation contains too many impurities to be high-purity dolomite. The upper 25 feet of the formation (member E) is high-purity dolomite at many places, but locally it is a little below 97 per cent carbonates. Analyses of samples from Joliet, Romeo, and Naperville show 97 to 98 per cent carbonates (A-13, 17, 19, table 6). Solubility tests of many samples show that the strata are commonly 97 to 99 percent soluble. Average analyses of stone taken from the old Romeo quarries when they were operating show only 95 to 96 per cent carbonates (R-1, R-2, table 6). It is not certain that the old quarries, now largely water-filled, worked only the upper Joliet strata, and some of the lower less-pure dolomite may have been included in the samples. In general, the high-purity dolomite in the Joliet formation appears to be less pure than much of the dolomite in the overlying Racine formation.

Distribution.—The Joliet formation is exposed in the west part of the region but farther east it is buried by younger formations (fig. 10). The uppermost strata (member E) which contain high-purity dolomite are exposed a short distance southwest of Joliet, in the upper part of the bluffs along DesPlaines Valley, but the beds dip easterly and occur below the valley-floor from the south side of Joliet northeast to the north side of Lockport. North of Lockport these strata are exposed in quarries and along the Illinois and Michigan Canal as far as Lemont, where they again dip beneath the valley-floor. They are also exposed along DuPage River at Naperville, and along Kankakee River at Rockville, and in the base of the Hillside quarry. Undeveloped deposits are described in the Romeo area (p. 41), and the Naperville area (p. 49).

Correlation.—The Joliet formation is named for the outcrops in the Joliet area.[8] [9]

Waukesha Formation

Character.—The Waukesha formation is 25 to 30 feet thick. It consists of dense fine-grained light gray buff-weathering dolomite, most of which is highly argillaceous. It contains thin lenticular partings of dark green pyritic clay, which in places are so abundant that they give the strata a laminated appearance. The upper beds are usually more argillaceous than the lower and contain lenses of soft white chert. The beds are usually 6 inches to 2 feet thick but some are 3 to 4 feet thick. The bedding-planes are smooth. The dolomite has been extensively quarried at Joliet, Lemont, and Sag Bridge for building stone and was formerly called "Athens Marble" and "Joliet Marble."

Distribution.—The Waukesha formation is exposed along DesPlaines Valley from Joliet to Sag Bridge, along Kankakee River about four miles northwest of Kankakee, and in the lower parts of the quarries at Hillside and Elmhurst.

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[8] Savage, T. E., Silurian rocks of Illinois: Bull. Geol. Soc. Am., vol. 37, p. 522, 1926.

[9] Recently the basal strata (probably those herein differentiated as member A) have been separated from the Joliet formation and named the Rockdale formation because they are well exposed near Rockdale, southwest of Joliet. Savage, T. E., in Correlation of the Silurian formations of North America: Bull. Geol. Soc. Am., vol. 53, chart No. 3, p. 538, 1942.

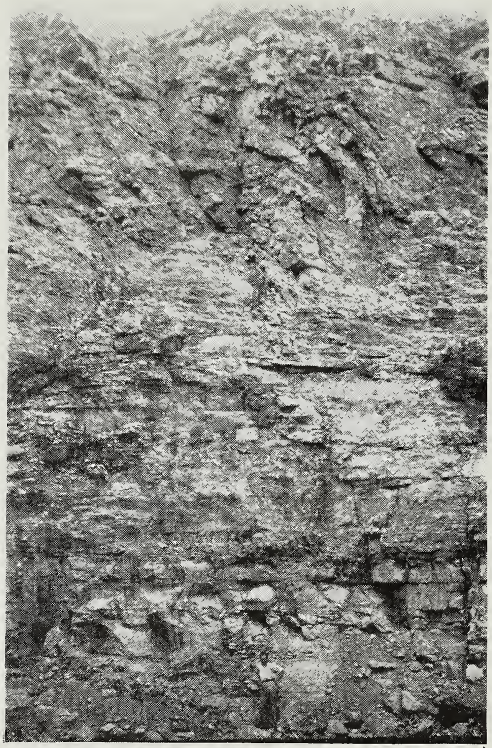
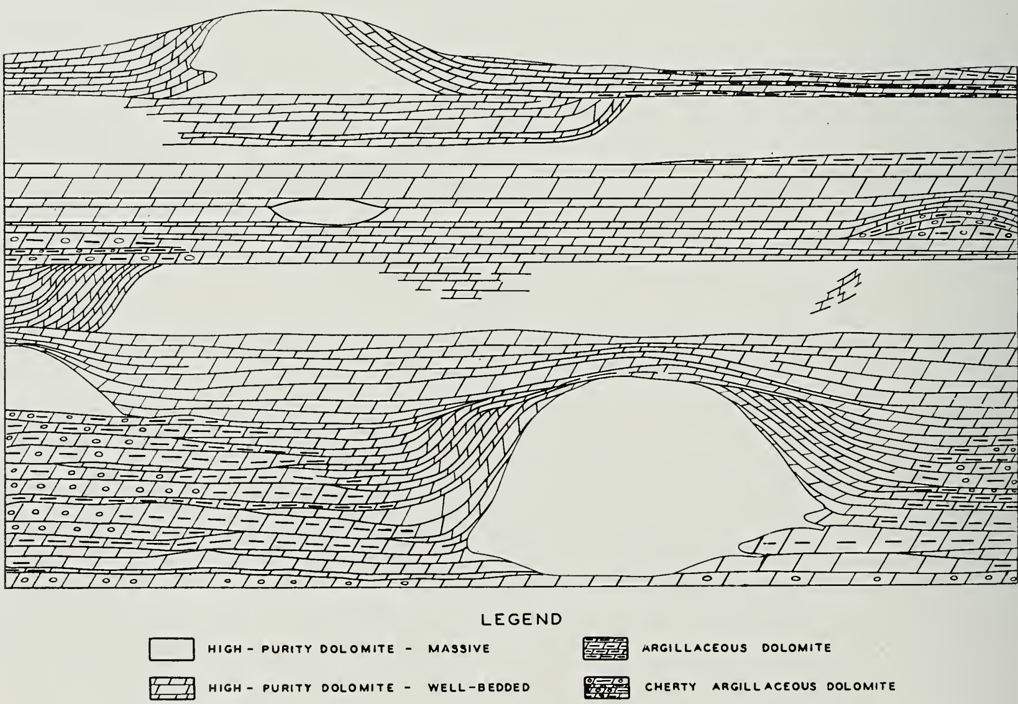


FIG. 11 (Left).—Part of the Racine formation. The upper third of the exposure is massive, irregularly jointed high-purity dolomite, forming the core of a reef. It overlies well-bedded interreef strata consisting of interbedded layers of dense argillaceous dolomite and porous high-purity dolomite.

FIG. 12 (Below).—Cross-section showing diagrammatically some of the structural relations between the principal types of dolomite in the Racine formation. This diagram is not representative of the formation at any specific locality but is a composite of many scattered exposures, between some of which the relations are inferred. It illustrates the complexity of the reefs and interreef strata (see Fig. 1) and the abrupt changes in character both laterally and vertically. It emphasizes the importance of careful prospecting before development of high-purity dolomite deposits in this formation. The formation is 250-300 feet thick.



Correlation.—The strata herein called Waukesha form a distinctive unit, recognizable throughout northeastern Illinois[10] and apparently equivalent to strata of the same character and about the same thickness in the type section at Waukesha, Wisconsin. The name Waukesha has been applied in Illinois to the strata described above together with overlying strata, giving the formation a maximum thickness of about 90 feet. In the present studies the higher strata have been found to be contemporaneous with the reefs which are considered to be part of the Racine formation.[11]

Racine Formation

Thickness.—The Racine formation has a maximum thickness of 250 to 300 feet. Because the upper surface of the formation is eroded throughout most of northeastern Illinois and the beds have a general easterly dip, the formation ranges from only a few feet thick in the western part of the region to its maximum thickness in the eastern part. Variations in thickness result from local changes in the dip of the strata and irregularities in the bedrock surface.

Character.—The Racine strata contain many coral reefs which consist predominately of high-purity dolomite (p. 13 and fig. 11). In the lower part of the formation interreef strata predominate, although reefs are present. In places the lower part of the formation contains as much as 75 feet of interreef strata. The bottoms of some reefs are at or near the base of the formation, and the reefs extend upward for many feet. The proportion of reefs increases higher in the formation, and in the upper part reefs may be almost continuous in some extensive areas. The interreef strata consist of argillaceous dolomite and high-purity dolomite interbedded, the relative proportions varying from place to place. The high-purity dolomite in the interreef deposits is similar to that in the reefs. It varies from massive to thin-bedded, and a few deposits contain a little chert and green clay partings. The argillaceous dolomite is generally variable in bedding and in composition. Some chert is usually present, and locally it is abundant. The presence of beds of reef-rock in the interreef strata generally serves to distinguish them from the argillaceous dolomite found in the underlying Waukesha dolomite. A diagrammatic cross-section illustrating some of the relations of the various types of rock in the Racine formation is shown in figure 12.

Composition.—Many of the Racine coral reefs are composed of exceptionally pure dolomite. Analyses commonly show more than 99 per cent carbonates and more than 21.5 per cent magnesium oxide (table 6). Many analyses show silica less than 0.3 per cent, some less than 0.1. Iron oxide is variable, but is commonly 0.1 to 0.4 per cent. Alkalies are commonly less than 0.1 per cent, some as low as 0.02. Phosphorus pentoxide is very low, usually not detectable in a 5-gram sample. Sulphur trioxide is variable, commonly 0.1 to 0.4 per cent but less than 0.1 in some samples.

The argillaceous interreef strata mostly vary from 80 to 95 per cent soluble. Some very impure strata are only about 60 per cent soluble.

Distribution.—The Racine formation is exposed along DesPlaines Valley near Joliet and Lockport and from Lemont to Riverside, along Hickory Creek east of Joliet, along Kankakee River at Kankakee and about 3 miles northwest, and also in quarries in Chicago, Elmhurst, Hillside, LaGrange, Thornton, and elsewhere (fig. 10).

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[10] These strata are not present in the Material Service Company quarry (Stearns quarry) in Chicago where the Racine formation directly overlies the Joliet formation (L. E. Workman, personal communication, 1943).

[11] As the term Waukesha has been discontinued in Wisconsin, the name Bellwood has recently been suggested for these strata in northeastern Illinois because they are well exposed in the Hillside quarry, near Bellwood, north of LaGrange. The term Bellwood as thus used includes strata herein considered Waukesha and Racine. Savage, T. E., in Correlation of the Silurian formations of North America: Bull. Geol. Soc. Am., vol. 53, p. 536, 1942.

Correlation.—The Racine strata have been correlated with similar strata at Racine, Wis.[12] As indicated (p. 29) the lower part of the Racine formation, as used herein, includes strata previously placed in the Waukesha. By this arrangement all the reefs in northeastern Illinois are included in the Racine formation.

Some of the higher strata in the Racine formation have been correlated by fossils with the Port Byron formation of Northwestern Illinois[13] and with the Guelph formation of New York.[14]

Pre-Niagaran Strata

Below the Niagaran Strata, the Kankakee and Edgewood formations consist of 100 to 120 feet of dolomite. Most of these strata are too argillaceous for use as high-purity dolomite. Some strata which consist of relatively pure dolomite contain partings of green clay, so that high-purity dolomite could not be produced from them commercially.

UNDEVELOPED DEPOSITS

In the Chicago region undeveloped deposits of high-purity dolomite can possibly be quarried in the areas shown in figure 10. In some of these areas the deposits are of large size, and outcrops and well data reveal the character of the deposits in sufficient detail to indicate favorable commercial possibilities. In other areas there are only a few outcrops and little direct information is available about the size or character of the deposits. Because some of these deposits may become more important as a result of new industrial developments or the possible exhaustion of other deposits, presentation of the information available appears to be desirable, especially where the undeveloped deposits are located close to transportation and the geological relations indicate the possibility of a deposit of commercial size. Location may be important enough to warrant drill-prospecting of such deposits before considering more distant but better exposed deposits.

Kankakee Area

The Kankakee area (fig. 13) contains numerous outcrops of high-purity dolomite which are part of the Racine formation. The high-purity dolomite has a thin overburden in large areas along the railroads. A quarry in this type of rock has been opened recently by the Manteno Lime and Stone Company 2½ miles south of Manteno, in the SW. ¼ SE. ¼ sec. 33, T. 32 N., R. 12 E.

Outcrops.—The best of numerous exposures of the high-purity dolomite are in abandoned quarries and in the bluffs of Kankakee River and the tributary ravines, especially from Kankakee northwest to the center of the NE. ¼ sec. 22, T. 31 N., R. 11 E., where the underlying argillaceous Waukesha dolomite is exposed (fig. 13).

Thickness.—The greatest exposed thickness of high-purity dolomite is about 50 feet in a small canyon on the northeast side of Kankakee River, southwest of Bourbonnais, in the SW. ¼ SW. ¼ sec. 19, T. 31 N., R. 12 E. About 40 feet of high-purity dolomite is exposed in a small gully on the west side of Kankakee River, in the NW. ¼ NE. ¼ NW ¼ sec. 31. When the water is low about 12 feet of high-purity dolomite is exposed in an old quarry 1½ miles south of Manteno.

The total thickness of the high-purity dolomite is not revealed by the outcrops, but samples of cuttings from the Bradley city well (A. fig. 13) in the NW. ¼ SE. ¼ NW. ¼ sec. 29, representing the upper 140 feet

[12] Savage, T. E., Silurian rocks of Illinois: Bull. Geol. Soc. Am., vol. 37, p. 524, 1926.
[13] Savage, T. E., 1926 citation, p. 525.
[14] Savage, T. E., 1942 citation, chart No. 3, p. 538.

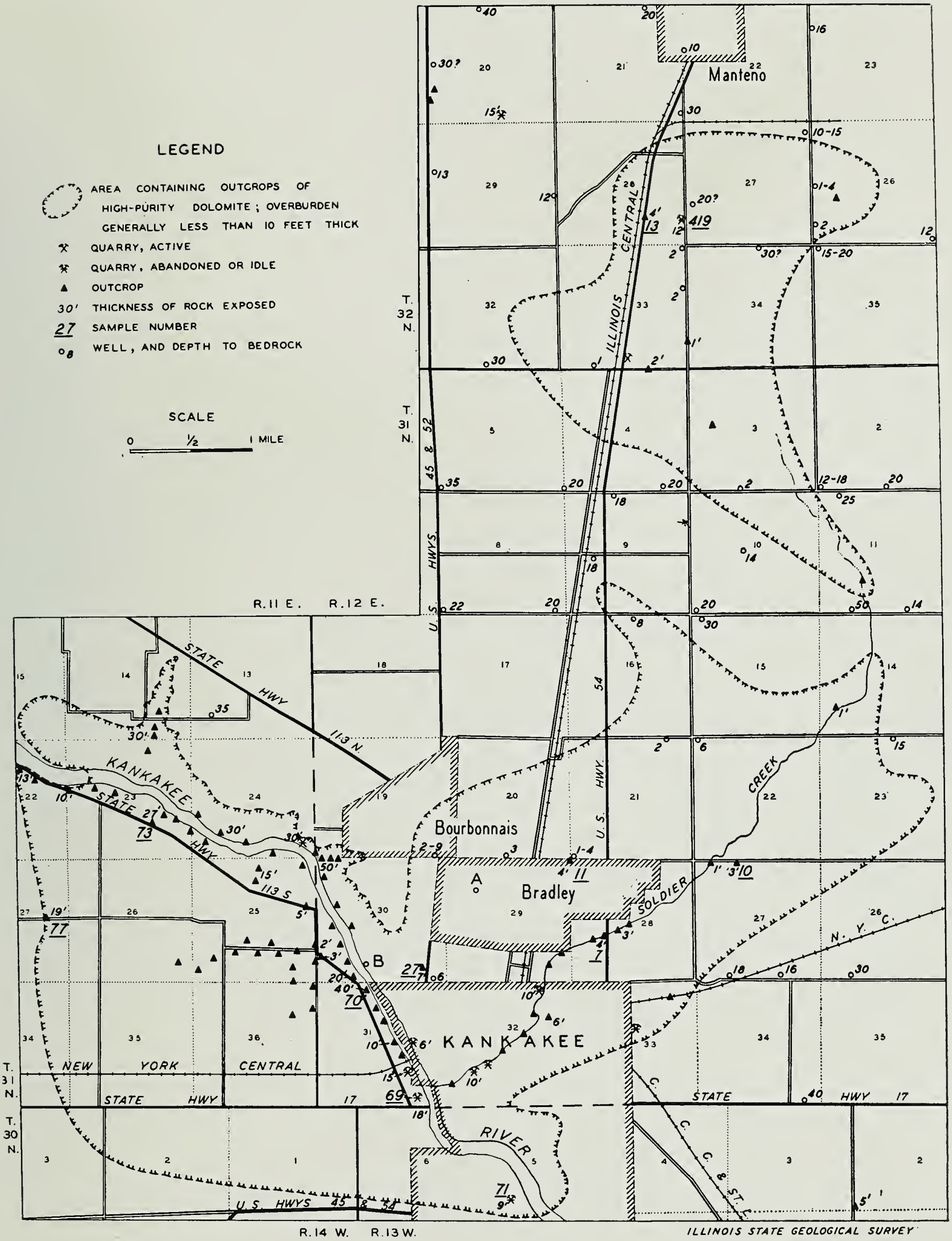

Fig. 13.—High-purity dolomite in the Kankakee area.

of rock, consist of porous dolomite similar to the high-purity dolomite in the outcrops. Samples of cuttings from a well at the Kankakee sewage-disposal plant (B, fig. 13), in the NW. ¼ SE. ¼ SW. ¼ sec. 30, revealed 38 feet of gravel, sand, and silt overlying 67 feet of porous chert-free dolomite. A short distance from the well the high-purity dolomite is exposed in the bluffs about 30 feet higher than the top of the well, so that, except in the valley-bottom, the total thickness of high-purity dolomite in this locality is apparently about 135 feet.

The Racine formation in the Kankakee area dips generally east or southeast and consequently the high-purity dolomite is probably thicker along the east side of the area than on the west side. The high-purity dolomite may be more than 100 feet thick in most of the area east of the line between Ts. 11 and 12 E. The high-purity dolomite thins westward and is only 20 feet thick along the east side of Wiley Creek in the SW. ¼ SE. ¼ NE. ¼ sec. 27.

Overburden.—The overburden is generally less than 10 feet thick in a large part of the area (fig. 13), and in several tracts it averages less than 5 feet thick. As the bedrock surface in the Kankakee area is locally cut by channels which are filled with glacial clay or gravel and are therefore not discernible from the present topography, the thickness of the overburden should be carefully determined at any proposed quarry site.

The overburden commonly consists of pebbly clay or gravel. West of Kankakee River the bedrock is locally covered with sand dunes, especially in the north part of sec. 25, T. 31 N., R. 11 E.

Character.—Most of the high-purity dolomite exposed in the area is porous reef-rock. It is light buff or light to dark gray on fresh surfaces but weathers light gray. In the samples from the Bradley city well the upper 40 feet is buff, below that the dolomite is mixed light gray and buff to about 90 feet, and below that the rock is mostly light gray with a small amount of light buff. In some places the dolomite is very fossiliferous with corals abundant. The reef-rock exposed in the hill 1½ miles southwest of Manteno differs from that found elsewhere in the area in the great abundance of fossils, especially a large fossil brachiopod named *Conchidium.*

The dolomite is commonly well-bedded in 2-inch to 1-foot beds, but locally it forms 5- to 10-foot ledges. The strata usually have dips of 2 to 5 degrees, and locally the dips are as high as 15 degrees. Most of the dips are related to reef structures. At many outcrops in the vicinity of Kankakee the beds dip southeast, but near the bend in Kankakee River northwest of Bradley the strata locally dip south, west, and northwest. In the quarry one mile south of Manteno the strata dip northwest 15 degrees, and in the south slope of the hill 1½ miles southwest of Manteno the strata dip south 10 to 15 degrees.

A few scattered outcrops of argillaceous dolomite occur within the reef-rock area. The only exposures of argillaceous dolomite observed in the area mapped are (1) at the north end of the quarry on the north side of Kankakee, in the NW. ¼ NE. ¼ NE. ¼ sec. 32, where 6 feet is exposed, and locally along the ditch southwest of the quarry, (2) in a small abandoned quarry northeast of Kankakee, in the SW. ¼ SW. ¼ NE. ¼ sec. 33, now largely filled with rubbish, (3) in the extreme southeastern corner of the area mapped, along Baker Creek, where about 5 feet of argillaceous dolomite crops out, and (4) in the small abandoned quarry on the extreme south margin of the hill 1½ miles southwest of Manteno, where about 6 feet of thin-bedded argillaceous dolomite is exposed.

South of the area mapped, argillaceous dolomite is exposed along the Gar Creek ditch, in the SW. ¼ sec. 11, in waste-piles at several places farther east along the ditch, and also along Kankakee and Iroquois rivers southeast of Kankakee. These may be interreef deposits contemporaneous with the reefs in the area mapped, or they may be younger deposits which overlie the high-purity Racine strata.

Composition.—Chemical analyses and solubility tests show that the reef rock is high-purity dolomite, much of it containing about 99 per cent carbonates. As nearly all the samples represent weathered material and are porous, they probably contain some argillaceous impurities washed in from the soil. The fresh rock should be even more pure.

A sample (70, fig. 13, table 6) representing 40 feet of the reef dolomite exposed along Kankakee River northwest of Kankakee contains 54.57 per cent $CaCO_3$ and 43.03 per cent $MgCO_3$, a total of 97.60 per cent carbonates. Another sample (11) representing the upper four feet of buff dolomite freshly exposed in a ditch along U. S. Highway No. 54 in Bradley, contains 54.71 per cent $CaCO_3$ and 44.43 per cent $MgCO_3$, a total of 99.14 per cent carbonates. A sample (419) representing 12 feet of strata exposed in the old quarry 1½ miles south of Manteno contains 99.17 per cent carbonates, consisting of 54.60 per cent $CaCO_3$ and 44.57 per cent $MgCO_3$.

The high purity of the dolomite is also shown by solubility tests of samples from widely separated places in the area, including samples from well cuttings and samples taken at closely spaced intervals from typical outcrops. The results of solubility tests on samples from several outcrops are as follows (locations in fig. 13):

Sample No.	Thickness Sampled *feet*	Soluble *per cent*
7	4	99.0
10	3	99.7
13	4	99.6
27	6½	99.6
69	12	99.4
71	9	99.7

Solubility tests of the cuttings from the Bradley city well (A, fig. 13) follow. Some of the cuttings may include a little extraneous material.

Depth *feet*	Soluble *per cent*
0-20	99.5
20-40	99.4
40-60	99.0
60-80	99.3
80-100	98.8
100-120	99.4
120-140	99.0

The uniformity in composition from bed to bed is shown by solubility tests of samples collected from three outcrops representing different parts of the formation. Sample set 70 was collected from a small ravine in the west bluff of Kankakee River, in the NE. ¼ NE. ¼ NW. ¼ sec. 31, T. 31 N., R. 12 E. The top of the rock sampled is believed to be about 125 feet above the base of the high-purity dolomite. The chemical analysis of a sample (70) from this outcrop is referred to above. Results of the solubility tests follow:

Sample No.	Position above base of outcrop		Soluble *per cent*	Sample No.	Position above base of outcrop		Soluble *per cent*
	feet	*inches*			*feet*	*inches*	
28...........	35	2	99.2	13...........	17	2	99.6
27...........	33	8	98.0	12...........	16	2	99.2
26...........	32	8	99.1	11...........	15	2	99.1
25...........	31	4	95.3	10...........	14	2	99.6
24...........	30	..	97.1	9...........	13	2	99.6
23...........	29	..	98.8	8...........	11	8	99.5
22...........	27	..	99.3	7...........	10	4	99.6
21...........	26	..	99.7	6...........	9	10	99.4
20...........	24	8	97.7	5...........	8	10	99.1
19...........	23	8	98.1	4...........	7	4	98.8
18...........	21	8	99.4	3...........	2	6	99.0
17...........	20	8	99.4	2...........	1	6	98.7
				1...........	..	6	98.8
16...........	19	8	99.4				
15...........	18	4	99.6				Avg. 98.9
14...........	18	2	99.1				

Sample set 73 was collected from a small ravine in the south bluff of Kankakee River in the SE. ¼ NW. ¼ SE. ¼ sec. 23, T. 31 N., R. 11 E. The top of the exposure is probably about 75 feet above the base of the high-purity dolomite. Results of the solubility tests follow:

Sample No.	Position above base of outcrop		Soluble *per cent*	Sample No.	Position above base of outcrop		Soluble *per cent*
	feet	*inches*			*feet*	*inches*	
20...........	24	..	99.6	9...........	9	6	99.8
19...........	23	..	99.9	8...........	8	..	99.7
18...........	22	..	99.6	7...........	7	..	99.6
17...........	20	6	99.6	6...........	6	..	99.7
16...........	19	6	99.6	5...........	4	..	99.6
15...........	18	6	99.8	4...........	3	..	99.6
14...........	17	6	99.8	3...........	2	..	99.8
13...........	15	6	99.9	2...........	1	..	99.7
12...........	14	..	99.9	1...........	..	2	98.9
11...........	12	..	99.6				Avg. 99.7
10...........	10	6	99.8				

Sample set 77 was collected from a road-cut on the east side of Wiley Creek, in the SW. ¼ SE. ¼ NE. ¼ sec. 27, T. 31 N., R. 11 E. The base of this exposure is the base of the high-purity dolomite. Results of the solubility tests follow:

Sample No.	Position above base of exposure	Soluble *per cent*	Sample No.	Position above base of exposure	Soluble *per cent*
	feet			*feet*	
17...........	22	99.1	8...........	10	99.9
16...........	20	98.7	7...........	8	99.9
15...........	19	98.5	6...........	7	98.0
14...........	18	99.0	5...........	4	98.1
13...........	17	99.7	4...........	3	96.5
12...........	16	99.4	3...........	2	98.1
11...........	15	99.8	2...........	1	97.7
10...........	14	99.1	1...........	0	99.5
9...........	12	99.8			
					Avg. 98.9

Development possibilities.—The outcrops along Kankakee River indicate that at places high-purity dolomite is continuous for several miles. However, because of the sharp and unpredictable lateral gradation of reef-type deposits to argillaceous dolomite, any proposed quarry site should be carefully drilled before development is undertaken.

The outcrops and the samples from wells indicate that the Kankakee area contains enormous resources of dolomite with more than 97 per cent carbonates, much of it with more than 99 per cent carbonates. Large areas in which the dolomite has a thin overburden occur along the Illinois Central Railroad south of Manteno and north of Bradley, along the New York Central Railroad west of Kankakee, and a short distance north of the New York Central Railroad northeast of Kankakee, along Soldier Creek (fig. 13).

Possibilities in Tracts Adjacent to Kankakee Area

East of the area mapped, dolomite has a thin overburden along Exline Slough, especially near Exline and St. George. Only a foot or two of the dolomite is exposed and it is slightly less pure than the reef-rock. Because of the general easterly dip of the strata, the high-purity beds exposed in the Kankakee area may occur below a thin overburden of the less-pure strata in the Exline-St. George tracts. If so, favorable places for development might be found along the New York Central Railroad, especially near Exline, in secs. 19, 20, and 30, T. 31 N., R. 13 E.

South of the Kankakee area, high-purity dolomite may underlie the outcropping argillaceous strata but the argillaceous rocks may be too thick to be stripped and quarrying may not be feasible.

West of the Kankakee area, a few feet of the basal part of the high-purity dolomite may be present locally, but most of the strata exposed contain less than 97 per cent carbonates. A considerable thickness of the Joliet formation is exposed in quarries and in outcrops along Kankakee River, but analyses and solubility data indicate that the dolomite in this area mostly contains a little less than 97 per cent carbonates, although a few beds may be high-purity dolomite.

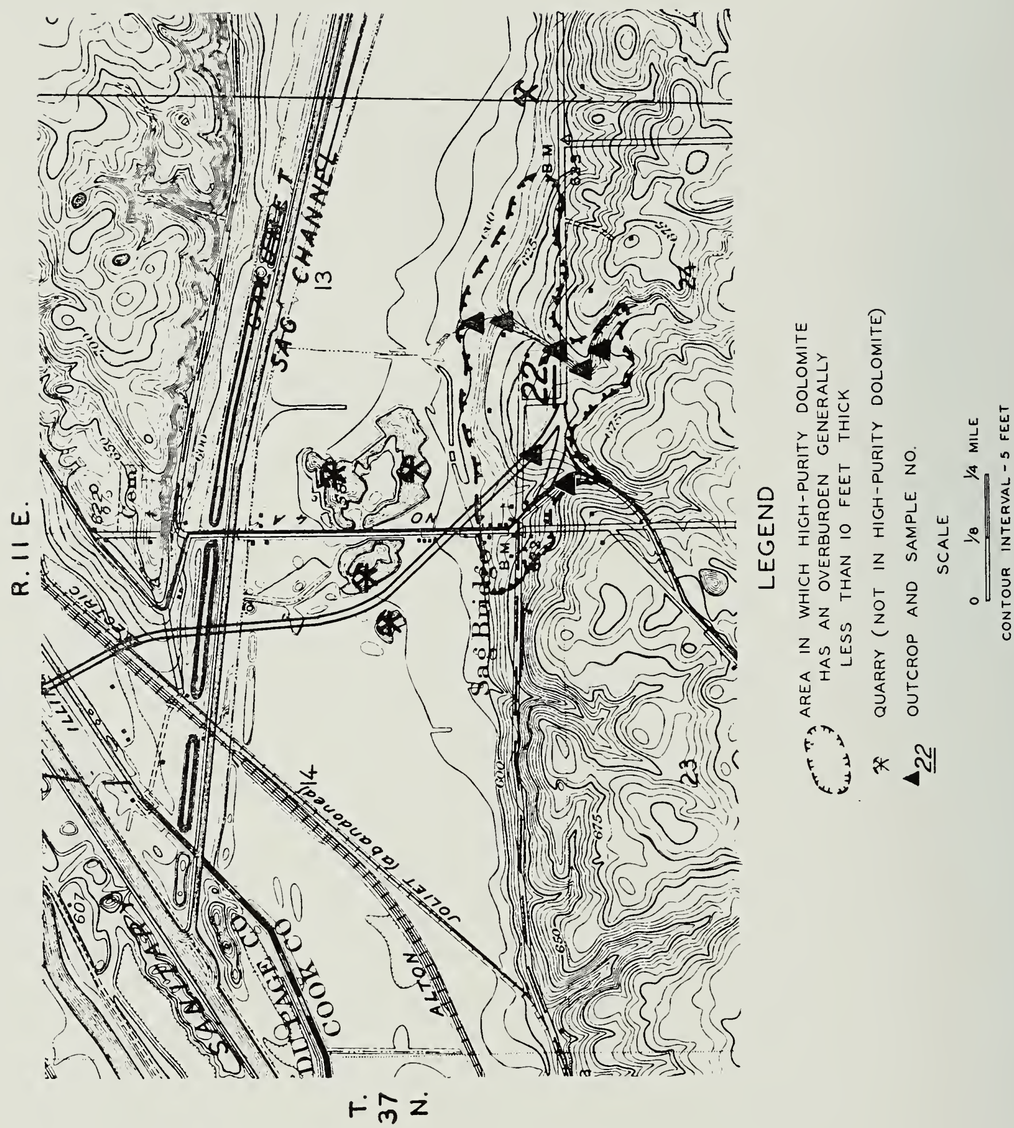

Fig. 14.—High-purity dolomite in the Sag Bridge area (part of the Sag Bridge quadrangle topographic map).

Sag Bridge Area

High-purity dolomite underlies a terrace along the south side of the Calumet-Sag Channel at Sag Bridge (fig. 14). There are no quarries in this deposit but the dolomite is well exposed along a small canyon that cuts through the middle of the deposit in the SE. ¼ SW. ¼ of sec. 13, T. 37 N., R. 11 E., and in shallow road-cuts along paved highways a quarter of a mile west. The deposit is a reef in the Racine formation.

Thickness.—The greatest thickness of high-purity dolomite exposed is in the canyon, where the almost vertical walls are commonly 15 to 20 feet high. The strata dip northeast and from the thickness of the individual beds exposed it might be assumed that the high-purity dolomite is more than 100 feet thick. However, the beds probably do not extend downward any great depth, as indicated by the horizontal bedding of the lower nonreef strata exposed in the quarries in the floor of the valley both east and north of the canyon. Assuming the dipping strata are part of an essentially horizontal reef with a relatively flat bottom, the true thickness of the high-purity dolomite is represented by the difference in elevation between the highest and lowest outcrops, about 50 feet, plus any additional strata not exposed. As the underlying nonreef strata are exposed only a few feet lower than the lowest reef strata, the maximum thickness is probably about 50 feet. The maximum thickness occurs only along the south and higher edge of the terrace. Elsewhere the upper part of the deposit has been eroded. The thickness probably exceeds 25 feet throughout the terrace.

Overburden.—On the terrace the dolomite has a thin overburden of soil and locally a little silt. South of the terrace the rock is overlain by glacial clay and, unless the bedrock rises under the hill, the overburden increases to 25 to 30 feet thick within a distance of 400 to 500 feet south of the terrace.

Character.—The dolomite is gray, fine- to medium-grained, and porous. Some beds are brecciated. Along the canyon north of the bridge the beds are mostly 2 to 6 inches thick but a few are as much as 3 feet thick. The strata dip 2 to 10 degrees northeast. South of the bridge the dolomite is massive and occurs in 3- to 6-foot ledges. The massive dolomite is probably in the core of the reef.

Composition.—A sample (22, table 6) collected from a 15-foot weathered face along the canyon about 200 feet north of the bridge is a high-purity dolomite containing 54.71 per cent $CaCO_3$ and 44.09 per cent $MgCO_3$, a total of 98.80 per cent carbonates.

Development possibilities.—The presence of the paved roads probably eliminates the west part of the terrace from consideration as a quarry site. In the remaining part of the terrace, about 35 acres north of the paved road has a thin overburden. There are two farm buildings in the tract west of the canyon but about 12 acres east of the canyon is open pasture. About five acres south of the paved road has a thin overburden and the area that can be worked depends on how much overburden can be profitably stripped to recover the 50 feet of high-purity dolomite that may be present in this part of the deposit. Because of the variations encountered in reef-type deposits drilling is needed to establish the quality, thickness, and amount of high-purity dolomite available.

The deposit is about three quarters of a mile from the Alton Railroad. The Sanitary and Ship Canal is about a mile northwest of the deposit but it is possible that barges could be loaded on the Calumet Sag Channel about a half mile north of the deposit.

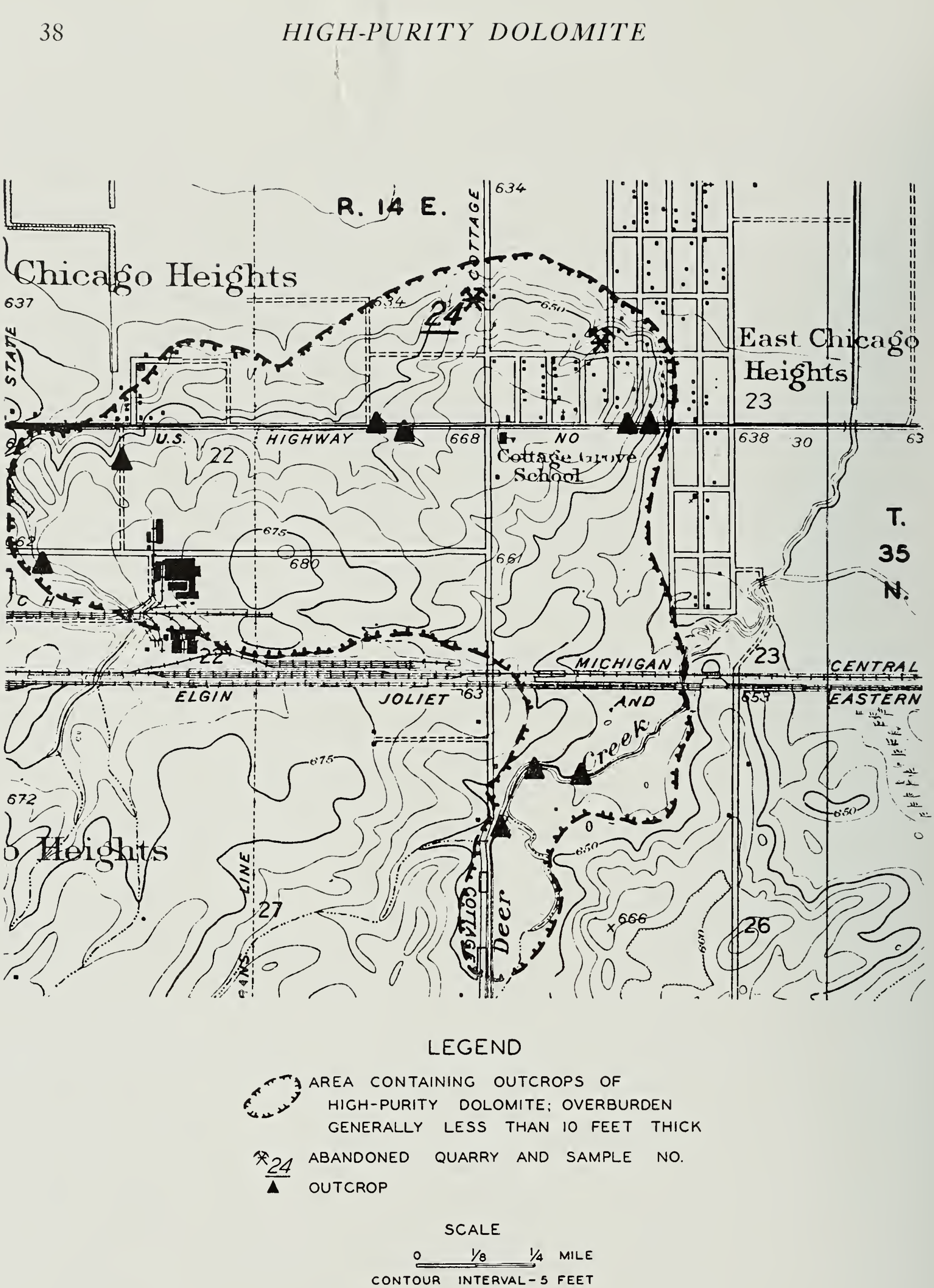

FIG. 15.—High-purity dolomite in the Chicago Heights area (parts of the topographic maps of the Calumet City and Dyer quadrangles).

Chicago Heights Area

High-purity Racine dolomite occurs in a hill one mile east of Chicago Heights (fig. 15). About 15 feet of dolomite is exposed in two small old quarries and in shallow road ditches. A foot of dolomite is exposed along Deer Creek.

Thickness.—The thickness of the reef-rock is not known. Deep wells in the vicinity indicate that probably at least 200 feet of Racine dolomite underlies the area. This may be all reef-rock but argillaceous interreef rock may also be present.

Overburden.—The overburden consists only of a thin soil throughout most of the tract about half a mile in diameter, centering about Cottage Grove School. The overburden is probably only 5 to 10 feet thick in the flat bottomland of Deer Creek. The extent of the area where the dolomite is believed to have an overburden generally less than 10 feet thick is shown in figure 15.

Character.—The dolomite is porous reef-rock and contains asphaltum. In a quarry along Cottage Grove Avenue on the north side of the hill the strata dip 15 to 30 degrees northwest and contain two thin beds of argillaceous dolomite. Beds of this type are commonly found in the marginal strata around reefs and they do not indicate such beds are present throughout the deposit. No argillaceous dolomite was found in any of the other exposures in the area.

Composition.—A sample (24, table 6) representing about 10 feet of the dolomite exposed in the quarry along Cottage Grove Avenue contained 54.41 per cent $CaCO_3$ and 42.36 per cent $MgCO_3$, a total of 96.66 per cent carbonates.

Development possibilities.—Much of the central part of the tract of dolomite with thin overburden near Cottage Grove School is occupied by houses. Since the topographic map (fig. 15) was made a number of houses have been added, especially north of U. S. Highway 30. If very large operations are not required quarries could possibly be opened around the north or west margins of the hill or in the larger undeveloped tract south of Cottage Grove School. Larger unoccupied tracts occur farther south, near the Michigan Central and the Elgin, Joliet, and Eastern railroads, but the overburden may be too thick.

The tract along Deer Creek is adjacent to the two railroads, and the dolomite might be quarried there if testing shows a sufficient thickness of high-purity dolomite with thin overburden. Diversion of the creek might be required for any large operation.

Stony Island Area

High-purity Racine dolomite occurs at Stony Island in a rock hill about a mile long and half a mile wide (fig. 16). The hill rises about 20 feet above the surrounding plain. About 10 feet of high-purity dolomite is exposed in an old quarry at the west end of the hill, on the east side of Stony Island Avenue. The entire thickness of the high-purity dolomite is not known, but the strata exposed are probably at least 200 feet above the base of the Racine formation so that a considerable thickness of high-purity dolomite may be present. The rock has only a thin soil overburden throughout the hill.

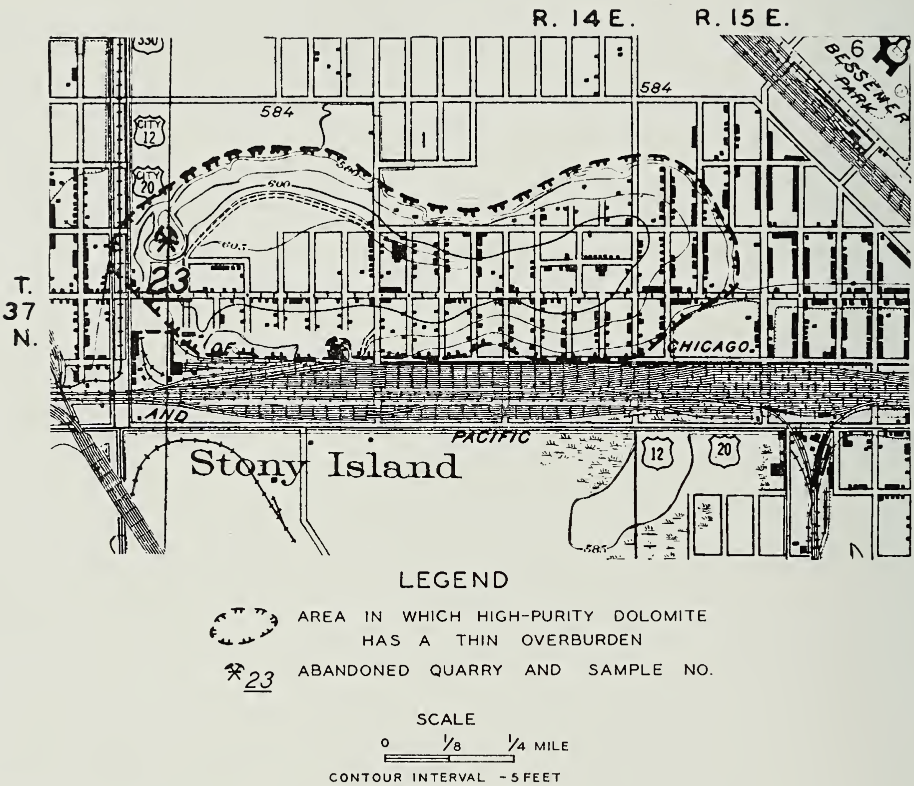

Fig. 16.—High-purity dolomite in the Stony Island area (part of the Calumet Lake quadrangle topographic map).

Character.—In the quarry at the west end of the hill the high-purity dolomite is porous gray to dark gray reef-rock. Many of the pores contain asphaltum. The dolomite occurs mostly in beds 6 inches to 1½ feet thick, which dip about 35 degrees northwest. Some beds are conglomeratic or brecciated, and locally the conglomeratic beds contain a few ½- to 2-inch pebbles of dense fine-grained slightly argillaceous dolomite. A sample (23, table 6) collected from northwest to southeast across all the beds exposed contained 54.16 per cent $CaCO_3$ and 42.46 per cent $MgCO_3$ or a total of 96.62 per cent carbonates. The rock sampled is weathered, and as many of the pores contain some dirt the fresh rock would probably have a higher percentage of carbonates than did the sample tested.

Development possibilities.—Most of the rock hill is occupied by a residential district and is not available for quarrying. However, an area along the north side of the hill extending east from the quarry described to Jeffery Avenue (nearly half a mile) and 500 to 1,000 feet wide, is largely undeveloped. The proximity of an industrial and residential district would presumably restrict blasting, but quarries are operated in more densely populated sections of the Chicago region. The deposit is along the Belt Railroad of Chicago and is closer to many steel mills than any other deposit of high-purity dolomite.

Romeo Area

High-purity dolomite or near high-purity dolomite was produced from three quarries at Romeo from about 1889 to 1916 and used as a blast-furnace flux. The dolomite is the uppermost member of the Joliet formation (p. 27).

Outcrops.—The dolomite is exposed above water in the old quarries, in the banks of the abandoned Illinois and Michigan Canal, and locally in the east bluffs of DesPlaines valley and in the west bluffs, especially in secs. 10 and 15 (fig. 17). Numerous shallow outcrops also occur elsewhere in the valley-bottom.

Thickness.—The Romeo quarries were worked only to a depth of 18 to 20 feet because below that the dolomite contained some chert. As argillaceous dolomite overlies the flux-rock in the bluffs east of the quarries at a level only slightly higher than the quarries, the maximum thickness of the zone is probably not much more than 20 feet. About 22 feet of similar dolomite is exposed in the frontal slope of a terrace which comprises the west bluffs of DesPlaines Valley in the S. ½ of sec. 10.

Overburden.—The dolomite has very little overburden in most of the floor of DesPlaines Valley. The area where the rock is close to the surface is shown in fig. 17. In most of the terrace on the west side of the valley in secs. 3 and 10 the rock has a cover of a few feet of sand and gravel.

Character.—The dolomite exposed in the quarries at Romeo is light gray and fine-grained, has medium to low porosity, is in beds mostly 2 to 6 inches thick, and locally has very thin clay partings along the bedding-planes. It is reported that a little chert was found locally in the quarries but that it was rare. No chert was seen in the strata now exposed but a little chert is locally present in the waste heaps along the Illinois and Michigan Canal. Chert is common in the huge waste piles along the Sanitary and Ship Canal which probably penetrated some of the cherty beds below the high-purity strata.

The dolomite exposed in the west bluffs of the valley near the south side of the area mapped is similar in appearance to the dolomite exposed in the quarries but the rock appears to contain a little more clay along the bedding-planes.

In quarries along the east bluff of DesPlaines Valley in secs. 25 and 35, the high-purity dolomite is overlain by the argillaceous buff-weathering uniformly layered Waukesha dolomite that is quarried for building-stone at Lemont.

Composition.—Two chemical analyses (R-1, R-2, table 6), each reported to be an average of several analyses of rock taken from the flux-rock quarries, show 53.73 and 52.61 per cent $CaCO_3$ and 42.13 and 41.84 per cent $MgCO_3$, or a total of 95.86 and 94.45 per cent carbonates. A sample (17) from 8 feet of dolomite exposed above water in the old flux-rock quarry along the Atchison, Topeka, and Santa Fe Railroad contains 54.80 per cent $CaCO_3$ and 42.54 per cent $MgCO_3$, a total of 97.34 per cent carbonates. A sample (47) representing 5 feet of dolomite above water in the extreme northeast corner of the quarry in NE. ¼ sec. 35 is 98.4 per cent soluble. A sample (48) representing the 22 feet of dolomite exposed in the west bluff of the valley is only 95.9 per cent soluble. As the sample consists of badly weathered rock, the fresh rock probably has a higher percentage soluble but it may not contain 97 per cent carbonates.

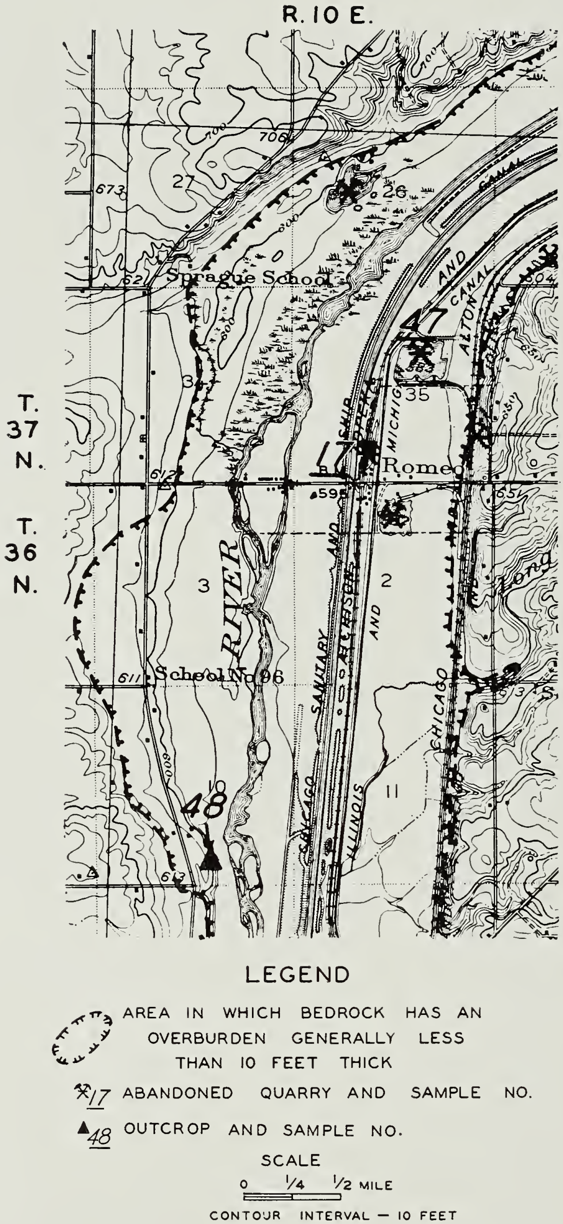

FIG. 17.—High-purity dolomite in the Romeo area (part of the Joliet quadrangle topographic map).

The dolomite in this area is not as high in carbonates as the reef-rock in the Racine dolomite. Chemical analyses and insoluble residues suggest that at best it is only a little over 97 per cent carbonates, and it may be expected to fall below that amount locally wherever there is a slight increase in the amount of chert and clay partings.

Development possibilities.—As the high-purity dolomite exposed in the quarries is nearly flat-lying, it probably underlies most of the valley-floor near the old Romeo quarries. Several hundred acres of undeveloped land with an overburden of only 1 to 2 feet occur in secs. 35 and 2 along the Alton Railroad and separated from the Atchison, Topeka, and Santa Fe Railroad only by the abandoned Illinois and Michigan Canal. The quarries themselves might be pumped out and reopened. It is reported that the quarries were abandoned because the steel mills at Joliet decided to change from dolomite to limestone flux-rock and not because of exhaustion of the same quality rock which had been used for many years.

North of Romeo the high-purity dolomite crops out along the Illinois and Michigan Canal and has a thin overburden continuously to the west side of Lemont (one mile east of the area mapped) where it is overlain by argillaceous dolomite. The high-purity bed is present in the deeper quarries on the northeast side of Lemont but they are now filled with water. There are other possible quarry sites in the valley-floor at Lemont, especially west of Lemont and north of the Sanitary and Ship Canal where the bedrock almost directly underlies a thin soil and the argillaceous dolomite is thin and locally absent.

In the valley-flat south of Romeo the dolomite also has a thin overburden, but the character of the rock is not well known. At Lockport, a short distance south of the area mapped, the high-purity bed occurs below the argillaceous dolomite that is exposed in the valley-floor.

As the high-purity or near high-purity bed is known to contain some chert locally, careful prospecting is desirable.

Hinsdale Area

High-purity Racine dolomite occurs below a thin overburden on the west side of Flag Creek, two miles south of Hinsdale (fig. 18). The dolomite is exposed in a shallow ditch along 71st Street and in small abandoned quarries south of 71st Street and south of U. S. Highway 66. Drilling is needed to prove the presence of a commercial deposit in this area.

Thickness.—Only about 6 feet of dolomite is exposed. The total thickness of high-purity dolomite is not known. As the dolomite exposed is in the lower part of the Racine formation, the high-purity dolomite may not extend much below the base of the outcrops.

Character.—The dolomite is medium-grained, porous, and fossiliferous. Most of the dolomite exposed is weathered light buff. The dolomite is mostly the massive rock found in the cores of the reefs, but at places it is well-bedded. The beds are inclined in various directions, mostly southwest. Chemical analysis of a sample (20, table 6) from the 6 feet of dolomite exposed in a ditch along 71st Street shows the rock is a high-purity dolomite containing 54.67 per cent $CaCO_3$ and 44.14 per cent $MgCO_3$, a total of 98.81 per cent carbonates. It contains only 0.27 per cent SiO_2 and as the sample represents weathered rock the fresh rock may contain even less.

Development possibilities.—The dolomite may be near enough to the surface to be quarried along the west valley-slopes of Flag Creek near the old quarries. The area with a thin overburden is probably not larger than 10 acres but the overburden may average less than 10 feet thick in about 20 acres in the NE. ¼ NE. ¼ sec. 30 and in a tract about as large in the SE. ¼

SE. ¼ sec. 19. The dolomite might also be quarried in the bottomland along Flag Creek. It is reported to have been encountered in ditches near the sewage disposal plant at the north end of the area.

FIG. 18.—High-purity dolomite in the Hinsdale area (part of the Hinsdale quadrangle topographic map.)

The deposit is about two miles north of the Santa Fe Railroad at Willow Springs and about three miles south of the Chicago, Burlington, and Quincy Railroad at Hinsdale. Stone from this deposit could possibly be shipped by barges on the Sanitary and Ship Canal, which is two miles south.

New Lenox Area

A few feet of high-purity dolomite, part of the Racine formation, is exposed along Hickory Creek at New Lenox (fig. 19). Samples of cuttings from wells indicate that the dolomite may be thick enough to warrant development. Areas with thin overburden occur only in the valley-flat.

Thickness.—The greatest thickness of high-purity dolomite exposed is only 5 feet and the total thickness is uncertain. Because the rocks generally dip easterly the high-purity dolomite is probably thicker in the east part of the area than in the west, but variations in thickness may result from local changes in dip and from lateral changes in character. Sample-cuttings show that a well on the north side of Hickory Creek (A, fig. 19) encountered bedrock at a depth of 4 feet and penetrated dolomite which appears to be of high-purity to a depth of 50 feet. Another well on the upland about three quarters of a mile south of Hickory Creek (B, fig. 19) entered bedrock at 58 feet, at a level about 20 feet higher than the outcrops near well A, but did not encounter high-purity dolomite.

Overburden.—The dolomite appears to have an overburden less than 10 feet thick, and mostly less than 5 feet thick, throughout most of the bottomland from the easternmost outcrop along Hickory Creek at New Lenox, northwest for about 1½ miles. East of New Lenox the depth to bedrock is uncertain although at the Chicago, Rock Island, and Pacific Railroad bridge over Hickory Creek, about 1½ miles east of the area, rock is reported to be close to the surface. West of the area the bedrock is more deeply covered and the next outcrops are about two miles down the valley. Below the upland area the dolomite is commonly covered by 25 to 60 feet of glacial deposits.

Character.—In an outcrop at the bridge over Hickory Creek at New Lenox and in an outcrop and small excavation on the south bank about three quarters of a mile northwest of New Lenox, the dolomite is typical porous reef-rock. A sample (26) from 3 feet of the dolomite exposed in the small excavation is 99.4 per cent soluble. In the well on the north side of Hickory Creek (A, fig. 19) the upper 26 feet of dolomite is mostly porous reef-rock. Below that the dolomite is less porous and does not appear to have as high purity as the overlying rock. However, a composite sample representing the entire 46 feet of dolomite is 96.8 per cent soluble. As the insoluble residue shows that the sample contains some surface sand, the entire 46 feet probably averages more than 97 per cent carbonates. The upper 37 feet of dolomite penetrated in the well south of Hickory Creek (B, fig. 19) is compact, very fine-grained, and only 88 to 92 per cent soluble. Below that the dolomite is cherty.

High-purity dolomite is also exposed in the south bank of Hickory Creek north of the house in the SE. ¼ NE. ¼ sec. 17. A sample (79) representing the upper 4 feet of massive porous dolomite was 98.0 per cent soluble, and a sample (78) of the lower 3 feet, which was thinner bedded and a little less porous, was 97.2 per cent soluble. A composite sample (78-79, table 6) from this outcrop contained 54.19 per cent $CaCO_3$ and 42.38 per cent $MgCO_3$, or a total of 96.57 per cent carbonates.

About 400 feet east of the outcrop just described the strata dip 1 to 3 degrees southeast, and the beds represented by samples 78 and 79 are overlain by about 6 feet of thin-bedded slightly porous buff-weathering dolomite. This rock is slightly less pure than the reef-rock and is probably not high-purity dolomite. Unless these beds thin out or change in character laterally, they underlie the high-purity dolomite which is exposed farther east but they would be more than 50 feet deep half a mile east of the outcrop. The dipping strata may be part of a reef structure.

LEGEND

AREA CONTAINING OUTCROPS OF HIGH-PURITY DOLOMITE, OVERBURDEN GENERALLY LESS THAN 10 FEET THICK

▲26 OUTCROP AND SAMPLE NO.

○58 WELL AND DEPTH TO BEDROCK

SCALE

0 1/8 1/4 MILE

CONTOUR INTERVAL – 5 FEET

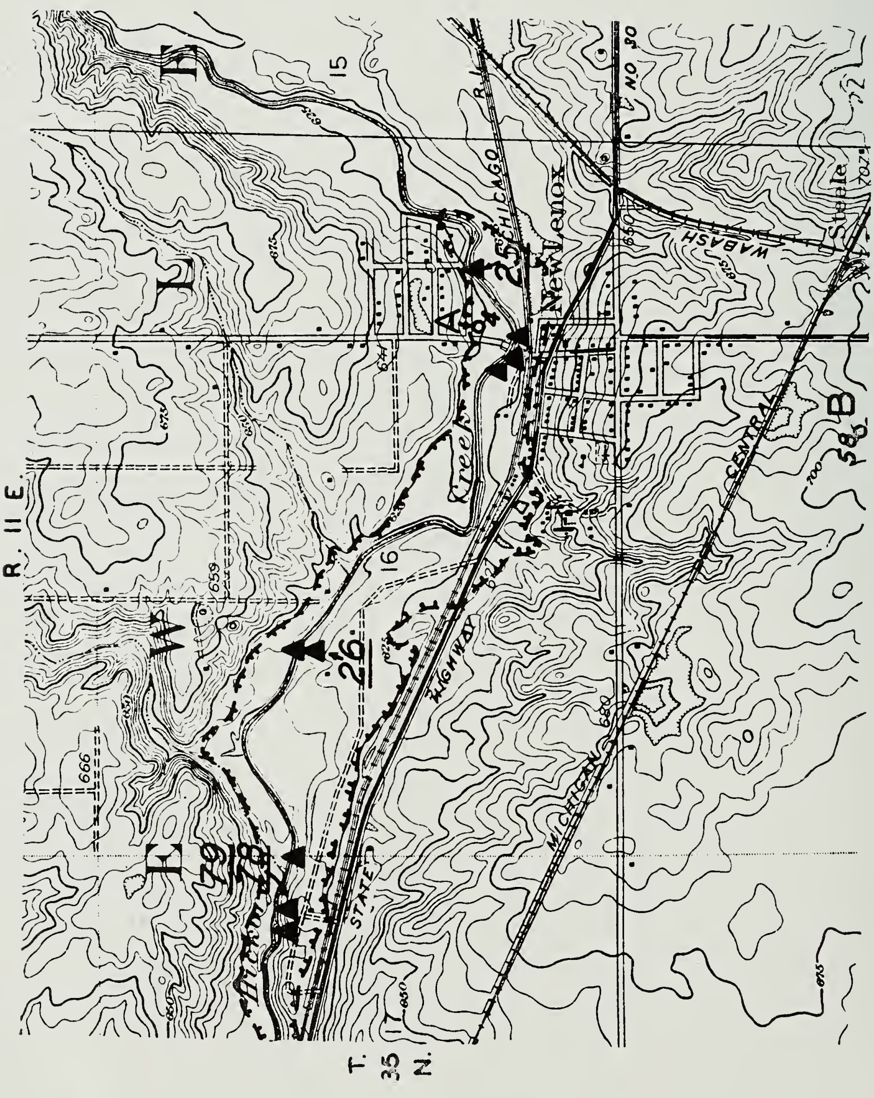

FIG. 19.—High-purity dolomite in the New Lenox area (part of the Mokena quadrangle topographic map).

About a quarter of a mile northeast of the bridge at New Lenox one foot of porous reef-rock overlies 2 feet of fine-grained, dense to slightly porous rock, the base of which is not exposed so its entire thickness is unknown. A sample (25) of the dense rock was only 96.2 per cent soluble, showing that it is not a high-purity dolomite. The strata here have a very slight dip northeast and the dense strata may therefore be found only eastward from the outcrop.

Development possibilities.—The dolomite appears to have a thin overburden in an area of 80 to 100 acres in the terrace between Hickory Creek and the Chicago, Rock Island, and Pacific Railroad west of New Lenox in sec. 16 and the east part of sec. 17. Drilling is necessary to determine whether there is a sufficient thickness of the high-purity dolomite to justify development, especially as some dolomite with less than 97 per cent carbonates is exposed near the west end of the tract and no high-purity dolomite was found in the well south of the valley.

The dolomite may be near enough to the surface to be worked in part of the broad terrace northeast of New Lenox between Hickory Creek and the Wabash and the Chicago, Rock Island, and Pacific railroads. The overburden is probably at least 5 to 10 feet thick in this tract, and it may be thicker. It may include some argillaceous dolomite.

Manhattan Area

High-purity dolomite, part of the Racine formation, is exposed along Jackson Creek, about two miles northwest of Manhattan and eight miles

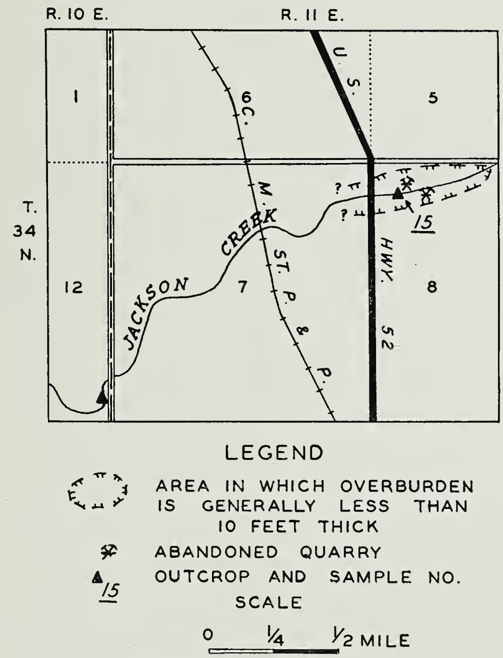

Fig. 20.—High-purity dolomite in the Manhattan area.

southeast of Joliet (fig. 20). Drilling is necessary to determine whether or not the deposit has commercial possibilities.

Outcrops.—The high-purity dolomite is exposed in the bed of Jackson Creek and in very small quarries east of U. S. Highway No. 52. Argillaceous dolomite is exposed about 1½ miles down the valley in the stream bed in the SE. ¼ SE. ¼ sec. 12.

Thickness.—The several small outcrops expose a maximum thickness of about 6 feet of high-purity dolomite. The entire thickness is unknown. Because the regional dip of the strata is to the east, the deposit probably thickens eastward. The argillaceous dolomite exposed down the valley is about 20 feet lower than the high-purity dolomite. The lower outcrop of argillaceous dolomite suggests that there is no great thickness of high-purity dolomite, but it gives little definite information because of the distance between the outcrops, the unknown character of the intervening strata, and the possibility of local variations in dip.

Overburden.—The dolomite has an overburden of pebbly glacial clay which is probably less than 10 feet thick only in the valley-flat and thickens to 20 to 40 feet in the upland areas (fig. 20). Because the surface of the bedrock is known to be undulatory, its depth in the areas where covered by glacial clay is uncertain. However, it may be only a few feet below the bottom of the valley, between Highway No. 52 and the Chicago, Milwaukee, St. Paul, and Pacific Railroad.

Character.—The high-purity dolomite is porous reef-rock and is mostly thin-bedded. The strata locally dip 10 degrees northeast which suggests the presence of a reef.

Composition.—No chemical analyses of the dolomite are available, but a sample (15) collected from relatively fresh dolomite thrown out in the excavation for a pipeline near the paved highway is 99.6 per cent soluble.

Development possibilities.—The exposures of high-purity dolomite are a little more than half a mile east of the Chicago, Milwaukee, St. Paul, and Pacific Railroad. Drilling is necessary to determine whether the high-purity dolomite is thick enough and the area of shallow overburden sufficiently large to justify development. If a preliminary test near the outcrops indicates that the high-purity dolomite is thick enough, the track west of Highway 52 where the valley is broader and near the railroad should be tested.

LaGrange Park Area

Dolomite was formerly produced from two small quarries along Salt Creek at 31st Street northwest of LaGrange Park (fig. 21). In addition an old excavation which may have been a quarry, judging from the numerous blocks of dolomite on its floor, occurs in the sand ridge along the east side of U. S. highway 45 near Salt Creek north of LaGrange Park. The dolomite is not now exposed at any of these quarries, and the two along 31st Street are mostly filled with rubbish. Numerous blocks of rock about the quarries all consist of porous high-purity reef-rock similar to that occurring in the quarries south of LaGrange, about two miles southeast of the 31st street quarries, and also in the Hillside quarry about 2½ miles north. The thickness of the high-purity dolomite is not known.

The surface of the bedrock in this vicinity is known to have a relief of at least 50 feet and it is possible that the old quarries are located in the tops of buried hills that are the only parts of the old bedrock surface sufficiently near the present surface to be quarried. Consequently, drilling is necessary to determine the thickness of both the overburden and the high-purity dolomite at any proposed quarry site. The most favorable areas for prospecting are near the old quarries and north of LaGrange Park along the Indiana Harbor Belt Railroad, in the north part of sec. 28, and the south part of sec. 21, T. 39 N., R. 12 E. The record of one boring near the railroad shows only 10 feet to bedrock.

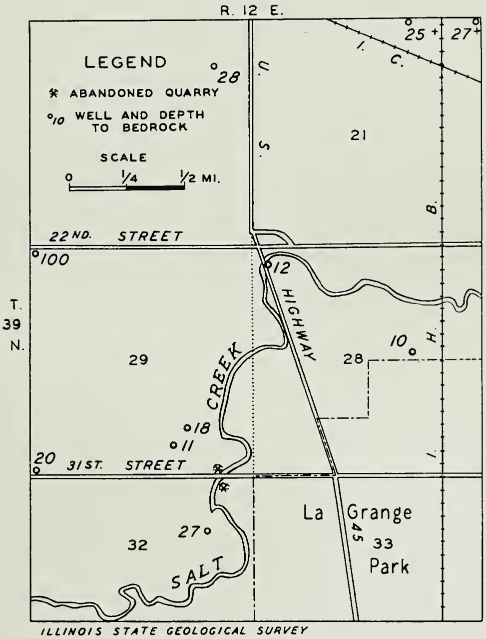

FIG. 21.—High-purity dolomite in the LaGrange Park area.

NAPERVILLE AREA

About 10 feet of high-purity dolomite, part of the Joliet formation, is exposed above water in several abandoned quarries along DuPage River on the southwest side of Naperville[15] (fig. 10). The high-purity dolomite may not be over 10 feet thick, and the area with thin overburden is probably not large.

The dolomite is fine-grained, buff, and porous. It occurs in 2- to 6-inch beds, but the bedding-planes are tight and the rock looks massive on fresh surfaces. It contains no chert or clay-partings. The strata have a slight westerly dip which is contrary to the regional dip and may be local. A sample (19, table 6) representing 7 feet of dolomite exposed on a face where a little stone has been taken out recently at the west end of the west quarry in the SE. ¼ SE. ¼ SW. ¼ sec. 13, T. 38 N., R. 9 E., contains 54.85 per cent $CaCO_3$ and 42.86 per cent $MgCO_3$, a total of 97.71 per cent carbonates. The character of the rock below water is not known, but the strata are probably cherty, as the lowermost 2 feet of rock exposed at the east end of the east quarry contains large chert nodules.

In a narrow terrace near the river the dolomite has an overburden of 2 to 6 feet of gravel, but the overburden increases greatly farther back from the river. Wells in Naperville on the upland encounter bedrock at a depth of about 50 feet. The dolomite may have an overburden thin enough to be stripped in a small area along the valley between the abandoned quarries and the Chicago, Burlington, and Quincy Railroad, but test-drilling is needed to determine this. The dolomite exposed along DuPage Valley a short distance below Naperville, especially near the center of the north line of sec. 30, T. 38 N., R. 10 E., contains clay partings and is not of high-purity.

[15] See plate II in the following report: Trowbridge, A. C., Geology and geography of the Wheaton quadrangle: Illinois Geol. Survey, Bull. 19, 1912.

Frankfort Area

A small abandoned quarry now filled with water occurs along a branch of Hickory Creek about three miles east of Frankfort and 200 yards south of the Elgin, Joliet, and Eastern Railroad (fig. 22). Although the rock in the quarry could not be examined, numerous slabs of rock near it are all porous reef-rock.

A well (A, fig. 22) a short distance north of the railroad, almost due north and about 10 feet higher than the quarry, penetrated reef-rock from 30 to 150 feet, as shown by samples of cuttings. No samples are available for the upper 30 feet, which was probably glacial clay. The reef-rock in the cuttings is porous and mostly white, except for some brown rock in the upper 10 feet and some gray bands at several levels. Small crystals of pyrite are present. Below 150 feet the samples consist of dolomite that is slightly less vesicular, finer-grained, and probably less pure than that above. At a depth of 290 feet, argillaceous dolomite was encountered.

The old quarry may be located in the top of a steep-sided buried hill in which case the area with thin overburden may be small. However, the overburden is probably less than 10 feet thick in the bottom of the valley near the quarry. The bottomland is only about 200 feet wide at the quarry but it widens to about 500 feet both up and down the valley. The overburden is probably 20 to 25 feet thick in a tract of about 10 acres east of the quarry along the south side of the Elgin, Joliet, and Eastern Railroad, but it is probably generally more than 40 feet thick in most of the upland area.

The dolomite may be near enough the surface to be quarried in the bottomland along Hickory Creek between the Elgin, Joliet and Eastern and the Michigan Central railroads. The bottomland is 500 to 1,000 feet wide. A considerable thickness of high-purity dolomite probably underlies this tract, but drilling is necessary to determine its possibilities.

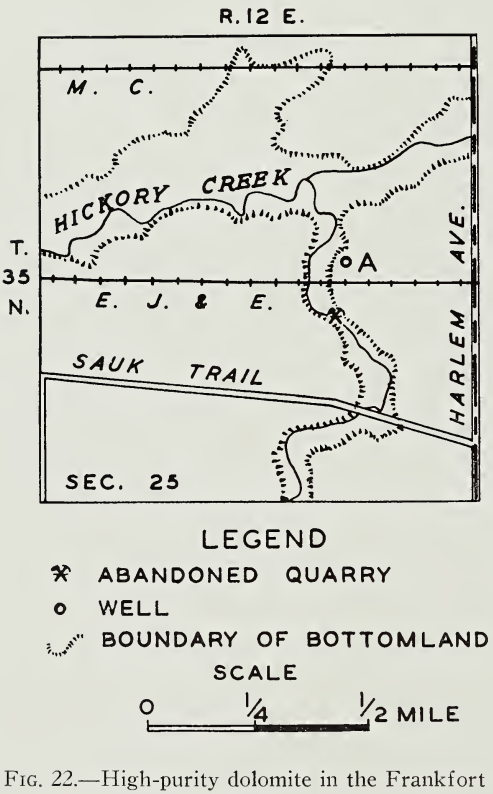

Fig. 22.—High-purity dolomite in the Frankfort area.

Lockport Area

About 20 feet of high-purity dolomite is exposed half a mile south of Lockport, along Fraction Run, in the E. ½ SW. ¼ sec. 26, T. 36 N., R. 10 E. (fig. 10). The dolomite is mostly in 2- to 4-inch beds but contains some 6-inch beds. The strata dip 5 to 10 degrees south and are part of a reef structure. A sample (45) representing 20 feet of weathered rock was 98.2 per cent soluble. The underlying rock, exposed farther down the valley, is cherty and argillaceous. The rock has a thin overburden only in the valley-flat, but there may be as much as 20 acres with an overburden averaging less than 10 feet thick. The area is half a mile east of DesPlaines Valley where transportation is available by the Atchison, Topeka, and Santa Fe and the Alton railroads and the Illinois Waterway.

Lemont Area

Dolomite that is high-purity or very close to high-purity is exposed in two tracts at Lemont (fig. 10). In the north bluff of DesPlaines Valley, in the center of the SE. ¼ sec. 17, T. 37 N., R. 11 E., the upper 15 feet of dolomite is reef-type but it contains some fossils which have been replaced by silica. A sample was 97.7 per cent soluble, indicating it contains about 97 per cent carbonates. The rock has a thin overburden in only an acre or two. Reef-type dolomite is also exposed in the south bluffs and along a tributary valley in Lemont, in the NW. ¼ NE. ¼ sec. 29, T. 37 N., R. 11 E., but has a thick overburden.

Other Areas

Below are briefly mentioned a few outcrops where high-purity dolomite is present or probably present but conditions appear to be unfavorable for quarrying.

Although dolomite is close to the surface at several places in Chicago, most of the quarries that were formerly operated in these areas have been abandoned and filled with rubbish. Because of the high value of the land and because of restrictions about blasting, new quarries will probably not be opened in the city.

Reefs which probably contain high-purity dolomite occur in Lake Michigan, especially near Hyde Park, the South Shore Country Club, and possibly south of Waukegan, and on the shore of Lake Michigan at Rocky Ledge Park. These deposits are mostly submerged and not suitable for quarrying.

About 10 feet of reef-type dolomite is exposed in a small abandoned quarry 1½ miles northeast of Lockport, in the NE. ¼ SE. ¼ SW. ¼ sec. 18, T. 36 N., R. 11 E. The rock appears to be of high purity but it has a thick overburden and the underlying rock contains chert.

About 3 feet of reef-type dolomite is locally exposed along the Illinois and Michigan Canal, one mile southwest of Willow Springs, near the center of the east line SE. ¼ sec. 6, T. 37 N., R. 12 E. Nearby outcrops consist of cherty argillaceous dolomite, and the quantity of reef-type dolomite is uncertain. Possible tracts for quarrying in this vicinity are small, but they are close to both the waterway and to railroads.

Dolomite with reef structure is exposed in an abandoned quarry two miles north of Hinsdale, in SE. ¼ NW. ¼ SW. ¼ sec. 24, T. 39 N., R. 11 E. The 6 feet of dolomite exposed is reef-type but contains thin clay partings, and a sample tested only 96.5 per cent soluble. The underlying rock is now below water but is reported to be cherty. These strata may be marginal to a reef of high-purity dolomite but the tract with thin overburden is probably not large.

All the known areas where high-purity dolomite has a thin overburden have been described, but there may be some undiscovered areas where the rock is near the surface but does not crop out and its presence has not been revealed by wells.

Underground Mining of High-Purity Dolomite

The preceding discussion deals with high-purity dolomite resources available by open-pit mining. Besides these resources, parts of the Chicago region are believed to contain large resources of high-purity dolomite which, because they are deeply buried by other materials, cannot be quarried but may possibly be worked by underground mining. Such deposits merit consideration especially in the immediate vicinity of Chicago where the amount of high-purity dolomite under thin over-burden in some deposits is limited.

Deposits of high-purity dolomite are especially common in the area underlain by the Racine formation (p. 29 and fig. 10), particularly in the upper part of the formation. Studies of the cuttings from many wells indicate that where the Racine formation is more than 100 feet thick it generally contains thicknesses of 25 to 100 feet or more of highly porous dolomite similar in texture to the high-purity dolomite in the outcrops. These porous strata do not necessarily underlie the surface deposits directly but may be overlain in addition by dolomite not of the high-purity variety. They are commonly found at depths of 50 to 100 feet. The porous probably high-purity dolomite appears to be so widespread that exploration will probably reveal unexposed deposits adjacent to industrial areas or railroads at many places.

Test-drilling is needed to determine whether these deposits are suitable for mining. Although the dolomite in the Chicago region is generally water-bearing, the excavation for the large water-supply tunnels for the city did not encounter great flows of water in the rock. In general the formation does not contain sufficient water for wells for industrial uses but in parts of the region it does furnish enough water for small domestic wells. Most of the high-purity dolomite occurs at depths less than those of some of the deep quarries formerly operated in Chicago.

SAVANNA-PORT BYRON REGION

Large deposits of high-purity dolomite, many of exceptional purity, occur in the Niagaran strata of Silurian age in the Savanna-Port Byron region. Many deposits are 50 feet thick, and some may be more than 200 feet thick. In several 40- to 160-acre tracts the dolomite has less than 5 feet of overburden. Some of the deposits contain several million tons of dolomite and are located along railroads and near Mississippi River. In addition many deposits are suitable for moderate- or small-scale development.

For this report the Savanna-Port Byron region is defined as that part of Northwestern Illinois in which the Niagaran strata crop out and contain deposits of high-purity dolomite. The principal deposits occur along Mississippi Valley from near Savanna to Port Byron and eastward to Mt. Carroll and Morrison.

The Niagaran strata comprise the major part of the Silurian rocks whose distribution in the Savanna-Port Byron region is shown in figure 23. A few areas of Silurian rocks also occur north of the region but are not known to contain high-purity dolomite. The Silurian rocks continue south and southeast of the region, but they are deeply buried by sand and gravel for several miles southeast of Rock River, and farther south they are overlain by younger bedrock formations, as they are south of Port Byron in the southwest corner of the region.

In the north part of the region, deposits of high-purity dolomite in the Galena-Platteville formations of Ordovician age occur along some of the deeper valleys which cut down through the Silurian deposits. The Galena-Platteville deposits differ in character from the Silurian deposits and are considered under the discussion of the Rockford region which for this report is defined to include all the Galena-Platteville deposits in northern Illinois.

Present Industry

A quarry operated by the U. S. Gypsum Company in a deposit of high-purity dolomite one mile south of Cordova on the Chicago, Milwaukee, St. Paul, and Pacific Railroad produces dolomite for making lime and for agricultural limestone and road-stone. High-purity dolomite is also crushed for agricultural limestone and road-stone at several other quarries which have portable equipment and are operated more or less intermittently. Quarries recently active are located about 2½ miles north of Mt. Carroll, three miles east of Fulton, at Morrison, and three miles north of Hillsdale. The locations of numerous small quarries are shown in figures 26-30.

Descriptions of Formations

The Niagaran strata consist of four formations as follows:[16]

Port Byron (youngest)
Racine
Waukesha
Joliet (oldest)

The Waukesha, Racine, and Port Byron formations consist principally of high-purity dolomite. The dolomite in the Joliet formation is mostly not high-purity, but locally the upper 5 to 10 feet is near or slightly over 97 per cent carbonates.

Many excellent exposures of these formations occur in the Mississippi Valley bluffs, as shown in a diagrammatic cross-section (fig. 24).

[16] Savage, T. E., Silurian rocks of Illinois: Bull. Geol. Soc. Am., vol. 37, pp. 526-532, 1926.

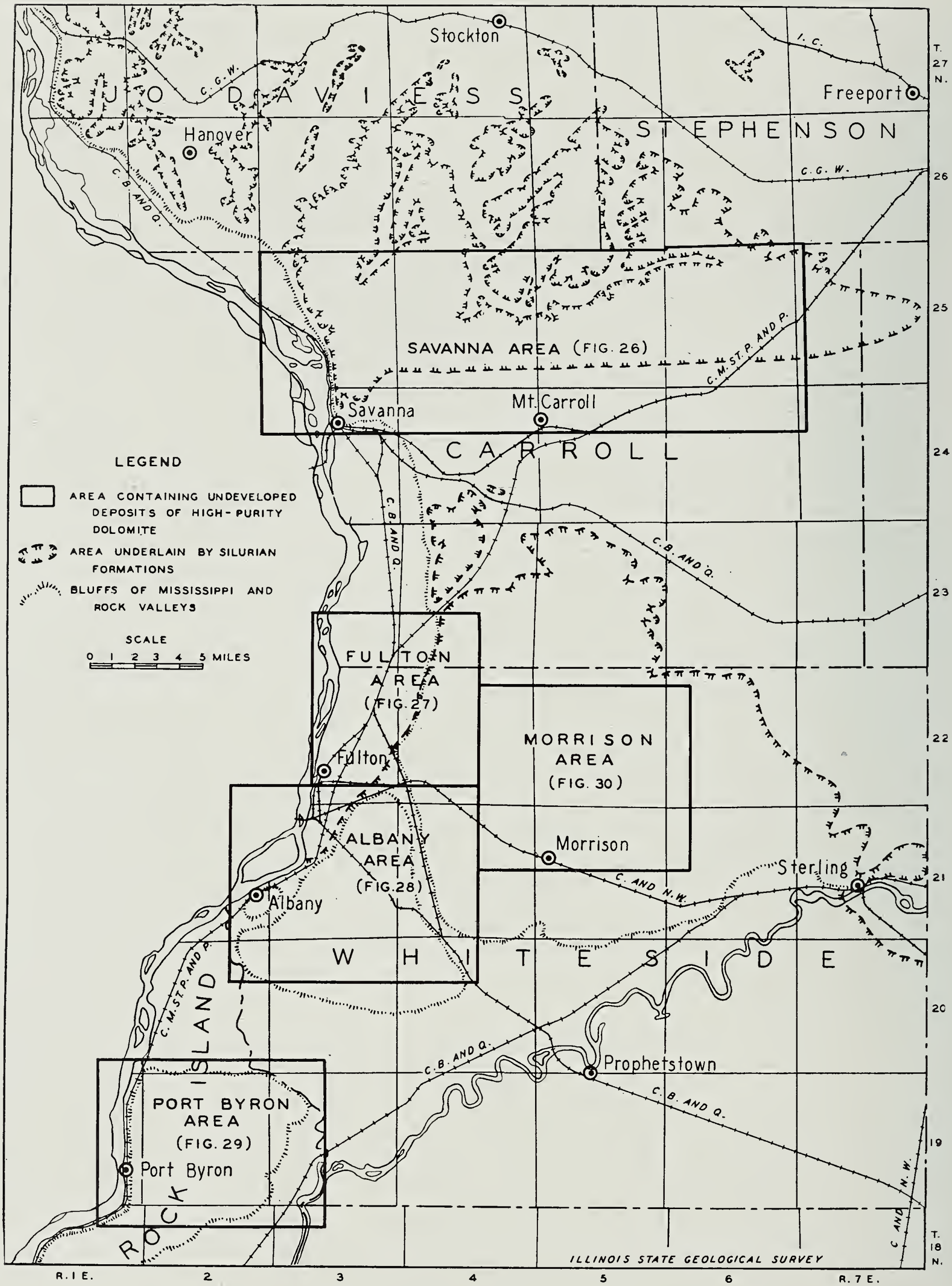

Fig. 23.—The Savanna-Port Byron region—showing the areas containing undeveloped deposits of high-purity dolomite and the area underlain by Silurian formations.

Joliet Formation

Character.—The Joliet formation consists largely of brownish-gray slightly porous fine-grained dolomite, 45 to 55 feet thick. It occurs in 1- to 4-inch well-defined beds with wavy bedding-planes. The beds are commonly separated by thin lenticular partings of green clay. In the upper 10 to 20 feet the bedding-planes are less distinct, so that the dolomite appears massive on fresh surfaces although it weathers thin-bedded. Large coral colonies are common, and in places the corals and other fossils are silicified. The clay partings and silicified fossils are more abundant in the lower part of the formation than at the top. A little chert is present locally. The formation is differentiated from the underlying Kankakee formation by the abundance of chert in the latter.

Composition.—Solubility tests of samples from beds in the Joliet formation indicate the total carbonates commonly vary from 85 to 95 percent, but some silicified beds in the lower part are less pure, and in places the upper 5 to 10 feet of the formation is more pure, probably exceeding 97 per cent carbonates.

Distribution.—The Joliet formation is well exposed in the Mississippi Valley bluffs in Mississippi Palisades State Park north of Savanna and both north and south of Johnson Creek east of Thomson, at many places along Plum River from Savanna to Keltner, and in southern Jo Daviess County.

Correlation.—The Joliet formation in northwestern Illinois is much different in lithology from the Joliet formation in northeastern Illinois and the correlation between the two areas is based on fossils.[17] The Joliet strata in northwestern Illinois are similar in appearance to the strata in the upper part of the Kankakee formation in northeastern Illinois.

Waukesha Formation

Thickness.—The Waukesha formation is about 50 feet thick in Mississippi Palisades State Park where its contacts with both the underlying Joliet formation and overlying Racine formation are exposed. Near Fulton the formation is at least 40 feet thick but the entire thickness is not revealed by the outcrops.

Character.—The Waukesha formation consists of buff highly porous high-purity dolomite, mostly in massive ledges from 5 to 20 feet thick (fig. 25). Although a relatively soft rock on fresh surfaces, it hardens on weathering. The Waukesha dolomite is more uniform in composition and physical characteristics than the other Niagaran formations. No impure beds, such as those which occasionally occur in the higher reef-bearing strata, have been observed.

The lower 5 to 15 feet of the formation is often referred to as the *Pentamerus* zone because it is composed of fossils of a bi-valve named *Pentamerus.* The fossils resemble modern clams. Many of the fossils are 2 to 4 inches long.

Although the upper part of the underlying Joliet formation is similar in appearance to the Waukesha formation, the contact can usually be determined because of the abundance of the fossil *Pentamerus* in the basal Waukesha and of corals in the Joliet. Also the Joliet is more grayish and less porous and weathers thin-bedded. Commonly 5 to 10 feet of strata at the contact is transitional in character, and where the *Pentamerus* zone is not well developed, as in the quarries in the northwest part of Fulton, exact location of the contact is difficult.

The contact of the Waukesha formation with the overlying Racine formation is placed at the top of the massive buff uniformly porous dolomite, or about 50 feet above the base of the *Pentamerus* zone. Where the contact is exposed in a quarry in the south part of Mississippi Palisades State Park north of Savanna, the basal beds of the Racine formation are brecciated, are 6 inches to 2 feet thick, and are separated from the Waukesha by a

[17] Savage, T. E., 1926 citation, p. 529.

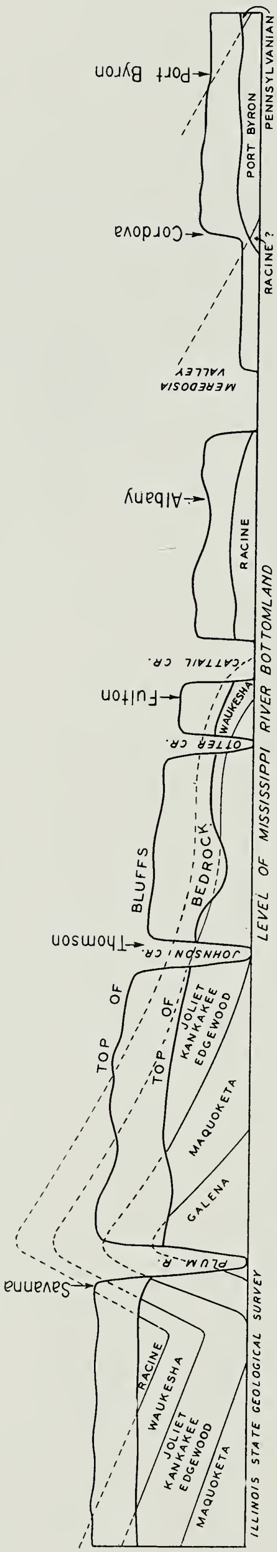

FIG. 24.—Diagrammatic cross-section of strata exposed in the Mississippi River bluffs in the Savanna-Port Byron region.

thin shale parting. The change in lithology is gradational, as the uppermost 5 to 10 feet of the Waukesha strata are not as massive as the lower beds.

Distribution.—The Waukesha formation is well exposed at many places in the Savanna, Fulton, and Morrison areas, described later. Many excellent exposures occur in Mississippi Palisades State Park north of Savanna.

Fig. 25.—Exposure of high-purity Waukesha dolomite showing its massive character.

Correlation.—Correlation of these beds with the Waukesha formation in northeastern Illinois is based on fossils.[18] Although typical exposures of the strata included in the Waukesha have been described, none record its contact with the Racine formation, and none record the total thickness of strata included in the Waukesha. The contact between the Waukesha and Racine formations, as used in this report, is arbitrarily placed at the position of a slight change in the physical character of the dolomite. Studies of fossils may reveal some other horizon which will correlate more accurately with that in northeastern Illinois.

The rock included in the Waukesha is totally unlike the Waukesha in northeastern Illinois which is thin-bedded, impure, and cherty. It is similar in appearance to some of the basal Racine beds in the Kankakee area, and except for its uniform buff color it is not greatly different from the massive dolomite which comprises the cores of reefs in the Racine formation in both northeastern and northwestern Illinois.[19]

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[18] Savage, T. E., 1926 citation, p. 529.

[19] The name Cordova has been suggested recently to replace the name Waukesha in northwestern Illinois. Savage, T. E., in Correlation of the Silurian formations of North America: Bull. Geol. Soc. Am., vol. 53, p. 537, 1942. The name was selected for the strata exposed in the quarry of the U. S. Gypsum Company, 1½ miles south of Cordova. This is the type locality for the Port Byron formation in northwestern Illinois, and the strata exposed are much higher in the Niagaran than the strata called Waukesha in previous publications and in this report.

Racine Formation

Thickness.—The total thickness of the Racine formation is uncertain because outcrops of the top and bottom strata are widely separated. The thickness of the formation can be estimated from the record of a well one mile southwest of Albany, at the pumping station in the SE. ¼ sec. 34, T. 20 N., R. 2 E. The well reached the base of the Silurian strata about 385 feet below the top of the Racine outcrops at Albany. If the Silurian strata below the Racine formation are about 160 feet thick at Albany as they are in the Savanna area, the Racine is about 225 feet thick. Because of the southerly dip the strata may be a little lower at the well than at the outcrops at Albany, so that an estimate of 200 feet of Racine strata at Albany is probably conservative. As the top of the formation is not exposed at Albany, this is not the complete thickness of the Racine strata. Strata thought to be at or very near the top of the formation are exposed in a quarry on the south edge of Cordova (p. 58). The thickness of the Silurian strata at Cordova is not known, but the base of the Silurian rocks is probably at least 50 feet lower than at Albany because of the southwesterly dip of the beds. Therefore, the total thickness of the Racine formation may be about 250 feet.

The greatest exposed thickness of the Racine formation is at Bob Upton's cave in Mississippi Palisades State Park where 80 feet of dolomite overlying the Waukesha strata are thought to be part of the Racine formation.

Character.—The Racine formation appears to be predominately high-purity dolomite. It is fine- to medium-grained and gray or locally mottled dark gray and weathers light gray. The pores in the rock near the outcrops are usually stained brown with iron oxide. Porosity varies from bed to bed; many beds have high porosity but others have medium or low porosity. The bedding varies from massive to thin-bedded. In places massive 3- to 5-foot ledges are interlayered with 2- to 6-inch beds. Although the bedding is mostly horizontal, it is steeply inclined in places, forming reefs like those in the Chicago region (p. 29). Argillaceous dolomite crops out at a few places but is absent in tracts of considerable size.

Composition.—Much of the dolomite in the Racine formation is of exceptional purity. The analyses (63, H-1, K-1, table 6) show an especially low silica content (0.10 in two samples). The samples analysed are all of weathered dolomite from quarries long idle, and the fresh rock may be even more pure. Dolomite containing more than 99 per cent carbonates can probably be produced from some of the Racine deposits.

Distribution.—The Racine formation is exposed along Mississippi Valley in the bluffs in Mississippi Palisades State Park north of Savanna, where it is present as a result of a downfold in the bedrock (fig. 24). It is absent from Savanna to Fulton but occurs in the bluffs about two miles southwest of Fulton, and all the dolomite outcrops from there south to Cordova are thought to belong to the Racine formation. The strata in a quarry on the south edge of Cordova, in the NW. ¼ SW. ¼ sec. 31, T. 20 N., R. 2 E., are thought to be Racine as they contain fossils which are more common in the Racine than the overlying Port Byron. If so, this is the southernmost outcrop of the Racine; the strata about one mile south in the quarry of the U. S. Gypsum Company in the SW. ¼ NE. ¼ sec. 1, T. 19 N., R. 1 E., are considered to belong to the Port Byron formation. Good exposures occur in the bluffs both north and south of Albany. East of Mississippi Valley good outcrops occur along the west side of Cattail Valley north of Fenton, and along Rock Creek near Morrison.

Correlation.—The correlation of the Racine strata in northwestern Illinois with those in northeastern Illinois is based on fossils.[20] The strata are also similar in lithology.

[20] Savage, T. E., Silurian rocks of Illinois: Bull. Geol. Soc. Am., vol. 57, p. 521, 1926.

Port Byron Formation

Thickness.—Wells at Watertown and Cleveland a short distance south of the Port Byron area show that the southerly dip of the strata continues and the Silurian rocks are probably 450, possibly 475, feet thick at the outcrops of the Port Byron formation on the south side of Port Byron. Of these, the upper 50 to 75 feet comprise the Port Byron formation. At Hillsdale the Port Byron formation is probably only a little thinner than at Port Byron.

Character.—The Port Byron formation is similar in lithology to the underlying Racine. It consists of high-purity dolomite, well-bedded in some places, massive in others. Reefs are common. No beds of argillaceous dolomite were found but clay pockets occur locally.

Composition.—The Port Byron dolomite probably has about the same chemical composition as the Racine dolomite as it is similar in appearance and character. One analysis (286, table 6) of Port Byron dolomite shows 98.48 per cent total carbonates.

Distribution.—The Port Byron formation is exposed in the Mississippi River bluffs near Port Byron, in Rock River Valley near Hillsdale, and in the bluffs facing Meredosia Valley north of Hillsdale. With the possible exception of the quarry on the south edge of Cordova, which may be of Racine age, all the dolomite exposed in the Port Byron area is thought to belong to the Port Byron formation. The strata exposed on the south side of Port Byron appear to be the uppermost Silurian in this region, because a short distance south they are overlain by younger Devonian and Pennsylvanian strata.

Correlation.—The formation is named for the town of Port Byron where it is well exposed.[21] There is no lithologic basis for separating the Racine from the Port Byron formation and the exact position of the contact has not been determined.[22] The Port Byron strata have been placed in a separate formation because they contain certain fossils, especially large cephalopods, which have not been found in the Racine.

Pre-Niagaran Strata

Beneath the Niagaran strata lie still other dolomite strata of Silurian age. These are called the Alexandrian series and they have been divided into two formations. The basal Edgewood formation consist of highly argillaceous dolomite, commonly 5 to 25 feet thick but locally as much as 75 feet thick. The overlying Kankakee formation is thin-bedded cherty dolomite, 25 to 50 feet thick. No workable beds of high-purity dolomite have been found in these formations.

Undeveloped Deposits

Many undeveloped deposits of high-purity dolomite occur in the Savanna-Port Byron region. They are described in the following areas, the locations of which are shown in figure 23.

Savanna Area

In the Savanna area high-purity dolomite occurs in an elongate area which extends north from Savanna about 5 miles and eastward from the Mississippi Valley bluffs about 20 miles (fig. 26). This distribution results from the occurrence of the high-purity dolomite in the center or trough of a downfold, called a syncline, the axis of which extends east-west across the area about three-quarters of a mile north of the Mississippi River bridge at Savanna (fig. 24). On the south flank of the syncline the beds dip 5 to 10 degrees north but on the north flank they dip south at a low angle, generally less than 1 degree. Small

[21] Savage, T. E., Silurian rocks of Illinois: Bull. Geol. Soc. Am., vol. 37, p. 531, 1926.

[22] It has been suggested recently that the name Port Byron be expanded to include both the Racine and Port Byron formations in northwestern Illinois. Savage, T. E., in Correlation of the Silurian formations of North America: Bull. Geol. Soc. Am., vol. 53, chart 3, p. 538, 1942.

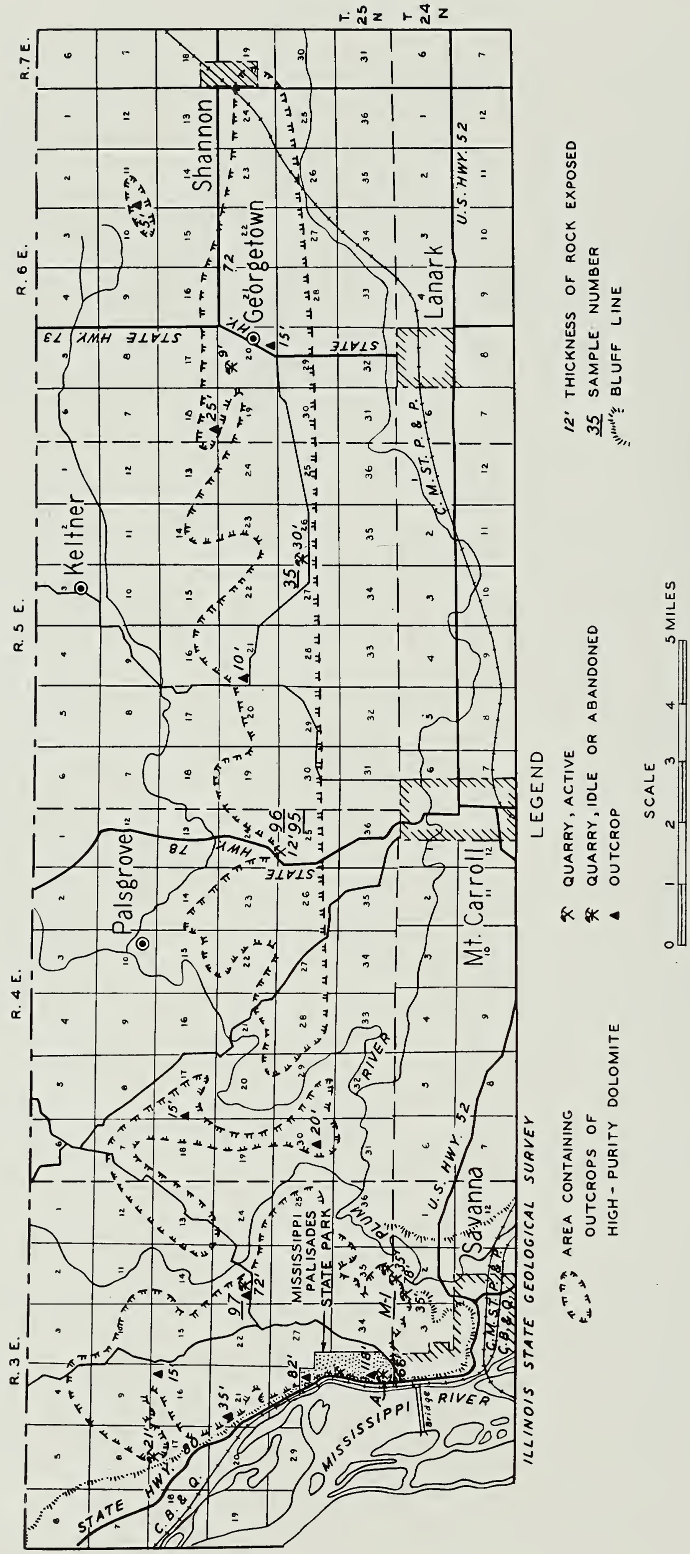


Fig. 26.—High-purity dolomite in the Savanna area.

faults are present in several places and there are local indications of major faults both parallel to and crossing the syncline.

The high-purity dolomite is the youngest bedrock formation in the area and lies immediately beneath the surficial materials. Many valleys cut through the high-purity dolomite and expose the underlying less pure rock. The high-purity dolomite consists of the Waukesha formation and the overlying Racine formation. Both Racine and Waukesha dolmites occur in an area about three miles wide north of the Mississippi River bridge at Savanna and eastward about three miles, but only the Waukesha dolomite occurs throughout the remainder of the region.

Outcrops.—Outcrops are scarce in much of the area because of a thick cover of brown silt (loess). However, in the Mississippi Valley bluffs outcrops are almost continuous, and many good exposures occur along the trails in Mississippi Palisades State Park. Relatively fresh dolomite is exposed in the abandoned quarry near the south end of the park, about half a mile north of the bridge across Mississippi River (A, fig. 26). East of the Mississippi Valley bluffs the high-purity dolomite is exposed in several quarries and in bluffs along the streams. The locations of a few typical exposures are shown in figure 26.

Thickness.—The greatest thickness of the high-purity dolomite is in the Mississippi Valley bluffs near Bob Upton's cave in Mississippi Palisades State Park, where 120 feet of high-purity dolomite is exposed at the axis of the syncline. Because the strata in the syncline have been truncated by erosion, the dolomite thins rapidly and is absent only half a mile south of the axis, but to the north it thins more gradually and is present for about four miles. About 1½ miles north of the axis at the north end of the park the dolomite is about 80 feet thick, two miles farther north it is only 35 feet thick, and a mile still farther north it is only 20 feet thick.

East of the Mississippi Valley bluffs about 80 feet of high-purity dolomite is exposed in a knoll on the northwest side of Plum River, near the center of the north line of sec. 2, T. 24 N., R. 3 E. Farther east the high-purity dolomite is generally thinner but at several places 25 to 30 feet is exposed without revealing the entire thickness present. The lower 50 feet of the high-purity dolomite comprises the Waukesha formation. The overlying Racine dolomite has a maximum thickness of about 70 feet. Where the high-purity dolomite is less than 50 feet thick it is all Waukesha.

Variations in thickness result from local folding of the rock strata and erosion of the upper surface of the formations. Generally the topography of the area, especially that part west of Georgetown, is rugged. Many of the deeper valleys cut completely through the high-purity dolomite, even along the axis of the syncline.

Overburden.—From the Mississippi Valley bluffs east to near State Highway 78 north of Mt. Carroll, the high-purity dolomite has an overburden of wind-deposited brown sandy silt or clayey silt, called loess. East of there the overburden also contains pebbly glacial clay (till) at many places. Although the loess is deeply eroded by small valleys so that its thickness varies greatly, it is generally thickest near the bluffs and thins eastward. In the bluffs it is commonly 20 to 35 feet thick, and it is probably somewhat thicker below the higher ridges ½ to 1½ miles east of the bluffs. Most of the higher ridges as far east as Mt. Carroll have 10 to 15 feet of loess and the slopes and bottoms of many valleys are also covered with loess. The bedrock has a thin overburden only in a narrow zone close to the bluffs and along some of the tributary valleys. Above the almost vertical bedrock cliffs in the bluffs, the loess forms less precipitous although steep slopes. Along the higher ridges northeast of Mt. Carroll the bedrock is commonly too deep to be quarried because of both loess and glacial clay, but the overburden is thinner along some slopes and in the valleys.

Character.—The high-purity dolomite consists of the massive porous buff Waukesha dolomite (p. 55) at the base overlain by the well-bedded gray to brown Racine dolomite (p. 58) which locally contains reefs. Where eroded by streams the high-purity dolomite forms high cliffs, but where deeply weathered it changes to a slightly consolidated rock that can be pulverized in the fingers, and some beds change to a loose sand consisting of dolomite grains. A few thin beds of slightly argillaceous dolomite are present locally but are not common and are not sufficiently abundant in any deposit studied to exclude it from the high-purity classification.

Composition.—Some of the strata in these formations contain more than 99 per cent carbonates, but the relatively high amount of iron oxide generally reduces the total carbonates below 99 per cent. The amount of iron oxide probably decreases back from the outcrops but the Waukesha dolomite is distinctly buff-colored even in quarry faces 50 feet back from the outcrops. The rock is comparatively low in silica and alumina.

A sample (M-1, fig. 26, table 6) representing 35 feet of Racine dolomite in an abandoned quarry, the face of which is only a few feet back from the natural outcrop, 1½ miles northeast of Savanna, contains 55.39 per cent $CaCO_3$ and 42.63 per cent $MgCO_3$, a total of 98.02 per cent carbonates. The silica content is only 0.16 per cent but the iron oxide is abnormally high, 1.37 per cent. A sample (35) representing 30 feet of comparatively fresh Waukesha dolomite in a quarry about 4 miles northeast of Mt. Carroll contains 98.08 per cent carbonates of which 54.66 per cent is $CaCO_3$ and 43.42 per cent $MgCO_3$.

The composition of the lower part of the Waukesha dolomite is shown by the solubility tests of samples representing the basal 66 feet of the formation in a quarry in Mississippi Palisades State Park, in the NE. ¼ SE. ¼ sec. 33, T. 25 N., R. 3 E. (A, fig. 26). Results of the tests follow (sample 16 at base):

Sample No.	Thickness Represented *ft.*	*in.*	Soluble *per cent*
44	4	6	98.0
43	1		98.0
42	2	6	98.9
41	2	2	97.8
40	2		98.8
39	2	2	96.8
38	1	8	97.8
37	2	10	98.3
35	1	10	98.5
34	2	2	98.0
33	2	4	98.4
32	3		98.3
31	3		97.3
30	2	6	99.6
29	2	4	99.3
28	2	4	99.1
27	1	6	99.5
26	1	8	99.2
25	3		99.2
24	3	8	99.8
23	2	8	99.4
22	1	10	99.5
21	2	2	99.3
20	2	4	99.6
19	2		99.2
18	1		98.8
17	3	2	99.2
16	2	2	98.8
Total	65	6	Av. 98.7

A sample (97) representing the basal 17 feet of the Waukesha formation in a quarry 2½ miles northeast of Savanna, in the SW. ¼ NW. ¼ sec. 23, T. 25 N., R. 3 E., was 98.8 per cent soluble. Scattered outcrops higher on the slope show the high-purity dolomite is probably about 70 feet thick in this vicinity. The upper 20 feet of the underlying Joliet formation at this place is similar in appearance to the Waukesha but contains some thin clay partings and a few silicified corals, probably in sufficient abundance to exclude it from the high-purity class.

A sample (96) representing the basal 12 feet of the Waukesha formation exposed at the top of a quarry 2½ miles north of Mt. Carroll along State Highway 78, in NE. ¼ NW. ¼ sec. 25, T. 25 N., R. 4 E., was 99.6 per cent soluble. In the same quarry the lower 13 feet consists of the upper part of the Joliet dolomite which contains a few thin clay partings. As a sample (95) was 97.5 per cent soluble, the upper Joliet strata are probably not quite high enough in carbonates to be considered high-purity dolomite.

Development possibilities.—The high-purity dolomite occurs near the Chicago, Burlington, and Quincy Railroad along the Mississippi Valley bluffs. The dolomite is thickest in Mississippi Palisades State Park but is presumably not available for quarrying. However, the formation is 75 feet or more thick at the north end of the park and it could possibly be quarried along the top of the bluffs in sections 16, 17, 21 and 28, T. 25 N., R. 3 E. Farther north the high-purity dolomite is thin and it is also more distant from the railroad. The overburden thickens back from the outcrops in the bluffs, and only a narrow zone along the bluffs has a thin overburden. The most favorable sites for quarries are probably at the mouths of small tributary valleys where the loess has been partly eroded. The loess is unconsolidated and could possibly be removed hydraulically if water is available from Mississippi River nearby. The dolomite is thick enough to be mined underground, leaving part of the rock for a roof.

The remainder of the area contains many tracts where the high-purity dolomite could be quarried but most of them are not near a railroad. The high-purity dolomite exposed along Plum River northeast of Savanna is 1 to 1½ miles north of the Chicago, Milwaukee, St. Paul, and Pacific Railroad. The dolomite may locally be shallow enough to be quarried along the same railroad near Shannon (fig. 26). The bedrock is only 8 to 10 feet deep in some wells in Shannon, but the high-purity dolomite is probably comparatively thin in that vicinity. The dolomite is also available at outcrops along State Highway 78 north of Mt. Carroll and State Highways 72 and 73 north of Lanark.

Fulton Area

The Fulton area (fig. 27) contains numerous deposits of high-purity dolomite some of which have been quarried for agricultural limestone, road-stone, and building stone. A quarry operated by Alldritt Brothers, three miles east of Fulton, produces agricultural limestone and road-stone but most of the quarries in the area are idle or abandoned. The high-purity strata in the Fulton area are mostly in the Waukesha formation but some of the uppermost Joliet strata may be of high purity, and some of the southernmost outcrops in the Mississippi Valley bluffs may be part of the Racine formation.

Outcrops.—High-purity dolomite is exposed at many places in the Mississippi Valley bluffs and along some of the steep valleys and ravines which dissect the upland areas. Southeast of Thomson, high-purity dolomite occurs only at the top of the bluffs but because of the southward dip of the strata, south of Otter Creek it comprises all the bedrock that is exposed (fig. 24). The locations of typical exposures are shown in figure 27. At Fulton the high-purity dolomite is exposed in quarries and outcrops around the edge of the hill on which the town is located. The freshest exposures of the dolomite are in quarries in the bluffs three miles east of Fulton.

Thickness.—In the Mississippi Valley bluffs north of Otter Creek the high-purity dolomite is nearly flat-lying and forms the upper 10 to 20 feet of the bedrock, except where it has been eroded along deep ravines. South of Otter Creek the strata dip southward, and as a result the thickness of the

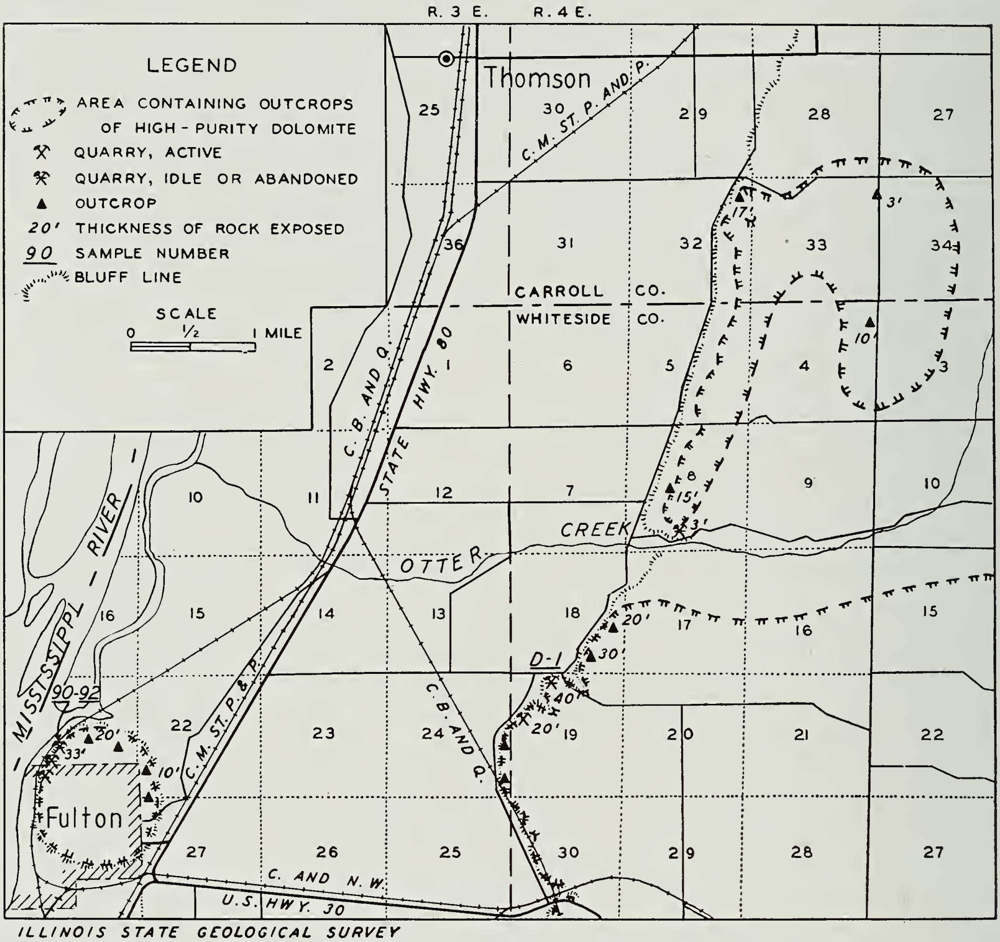


FIG. 27.—High-purity dolomite in the Fulton area.

high-purity dolomite increases. The base of the high-purity formation lowers from the upper part of the bluffs to the level of the valley-floor in about a mile, and 40 to 50 feet of high-purity dolomite is exposed in a quarry in the NW. ¼ NE. ¼ NW. ¼ sec. 19, T. 22 N., R. 4 E. At this quarry the base of the high-purity dolomite is probably 15 feet or more below the base of the strata exposed.

At Fulton about 35 feet of high-purity dolomite occurs along the west side of the hill near Mississippi River, but along the north and east sides the dolomite is thinner, varying from 10 to 20 feet thick. About 10 feet of the underlying Joliet dolomite, although slightly less pure than the higher stone, may also be high-purity dolomite.

Overburden.—The bedrock has a thick overburden throughout most of the area except in a narrow zone along the bluffs and in the bottoms of some valleys. The overburden consists of brown clayey silt (loess) or of loess and pebbly clay (till) on the higher ridges, and loess and sand in the Mississippi Valley bluffs. The upper 50 feet of the bluffs is commonly loess and sand, and locally north of Otter Creek almost the entire bluff consists of sand.

The dolomite exposed in the bluffs in the S. ½ SE. ¼ sec. 18, T. 22 N., R. 4 E., has an overburden of loess 15 to 30 feet thick. However, along the top of the bluffs the loess occurs in steep-sloping ridges or hills 50 to 100 yards wide, and east of the ridges the ground surface is much lower. Consequently, if the top of the bedrock maintains the same level as in the bluffs, a tract of 20 to 40 acres may have an overburden less than 10 feet thick.

In the upland area east of the bluffs the high-purity dolomite is locally exposed in road-cuts, especially along the road between secs. 3 and 4, T. 22 N., R. 4 E. There may be tracts in this area where the overburden will average less than 10 feet thick.

The upper 15 to 30 feet of the hill at Fulton consists of loess except locally around the margin of the hill where the loess has been eroded.

Character.—The Waukesha dolomite in the Fulton area is similar in character to that found in the Savanna area. It consists of porous buff dolomite which occurs in massive ledges 5 to 10 feet thick. Some ledges have poorly developed bedding-planes which are not recognizable on fresh surfaces but develop into reentrants on weathered surfaces.

Composition.—The high-purity of some of the dolomite in this area is shown by the analyses of a sample (D-1, fig. 27, table 6) from 40 feet of dolomite freshly exposed in a quarry three miles east of Fulton. This sample contains 99.31 per cent carbonates of which 56.83 per cent is $CaCO_3$ and 42.48 per cent is $MgCO_3$. Solubility tests of samples from a quarry near the northwest corner of Fulton, in the SW. cor. sec. 21, T. 22 N., R. 3 E., show that the upper 33 feet, which is Waukesha dolomite, is of high purity. The upper 25 feet (92) is 99.8 per cent soluble, and the lower 8 feet (91) is 98.8 per cent soluble. Below the Waukesha dolomite in the same quarry the upper 9 feet of the Joliet formation (90) is 97.8 per cent soluble and may also be high-purity dolomite. Below that, 5 feet more of Joliet strata are exposed, but they contain green clay partings and silicified corals in sufficient abundance to reduce the carbonate content to less than 97 per cent.

Development possibilities.—Although the Fulton area contains a large quantity of high-purity dolomite, most of the deposits appear to have a thick overburden except in small tracts near the outcrops. Areas of 5 to 10 acres of dolomite with an overburden averaging less than 10 feet thick can probably be found at the outcrops in the bluffs. The more favorable areas are in the bluffs extending northeast from the Chicago, Burlington, and Quincy Railroad for 1½ miles, especially near the railroad in the SE. ¼ sec. 24, T. 22 N., R. 3 E., where the high-purity dolomite is more than 40 feet thick and removal of a heavy overburden might be economically possible. As the high-purity formation is thick it could be mined underground, leaving part for a roof.

The high-purity dolomite might also be quarried along the north side of the hill at Fulton near the Chicago, Burlington, and Quincy Railroad, but it is doubtful if more than 10 acres of dolomite 20 to 30 feet thick can be found with an overburden averaging less than 10 feet thick. The overburden appears to be thinner on the east side of the hill about one-fourth mile west of the Chicago, Milwaukee, St. Paul, and Pacific Railroad. The high-purity dolomite may not be more than 10 feet thick in this area, although the exposures are not adequate to reveal the possibilities.

The high-purity dolomite may have an overburden less than 10 feet thick in part of the upland north of Otter Creek in secs. 3 and 4, T. 22 N., R. 4 E., and secs. 33 and 34, T. 22 N., R. 4 E. The dolomite probably is generally less than 15 feet thick, and the tract is two to three miles southeast of the Chicago, Milwaukee, St. Paul, and Pacific Railroad.

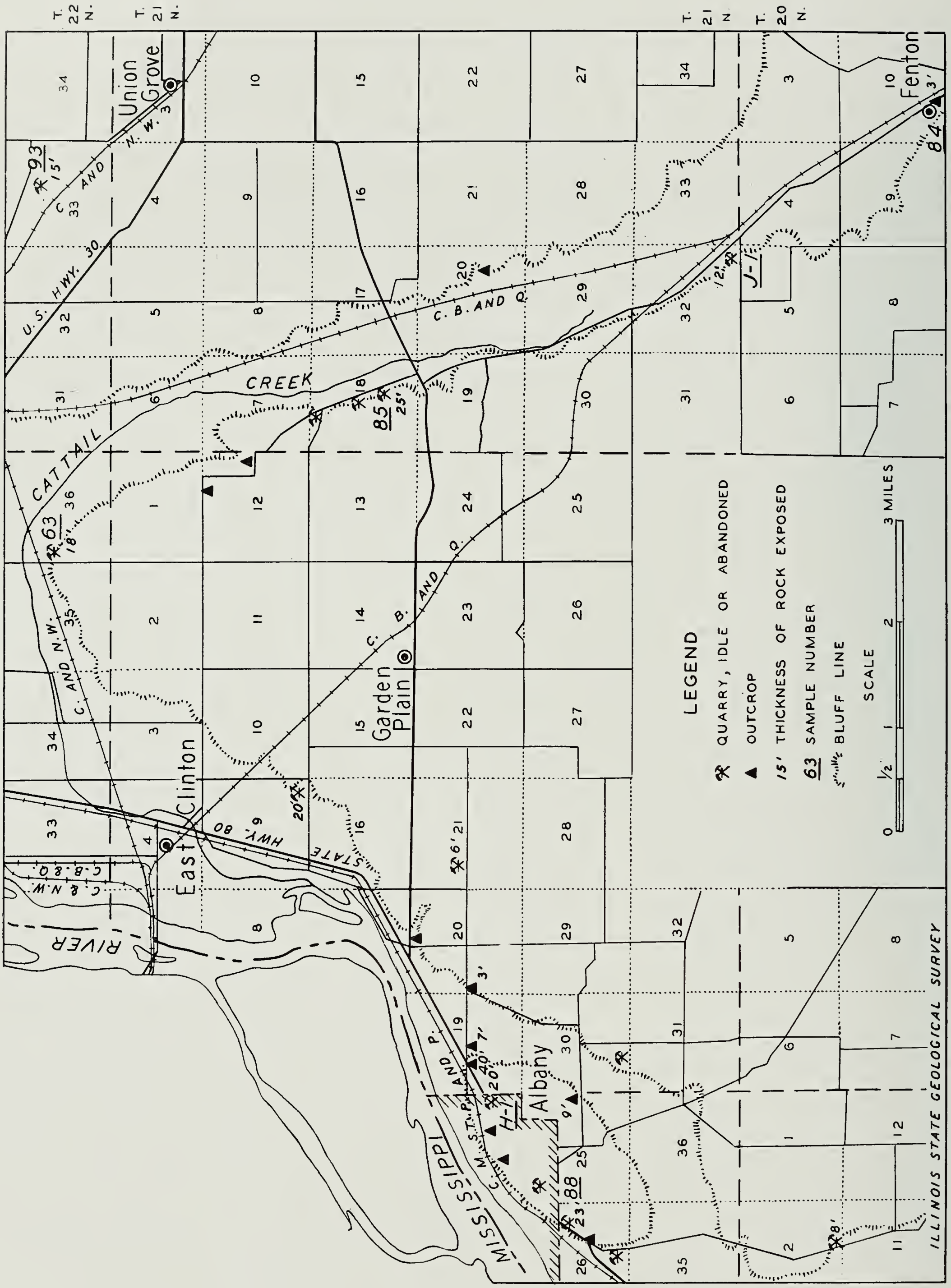


FIG. 28.—High-purity dolomite in the Albany area.

Albany Area

Nearly all the bedrock outcrops in the Albany area consist of high-purity dolomite that is part of the Racine formation (fig. 28). As the rock exposed is probably underlain by the high-purity dolomite of the Waukesha formation, the high-purity dolomite may be more than 100 feet thick. The Albany area contains small quarries but none are active.

Outcrops.—The high-purity dolomite is exposed in the bluffs along Mississippi Valley and Cattail Valley. The best exposures occur in abandoned quarries, whose locations are shown in figure 28. The dolomite is probably present in the lower part of the bluffs throughout most of the area but in many places it is covered by sand and clayey silt (loess) which has slumped from the upper part of the bluffs.

Thickness.—The greatest thickness of high-purity dolomite exposed is 40 feet at the northeast end of the hill at Albany. Thicknesses of 20 to 25 feet of dolomite are exposed at other places (fig. 28). As the strata have a southerly dip in the Albany area (fig. 24), the high-purity dolomite is probably thicker in the south part of the area than in the north. The dolomite exposed in a quarry about three miles east of East Clinton is probably near the base of the Racine formation, as outcrops a short distance northeast in the Fulton area consist of underlying Waukesha strata. The outcrops at Albany are probably 100 feet higher in the Racine than those east of East Clinton. The combined Waukesha and Racine dolomites may be 250 to 275 feet thick in the south part of the area.

Overburden.—In most of the area the dolomite has a thick overburden of loess, sand, and glacial clay. The overburden is thin only in areas where it has been eroded along the valley bluffs and in the stream floors. In much of the bottomlands of Mississippi Valley and Cattail Valley the bedrock is deeply buried by sand and gravel, locally as much as 200 feet thick. However, at a few places the bedrock extends a short distance out from the bluffs beneath the valley-floor and has only a thin overburden. This situation is revealed in quarries southeast of East Clinton, in the SE. ¼ sec. 9, T. 21 N., R. 3 E.; southwest of Albany, in the SW. ¼ SE. ¼ sec. 26, T. 21 N., R. 2 E.; and in an outcrop along a stream northeast of Albany, in the NW. ¼ SE. ¼ sec. 19, T. 21 N., R. 3 E.

Probably the largest areas of dolomite with thin overburden occur in terraces along the bluffs, especially at the north end of the upland area east of East Clinton in the S. part of secs. 35 and 36, T. 22 N., R. 3 E., and at the northeast end of the Albany hill, especially in the SW. ¼ sec. 19, T. 21 N., R. 3 E. In these terraces the bedrock locally protrudes through the soil but it commonly has a cover of 1 to 5 feet of sand or loess.

Throughout much of the Albany hill the dolomite has an overburden of loess and sand varying from 10 to 35 feet thick.

Character.—The dolomite exposed in the Albany area consists largely of reef-rock but the argillaceous interreef type of dolomite occurs locally. The reef-rock is largely light gray or nearly white but is usually irregularly stained brown near the outcrops. Some beds are uniformly buff. Most of the dolomite weathers light gray, except where darkened by organic substances. It is fine- to medium-grained and most beds are highly porous. Commonly the dolomite is massive but locally it is well-bedded. At places the strata have the characteristic structures of reefs.

The argillaceous interreef dolomite is exposed south of Albany in a quarry in the SW. ¼ SE. ¼ sec. 2, T. 20 N., R. 2 E. In a road-cut on the east side of the Albany hill a 1-foot bed of argillaceous dolomite occurs in an exposure of 8 feet of dolomite. The outcrops along the west side of Cattail Valley, three miles east of Garden Plain, are mostly reef-rock, but 8 feet of argillaceous dolomite is exposed in a quarry in the NE. ¼ NW.¼ sec. 18, T. 21 N., R. 4 E.

Composition.—The chemical composition of the reef-rock is shown by analyses of two samples. A sample (H-1, fig. 28, table 6) from 20 feet of dolomite exposed in an old quarry on the northeast side of Albany contains 99.52 per cent carbonates, consisting of 55.89 per cent $CaCO_3$ and 43.63 per cent $MgCO_3$. A sample (63) representing 18 feet of the dolomite exposed in an old quarry three miles east of East Clinton contains 98.3 per cent carbonates, of which 55.26 per cent is $CaCO_3$ and 43.07 per cent is $MgCO_3$. Both samples contain only 0.10 per cent silica, which is exceptionally low considering the weathered character of the samples.

The purity of the dolomite is shown by solubility tests on several samples from outcrops and quarries. The locations of the samples are given in figure 28. Results of the tests follow:

Sample No.	Thickness sampled *feet*	Soluble *per cent*
84	3	99.8
85	25	99.7
88	23	99.7
93	15	99.9
J-1	12	99.6

Development possibilities.—Several tracts in the Albany area appear to contain millions of tons of high-purity dolomite under a thin overburden and near railroads. Several other deposits may also be suitable for development but outcrops are not adequate to determine the possibilities. Because argillaceous rocks are locally associated with the high-purity dolomite, the deposits should be carefully prospected by drilling before any large-scale development is undertaken. However, the data available from outcrops indicate that the high-purity dolomite is preponderant in this area and large deposits free from argillaceous dolomite are probably present.

The most favorable sites for development are as follows:

(1) Near the Chicago, Milwaukee, St. Paul, and Pacific Railroad and Mississippi River at the northeast end of the hill at Albany in the SW. ¼ sec. 19 and the NW. ¼ sec. 30, T. 21 N., R. 3 E., and in the SE. ¼ sec. 24, T. 21 N., R. 2 E. About 40 feet of high-purity dolomite (sample H-1) is exposed in small quarries and outcrops. An outcrop along the stream about ⅛ mile east of the northeast end of the hill shows 7 feet of high-purity dolomite at a lower level. Locally the upper surface of the dolomite is rough and the rock protrudes through the soil. Shallow borings by the Soil Survey[23] indicate that the rock is only 1 to 2 feet deep in a tract of about 40 acres, principally in the SW. ⅛ sec. 19. The outcrops suggest that the overburden will probably average less than 10 feet and possibly less than 5 feet in a tract of about 160 acres. The outcrop about ⅛ mile east of the northeast end of the hill shows that the dolomite has an overburden of only 2 to 4 feet of soil and silt in the bottomland adjacent to the above tract. The extent of the bottomland with thin overburden is uncertain. As previously indicated, the high-purity dolomite may extend more than 100 feet below the rocks exposed, but test-drilling is necessary to determine the complete thickness available.

(2) Near the Chicago and Northwestern Railroad three miles east of East Clinton, in the SW. ¼ sec. 36, extending into the east central part of sec. 35, T. 22 N., R. 3 E., and the north central part of sec. 1, T. 21 N., R. 3 E.

23 Smith, R. S., Ellis, O. I., DeTurk, E. E., Bauer, F. C., and Smith, L. H., Whiteside County soils: Univ. of Illinois Agr. Exp. Sta. Soil Report No. 40, Map p. 3, p. 18, 1928.

About 18 feet of high-purity dolomite (sample 63) is exposed in a small quarry east of the road at the north end of the tract. The dolomite probably overlies the high-purity dolomite described in the Fulton area and 50 feet or more of high-purity dolomite may be present. Borings by the Soil Survey[24] indicate that the dolomite has an overburden less than 2 feet thick in an area of about 180 acres.

(3) Near the Chicago, Milwaukee, St. Paul, and Pacific Railroad southwest of Albany on the southwest side of the Albany hill, in sec. 26, T. 21 N., R. 2 E. High-purity dolomite (sample 88) at least 23 feet thick is exposed in old quarries and outcrops. The loess overburden is thin only in a narrow zone along the bluffs. Near the edge of the bluffs the loess occurs in hills and is as much as 25 feet thick below the tops of some of the higher hills. Between the hills and in a large area east of the hills the overburden may average about 10 feet thick if the surface of the bedrock maintains the same level as in the bluffs.

(4) Near the Chicago, Burlington, and Quincy and the Chicago, Milwaukee, St. Paul, and Pacific railroads southeast of East Clinton, in the valley-bottom in secs. 9, 10 and 16, T. 21 N., R. 3 E., especially near the old quarry in the SE. ¼ sec. 9. Although 20 feet of high-purity dolomite is exposed, the area with thin overburden is probably not large.

(5) One-half mile west of the Chicago, Burlington, and Quincy Railroad, three miles east of Garden Plain, in sec. 18, T. 21 N., R. 4 E. About 25 feet of high-purity dolomite (sample 85) is exposed along the west bluff of Cattail Valley, but the area with thin overburden appears to be limited.

(6) Along the Chicago, Burlington, and Quincy Railroad near Fenton Junction, in the SE. ¼ SE. ¼ SE. ¼ sec. 32, T. 21 N., R. 4 E. About 12 feet of high-purity dolomite (sample J-1) is exposed in a terrace on the west side of Cattail Valley. The overburden appears to range from 2 to 15 feet thick in an area of about 20 acres. The outcrops are not adequate to estimate accurately the average thickness of the overburden, but except near the outcrop it may be 10 feet or more.

(7) One-fourth mile northeast of the Chicago and Northwestern Railroad, 1½ miles northwest of Union Grove, in the SE. ¼ NW. ¼ sec. 33, T. 22 N., R. 4 E. About 15 feet of high-purity dolomite (sample 93) is exposed in a small quarry and outcrop along the southeast side of a creek. At the outcrops the area with thin overburden is not large. If the top of bedrock does not lower southward the dolomite may be shallow in the tract between the outcrops and the railroad.

(8) Near the Chicago, Burlington, and Quincy Railroad at Fenton, near the center of the S. line of sec. 10, T. 20 N., R. 4 E. Three feet of high-purity dolomite (sample 84) is exposed in a road-cut. The deposit has a thick overburden at the outcrop, but it may be shallower along the railroad a short distance northwest of the outcrop.

[24] Op. cit.

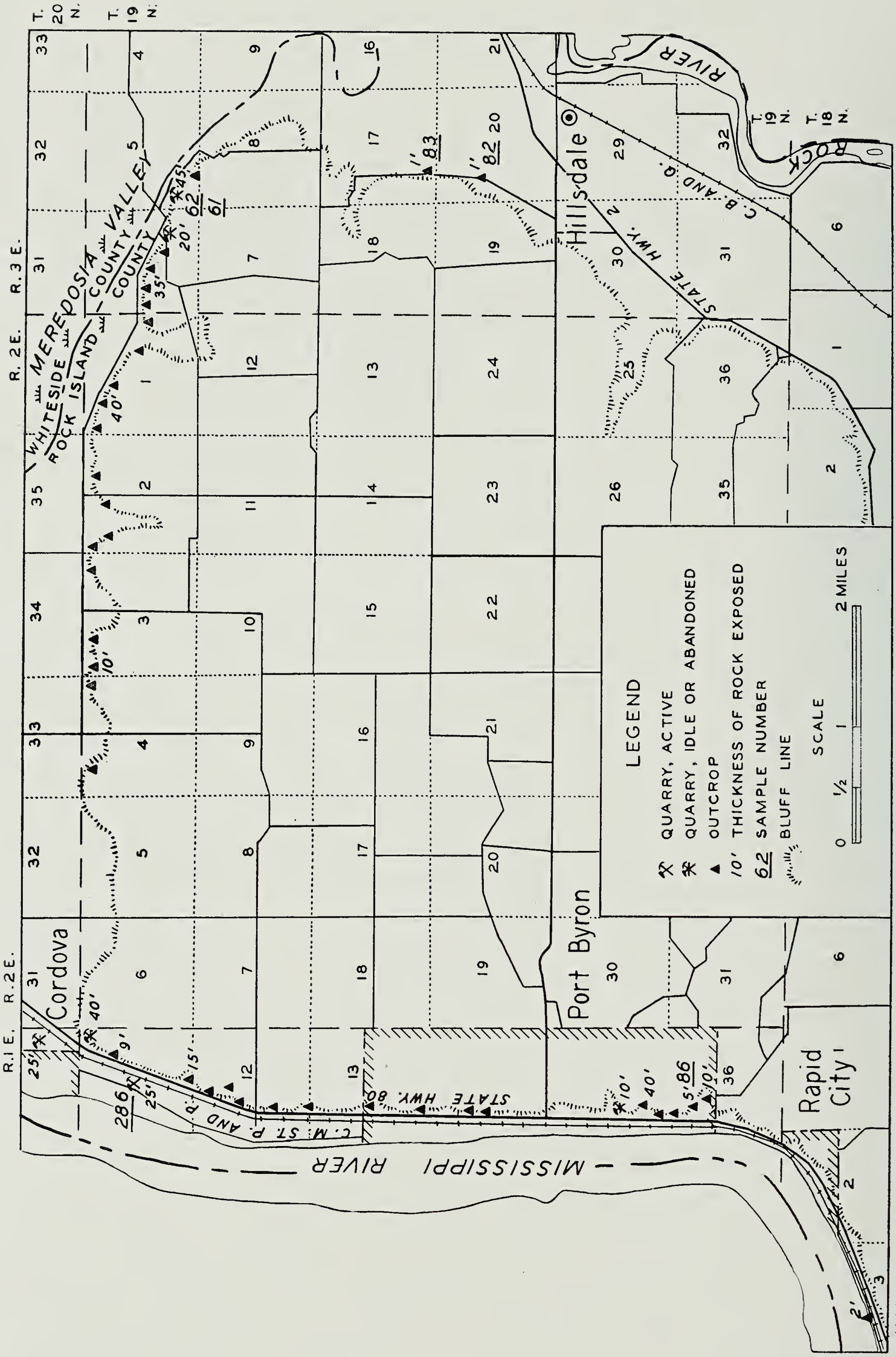


FIG. 29.—High-purity dolomite in the Port Byron area.

Port Byron Area

The Port Byron area (fig. 29) contains many deposits of high-purity dolomite. A deposit one mile south of Cordova is quarried by the U. S. Gypsum Company and used in the manufacture of lime and agricultural limestone. The strata exposed in the area belong to the Port Byron formation (p. 58) with the possible exception of the quarry on the south edge of Cordova, where the strata may be Racine.

Outcrops.—High-purity dolomite is exposed at many places in the Mississippi Valley bluffs and tributary ravines and in bluffs along Meredosia Valley north of Hillsdale. In Rock Valley small outcrops occur about a mile northwest of Hillsdale.

Thickness.—The greatest thickness of high-purity dolomite exposed is 40 to 45 feet in quarries at Port Byron, Cordova, and three miles north of Hillsdale. The exposed strata are underlain by the Racine and Waukesha dolomites which are probably about 300 feet thick. These formations together with the Port Byron probably total at least 350 feet thick. Each of these formations, as observed in outcrops in this area and the areas to the north, is composed largely of high-purity dolomite. Therefore, a great thickness of such rock may be present in the Port Byron area. However, impure strata are known to occur locally in the formations and the potentially great thickness should not be regarded as a certainty.

Overburden.—In the upland areas the dolomite is buried beneath 50 to 100 feet of clayey silt (loess), sand, and glacial clay. These deposits have been eroded locally in the bluffs, in narrow terraces along the base of the bluffs, and in the bottoms of valleys. At many of the outcrops the thickness of the overburden increases greatly only a few feet back from the exposures. The largest areas with a thin overburden are in the bottomland of Rock Valley near Hillsdale.

Character.—The high-purity dolomite is reef-rock similar to that in the Racine formation in the Albany area. Most of the dolomite is in massive ledges 3 to 10 feet thick but in places it is more thinly bedded, especially in the steeply dipping beds on the flanks of reefs. Gray to white clay in irregular pockets, some 10 to 15 feet across and more than 25 feet deep, is present in the upper surface of some deposits.

In places some of the dolomite beds are white or very light gray, but generally the light color is not persistent and some pores and some fracture surfaces are stained brown with iron oxide. Although the brown iron oxide is more abundant near the outcrops, some quarry faces which have been worked back 25 to 50 feet from outcrops contain the brown stain in places. The light color does not necessarily indicate an extremely low iron content, because some iron is present as finely divided pyrite and also in the mineral dolomite. However, the white or light rock is lower in iron content than the buff dolomite. It is doubtful if any considerable quantity of white dolomite can be produced by quarrying but some deeply buried stone may be white and could possibly be mined.

Although no outcrops of argillaceous interreef dolomite were found in the Port Byron area, such rocks may be locally present.

Composition. The high purity of the dolomite in this area is shown by the analysis of a sample (286, fig. 29, table 6) from the quarry of the U. S. Gypsum Co., one mile south of Cordova. The sample contains 98.48 per cent carbonates, including 54.39 per cent $CaCO_3$ and 44.09 per cent $MgCO_3$, and only 0.12 per cent SiO_2. Samples (61, 62) representing the lower 25 feet and the upper 20 feet of dolomite exposed in a quarry three miles north of Hillsdale are both 99.9 per cent soluble in acid. Two samples (82, 83) collected from about 1 foot of dolomite exposed in road-cuts about a mile northwest of Hillsdale are 99.9 and 99.8 per cent soluble. A sample (86) from 5 feet of dolomite exposed in a road-cut on the south side of Port Byron was 99.7 per cent soluble.

Development possibilities.—As the dolomite exposed in the Port Byron area is all high-purity stone and the thickness of the deposits may exceed 100 feet, the problem of finding suitable quarry sites is largely one of finding deposits with thin overburden located near transportation facilities. The possibility that the deposits may locally contain some argillaceous strata and perhaps clay-filled joints necessitates careful prospecting of any proposed site. The areas possibly suitable for development are as follows:

(1) One of the most promising areas is along the Chicago, Burlington, and Quincy Railroad near Hillsdale in Fox Valley. The only outcrops observed were about one mile northwest of Hillsdale in the SW. ¼ NW. ¼ sec. 20 and the SE. ¼ SW. ¼ sec. 17, T. 19 N., R. 3 E., where about 1 foot of high-purity dolomite (samples 82, 83) is exposed in several shallow road-cuts. No outcrops were observed along Rock River but rock is reported to be shallow and at times has been exposed near Hillsdale. The bedrock appears to be near the surface in a large part of the flat bottomland near Hillsdale. Borings by the Soil Survey [25] reached bedrock at a depth of less than 30 inches, commonly about 17 inches, in several tracts which total about 160 acres in the central part of the S. ½ sec. 20, the NW. ¼ sec. 29, and the NE. ¼ sec. 30. In the areas between these tracts the bedrock is more than 30 inches deep, which is the depth of the Soil Survey borings, but it may not be much more than 30 inches deep in an area of a square mile or more. The surface of the bedrock is cut by shallow channels filled with sand or gravel so that the thickness of the overburden may vary considerably. There is a possibility of more than 200 feet of high-purity dolomite but this can be determined only by drilling. Because of the size of the tract and the possibility of sharp lateral changes from reef to interreef types of rock, a number of borings would be required to determine the possibilities of the area.

(2) In the bluffs of Meredosia Valley, three miles north of Hillsdale, 35 to 45 feet of high-purity dolomite (samples 62, 63) has an overburden of clayey silt and sand 20 to 50 feet thick. Because of the lateral extent of the outcrops, a large quantity of stone could possibly be quarried in a narrow zone along the bluffs, especially in secs. 5 and 6, T. 19 N., R. 3 E., and sec. 1, T. 19 N., R. 2 E. A smaller thickness of rock is exposed in the bluffs farther west, in secs. 2, 3, and 4, T. 19 N., R. 2 E., but because the upper slopes of the bluffs are more gentle and the lower slopes have narrow terraces along them, detailed prospecting might reveal quarryable tracts where the overburden will average less than 10 feet thick. These deposits are three to five miles from the Chicago, Burlington, and Quincy and the Chicago, Milwaukee, St. Paul, and Pacific railroads and are accessible only by secondary roads.

(3) Because of the great thickness of high-purity dolomite that may be present, some localities which because of the heavy overburden would ordinarily be considered to have little promise as quarry sites deserve mention. As about 2¾ acres of dolomite 100 feet thick would contain a million tons, it might be profitable to remove 20 or 30 feet of overburden, if the character or location of the deposit favored the site. This applies particularly to the outcrops of high-purity dolomite (samples 86, 286) in the bluffs along Mississippi Valley near the Chicago, Milwaukee, St. Paul, and Pacific Railroad. A few such localities are as follows:

Along the valley at the south edge of Port Byron, in the center of sec. 36, T. 19 N., R. 1 E.

[25] Smith, R. S., Ellis, O. I., DeTurk, E. E., Bauer, F. C., and Smith, L. H., Univ. of Illinois Agr. Exp. Sta. Soil Rept. No. 31, Map p. 9, p. 22, 1925.

Along the small valley north of Port Byron, along the north line of sec. 13, T. 19 N., R. 1 E.

Along a small valley near the center of the north half of sec. 12, T. 19 N., R. 1 E.

At the mouth of a ravine on the south line of sec. 1, T. 19 N., R. 1 E.

In the terrace along and east of the Chicago, Milwaukee, St. Paul, and Pacific Railroad at Cordova, especially in the S. ½ sec. 31, T. 20 N., R. 2 E., the SE. ¼ sec. 36, T. 20 N., R. 1 E., and the NE. ¼ sec. 1, T. 19 N., R. 1 E. In the terrace farther north and northeast the bedrock has a thick cover of sand and gravel but near the bluffs the bedrock may be shallow.

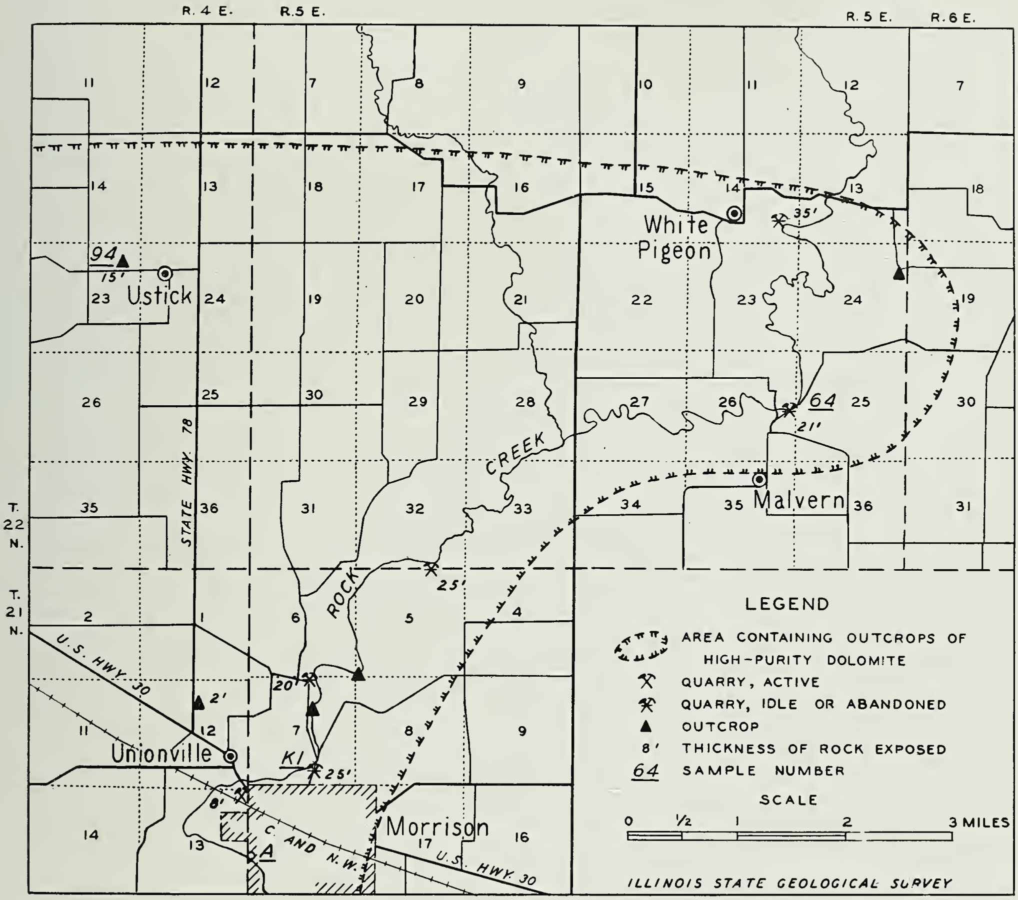


FIG. 30.—High-purity dolomite in the Morrison area.

MORRISON AREA

High-purity dolomite occurs in the Morrison area (fig. 30) and has been worked in several small quarries for agricultural limestone and road-stone. At present the only active quarry is operated by Johnson and Akker on the west edge of Morrison, for agricultural limestone. The high-purity dolomite occurs in the Waukesha and Racine formations (pp. 55-58).

Outcrops.—The approximate boundary of the tract in which the high-purity dolomite occurs is shown in figure 30. For a mile or two southwest of the boundary the Waukesha dolomite occurs principally in the higher ridges and the underlying Joliet and Kankakee formations are exposed along the valleys, but farther southwest the outcropping rocks are all part of the Waukesha and Racine formations. The Waukesha is exposed along Rock Creek near White Pigeon and the Racine near Malvern, Morrison, and Ustick. The locations of a few typical outcrops are shown in figure 30. Only that part of the area near the Chicago and Northwestern Railroad has been examined in detail and there are no doubt many other exposures along Rock Creek and its tributaries. The high-purity dolomite is probably present beneath the uplands in the part of the area southeast of Rock Creek and also south and southeast of the area, but it does not crop out.

Thickness.—The greatest thickness of high-purity dolomite exposed is 25 to 35 feet in quarries at Morrison and White Pigeon. As the strata generally dip southwest in this region, the thickness of the high-purity dolomite probably increases in that direction. The city well at Morrison (A, fig. 30), in the NE. cor. SW. ¼ NW. ¼ SW. ¼ sec. 18, T. 21 N., R. 5 E., penetrated 15 feet of glacial drift and 225 feet of Silurian strata. The upper 135 feet of the Silurian strata is probably Waukesha and Racine dolomite and may all be high-purity. Therefore, at the outcrop on the north edge of Morrison, where the top of the rock is about 60 feet higher than it is in the well, there may be as much as 200 feet of high-purity dolomite.

Overburden.—Except along some valleys the dolomite generally has a thick overburden of clayey silt (loess), sand, and glacial clay. Probably the largest areas with thin overburden occur in the broad terrace area northwest of Morrison.

Character.—The dolomite is light gray whitish-weathering reef-rock. It is mostly porous but relatively dense beds are common. It is massive in some places and well-bedded in others. Locally the upper 10 to 15 feet is weathered to a sand containing irregular blocks of the solid rock, but at other places the rock shows no disintegration. Where much weathered the rock is generally stained brown with iron oxide.

Composition.—The high purity of some of the dolomite in the Morrison area is shown by the chemical analysis of a sample (K-1 fig. 30, table 6) representing 26 feet of dolomite exposed in a quarry north of Morrison in the SW. ¼ SE. ¼ sec. 7, T. 21 N., R. 5 E., which contains 55.95 per cent $CaCO_3$ and 43.22 per cent $MgCO_3$, a total of 99.17 per cent carbonates. All of 19 samples collected from different beds in this quarry were more than 99 per cent soluble in acid. A sample (94) representing 15 feet of high-purity dolomite exposed along a stream at Ustick, in the SW. ¼ NE. ¼ NE. ¼ sec. 23, T. 22 N., R. 4 E., was 99.9 per cent soluble in acid. A sample (64) representing 21 feet of dolomite mostly weathered to a sand, in a quarry half a mile north of Malvern, in the NE. ¼ NE. ¼ SE. ¼ sec. 26, T. 22 N., R. 5 E., was 98.5 per cent soluble.

Development possibilities.—The Morrison area contains a large tonnage of high-purity dolomite but only the southwest corner of the area near Morrison is near a railroad, and in this area the outcrops do not demonstrate the presence of any large tracts with a thin overburden, though such tracts may exist.

Probably the most favorable area for investigation is northwest of Morrison, in a terrace which is 1 to 1½ miles wide and extends northwest from Rock Creek, principally on the north side of the Chicago and Northwestern Railroad, in the W. ½ sec. 7, T. 21 N., R. 5 E., and the N. ¾ sec. 12 and the S. ½ sec. 1, T. 21 N., R. 4 E. The high-purity dolomite in this tract at least locally has a thin overburden, as shown by an outcrop of 2 feet of dolomite with 2 to 5 feet overburden in a small stream along State Highway 78, half a mile northwest of Unionville, and also by the thin cover on the dolomite at a quarry a mile east at the top of the west bluff of Rock Creek, in the NW. ¼ NW. ¼ NE. ¼ sec. 7. Drilling might reveal tracts with a thin overburden nearer the railroad, especially in sec. 11 and SW. 1/4 sec. 12, T. 21 N., R. 4 E. Along Rock Creek at Unionville and north of Morrison the top of the dolomite locally contains a channel filled with Pennsylvanian or "Coal Measures" sandstone and similar deposits might be found in part of the terrace area.

Although the dolomite is not exposed along Rock Creek south of the Chicago and Northwestern Railroad, it may not be deeply buried in the broad valley-flat in the N. 1/2 sec. 13, T. 21 N., R. 4 E. The dolomite is exposed on the north side of the railroad, and it is only 15 feet deep in the Morrison City well half a mile down the valley. Development of a quarry near the railroad might be feasible, if drilling confirms the presence of a considerable thickness of high-purity dolomite.

The deposits of high-purity dolomite north and northeast of Morrison are a considerable distance from the railroad, and those examined have a thick overburden except in small tracts. Many deposits suitable for small-scale development are probably present and a detailed study of the area may reveal the presence of large deposits with a thin overburden.

Other Areas

In the part of the Savanna-Port Byron region north of the Savanna area (fig. 23) Silurian dolomite caps the higher ridges. Most of the deposits consist of the argillaceous or cherty Edgewood and Kankakee formations and less commonly the Joliet formation. Locally some chert-free beds in the Kankakee and Joliet formations are relatively free of impurities and may be high-purity dolomite. One 12-foot bed exposed above the west end of the Winston tunnel of the Chicago Great Western Railroad, in the NW. 1/4 SE. 1/4 NW. 1/4 sec. 14, T. 27 N., R. 1 E., was 98.4 per cent soluble and is probably high-purity dolomite. The same bed is exposed near the top of the Mississippi Valley bluffs above the Chicago, Burlington, and Quincy Railroad, in the SW. 1/4 SE. 1/4 sec. 28, T. 27 N., R. 1 E. At both places the bed has a heavy overburden of cherty dolomite but may be minable.

At several places between Sterling and Hillsdale, Rock River cuts into bedrock which forms rapids in the river. It is reported that some rock has been quarried from the banks or floor of the river, especially near Lyndon, Erie, and Hillsdale.[26] This rock is probably high-purity dolomite, but it is exposed only during low stages of the river. These localities are all subject to flooding.

In that part of the Savanna-Port Byron region southeast of Rock River (fig. 23) and also farther south, the high-purity dolomite is deeply buried by sand and gravel or younger bedrock formations. Near Rock Island and Moline the dolomite could probably be mined by shaft-mines at a depth of 100 to 150 feet.

ROCKFORD REGION

Many large deposits of high-purity dolomite occur in the Galena-Platteville formations which are exposed in an extensive area in northern Illinois. For convenience, in this report this area is referred to as the Rockford region (fig. 31). The Galena-Platteville formations consist of 300 to 350 feet of dolomite and limestone, and in places they contain as much as 75 feet of high-purity dolomite (p. 20). The high-purity dolomite commonly contains 1 to 2 per cent more impurities than most of the high-purity dolomite in the Niagaran formations in both the Chicago and Savanna-Port Byron regions. Most of the dolomite contains about 1 per cent silica and the carbonate content is usually close to 97 per cent, although several samples contain more than 98 per cent carbonates.

[26] Shaw, James, Geology of Whiteside County, in Geology and Paleontology: Geol. Survey of Ill., vol. 5, p. 149, 1873.

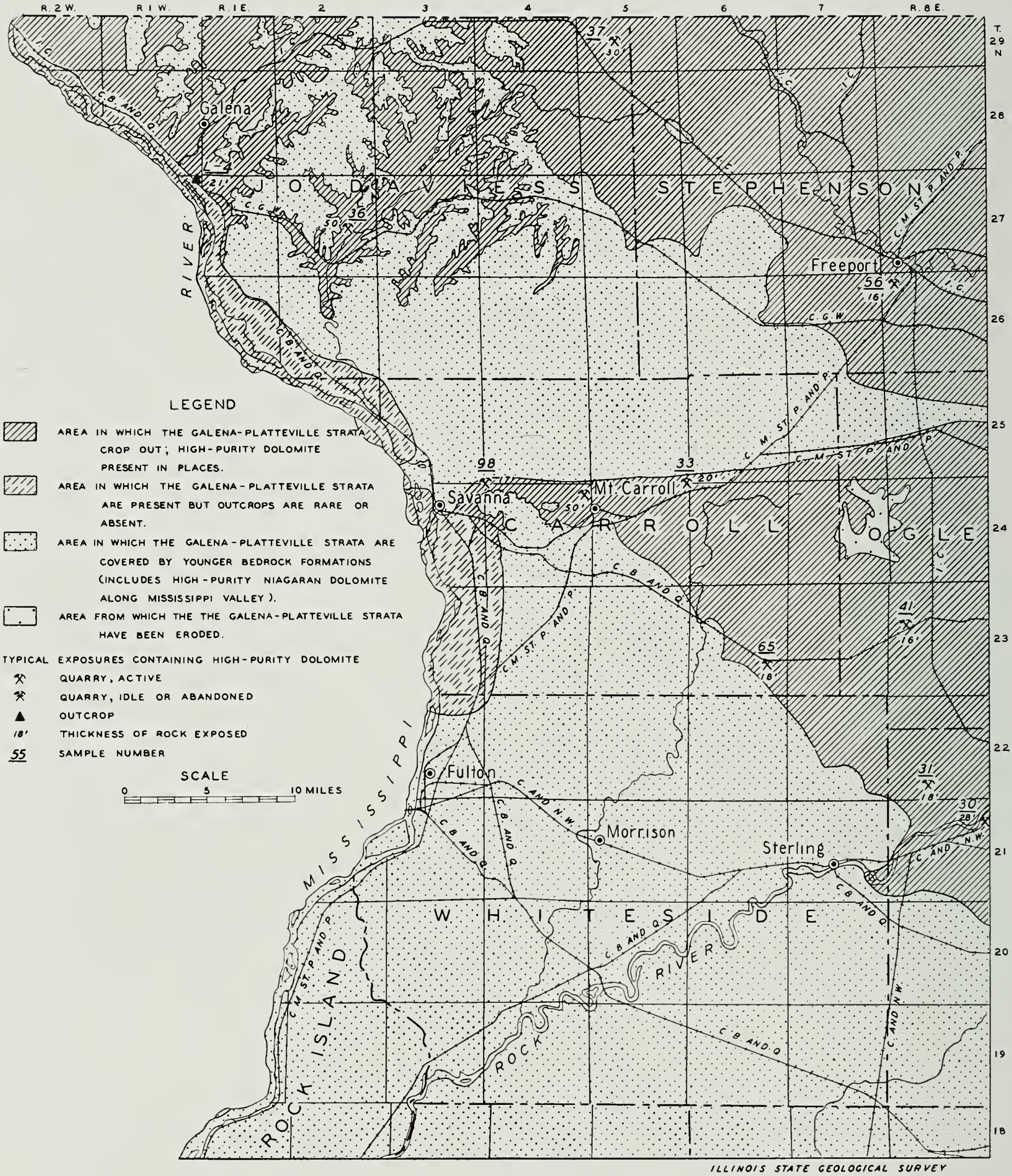
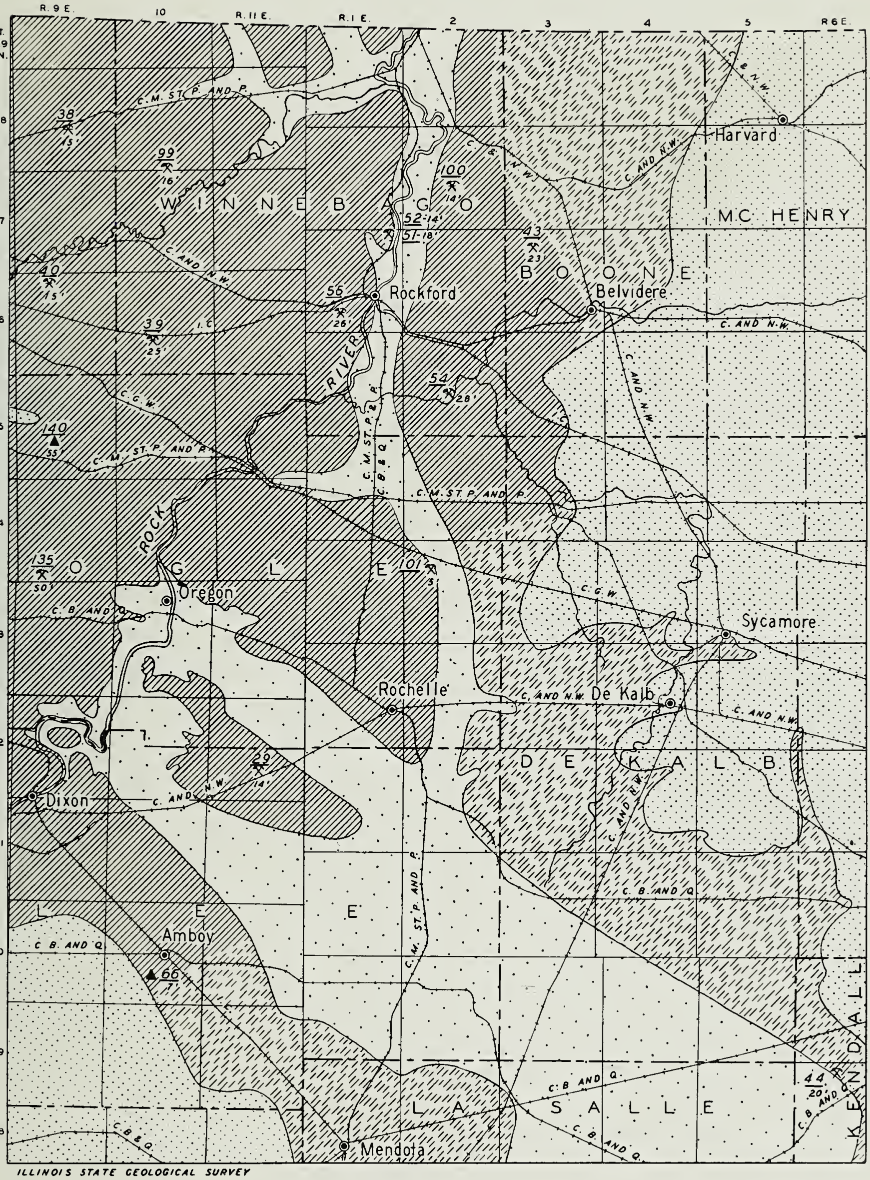


Fig. 31.—The Rockford region—showing the areas underlain by the Galena-Platteville formations



which contain undeveloped deposits of high-purity dolomite in places.

Present Industry

The Rockford region contains hundreds of small quarries, but many are not in the high-purity beds. Some of these quarries are worked more or less intermittently for agricultural limestone and road-stone, and some were formerly worked as sources of building-stone and of stone for lime-making. A few quarries are equipped to produce a considerable tonnage of stone for local markets. Although many of the quarries are located near the railroads, none now ship by rail.

Description of Formations

The Galena-Platteville strata consist of three formations, the Platteville (at the base), Decorah, and Galena formations. Most of the deposits of high-purity dolomite occur in the Galena formation. The dolomite in the Platteville and Decorah formations is generally not of high purity but a few deposits are very near high purity.

Platteville and Decorah Formations

Character.—The Platteville and Decorah formations are 100 to 150 feet thick. They comprise a variable sequence of dolomite, limestone, and strata composed of intermixed dolomite and limestone. The relative amounts of dolomite and limestone are widely variable both laterally and vertically, and locally the proportions change notably in short distances. Some of these strata are argillaceous or sandy, some are cherty, and locally beds of shale or shaly dolomite are present.

Composition.—Some beds in the Platteville and Decorah formations probably contain locally as much as 97 per cent carbonates, but most of the strata contain less than 95 per cent carbonates. One sample (29, table 6) representing 15 feet of Decorah dolomite at Ashton has nearly 97 per cent carbonates, containing 54.23 per cent calcium carbonate and 42.42 per cent magnesium carbonate. A sample representing 18 feet of dolomite from the lower part of the Platteville (Pecatonica member) in a quarry one mile south of Rockton, is 94.7 per cent soluble in acid. Chemical analyses of three samples[27] collected from the Platteville formation exposed in a quarry near Winslow show a carbonate content of 91 to 95 per cent. A sample from 22 feet of Platteville dolomite exposed in a quarry ½ mile south of Byron, in the SW. ¼ SE. ¼ SW. ¼ sec. 32, T. 25 N., R. 11 E., contains 93 per cent carbonates.

Distribution.—The Platteville and Decorah strata are exposed at many places, especially in that part of the region which is near outcrops of the underlying strata (fig. 31). Many exposures occur in Rock River Valley, near Dixon, Oregon, Rockford, and Rockton, and also along Pecatonica River in the north and east parts of Stephenson County. South of the region mapped (fig. 31) they are also exposed near LaSalle, Lowell, and Ottawa but are mixtures of limestone and dolomite.

Galena Formation

Character.—The Galena formation is 200 to 250 feet thick. It consists largely of brown porous massive fine-grained dolomite (figs. 32, 33). Some of the dolomite contains 5 to 20 per cent chert, but part contains very little or none. Locally the dolomite beds are separated by thin shaly partings or contain thin discontinuous lenses of shale. In places the formation grades into a mixture of limestone and dolomite. The character and classification of the formation is shown in table 4.

[27] Bleininger, A. V., Lines, E. F., and Layman, F. E., Portland Cement Resources of Illinois, Illinois Geol. Survey, Bull. 17, 1912, pp. 95. 100.

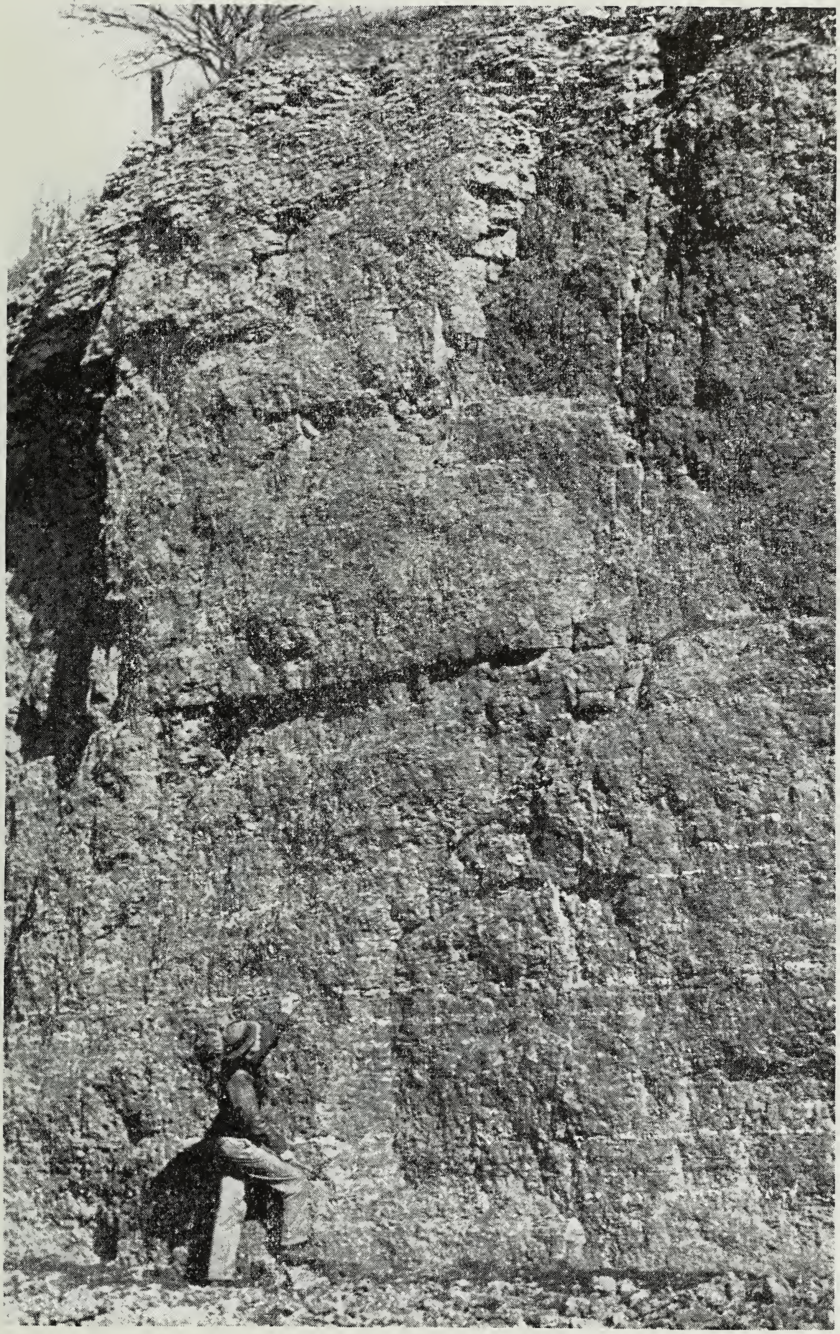


FIG. 32.—Exposure of massive Galena dolomite. The dolomite is high purity above the prominent bedding-plane near the middle of the exposure but below the plane it contains many thin bands of white chert, to one of which the man is pointing.

Fig. 33.—Smooth surface of Galena dolomite showing variations in porosity. The dark areas are holes or pores. (One-half natural size.)

Table 4.—Classification of the Galena Formation

Character	Approximate thickness *feet*	Name of Member: Old classification[a]	New classification[b]	
Thin to medium beds with shaly partings....	30	Upper thin-bedded	Dubuque	
Massive noncherty.....	40	Upper massive noncherty	Stewartville	
Massive noncherty.....	30		Prosser	(uppermost)[c]
Massive cherty........	80-100	Massive cherty		(middle)[c]
Massive noncherty.....	20-50	Lower massive noncherty		(lowermost)[c]

a Trowbridge, A. C., and Shaw, E. W., Geology and geography of the Galena and Elizabeth quadrangles; Illinois Geol. Survey, Bull. 26, 1916, pp. 45-52.

b Kay, G. M., Ordovician system in the upper Mississippi Valley: in Guidebook Ninth Annual Field Conference, Kansas Geol. Soc., 1935, pp. 289-293.

c The terms lowermost, middle, and uppermost Prosser are not standard geological nomenclature but are used here for convenience.

The Prosser member consists of 150 to 175 feet of massive porous dolomite which is of high-purity except where it contains chert. The lowermost Prosser is commonly a chert-free zone, 20 to 40 feet thick, at the top of which a fossil sponge, *Receptaculites,* often called the "sunflower coral," is abundant in a broad, ill-defined zone. This is the lower *Receptaculites* zone.[28] In the middle Prosser, which is 80 to 100 feet thick, chert is generally common, but locally zones as much as 25 feet thick are free or nearly free of chert and are high-purity dolomite. The uppermost Prosser consists of about 30 feet of chert-free high-purity dolomite. The terms uppermost, middle, and lowermost Prosser may not always be strictly comparable, because the top and especially the bottom of the cherty zone are not always at exactly the same horizon.

The Stewartville member consists of about 40 feet of chert-free dolomite similar to that in the underlying Prosser member and is differentiated from it by fossils. The base of the Stewartville is marked by a zone in which *Receptaculites* is abundant. This is the upper *Receptaculites* zone.[29]

The Dubuque member comprises the upper 30 feet of the Galena formation and is differentiated both on the basis of fossils and its thin-bedded shaly character. It contains too much shale to be high-purity dolomite, but it commonly is more than 90 per cent carbonates, and at a few places where the shale partings are very thin it is not much below 97 per cent carbonates.

As the differentiation of the Galena formation into the Prosser, Stewartville, and Dubuque members is comparatively recent, the members have not been identified throughout the region. Therefore, the old terms—upper thin-bedded, upper massive noncherty, massive cherty, and lower massive noncherty—are also used, as shown in table 4.

Composition.—Chemical analyses show variations of 1 to 2 per cent in the amount of impurities in face samples of the various chert-free zones, but no one zone is consistently more pure than another. The samples analyzed (table 6) are listed below:

Member	Sample numbers
Stewartville	31, 33, 36, 37, L-4, MC
Prosser (uppermost) and Stewartville	43, 44
Prosser (uppermost)	39, 40, 56
Prosser (middle)	41
Prosser (lowermost)	30, 38, 55, 135, 140

Sample 30 is typical of the purest rock found in the Galena formation. It contains 98.45 per cent carbonates, consisting of 54.84 per cent $CaCO_3$ and 43.61 per cent $MgCO_3$, and 0.92 per cent SiO_2, Al_2O_3, and Fe_2O_3. Sample 135 is representative of the usual composition of the Galena dolomite and contains 97.00 per cent carbonates, consisting of 54.76 per cent $CaCO_3$ and 42.24 per cent $MgCO_3$, and 2.09 per cent SiO_2, Al_2O_3, and Fe_2O_3.

The uniformity in composition is shown by the solubility tests on 22 samples of chert-free dolomite from localities scattered throughout the region. They averaged 98.5 per cent soluble, range from 97.3 to 99.7 per cent, and 15 of the samples are between 98 and 99 per cent soluble. Nine of these samples are listed in table 5. The others were analyzed chemically and are listed in table 6.

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28 Trowbridge, A. C., and Shaw, E. W., op. cit., p. 48.

29 Trowbridge, A. C., and Shaw, E. W., op. cit., p. 49.

Table 5.—Results of Solubility Tests of Galena Dolomite

Sample No.	Town at or near	Location							Member	Thickness sampled *feet*	Soluble in HCl *per cent*
		¼	¼	¼	Sec.	T.	R.	County			
51	Genet	SW	SE	NW	1	44N	1E	Winnebago	Prosser (lowermost)	18	98.4
52	Genet	SW	SE	NW	1	44N	1E	Winnebago	Prosser (middle)	14	99.0
54	Perryville	SE	NE	NE	21	43N	2E	Winnebago	Prosser (middle)	28	98.3
65	Milledgeville	NE	NE	NE	26	23N	6E	Carroll	Stewartville	18	98.0
66	Amboy	SE	NE	NE	28	20N	10E	Lee	Stewartville?	7	99.7
98	Savanna		NW	NW	6	24N	4E	Carroll	Stewartville	17	98.3
99	Durand	SE	SE	SE	33	28N	10E	Winnebago	Prosser	16	98.8
100	Harlem	SE	NE	NW	22	45N	2E	Winnebago	Prosser?	14	97.3
101	Lindenwood	SE	SW	NE	8	41N	2E	Ogle	Prosser (uppermost)	5	99.5

Distribution.—The two noncherty zones in the Galena dolomite are widely distributed throughout the region. Their distribution has not been determined in sufficient detail to permit their being mapped separately, but their general distribution can be observed in figure 31, which shows the area in which the combined Galena-Platteville strata are exposed, where they are overlain by younger strata, and where they have been completely eroded and older formations are present. The upper noncherty zone (Stewartville and uppermost Prosser), about 30 feet below the top of the Galena, is commonly exposed in that part of the region which is close to the area where the formation is overlain by younger formations, that is, near the east and west boundaries of the region (fig. 31). The lower zone (lowermost Prosser), about 200 feet from the top of the Galena and 100 to 150 feet from the base of the Platteville formation, is widely distributed throughout the central part of the region between the areas of overlying and underlying strata. In some local areas where the strata are tilted and faulted or where the topographic relief is 200 feet or more, the entire Galena formation is exposed. There are hundreds of places where the various members may be examined. The places sampled are typical (fig. 31, detailed locations in tables 5 and 6).

The Galena formation is also exposed at numerous places south of the region mapped (fig. 31), near Lowell, Lisbon, and Morris. The formation in these places, although in part high in total carbonates, is mostly a mixture of limestone and dolomite, and no thick deposits composed entirely of dolomite have been observed.

Development Possibilities

The high-purity dolomite in the Galena-Platteville formations can be quarried at many places throughout the region. In addition to the typical localities referred to in this report, there are no doubt many other places equally if not better suited for quarrying. Some of the favorable localities are those where samples were collected, as shown in figure 31, but sampling was necessarily confined to those places where the rock is well exposed, and investigation of the nearby areas may reveal more favorable quarry sites. The locations of many outcrops and quarries in the Galena-Platteville strata have been published,[30] but many of these are not high-purity dolomite.

As a general quide to prospecting for high-purity dolomite in the area of Galena-Platteville strata (fig. 31), any exposure of brown porous massive dolomite that is free of visible impurities, such as chert, shaly beds, or clay partings along the bedding-planes, is probably a high-purity dolomite. As the dolomite free from these impurities commonly contains 1 to 2 per cent of finely divided noncarbonate material, even a low percentage (1 to 2 per cent) of the visible impurities will probably exclude the deposit from the high-purity classification. This is especially true where there are clay-partings or shaly beds, as they commonly are accompanied by an increase in the amount of impurities in the surrounding dolomite. A few scattered nodules of chert, although conspicuous, may not be seriously detrimental to the total carbonate content. However, because chert is a highly variable component of many deposits, increasing from none to 5 per cent or more in a few feet horizontally, the presence of any chert nodules in a deposit demands especial care in prospecting. This is particularly critical in any chert-free zones occurring in the normally cherty middle part of the Galena formation (middle Prosser) but must also be considered for those portions of the formation which are normally noncherty.

Chemical analysis is necessary to demonstrate that any of the dolomite is high-purity, but if the dolomite is over 98 per cent soluble in hydrochloric acid, it is probably high-purity dolomite (p. 21). However, this is not always

[30] Krey, Frank, and Lamar, J. E., Limestone resources of Illinois: Illinois Geol. Survey Bull. 46, 1925.

the case for the Platteville and Decorah formations, and locally for the Galena, because some strata that are more than 98 per cent acid soluble contain beds or irregular masses of limestone and as a result are too low in magnesium carbonate to be called high-purity dolomite.

The general situation in each of the counties is summarized below. Most of the deposits referred to are exposed in small quarries and in outcrops along streams, and therefore drilling and testing of samples is needed to establish the presence of deposits suitable for large-scale development.

Boone County.—The Galena formation is the uppermost bedrock formation in the northwest part of Boone County, but outcrops are scarce in most of that area. The upper massive noncherty member (sample 43 table 6) is the principle possibility for high-purity dolomite and is exposed west of Belvidere near the Chicago and Northwestern Railroad, along Kishwaukee River, and along Beaver Creek.

Carroll County.—The upper massive noncherty member of the Galena formation (samples 33, MC, table 6) is exposed at many places in Carroll County, especially near Hickory Grove and Milledgeville along the Chicago, Burlington, and Quincy Railroad and near Savanna, Hickory Grove, Mt. Carroll, and Lanark along the Chicago, Milwaukee, St. Paul, and Pacific Railroad.

DeKalb County.—The Galena formation underlies the western and southern part of DeKalb County but is near enough to the surface to be quarried only in the extreme northwest part of the county. The strata exposed are part of the upper thin-bedded (Dubuque) member of the Galena formation, contain shaly beds, and are not high-purity dolomite. The upper massive noncherty dolomite may locally occur at a shallow depth.

Jo Daviess County.—Most of the valleys in the northern two-thirds of Jo Daviess County cut into but not through the Galena formation. The hills and ridges between the valleys are mostly capped with younger strata (Maquoketa shale) except in the northeast and northwest parts of the county, and the most favorable quarry sites are usually in the valleys or valley-bluffs. The upper massive noncherty member (samples L-4, 36, 37, table 6) is the principal possibility for high-purity dolomite and it is well exposed at many places along the railroads, especially the following:

Chicago, Burlington, and Quincy Railroad—in the Mississippi Valley bluffs near Blanding and Galena Junction.

Chicago Great Western Railroad—along Apple River near Woodbine and Elizabeth and in the Mississippi Valley bluffs near Galena Junction.

Illinois Central Railroad—near Warren and Apple River and along Galena River and the Mississippi Valley bluffs north of Galena Junction.

Lee County.—Many outcrops of Galena dolomite occur in the northwest part of Lee County, near Rock Valley. Farther south the formation is only locally exposed. Both the lower (sample 30 table 6) and upper (sample 31) massive noncherty members crop out. Possible quarry sites occur near the Chicago and Northwestern and Illinois Central railroads, near Dixon.

The underlying Decorah and Platteville members are also widely exposed, especially along Rock River at and northeast of Dixon, and in the vicinity of Ashton. A sample (29) of part of the Decorah formation at Ashton has only slightly less than 97 per cent carbonates.

Ogle County.—Ogle County contains many exposures of high-purity dolomite in both the upper and lower (samples 135, 140, table 6) massive noncherty members of the Galena formation. A noncherty zone in the normally cherty middle part of the Galena is also high-purity dolomite (sample 41).

High-purity dolomite is available at many places along the railroads, especially the following:

Chicago, Burlington, and Quincy Railroad—near Polo and Stratford.

Chicago Great Western Railroad—near Myrtle and Lindenwood.

Chicago, Milwaukee, St. Paul, and Pacific Railroad—near Adeline.

Stephenson County.—The Galena formation is widely exposed in all of Stephenson County except the extreme southwest part where it is overlain by younger beds. Both the lower and upper massive noncherty members are well exposed, the lower (sample 38 table 6) especially in the east and the north-central parts of the country and the upper (samples 40, 56) in the south and the west parts of the county. Good exposures occur along the railroads, especially at the following localities:

Chicago and Northwestern Railroad—near Ridott and Freeport.

Chicago Great Western Railroad—near German Valley and Dunbar.

Chicago, Milwaukee, St. Paul, and Pacific Railroad—near Freeport, Dakota, and Davis.

Illinois Central Railroad—near Evarts, Freeport, Lena, and Buena Vista.

Whiteside County.—The Galena formation crops out in the northeast corner of Whiteside County. The upper massive noncherty member may be available locally.

Winnebago County.—The Galena formation is widely exposed in Winnebago County. Both the lower (sample 54, table 6) and upper (samples 39, 55) massive noncherty members are exposed along the railroads, especially in the following localities:

Chicago, Milwaukee, St. Paul, and Pacific Railroads—near Genet.

Chicago and Northwestern Railroad—near Pecatonica, Rockford, and Cherry Valley.

Illinois Central Railroad—near Seward and Rockford.

The underlying Decorah and Platteville formations are also exposed, especially in the Rock and Pecatonica valleys, but are not known to contain high-purity dolomite.

GRAFTON-HARDIN REGION

High-purity dolomite occurs in the Silurian formations exposed near Grafton in Jersey County and may also be present in the same formations near Hardin in Calhoun County, about 25 miles northwest of Alton (fig. 34). The high-purity dolomite is about 20 feet thick and generally has a thick overburden. It can be quarried in areas of four or five acreas and could be mined underground. The high-purity dolomite has been worked on a small scale in the quarry of the Keller Quarry Co., in the Mississippi bluffs half a mile east of Grafton, but the quarry is principally in the strata overlying the high-purity dolomite.

Character.—The Silurian formations are locally absent but have a maxium thickness of over 100 feet. Most of the Silurian dolomite is not of high-purity. The greatest thickness of high-purity dolomite observed is 20 to 25 feet at the Keller quarry at Grafton. It is light brownish-gray, highly porous, and medium-grained and occurs in 2- to 4-foot ledges but locally is more massive. It grades upward into less pure dolomite which is thinner bedded and contains thin partings of green clay.

Composition.—The analysis of a sample (80, table 6) representing the upper 16 feet of the high-purity strata exposed at the base of the Keller quarry shows 97.30 per cent carbonates, consisting of 54.75 per cent $CaCO_3$ and 42.55

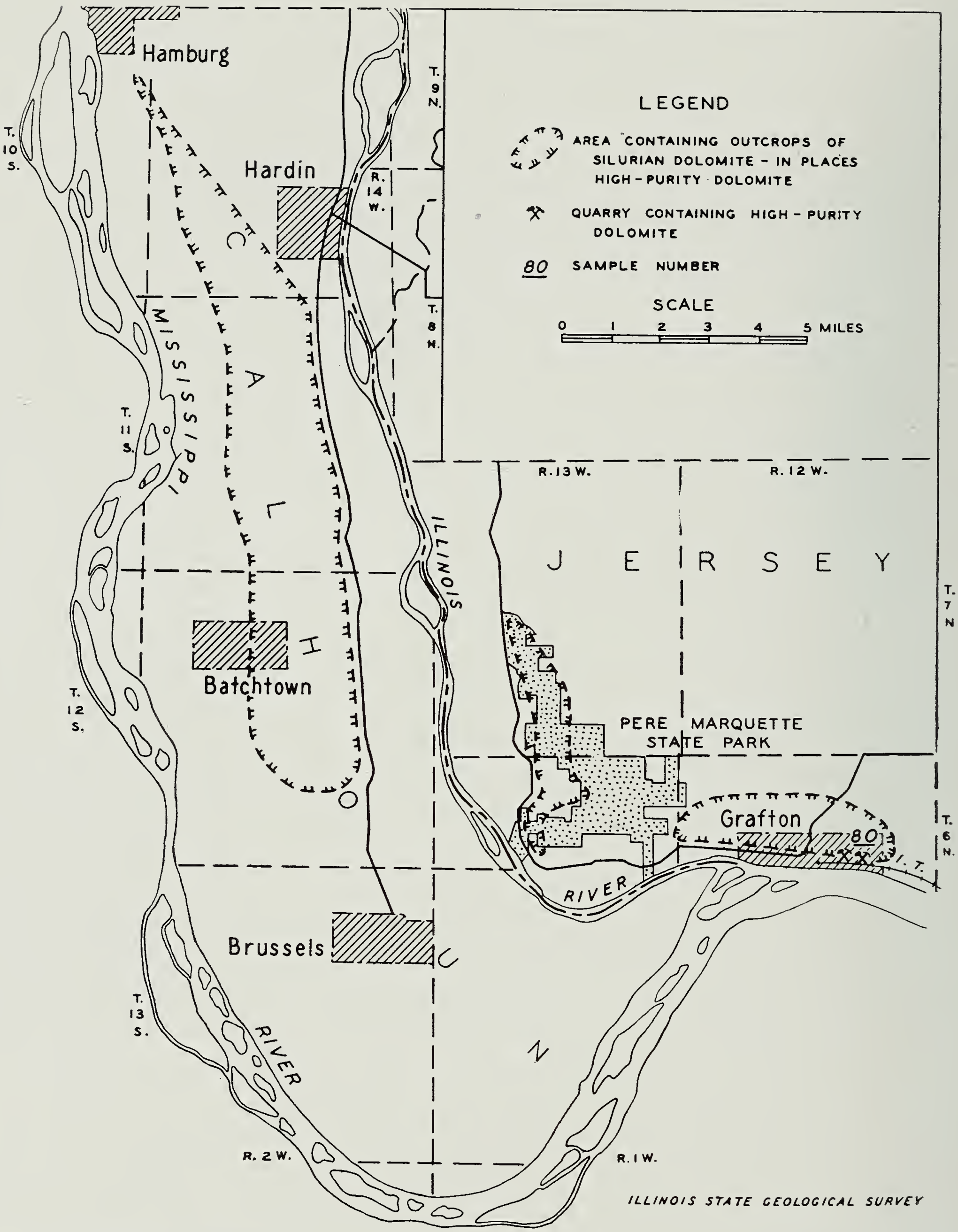

Fig. 34.—The Grafton-Hardin region—showing the areas containing outcrops of Silurian dolomite which in places is high-purity dolomite.

per cent $MgCO_3$. The uniformity of the dolomite is indicated by solubility tests of samples collected from the same strata included in sample 80, as follows:

Sample No.	Thickness represented *ft.*	*in.*	Soluble *per cent*
13		7	97.5
12	1	2	98.4
11	2	3	97.8
10		8	98.7
9		11	98.6
8		8	98.0
7	1		97.8
6	1	4	97.4
5	1	5	98.8
4		10	99.1
3	1	7	98.8
2	1	7	98.5
1	2		98.2
Total	16		Av. 98.3

Outcrops along Simms Hollow, west of the Keller quarry, show that 5 to 10 feet of dolomite underlying that sampled in the quarry has the same character. Below that the dolomite is argillaceous and cherty. The 30 to 40 feet of Silurian dolomite above the high-purity strata is similar in appearance but contains clay partings, and tests of 12 samples from different beds show the amount soluble varies from 90 to 96 per cent.

Distribution.—In Jersey county the high-purity dolomite occurs in the bluffs of Illinois and Mississippi Valleys from the mouth of Rice Hollow, one mile east of Grafton, to the mouth of Graham Hollow, two miles west of Grafton. It is exposed in the Keller quarry, in an abandoned quarry west of the Keller quarry, along State Highway 100 in Grafton, and at places along several of the hollows near Grafton.

The same strata also crop out in the east bluffs of Illinois Valley from Pere Marquette State Park north to Rosedale and are well exposed at Twin Springs in the park.

In Calhoun County the Silurian dolomite is much thinner, and it is not certain that any beds of quarryable thickness are high-purity. The dolomite is exposed in the Illinois Valley bluffs from two miles south of Hardin to Meppen and in the Mississippi Valley bluffs from three miles north of Batchtown to two miles south of Hamburg.

The Silurian rocks also occur north of areas described in both Jersey and Calhoun counties but are predominantly limestone with locally some argillaceous dolomite.

Development possibilities.—The most favorable area for development is near Grafton, which is the only place in the region where the high-purity dolomite occurs near a railroad. The largest areas where the high-purity dolomite has a thin overburden are in the floors of the Keller quarry and the abandoned quarry to the west, a total of 8 to 10 acres. Because the strata overlying the high-purity dolomite are better bedded and are more easily quarried for riprap and building rubble, they have been extensively worked. As a result, the top of the high-purity dolomite forms the quarry floors, except for a small area in the Keller quarry where some of the high-purity dolomite has been quarried.

Elsewhere in the region the high-purity dolomite is exposed in steep bluff-faces and has a heavy overburden. It could be mined by drift-mines at several places near Grafton.

The Illinois Terminal Railroad has a branch line to Grafton and most of the deposits in this region are not far from the Mississippi and Illinois waterways.

Table 6.—Locations and Chemical Anal-

The samples were collected from the faces of quarries and outcrops. Those taken from operating quarries do not necessarily rep-

Sample No. and Source[a]	Formation	Thickness sampled (feet)	County and Town (In or near)	Location ¼	Sec., Twp., Rge.	$CaCO_3$[c]	$MgCO_3$[c]	SiO_2	TiO_2	Al_2O_3	Fe_2O_3
293E; A...	Racine	15½	Cook—Hillside	SE, NE	17—39N—12E	54.69	44.30	0.49		0.15	0.33
294E; A...	Racine	30	Cook—LaGrange	SE, NE, NW	10—38N—12E	54.92	43.05	0.28		0.37	0.31
104; A.....	Racine	15½	Cook—McCook	SW, NE	15—38N—12E	54.37	43.86	0.40		0.47	0.16
296A; A...	Racine	10	Cook—McCook	SW	15—38N—12E	53.91	44.51	0.84		0.42	0.38
296C; A...	Racine	19	Cook—McCook	SW	15—38N—12E	54.35	44.14	1.02		0.12	0.33
296D; A...	Racine	21	Cook—McCook	SW	15—38N—12E	54.05	43.36	1.62		0.47	0.38
296E; A...	Racine	29½	Cook—McCook	SW	15—38N—12E	54.15	44.34	0.32		0.46	0.30
J2; A......	Racine		Cook—McCook	SW, SW	15—38N—12E	54.91	43.84	0.68	0.02	0.25	0.09
46; A......	Racine	50	DuPage—Elmhurst	NW, SW, NW	2—39N—11E	54.14	43.26	0.84		0.57	0.20
299B; A...	Racine	40	Cook—Chicago	NE, SW	25—39N—13E	54.39	43.76	0.36		0.42	0.34
292B; A...	Racine	30	Cook—Chicago	NE, SE	29—39N—14E	54.84	44.36	0.22		0.25	0.29
292C; A...	Racine	76	Cook—Chicago	NE, SE	29—39N—14E	54.84	43.47	0.69		0.22	0.34
292D; A...	Racine	59	Cook—Chicago	NE, SE	29—39N—14E	55.01	44.24	0.29		0.16	0.27
292E; A...	Racine	40	Cook—Chicago	NE, SE	29—39N—14E	55.10	43.34	0.56		0.06	0.35
292F; A...	Racine	11	Cook—Chicago	NE, SE	29—39N—14E	55.12	44.03	0.12		0.47	0.27
G1; A.....	Racine		Cook—LaGrange	NW, NW	10—38N—12E	54.98	43.65	0.36	0.03	0.26	0.12
409; A.....	Racine	50	Cook—Thornton	NW, SE	28—36N—14E	55.69	42.76	0.11		0.30	0.19
F1; A.....	Racine		Cook—Thornton	NW, SE	28—36N—14E	54.57	44.30	0.06	0.00	0.25	0.02
F2; A.....	Racine		Cook—Thornton	NW, SE	28—36N—14E	55.17	44.30	0.12	0.03	0.19	0.01
A13; A....	Joliet		Will—Joliet	NE, SE	21—35N—10E	54.84	43.30	0.98	0.10	0.00	0.06
11; A......	Racine	4	Kankakee—Bradley	SW, SE, SW	21—31N—12E	54.71	44.43	0.09		0.23	0.11
70; A......	Racine	40	Kankakee—Kankakee	NE, NE, NW	31—31N—12E	54.57	43.03	0.65		0.43	0.25
419; A.....	Racine	12	Kankakee—Manteno	NE, SE, SE	28—32N—12E	54.60	44.57	0.20	0.05	0.18	0.21
22; A.....	Racine	15	Cook—Sag Bridge	SW, SE, SW	13—37N—11E	54.71	44.09	0.27		0.25	0.19
24; A......	Racine	10	Cook—Chicago Heights	NE, SE, NE	22—35N—14E	54.41	42.36	1.20		0.52	0.38
23; A......	Racine	9	Cook—Chicago	SW, NW, SW	1—37N—14E	54.16	42.46	1.19		0.58	0.42
17; A......	Joliet	8	Will—Romeo	NE, SE, SW	35—37N—10E	54.80	42.54	1.29		0.40	0.50
R-1; B....	Joliet		Will—Romeo			53.73	42.13	1.99		0.63	1.15
R-2; B....	Joliet		Will—Romeo			52.61	41.84	1.90		0.64	2.08
20; A......	Racine	6	Cook—Hinsdale	SW, SE, SE	19—38N—12E	54.67	44.14	0.27		0.21	0.16
78-79; A...	Racine	7	Will—New Lenox	NE, SE, NE	17—35N—11E	54.19	42.38	2.04		0.37	0.35
19; A.....	Joliet	7	DuPage—Naperville	SE, SE, SW	13—38N— 9E	54.85	42.86	0.97		0.38	0.29
M-1; A....	Waukesha	35	Carroll—Savanna	SE, NW, NW	2—24N— 3E	55.39	42.63	0.16		0.25	1.37
35; A.....	Waukesha	30	Carroll—Mt. Carroll	SW, SW, NW	25—25N— 5E	54.66	43.42	0.33		0.29	0.64
D-1; A....	Waukesha	40	Whiteside—Fulton	NW, NE, NW	19—22N— 4E	56.83	42.48	0.18		0.63	0.36
63; A......	Racine	18	Whiteside—Fulton	NW, NW, SW	36—22N— 3E	55.26	43.07	0.10		0.24	0.41
H-1; A....	Racine	20	Whiteside—Albany	SE, NE, SE	24—21N— 2E	55.89	43.63	0.10		0.25	0.21
286; A.....	Port Byron	25	Rock Island—Cordova	SW, SW, NE	1—19N— 1E	54.39	44.09	0.38		0.12	0.30
K-1; A....	Racine	26	Whiteside—Morrison	NW, SW, SE	7—21N— 5E	55.95	43.22	0.24		0.19	0.25
29; A......	Guttenberg	15	Lee—Ashton	SE, NW	27—39N—11E	54.23	42.42	1.59		0.58	0.37
30; A......	Prosser (lowermost)	16	Lee—Dixon	SE, SE, NE	12—21N— 8E	54.84	43.61	0.26		0.29	0.37
31; A......	Stewartville	12	Lee—Palmyra	NE, SW, NW	33—22N— 8E	54.55	41.46	1.30		0.51	1.15
33; A......	Stewartville	12	Carroll—Lanark	NE, NE, NE	1—24N— 5E	53.71	43.28	1.29		0.47	0.60
36; A......	Stewartville	45	Jo Daviess—Elizabeth	NW, NW, SW	23—27N— 2E	54.71	42.13	1.36		0.50	0.41
37; A......	Stewartville	20	Jo Daviess—Warren	SW, SW, NW	28—29N— 5E	53.96	42.17	1.80		0.59	0.63
38; A......	Prosser (lowermost)	15	Stephenson—Rock City	SW, NW	22—28N— 8E	53.21	42.77	2.20		0.58	0.40
39; A......	Prosser (uppermost)	25	Winnebago—Seward	NW, NE, NW	28—26N—10E	54.66	42.13	1.16		0.45	0.51
40; A......	Prosser (uppermost)	15	Stephenson—Ridott	NE, SE, SW	4—27N— 9E	54.03	43.55	1.12		0.33	0.63
41; A......	Prosser (middle)	16	Ogle—Polo	NW, NW	17—23N— 8E	56.85	40.85	0.63		0.20	0.80
43; A......	Prosser and Stewartville	17	Boone—Belvidere	NW, SE, NE	8—44N— 3E	54.16	42.67	1.58		0.52	0.51
44; A......	Prosser and Stewartville	20	Kendall—Plano	SE, NW, SE	4—36N— 6E	55.53	41.61	0.83		0.37	1.58
55; A......	Prosser (lowermost)	26	Winnebago—Rockford	NE, SE, SE	29—44N— 1E	54.32	43.44	0.94		0.40	0.32
56; A......	Prosser (uppermost)	16	Stephenson—Freeport	SE, NE, SW	6—26N— 8E	54.10	43.47	0.95		0.35	0.38
135; A.....	Prosser (lowermost)	50	Ogle—Mt. Morris	NE, SW, SE	32—24N— 9E	54.76	42.24	1.09		0.40	0.60
140; A.....	Prosser (lowermost)	55	Ogle—Adeline	NE, SW, SW	21—25N— 9E	55.82	42.23	0.23		0.07	0.44
L-4; A....	Stewartville	21	Jo Daviess—Galena Jct.	cen.	1—27N— 1W	55.17	43.13	0.98		0.40	0.85
MC; C....	Stewartville		Carroll—Mt. Carroll			54.06	43.68	1.62		1.12	
80; A......	Silurian	16	Jersey—Grafton	SE, NW, NW	14— 6N—12W	54.75	42.55	1.26		0.68	0.36

a. SOURCE—
A—Analysis by Geochemical Section, Illinois State Geological Survey, under the supervision of Dr. O. W. Rees.
B—Illinois Geol. Survey Bull. 8, 1908, p. 355.
C—U. S. Geol. Survey Min. Res. Pt. II, 1911, 1912, p. 663.

b. Not detectable in 5 grams.
c. For method of calculating carbonates. see page 21.

ES OF SAMPLES OF ILLINOIS DOLOMITE.

resent the product of the plants. In many cases the rock sampled has since been quarried.

FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	H_2O-	CO_2	SO_3	Loss on ignition	Total	Remarks
Chemical Analyses												
CHICAGO REGION												
Operating Quarries												
		21.74	30.64				0.08	47.17	0.12	47.18	100.65	Consumers Co. quarry, top.
	.010	21.63	30.77	0.10	0.00	0.00[b]	0.01	46.62	0.09	47.09	100.65	Consumers Co. quarry, abandoned, top.
		21.40	30.46	0.06	0.07		0.02	46.80	0.09	47.25	100.27	Consumers Co. quarry, top of middle bench, NW. face.
		21.59	30.20				0.03	46.94	0.30	46.96	100.69	Dolese and Shepard Co. quarry, 0-10′ above base.
		21.53	30.45				0.12	46.94	0.27	46.85	100.57	Dolese and Shepard Co. quarry, 29½-48½′ above base.
		21.25	30.28				0.11	46.40	0.25	46.46	100.71	Dolese and Shepard Co. quarry, 48½-69½′ above base.
	.015	21.92	30.33	0.00	0.03	0.00[b]	0.08	46.96	0.11	47.14	100.63	Dolese and Shepard Co. quarry, top.
.18		21.32	30.76	0.15	0.07		0.10	47.03		46.85	100.37	Dolese and Shepard Co. quarry.
		21.23	30.33	0.00	0.10		0.16	46.39		47.23	100.50	Elmhurst-Chicago Stone Co. quarry, west face.
		21.91	30.47				0.00	46.76	0.17	46.72	100.39	House of Correction quarry, abandoned, 34-74′ above water.
		21.45	30.72				0.07	47.27	0.40	47.43	100.76	Material Service Co. quarry, 15-45′ above base.
		21.28	30.72				0.02	46.81	0.42	46.95	100.62	Material Service Co. quarry, 45-121′ above base.
		21.58	30.82				0.02	47.28	0.30	47.24	100.66	Material Service Co. quarry, 211-180′ above base.
		21.32	30.87				0.03	46.85	0.40	47.19	100.75	Material Service Co. quarry, 180-221′ above base.
		21.45	30.88				0.11	47.22	0.02	47.23	100.44	Material Service Co. quarry, 221-228′, 232-237′ above base.
.13		21.56	30.80	0.09	0.05		0.08	46.96		46.93	100.33	Material Service Co. quarry.
	.015	20.45	31.20	0.06	0.00	0.00[b]	0.08	47.05	0.10	47.87	100.30	Material Service Co. quarry, north quarry.
.07		21.54	30.57	0.11	0.01		0.19	47.12		47.74	100.37	Material Service Co. quarry.
.08		21.60	30.91	0.20	0.03		0.23	47.38		47.17	100.34	Material Service Co. quarry.
.32		20.92	30.72	0.12	0.06		0.11	46.72		46.77	100.05	National Stone Co. quarry.
Kankakee Area												
		21.71	30.65				0.07	47.25			100.04	Excavation for water main.
		21.16	30.57	0.06	0.06		0.05	46.46		47.06	100.24	Outcrop.
	.015	21.52	30.59	0.07	0.00	0.00[b]	0.09	47.27	0.03	47.38	100.25	Abandoned quarry.
Sag Bridge Area												
.08	.015	21.47	30.65	0.02	0.00	0.00[b]	0.08	47.07	0.02		100.04	Outcrop.
Chicago Heights Area												
		20.74	30.48				0.06	46.04			99.36	Abandoned quarry.
Stony Island Area												
		20.80	30.34				0.11	45.98			99.31	Abandoned quarry.
Romeo Area												
		20.44	30.70				0.02	46.30			99.63	Abandoned quarry.
						0.014					99.64	Abandoned quarry, average analyses.
						0.012			0.054		99.13	Abandoned quarry, average analyses.
Hinsdale Area												
		21.32	30.62				0.08	47.08			99.66	Road-cut.
New Lenox Area												
		20.78	30.36				0.15	45.95			99.85	Outcrop.
Naperville Area												
.13	.040	21.06	30.73	0.01	0.07	0.00[b]	0.09	46.49	0.04		100.21	Abandoned quarry.
AVANNA-PORT BYRON REGION												
Savanna Area												
		20.93	31.03				0.08	46.61		46.71	100.45	Abandoned quarry.
		21.19	30.62				0.08	46.70			99.77	Abandoned quarry.
Fulton Area												
	.025	20.59	31.84	0.00	0.00	0.00[b]	0.09	47.16	0.02	46.97	100.62	Abandoned quarry.
Albany Area												
		20.60	30.96	0.04	0.00		0.05	46.96		47.31	99.66	Abandoned quarry.
	.015	20.99	31.31	0.00	0.00	0.00[b]	0.09	47.35	0.04	47.57	100.49	Abandoned quarry.
Port Byron Area												
	.005	21.09	30.47	0.11	0.00	0.00[b]		47.18	0.06	48.07	100.61	U. S. Gypsum Co. quarry.
Morrison Area												
	.010	21.52	31.35	0.00	0.00	0.00[b]	0.09	47.16	0.04	47.13	100.73	
ROCKFORD REGION												
		20.77	30.38				0.09	45.99			99.68	Abandoned quarry, below upper 10′.
		21.36	30.72				0.08	46.88			99.88	Gerdes quarry, top.
		20.29	30.56				0.12	45.63			99.44	Abandoned quarry, below upper 8′.
		21.08	30.09				0.10	46.21			99.74	Abandoned quarry, below upper 8′.
.20	.045	20.53	30.65	0.06	0.11	0.02	0.12	46.05	0.06		100.00	Seeley Construction Co.
.19	.050	20.59	30.23	0.06	0.11	0.02	0.12	45.74	0.04		100.05	Abandoned quarry.
		20.95	29.81				0.08	45.72			99.66	Abandoned quarry, below upper 8′.
.20	.045	20.60	30.62	0.11	0.07	0.02	0.18	46.03	0.06		99.88	Abandoned quarry.
		21.19	30.27				0.08	46.49			100.03	Abandoned quarry, top.
		20.21	31.85				0.06	46.32			100.01	Abandoned quarry, bottom.
		21.10	30.34				0.10	46.09			100.14	Abandoned quarry, below upper 6′.
		19.90	31.11				0.08	46.20			99.99	Abandoned quarry.
		21.20	30.43	0.02	0.04		0.07	46.56		47.03	100.38	Abandoned quarry.
		21.15	30.31	0.03	0.05		0.08	46.48		47.09	100.31	Abandoned quarry, top.
		20.20	30.68				0.00	46.35		46.89	99.86	Abandoned quarry.
		21.62	31.27				0.00	46.59		46.91	100.54	Outcrop.
		20.66	30.91				0.12	46.77		46.90	100.70	Outcrop.
											100.48	Outcrop.
GRAFTON-HARDIN REGION												
		20.70	30.67	0.12	0.15		0.03	46.29	0.02	46.63	100.59	Keller Quarry Co. quarry, bottom.